CODESRIA

Thesis By

BOLADALE OPEYEMI AKANiI

Department of Agricultural Economics

UNIVERSITY OF IBADAN

HEDONIC-PRICE ANALYSIS OF THE DEMAND FOR GRAIN CROPS IN NIGERIA: THE CASE OF RICE AND COWPEA

FEBRUARY 1996

HEDONIC-PRICE ANALYSIS OF THE DEMAND FOR GRAIN CROPS IN NIGERIA: THE CASE OF RICE AND COWPEA

BY

BOLADALE OPEYEMI AKANJI

B.SC. AGRIC. ECONS (IBADAN)

M.SC. AGRIC. ECONS (IBADAN)

A Thesis in the Department of Agricultural Economics

Submitted to the Faculty of Agriculture and Forestry

in Partial fulfillment of the Requirements

for the Degree of

DOCTOR OF PHILOSOPHY

UNIVERSITY OF IBADAN

FEBRUARY 1996

ABSTRACT

The observed price spread between different varieties or market samples of the same variety of grain crops motivated this study. The objective was to identify the desirable/undesirable physical attributes of selected grains, estimate the relative influences of such traits on market price, rank them in order of importance and to find out if the preferences are significantly different across socio-cultural blocks in Nigeria.

The Consumer Goods Characteristic Model employed in this study is based on the hedonic principle which views the pleasure/satisfaction/utility derived from the quality of a product as a priced commodity. The marginal rate of substitution between income and a unit change in each of some identified quality characteristics of cowpea and rice or Marginal Implicit Price (MIP) was thereby derived. The discriminant analysis was used to test for the presence of sub-markets or diagnose the extent of market segmentation. The degree of price-quality integration was assessed via analysis of the parameter estimates of the hedonic functions.

One-shot data was collected on all available market samples of cowpea and rice in three markets - Ibadan, Enugu and Nguru. These represent three major geo-cultural populations of the Yoruba, Igbo and Hausa/Fulani ethnic groups respectively in Nigeria. Component characteristics such as seed colour, seed configuration, seed weight, grain length, grain purity, milling quality, swelling ability, cooking time and so on were evaluated and scored for the quantity of each characteristic induced through genetic, on-farm or off-farm

As a test of market efficiency, the study found considerable price-quality integration in the different cowpea markets except Enugu. The rice markets (except Ibadan) were considerably less integrated.

The rank order of the relative pricing and net marginal value product of each grain sample was used to derive three systems of grading grain crops in Nigeria. These are the **Hyslop Scale** which is based on the nominal order of%whe characteristic scores(MIPs), the **Martin scale** which identifies the five most important crop attributes (Premium Attributes) from a given market's hedonic behaviour and the **Knapp Scale** which rates the magnitude of the net marginal value product of all available 'grades'. These grading systems provide the basis for prioritizing crop improvement research objectives for sub-populations, with respect to each of the technological processes that confer quality on the final market samples of a grain crop.

In conclusion, the findings demonstrate that a viable framework exists for grading grain crops in Nigeria but that a uniform grading system for the whole country may be unrealistic. They also show that current pricing structures for cowpea and rice in various markets reflect hedonic behaviour among consumers, attesting to quality responsiveness of grain prices. This quality responsiveness calls for strategic research into crop quality improvements that take into consideration the identified regional disparities in consumer preference.

ACKNOWLEDGEMENT

The actualization of this thesis is due to the love and support of many people.

First, I wish to acknowledge the funding assistance of CODESRIA's Small Grants Programme. I thank the organisation for counting the project worthy of the support.

I would like to express my sincere thanks to Prof. J. A. Akinwumi who supervised the thesis. Throughout the duration of the work, he showed immense understanding and patience for a student and a woman with multiple roles. Without his kind of encouragement, I doubt whether I could have scaled many of the hurdles towards this end. He painstakingly edited all my drafts and gave deep insights into the conceptual framework which remain invaluable to the work.

My deep thanks also goes to my co-supervisors,Professor J. K. Olayemi and Dr J.T.Atobatele.

Professor J. K. Olayemi gave me the last twist of thought that crystalized the proposal for the thesis, although he may not realise it. Also, his patient perusal of the draft report and tacit endorsement of my efforts has given me the ultimate confidence in this piece of work. Dr. J. T. Atobatele, despite his busy schedule, found the time to read the draft and gave very practical suggestions for its improvement. Dr. Saa Dittoh, before he left Nigeria, was a constant help, especially through the maze of econometric modelling of the work.

My sincere thanks goes to Dr. Ben Arimah, a pioneer author in Hedonic-Price Analysis in Nigeria who put all his experience at my disposal to see me through the process of data analysis and write up.

I owe a debt of gratitude to several scientists of the West African Rice Development Association (WARDA) and INGER-Africa Program as well as the Grain-Legume Improvement Programme (GLIP) all based in IITA. In particular, Dr. Alluri for granting me access to IITA facilities for the quality tests; Mr. Kola Oladejo of the Grain Quality Laboratory for his technical assistance during the tests. I also thank Messrs. Lanre Ogunyinka and Solomon Adebayo of the Training Unit, Mr. Sam Korie of Biometrics Unit and Mr. Akintunde of COSCA Programme for assistance during data analysis.

Messrs. Cajetan Akujobi, Kayode Adetoro, Kola Yekini and Kayode Ogunmola, all of NISER gave me invaluable assistance in the field work, data analysis and word-processing of this thesis. Mr Lere Aminu also coordinated the field work in Nguru for several months. May God Almighty grant them all the rewards that only He can give.

I acknowledge the crucial role of my family in this achievement. I thank my dear husband, sponsor and mentor, Abayomi, my loving children Tomilola, Babaseinde and Opeyemi and my dear sister Felicia Olapade for their love, total support and identification with this project. Special gratitude goes to Babaseinde and Felicia for their contributions to the word-processing of the report, even at periods when most children would rather play 'bingo' and who carried the recurrent ring of the word 'hedonic' in their sub-conscious for months. My husband remains my one constant source of academic inspiration and push. A man who delights rather than feel threatened by my academic progress, I will always be proud of his own giant intellectual status.

In total submission and thanks, I acknowledge the hand of the Almighty God in my life and in this work. For it is He who grants knowledge, understanding and success in using them to a logical end. I will forever praise Him for setting me apart for this crowning glory.

BOLA O. AKANJI.

CERTIFICATION

I certify that this work was carried out by Boladale O. Akanji in the Department of Agricultural Economics, University of Ibadan.

....

SUPERVISOR

J. A. Akinwumi, M.Sc. Ph.D.
Professor of Agricultural Economics,
University of Ibadan, Ibadan,
NIGERIA.

FEBRUARY 1996

DEDICATION

To the memory of my late Father

CORNELIUS AKINBOWALE TEWE (1919 - 1993)

Whose deep intellect surpassed that of his time;

Who fought the repressions of truth and intellect

all his life;

Who imprinted my feet in the path of truth and intellect;

Who so much believed in my abilities;

But who never lived to see this crowning glory.

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

LIST OF ACRONYMS

NSS - National Seed Service

NCRI - Nigerian Cereals Research Institute

WARDA - West African Rice Development Association

INGER-Africa - International Network for Genetic Evaluation of Rice in Africa

GLIP - Grain-Legume Improvement Programme

NSPRI - Nigerian Stored Products Research Institute

FIIRO - Federal Institute for Industrial Research and Organisation

RAIDS - Rural Agro-Industrial Development Scheme

CRET - National Rice Evaluation Trials

NAFPP - National Accelerated Food Production Programme

IRRI - International Rice Research Institute, Philippines

IRAT - Institute de Recherche Agronomique Tropicale

CIAT - Centre Internationale Agriculture Tropicale

CPP - Consumer Price Perception

SCK - Shared ConsumerKnowledge

LCT - Linear Consumption Technology

NNMU - Non-Negative Marginal Utility

ICD - Independent Utility Distribution of Characteristics

ICM - Input Characteristic Model

CGCM - Consumer Goods Characteristic Model

MIP - Marginal Implicit Price

NMVP - Net Marginal Value Product

CHAPTER ONE

INTRODUCTION

1.1 BACKGROUND SETTING AND PROBLEM STATEMENTS

The cultivation of grain crops cuts across different farming systems in Nigeria. Their consumption and marketing also cut across the different geo-cultures of the Nigerian population. Grain crops thus constitute a greater proportion of staple foods compared to other food crops. As early as 1965, the Food and Agricultural Organisation (U.N.FAO) estimated that 65% of the calories in the northern states are derived from cereals, 17% from roots and tubers, 9% from pulses and nuts and 4% from fats and oils. In the southern states, roots and tubers contribute up to 53% of calories, cereals contribute 22%, oils 13% and pulses and nuts, 5%. The income elasticity of demand for the cereals (rice in particular) was also put at between 0.6 and 0.7. Anthonio,(1966) and NISER,(1985) corroborated this. The price elasicity of demand is believed to be much lower (particularly for cowpea).

As a result of the above scenario, problems and prospects within the grain markets have consistently been an important policy issue in Nigerian agriculture.

The problems usually manifest as distortions in the pricing structure. These centre, not only around non-market factors such as direct and indirect policy actions which have largely constrained free market practices in Nigeria, but also the peculiar form and function of the markets with respect to the available production technologies and post harvest handling of grains in Nigeria. Also the consumption (preference) pattern for specific grain crops vis a vis their production zones and production cycles has implications for inter-regional movement of goods and long term storage. The observed distortions have led to pricing inefficiency and lack of market integration across all dimensions: space, time and quality. Many studies have indeed identified the problems of lack of market integration in the grain market.

For rice, there has been persistent supply-demand gap being filled through importation. Production has not been able to keep pace with consumption level which was predicted (FACU, 1985) to reach 1.91 million tonnes by 1990 compared with a projected production level of 0.98 million tonnes at an annual growth rate of 3.5%. Over the years therefore, the ratio of imported to domestically produced rice has shown a progressive trend. Especially since the mid to late 1970s, a period coinciding with phenomenal increase in money supply and income within the economy, the proportion of imported to locally produced rice increased from only 9.87% in 1976 to 652.17% by 1981. This proportion has gradually declined since then, although coinciding with the economic recovery policies of the nation, with attendant restriction on importation. By 1990, imported rice still constituted over 36% of total rice consumption. Per capita consumption increased from 3.2kg in 1970 to 12.4kg in 1980 (Chaudhary and Nanda, 1984) and has dropped to 7.5kg in 1990. Self sufficiency dropped from 99% in 1970 to 38%

in 1980 and again rose slightly to 41.5% by 1990. From the above, the implication is that although local production has increased, import volume is decreasing at a slower pace. This implies a higher preference for imported varieties of rice which indicts not only the agronomic performance but the final form of the processed product. The price differentials between imported and local rice varieties also indicate changes in preference pattern over time and space. In essence, the price spread of 18.47% between 1986 and 1990 had risen to 19.18% during the 1992 to 1994 period, in favour of imported rice. The percentage price spread between local and imported rice was 13.9% in 1992, the same figure was 19.06% in 1993 and 24.6% in 1994.

Similar patterns are exhibited in the cowpea market. Although statistics are unavailable for market movements of different cowpea varieties, price statistics show varying preferences for the brown and the white varieties in different parts of the country. For instance, the price spread between the brown and white varieties are virtually nil at 0.31% in the north in favour of white varieties between 1992 and 1994. The percentage is 3.68% in the southeast in favour of brown beans and 11.15% in the southwest, also in favour of brown beans. Across the country the mean price spread rose from 3.8% between 1986 and 1990 to 6.6% in the 1992 - 1994 period in favour of brown beans.

Earlier studies have indeed shown that preference for these two types of cowpea varieties are affected by the food dish to be prepared (Williams C.E, 1974), reinforcing the thesis of socio-cultural influences on demand pattern.

For market integration and pricing efficiency, demand prices must reflect the quality premiums implied in the pricing structure of these alternative varieties. Hence crop grading becomes importance as it essentially aligns crop qualities to the internal reference price of the consumer. This also underscores the need for crop improvement programmes to prioritize their goals in 'seed' production to reflect consumer preference patterns for the 'grain'. The above holds if and only if consumer preferences are transmitted through observed market signals to the seed producing scientists, the farmer and the marketers. The absence of this framework reinforces the problems of the Nigerian grains market.

The scenario outlined calls for a closer look at the ways and means by which consumers of major grain crops in Nigeria make choices, the factors influencing their choice patterns and the relative values assigned to different quality traits which implicitly impose grades on crop varieties, despite the absence of standard grading schemes.

As Kohl and Uhl (1985) state, form utility of an agricultural commodity is a product of the primary production process as well as the post harvest handling. Primary production in grain involves the use of 'seed' with certain genetic characteristic to produce the grain. These characteristics affect not only the agronomic performance but also the morphological and biochemical form of the harvested grain and its processing and storage properties. All these determine the relative demand for and prices of alternative varieties of the same commodity.

1.2 THE NEED FOR THE STUDY

The problems highlighted in the last section motivated the current study. These problems become relevant in light of the fact that many past and present programmes aimed at quality improvement for grain crops in Nigeria and Africa have not effectively impacted on market integration.

The programmes include those of the National Seed Service (NSS), Nigerian Cereals Research Institute (NCRI), West African Rice Development Association (WARDA), International Network for Genetic Evaluation of Rice in Africa (INGER-Africa) and IITA's Grain-Legume Improvement Programme (GLIP) which all have mandates for genetic improvement of grain crop varieties. They aim primarily to tailor the yield, production profile as well as chemical and physical characteristics to meet consumer tastes and demand. Some other programmes have aided the development of better storage methods to reduce quality changes induced by infestation by pests, mould and excessive weight loss, in particular the Nigerian Stored Products Research Institute (NSPRI). Others still include the Federal Industrial

Research Institute (FIIRO) and Rural Agro-Industrial Development Scheme (RAIDS) which aim to develop better processing methods with a view to optimising the crop-waste ratio or processing yield of various crops.

For most of these programmes, evaluation of success has focused mainly on rate of adoption of different varieties by farmers and consumers, as well as the agronomic problems militating against adoption. These studies include Ashraf et. al. (1988), Ashraf and Balogun (1985), IITA (IADP report series 1982,1984), Blackenburg (1971), Filani (1980) and so on. Studies that focus on the economics of technology transfer have limited their scope to problems of input supply vis-a-vis the recommended production profiles, yield appraisals and production projections (Hays and Rahaja, 1977; Nyanteng, 1987); Njoku, 1988; etc.). Few studies have related the success of technology to consumer preference and output prices, among which are the Consumer Preference Network Study for Cowpeas and other Grains (MANR/IDRC, 1974/75; IITA Acceptability Surveys, Akinpelu, 1974; Adrian and Daniel, 1976; and Aligbe,1977. None of these studies went beyond ordinal scales, at best, to quantify preferences for grain qualities.

Similarly, many marketing research studies in Nigeria have attempted to identify the nature of the problems of the food grain market via its performance but few have looked at the alignment of prices to quality differentials. Most of these studies have concentrated on the analysis of market performance based on temporal and spatial problems in Nigeria and the developing world. These include those of Welsch,1963, 1965; Jones, 1968, Aken'Ova and Anthonio, 1968; Anthonio, 1968; Thodey, 1969; Osifo, 1971; Olayemi,1973, 1975; Hays, 1975; Ejiga, 1977; Hays and McCoy, 1978; Ngawa, 1983; Adekanye,1986 and Dittoh,1992, 1994. Relatively less attention has been directed at the quality dimension of market integration in Nigeria and Africa. Whereas it has been long established that the form of a market product determines the prices that consumers are willing to pay (Samuelson, 1948; Quandt, 1956; Lancaster, 1966; Kohls and Uhl, 1985.

Most of these studies have therefore fallen short of linking the interactive effects of all the classical components of price variations on farm commodities. They have also done little to explore the determinants of other random price variations which are usually lumped up as socio-economic factors or demand shifters. Of note here is the quality dimension of price variation which many of the earlier studies in Nigeria implicitly refer to. They have yet to be empirically fitted into an appropriate model whereby their pattern of influence, their relative influences and the responsiveness of price to them can be estimated.

There are nonetheless a few pioneering works in this respect. Osuji (1974) looked at the price spread between different market distributors and noted the absence of uniform grades of rice but his findings provided no prospects for bridging this gap. Adekanye (1986) analysed the quality of rice in Nigeria and identified quality differences and corresponding choice differences but only in relation to market supply rather than consumer demand.

Fosu (1987) worked closest to this framework of research in Nigeria by focusing on consumer choice as an important variable in the adoption of cowpea varieties. He identified those physical properties perceived by consumers and which significantly affect their choice pattern. However, Fosu neither related these patterns to the market performance in any respect nor to the crop improvement technologies and their objectives. Also he studied cowpea in only one geographical location, making generalization of findings across Nigeria difficult, given the countiry's heterogeneity.

In industrialized economies, authors like Waugh, 1928; Adelman and Griliches, 1961; South Worth, 1961 and Farris, 1960 have appraised the market mechanism and attempted, not only to quantify goods' characteristics but also to assign monetary value to them. More recent works in this regard, especially those of Ladd and Suvannunt, 1976; Ladd and Martin, 1976 and Unnevehr, 1986 have related these to consumer demand.

So far in developing countries it has been possible to identify and itemise desirable and undesirable traits of several grain crops, but it has not been possible to discover the effects of these traits in value terms on their demand price or to rank them in order of importance. Moreover, although cultural variations in consumer tastes have been identified, it is doubtful whether these findings have significantly affected the design of regional objectives of grain quality improvement programmes.

Secondly, the absence of standard grades of food crops in Nigeria can not be dissociated from the problems of price distortions. Except for export crops like cocoa which have benefited from foreign trade standards, no known framework exists to provide a workable methodology for grading foodcrops. Yet, the relevance of grades to the improvement of marketing efficiency is a sine qua non for greater development strides in production planning, modern marketing strategies and international trade relations.

This study has attempted to bridge these identified gaps with respect to rice and cowpea, two important grain crops in Nigeria.

1.3 OBJECTIVES AND HYPOTHESES STATEMENTS

The study's aims are to relate the price of different market samples of the same grain crop to the price structure of the crop's physical characteristics. This is with a view to comparing the consumer preference patterns and the relative price responsiveness of each of the characteristics in different markets and assessing the effects of this on market performance in Nigeria.

Specifically, the study aimed to:

(1) Assess the nature of price spread on different qualities (varietal samples) of rice and cowpea with a view to determining the demand price for each of the products' characteristics in each market;

(2) Assess the differentials in consumer preference in order to determine the extent of segmentation in the market for grain characteristics in Nigeria.

(3) Derive consumer preference scales for all relevant physical characteristics;

(4) Define a framework for grading different varieties of locally produced rice and cowpea in Nigeria;

(5) Assess the level of integration of the market with respect to quality differentials;

(6) Present the policy implications of the above with emphasis on the problems and prospects for establishing a grading system for grain crops in Nigeria and the need for regional objectives in crop quality improvement programmes.

HYPOTHESES

The following hypotheses are tested in this study.

1. Ho: For each product consumed, the price paid by the consumer is not equal to the marginal value product of all the grain's characteristics.

H1: For each product consumed, the price paid by the consumer equals the sum of the marginal value product of all the grain characteristics.

2. Ho: Consumer preference for grain quality characteristic across different socio-economic and cultural classes of people in Nigeria is not significantly different.

H1: Consumer preference pattern for grain quality characteristic across different socio-economic and cultural classes of people in Nigeria is significantly different.

3. Ho: The market for grains in the study araes is not integrated with respect to quality of products.

H1: The market for grains in the study areas is integrated with respect to quality of products.

1.4 PLAN OF THE REPORT

This report is in nine chapters. The next chapter is an overview of the production technological systems and economics of cowpea and rice production and distribution in Nigeria. In chapter three a review of literature provides insight into the state of marketing research for the grain crops under review as well as an exposition of relevant theories which inform the analytical methods of the study. Chapter four presents these analytical methods, the requisite empirical tests and data needs and details the methodology for data collection as well as the limitations and modification to the data.

In chapter five, six and seven, the main findings from the price analysis and the characteristic models are presented. The applications of these findings are discussed in chapter eight with respect to grading and definition of objectives for crop quality improvement in spatially and culturally differentiated populations in Nigeria. The last chapter presents the summary of this thesis with recommendations on policy and suggestions for future research.

CHAPTER TWO

OVERVIEW OF RICE AND COWPEA ECONOMY IN NIGERIA PRODUCTION, CONSUMPTION AND PRICES

2.1 RICE IN THE NIGERIAN ECONOMY

Rice is an important staple which cuts across all socio-economic classes in Nigeria. Olayide et al (1972) estimated the per capita rice consumption in Nigeria to be 6.06 kg per annum. This has increased in recent times as food taste changed with increase urbanisation. Per capita consumption is now about 7.5 kg per annum per capita in 1990, compared with other cereals.

2.1.1 RICE CULTIVATION AND BREEDING RESEARCH IN NIGERIA

Rice cultivation dates back to the 16th century with the introduction of Oryza glaberrima, a West African indigenous specie. Oryza sativa, the white grain specie was introduced in the forest zone a little over 100 years ago. The flood resistant varieties were more recently developed in the floating rice areas (lowland species). The three types cultivated to date in Nigeria are the upland, swamp and lowland (floating). While the floating rice grows in natural flood plains, the swamp rice grows both in non-inaundated irrigable lowlands and fresh water mangrove swamps with high organic matter and acid swamp soils.

Upland rice is found in hilly areas with high rainfall. The latter is of two main types in two distinct ecologies. **Dryland type** grows in freely draining soils where only direct rainfall is available for its moisture needs. Dryland rice in particular needs well drained rich fertile and acidic soil with PH of 4 to 5. High and evenly distributed rainfall (averaging 10.1 millimetres of rain per day) is also a prerequisite. Temperature should normally exceed 37°C. A spell of rainless period in excess of 2 weeks and temperature lower than 37°C may result in death of the plant. The second type is the **hydromorphic rice** which grows on soils with impeded drainage. It may not receive additional water for its moisture requirement. This hydromorphic condition results in "wet-feet" rice when water lies close to the soil surface. Its cultivation requires well tilled or ploughed and harrowed soil. No grass roots or other undergrowths can be tolerated.

The Focus of rice research has been mainly to solve the numerous ecological problems that limit production capacities such as poor flood control in the lowland, insufficient moisture in the highland and soil preparation problems with a view to improving agronomic practices, reducing on-farm losses and improving yield. Poor on-farm and post harvest handling methods have also resulted in poor final form of the product - hence low returns. Some of the initiatives to solve the problems over time are highlighted:

- Several new breeds have been developed-mainly as more adaptive varieties to the prevailing ecological and agronomic conditions;

- Irrigation facilities have been boosted to increase production cycles (mainly by River Basin Development Authorities). Efforts to produce early maturing breeds are also being developed for the same purpose;
- NCRI has developed simple crop handling and paddy processing methods to improve quality of harvest;
- The Green Revolution Programme, ADPs, and State Ministries of Agriculture went into direct rice production and other farm support aids programmes to increase farmers' production, mainly input supplies;
- NAFPP Via the Green Revolution programme had manpower development programmes in agricultural research and extension;
- World Bank - Cross River Rice Projects aimed at boosting production of swamp rice and irrigated rice by having two cycles of production. This project terminated after 3 years (1975 - 1978) due to fund constraint and termination of the loan agreement between the Bank and the beneficiary state;
- Imo State - World Bank Rice Project had the same aims as above and operated from 1976 - 1982. The project improved production in the state considerably but could not do much about the poor milling and marketing services in the state. Farmers achieved increased yield up to 2.5 and 3.5 tons per ha with 2 crops per year;

- Federal Rice Production Programme (FRPP) was introduced through the ADPs in 1981. This was geared to enable the existing rice projects increase production dramatically over a short period through provision of funds and equipment.

With respect to breeding improvements, a lot has been done globally. Over 60,000 genetic varieties of rice are available world wide (IRRI 1983). These come from different parts of the world. In Nigeria and Africa, Oryza sativa, the common specie is in fact not native to Africa but introduced from Asia. The widely acceptable varieties FARO 11 and FARO 29 were introduced by WARDA from Zaire and Sri Lanka respectively. Combination breeding has been essential to produce varieties with highly demanded traits.

The general approach in breeding is the collection and screening of germplasm from various parts of the world. These are observed for genetic evaluation and utilization. The contributing centres are mainly International Rice Research Institute (IRRI), Institute de Recherche Agronomique Tropicale (IRAT), West African Rice development Association (WARDA), Centre Internationale Agriculture Tropicale (CIAT) and IITA. Collaborative programmes exist to coordinate all the efforts. NCRI started releasing new rice varieties in the 1950s. By 1984, 29 varieties for various ecologies have been developed. While some are well accepted, others are not. Also the pattern of acceptance varies in different parts of the country. While the FARO 11 and FARO 25 are widely cultivated in Oyo, Ondo, Ogun, Bendel and the

Northern states with adequate rainfall, the lowland variety, FARO 20 (long grained variety) FARO 15, (nitrogen responsive) and FARO 29 (high yielding) are widely accepted in the rice growing swamp areas. Currently viable programmes are WARDA Coordinated Project, African Rice Testing Programme coordinated at IITA and NCRI- coordinated National Rice Evaluation Trials (CRET). There is collaboration between IITA, NCRI, NAFPP etc. for variety screening. National Seed Service also liases with other institutions in matters pertaining to seed production, marketing and outgrower projects.

All the outlined programmes have gone a long way in promoting domestic rice production.

2.1.2 RICE PROCESSING AND POST HARVEST CHARACTERISTIC CHANGES

Rice processing in Nigeria is mainly by the traditional method. This involves harvesting by hand and the paddy is left to dry for a few days. After this, threshing is done by beating the grains in pits or on the floor with sticks. The drying method is by sun drying, both before and after threshing by spreading it outside.

Parboiling is a critical process involving the hydrothermal treatment of rice paddy before milling. In the traditional process, parboiling is done by steeping paddy in cold water for three or more days. After this, the cold water is drained off, fresh water is added and the paddy is boiled for an unspecified period of time or until the husks begin to split. The parboiled rice is once again spread out to sundry.

Traditional small-capacity, single-stage rice mills are available in many villages. These convert the paddy into milled rice. These mills are usually diesel powered. Oni and Ikpi in 1981 estimated that there are roughly 987 small mills in Nigeria. Where a mill is not available, threshing is the sole means of processing rice. The picture has changed phenomenally and research is required to determine the current status of small scale rice processing in Nigeria.

Traditional processing methods often reduce the quality of rice in certain ways:

- **Manual harvesting** leads to high harvest losses;
- **Sundrying** exposes the paddy to foreign matter for which there is no scope for separating before milling;
- Losses caused by rodents and bird attack all occur during the days of open drying;
- Low solar radiation during certain periods after harvest (for varieties harvested mid year) leads to deterioration of rice quality due to excessive moisture retention;
- Sundrying cannot be controlled and over drying often results in easy breakage of grains during milling;

Threshing by sticks also introduces foreign matter especially sand and stones;

- Grain breakage often leads to a high percentage of brokens;

- Irregular pressure does not allow for total removal of husks so that shaft materials pollute the quality;
- Various stages of cleaning by **winnowing** has to be done; This is labour intensive and therefore often not well done;
- **Parboiling** by long cold treatment often leads to discoloration and loss of taste due to fermentation which causes off taste;
- Often the hot water parboiling is not regulated and thus uneven effects reduces milling efficiency and
- **The single stage milling** does not involve any cleaning, winnowing or polishing of the grains.

Improved Rice Processing involves the use of mechanised large scale processing machines. Adoption rate of this is still very low because production has remained with small holders. However research recommendations have led to improvement in harvesting and preparation for milling. Grains are harvested with straw, tied in bundles and stacked upright in the field. Harvesting is done between 28 and 35 days after heading. Threshing is done on mats or tarpaulin. Sundrying is still widely practiced but on mats, tarpaulin or concrete floors. Parboiling methods now consist of steeping in waters at 70 - 80°C for 5 to 6 hours in steam boilers, depending on the variety.

Alternatively, this can be done by steaming i.e. lowering paddy rice packed in jute bags into boiling water. This is done when steam boilers are not available. NCRI has designed a system whereby parboiling can be powered by firewood or electricity. The parboiling hardware is designed for the small-scale processor with capacity of 500 kg per hour.

The improved processing has the advantages of:

- Less harvesting losses due to improved harvesting system.
- Little foreign matter pollution due to improved drying and threshing methods on cleaner surface.
- Parboiling produces rice with less odour, more oven splitting of husk, higher milling recovery and higher consumer acceptability (Ayotade 1982, African Regional Centre for Technology, 1982).

Now there are several large mills located in Sokoto, Bida, Jos, Pateggi etc of 6 - 10 tons/hour as well as collectively owned medium-scale mill-assemblages at Abakaliki, Otukpo, Gboko and so on. From observations at the Bida, Pateggi, Otukpo and Gboko mills however, these larger systems suffer from under-utilization compared to the medium ones because of lack of adequate supply of paddy of uniform characteristics in the producing areas.

2.1.3 RICE PRODUCTION AND CONSUMPTION IN NIGERIA

Of the 73.7 million hectares of arable land in Nigeria, only about 0.75% is currently cultivated to rice. Of this, sixty per cent is rain-fed, 5 per cent is irrigated while the rest is under swamp land and fadamas. Paddy rice production in Nigeria first experienced a boom between 1970 and 1974. The production ranged between 500 thousand metric tonnes and 580 thousand metric tonnes. Total land area ranged between 269 and 370 thousand hectares while yield per hectare was between 1486 kilograms and 1942 kilograms per hectare over the five year period. However, although the area increased from 300 to 550 thousand hectares over the next few years, yield dropped to about 1500 kilograms per hectare by 1981. Thus, production increases accrued mainly from land expansion.

Over the next 10 years, paddy production declined, down to an all-time low of 99,000 tonnes in 1984. Area under cultivation still remained below 300,000 hectares as at 1992. Yield appears to have benefitted from continued efforts to sustain household level productivity and food selfsufficiency. This has gradually improved to about 2300 kilograms per hectare by 1992 (Table 2.1).

Table 2.1 Trends in Hectarage and Yield of Paddy Rice in Nigeria

Year	Area ('000ha)	Yield ('000kg per Ha)
1970 - 1974	300	1.800
1975 - 1980	420	1.600
1981 - 1984	220	1.861
1985	124	3.879
1986	121	2.092
1987	165	3.311
1988	272	1.944
1989	199	1.703
1990	165	2.595
1991	241	1.622
1992	269	2.327

Source: FACU (1985):Rice Production in Nigeria,
FOS Annual abstract of Statistics, Various Issues

In spite of all efforts, production levels in Nigeria in the country still shows sub-optimal pattern when compared with what obtain in other rice producing parts of the world. For instance, in 1973, mainland China produced 34.7% of the world's total paddy rice while only 2.2% was produced in all of Africa. Of this, Nigeria contributed only 0.2% of world production or 7.9% of African production.

The demand on the other hand has increased at a faster rate than production over this period leading to steadily increasing demand-supply gap. Rising demand resulted from increasing population growth and increased income levels following the discovery of crude oil. The income elasticity of demand for rice rose. There were also dietary shifts from conventional foods staples to rice due to urbanisation and demand for convenience food. Thus per capita consumption virtually doubled.

Importation of milled rice from other parts of the world therefore increased to bridge the production shortfall. Sutcliffe (1984) estimated about 99% self sufficiency in rice in 1975. The self sufficiency had declined to 38% in 1975-1979 period and slightly revamped to about 63% by 1990 (Table 2.2).

Table 2.2 Trends in Rice Imports into Nigeria (1970 - 1990)

Year	Imported Milled Rice ('000 tons)	Domestic Production ('000 tons)	Self-Sufficiency Ratio.**
1970-74	5.7	540	99
1975-79	1125.0	672	38
1980-84	541.0	410	43
1985	356.0	480	57
1986	133.0	253	66
1987	300.0	546	65
1988	200.0	529	73
1989	200.0	339	63
1990	250.0	428	63

Sources: ** Estimated
1. Rice Production in Nigeria, FACU, 1984
2. FOS Annual Abstracts of Statistics, Various Issues
3. FAO Production Year Book, Various Issues
4. International Yearbook of Statistics, Various Issue

High preference for imported rice has also been shown by the ratio of imported rice to domestic rice production. Even while local production increased in the late 1980s and 1990, self sufficiency has not increased commensurately. This implies that preference is being displayed for imported rice varieties over local varieties, despite wide price differentials. Consistently high price spread between the local and imported rice varieties has done little to curb the annual growth rate of rice imports over time. The pattern negates the a priori notion of the demand response of a normal good to rising price [Stigler, 1966; Henderson and Quandt,1980]. Neither have the huge development costs built into production improvements succeeded in bridging the supply shortfalls. The trend indicates that rice or certain qualities of rice have fallen into the category of luxury goods, whose utility comes, not only from economic but on some other non-economic measures of satisfaction that border on quality preferences. This is a **hedonic** response as shown by earlier workers of this principle which sees quality of a good as a priced commodity. It points to a need to relate quality aspects of its production and marketing to the pricing mechanism in Nigeria to determine the degree of quality responsiveness being exhibited by consumers of certain food commodities.

Because of this trend, which has swelled the country's external debt position, efforts continued to be geared not only to bridge the demand-supply gap (Table 2.3) but also to improve the characteristics of the local breeds so that they can compare favourably with the imported breeds.

Table 2.3 Demand-Supply Gap for Rice in Nigeria ('000 MT)

Year	Demand**	Production	Dd-Ss Gap
1985	640	480	160
1986	676	253	423
1987	715	546	174
1988	756	529	227
1989	799	339	460
1990	844	428	416
1991	892	391	501
1992	944	626	318
1993	997	605	392
1994	1054	623	431

Source: NISER: Nigerian Food Balance Sheet 1985 - 1995 Prepared for Agricultural Division, Federal Ministry of National Planning.
** Demand projections at 2.5% annual growth rate.

The foregoing shows that the final economic characteristic of rice that is presented to consumers to determine its price depends not only on the agronomic properties but also on the processing and storage methods.

Varietal characteristics have been found to be an important factor both in crop breeding and cultivation and processing programmes. The on-farm characteristics of the plants comprising of vegetative organs and reproductive organ are seen to be related only to yield potential.

In the Nigerian ecosystem, certain crop characteristics have been identified as most suitable. The north requires drought resistant varieties while the south need pest and resistant varieties. These agronomic characteristics, as well as others, determine the demand for variety which is therefore hinged on three factors: climatic condition, cultural practices and consumer preference.

2.2 COWPEA IN THE NIGERIAN ECONOMY

Cowpea was traditionally considered to be a food legume for farmers subsistence. It has, however, acquired a very important economic place in farm business and household food budgets across all socio-economic classes. It is a secondary crop grown mainly in the semi-arid zones, in association with millet, sorghum, maize, cassava or cotton. Cowpea may be consumed at different stages in its development as green or dried leaves, as green pods, as green peas or as grain, of which the last is the most popular in Nigeria where it is grown for dry grain and fodder for animals.

Dried cowpea contains 24% protein, 20% oil and 56% calories and minerals. Although, grain legumes generally take a long time to cook, cowpea takes comparatively less time to cook than most others. All these qualities enhance the relative importance of this crop in energy scarce regions. The appearance and characteristics, however, differ according to the genetic properties, climatic conditions, cropping system and agronomic problems.

2.2.1 COWPEA CULTIVATION AND RESEARCH FOCUS IN NIGERIA

Cowpea cultivation originated in North eastern Nigeria and this country remains the world's largest producer of the crop. Its cultivation has spread over the tropics within a zone of 15° N and 15° S of the equator.

Cowpea growing regions in Nigeria are the dry and moist savanna where it is intercropped with the cereal crop after it is established. Early to medium maturing varieties are generally preferred and these are mostly planted in the lowland humid tropics where cowpea is planted in the second (short rainfall) season, on fields already established with cereal or root crop mainly cassava. In the heavy forest zones, cowpea is traditionally grown on trellis for green pods mainly for subsistence rather than for dry grain, due to the long spell of rainfall through most of the year.

Major problems of cowpea cultivation in Nigeria include late maturation of available species, drought or excessive moisture at different periods in the production cycle, disease and pest susceptibility and poor breeding stock. Brucchids or seed storage weevils are very rampant, attacking harvested grains and causing serious post harvest losses. In Nigeria, estimated cowpea losses from Brucchids (weevil) is over $1.0million worth of grains annually.

Despite numerous germplasm screening, the resistance of existing ones to these pests is still low. This calls for continuous effort to stabilize yield under farm conditions and reduce storage losses from off farm insect pests.

The bulk of research on cowpea improvement in Nigeria is done at the IITA, in collaboration with host institutions for various aspects of cowpea research. These include Institute of Agricultural Research, Zaria (IAR), University of Ibadan's Agronomy department, Federal University of Technology, Akure (FUTA) and the School of Biological Sciences, Imo State. IITA has contracted research for resistance to Striga gesnenoides and Alectra vogelli to the IAR, for **root knot nematode** to the University of Ibadan and on research for resistance to brucchids to FUTA as well as the School of Biological Sciences, Imo State University. The main aim of cowpea research in Nigeria is to reduce cultivation risk to farmer and thereby increase his productivity and income.

The main objectives of these programmes emphasize:

- Morphological and physiological adaptation for intercropping with cereals including the development of seed colors, sizes and coat characteristics to suit different regions of the tropics.
- Incorporation of multiple pest and disease resistance especially resistance to post-flowering pests into locally adapted varieties

- Improved, early maturing types from 60 -80 days to meet the needs of various cropping systems

Through the breeding program of IITA, several pest resistant varieties have been identified, field-tested and introduced to farmers. Research goals however vary from region to region. In the savannah zone for instance, insect resistance especially aphids, thrips, brucchids are paramount. There is also attention to adaptation to the millet/sorghum and maize based cropping systems. Long term goals include advancement in biotechnology research and Integrated Pest Management (IPM) towards biological control of pests. Comparatively less is being done about acceptability although prediction of acceptability is the final test of success since the preference pattern affects the direction for development of new varieties.

2.2.2 COWPEA PRODUCTION AND CONSUMPTION IN NIGERIA

Of the world's total 7.7million hectares of cowpea, 6.1 million (about 80%) is in West Africa, 4 million of this is in Nigeria alone (FAO,1980).

Although Africa has the largest production level, it has the world's lowest yield, at about 200kg per hectare compared with 1000kg per hectare in the USA. Reasons for the poor yield are hinged on the prevalent mixed cropping system whereby effective crop population is lowered. There is also the shading effect of the associated crops as well as high incidence of pests and diseases as highlighted above. In Table 2.4 we see the relative position of Nigeria in terms of output and yield of cowpea compared with other parts of the world.

Table 2.4: Global Cowpea Production (1980)

Regions of Production	Area ('000 ha)	Production ('000 MT)
Far East	51.8	33.3
Asia	54.4	36.2
Europe	10.1	12.6
Central America	87.1	32.2
U.S.A.	60.0	60
Brazil	1260.0	600
Africa	6177.5	1479.0
Total World Production	7700.9	2272.2
Nigeria	4000.0	1035.3

Source: IITA Varietal Improvement and Cowpea Crop Production Training Series, 1984.

The distribution of cowpea production in Nigeria indicates that the savanna and sudan ecologies dominate the production scene. Although the aggregate picture from these areas is that of progressive production trends especially in the last five years (1990 - 1995) compared with the previous five years, data on agronomic performance of cowpea in selected households show that yields have dropped and resource shifts (especially land) may be occurring between cowpea and other crops. Reasons advanced are massive crop failures and pest attack leading to harvest and post harvest losses as well as the high requirement of agro-chemicals to improve and sustain yield throughout the production cycle. Trends in national production of cowpea and the self-sufficiency implications are as shown in Table 2.5. This shows that production is increasing at a steady rate, indicating the success of research into genetic and agronomic improvements. However, there is also evidence of differentials in consumer preferences for cowpea due to very varied food options across the country. A lot more than in the case of rice has been done locally to test acceptability of various species of cowpea. These show that marketing supply has been successful in dictating the pattern of preferences over time. There is also marketed price spread between varieties especially the white and brown as the price analysis in the next section shows. This indication of quality responsiveness needs to be characterised to influence breeding and other handling processes of the crop.

Table 2.5 Demand-Supply Gap for Cowpea in Nigeria ('000 MT)

Year	Demand**	Prod*** ('000mt)	Production Surplus	Self Sufficiency Ratio
1985	802	611	191	76.18
1986	838	732	106	87.35
1987	876	688	-188	78.54
1988	915	1263	348	138.03
1989	956	1232	276	128.87
1990	999	1354	355	135.54
1991	1044	1352	308	129.50
1992	1091	1411	320	129.33
1993	1140	1576	436	138.25
1994	1192	1671	479	140.18

Source:NISER (1985): Nigerian Food Balance Sheet 1985 - 1995.
(op cit)
** Demand projections at 2.5% annual growth rate.
*** Based on Extrapolations from 1983/84 period

The next chapter provides the theoretical basis for consumer choice patterns with empirical evidences from literature showing apparent preferences for varying characteristics of crops by different groups of consumers.

CHAPTER THREE

THEORETICAL FRAMEWORK AND LITERATURE REVIEW

The emerging views on the state of the grains economy would indicate that many factors contribute to the price formation process of agricultural products. Notable is the very apparent price spread between different varieties, the demand-supply mechanisms which imply production seasonality and the suboptimal state of the technological processes which influence the form of the market samples viz breeding, production, processing and storage. These reinforce the need to explore via more rigorous econometric methods, the effect of some of these factors that account for the choice pattern for different varieties between consuming populations.

The findings of this research are expected to complement a host of past studies of the Nigerian agricultural markets in general and the grain markets in particular. Most of these studies fall short of linking the interactive effects of the classical components of price variations of farm goods viz: temporal, spatial, and random factors. In particular, there has been little effort to explore the determinants of random price variations which are usually at, best lumped up as socio-economic factors or demand shifters. The underlying thesis in this study is to show that the much understudied quality dimension of price variations constitute an ordered component of product's price and may further explain spatial dimensions of these random price changes. Many of the earlier studies of the temporal and spatial components of price implicitly refer to the quality dimensions but without any rigorous analytical models to explore the relationships. A broad overview of some of the earlier studies which inform the background concepts of the current study are presented.

3.1 MARKETING RESEARCH IN NIGERIA AND AFRICA

While the earlier studies dwelt on the structure and conduct of the market, overwhelmingly, many more studies have continued to research into the performance of the market as the most critical indicator of the essential linkages of supply and demand in price determination. Many of these studies assume that the marketing functions involving storage and transfer costs inform the process of price formation. Thus marketing margins are attributed mainly to wholesalers and retailers without adequate regard for the function of processors, breeders and farm producers. For instance, Lele (1967) examined whether regional differences in commodity prices were due to speculative activities of middlemen in India. He found high interdependence between wholesalers in price determination i.e. perfect information flow. Although he also found that spatial price differentials resulted from differences in the varieties of grains traded, he attributed these only to varying transportation costs and the effects of government policies in different regions. Ilori's study in Nigeria, also in 1967 was of the role of middlemen in Western State in order to determine marketing margins by commodity and by location. He found that margins were higher in urban than rural areas but did not take account of the labour supply of the middlemen (marketers and their families). Jones (1968) gave basically the same conclusion.

Adeyokunnu (1973) also estimated wholesalers margin to be between 20% and 24% and retailers margin to be as low as 10% comparatively. This is however compensated for by higher market share of retailers. In effect, she pointed to a more fundamental role for retailers than wholesalers in the Nigerian marketing system.

As to the conduct and performance of the market, Anthonio (1967, 1968) did some pioneering works in the study of market structure and performance in Nigeria. In a study of the supply and distribution of Yam in Ibadan city, he noted bottlenecks mainly caused by poor transportation and poor storage facilities. Furthermore, in 1968, he analysed the pricing efficiency of food staples and concluded that prices are highly competitive and market determined and that the bulk of marketing costs arise from transportation and storage risks. Osuntogun (1972) examined obstacles impeding efficient food marketing in West Africa and found the role of middlemen, poor market information flows and high transfer costs resulting from a large-scale segmentation of production as the major constraints. Olayemi (1973) in a study of rice marketing and prices in Kwara State traced the weakest points as the seasonal price fluctuations and inter-market price disparities. These are also linked to problems of storage, information flows and poor road networks.

In 1975, Olayemi attempted to determine the process of price determination in food markets and identify factors influencing price margins. He found that changes in wholesale prices are often higher than corresponding changes in rural and retail prices. He concluded that the wholesale market is more critical in the process of price adjustment.

This is a variant of opinion from Adeyokunnu's findings and Osuji's work in 1974. He (Osuji) looked at price spreads between various distributors in the rice market. He identified lack of competition at wholesale level as one of the causes of high marketing costs. He also noted that all marketing functions are taken out of the farmers reach due to his poor financial position. Hence the farmer's market share of the market price tends to be low. More incisively, Osuji identified absence of uniform grades and measures as an impediment to efficient price formation. He opined that grading leads to gains in time for market transaction which lowers marketing costs. He observed for instance that the wide margin between the farm gate (paddy) price and the market (milled rice) price is not only accounted for by the milling or processing cost, an implication for quality response.

Faruk (1972) studied the rice market in Pakistan and also noted that prices for different grades were higher than transfer and storage costs. He concluded that this yields excess profit to market functionaries which is not accounted for and which does not accrue to the producer or processor.

Many factors relating to differences on rice quality are implicated in these studies. If the presence or absence of grades affects the operational efficiency of markets, then quality traits are important in price determination. The findings of Ilori, Jones and Adeyokunnu imply that the functions of retailers, many of which impose changes in the handling properties of the commodity are crucial to price (and thus) quality differentials. The findings of Osuji and Faruk clearly point to the relevance of consumer preference patterns in price determination, and while in Osuji's case (Nigeria) the absence of a clear framework to graduate these preferences into uniform grades affected price formation, Faruk's case (Pakistan) demonstrates the relative importance of quality and other marketing costs in price formation. This calls for a closer look at the function of grades on quality of goods and the role of consumer choice in price determination and the operating efficiency of food crop markets which this study attempts to provide.

3.2 CONSUMER CHOICE OF COMMODITY ATTRIBUTES:IMPLICATIONS FOR MARKETING RESEARCH

The concept of consumer choice derives from the ways and manner in which consumers choose between alternative quality traits of the same commodity, their willingness to pay for preferred traits and the level of the responsiveness of price to these quality changes.

The main question in much of marketing studies involving consumer choice reflect this concept which explore solutions to posers such as: How do buyers evaluate products" or what cues do they search for in order to make price judgements? How do these clues affect their decision (behavioural intentions) and price estimates? To what extent do their price estimates approximate the quality of the product i.e. what is the nature of price-quality relationships for products involving choice between alternatives?

Classical economic theory assumes that buyers have perfect information about products and prices and that they are capable of processing the information. In reality however, buyers face an increasingly complex market situation, numerous products, incomplete or imperfect information and limited capacity to process information. (Adekanye, 1986, Kohls and Uhl, 1985) Therefore, what obtains is an uncertain environment where decisions have to be made based on cues. The most important ones are advertised prices, reference price (last price paid) and certain attributes of the product as perceived by their utility giving ability.

These cues are used as indicators of product quality and of monetary sacrifice. A buyer trades off these opposite indicators to make price assessment which influences price formation processes at the market, since multiplicity of buyers means multiplicity of consumer price perceptions.

Consumer choice of crop varieties impacts on producer choice of seed materials. It has implications not only on marketability of final product but on farmers' acceptability of improved seeds or the success of research innovation (a function of consumer choice). The responsiveness of consumers to a given crop variety to specific characteristics of the product thus is a viable research information. Producers will delete or minimise the introduction of the magnitude of unacceptable characteristics into the product and optimise the inclusion of marginal units of desirable characteristics.

It would therefore seem important to study those factors which are capable of affecting the choice patterns among different samples of the same populations. Indeed if the premise of differentials in choice pattern holds, then the demand for a commodity is affected by the commodity's characteristics. This theme has been variously explored in agriculture and other fields. Similarly, literature abounds on the possible determinants of demand for products and products characteristics. These guide the analytical models of the current study.

3.3 MARKET FACTORS INFLUENCING CONSUMER CHOICE OF CROP VARIETIES

The factors identified include not only socio-economic ones but also the physical attributes of the crop as well as cultural and the cumulative effects of these on the personal judgement of the buyer of the crop. Some of these factors are highlighted.

3.3.1 Socio-economic Factors

Gifft et al (1972) note that the acceptability of food is determined by the values, attitudes and beliefs of the cultural framework within which food habits develop. Therefore not only economic factors but also social and cultural factors influence its consumption or explain the choice of grain varieties by consuming households. The need to consider social variables in a bid to deepen the foundation of the analytical system was first posited by Loentiff (1971). He argued that the achievement of a better understanding of consumer behaviour must transcend conventional consumption function studies to involve a systematic study of the structural characteristics of the functioning of households - here "social, anthropological and demographic factors must occupy centre stage" (Ibid. p. 4).

Akinpelu (1974) however identified purchasing cost, tradition and past experience as some important social factors influencing preference for cowpea types in Ibadan. Smirl and Zoaka (1987a) observed that the type of cowpea dish often prepared influences choice in Northern Nigeria. Also Dovlo (1974) noted these and also that different tribes had varietal preferences. She identified religious background and ceremonies as important factors in choice of varieties. Adrian and Daniel (1976) identified family income, degree of urbanisation, educational attainment of homemaker in the U.S. Aligbe (1977) identified age of household decision-maker and prices as determinants of food nutrient choice in Oyo State.

3.3.2 Physical Factors

With respect to crop attributes, most of the works in Nigeria have been on cowpea characteristics. Smirl and Zoaka (op cit) also observed that size of cowpea grain influences demand. For instance, the speckled variety in Northern Nigeria was never used for preparing 'rice and beans' in view of its small size. Other cowpea characteristics important to consumers are colour, swelling capacity, ease of grinding and taste of the dish.

IADP report on cowpea acceptability identified size, colour, skin texture, soaking time, cooking time, weight increase after soaking or swelling capacity, ease of dehulling, palatability as determinants of consumer preference.

More educated consumers are likely to react to nutritional quality, protein content, calories content as well as vitamins and mineral content. Akinpelu noted ease of seed coat removal, binding quality, cotyledon hardness, ability to incorporate air, undesirable colouring material, keeping qualities etc. as attributes that influence choice. Ojomo (1968), Chhedda (1972) indicated that cooking time and ease of softening are most important and are closely related to seed coat texture and soaking qualities. Dovlo identified in Ghana, colour appeal, quick cooking (cooking time) swelling capacity, seed eye type (less black eye desirable) susceptibility to weevil infestation. Nwanze and Horker (1975) show that there is a statistical significance between seed size and weevil attack (at 0.01 level). They estimated correlation level of 0.72 between mean seed weight and weevil attack. Larson and Hisher (1938) found that although cowpea weevil prefer smoother seed coats for oviposition, seed colour has little impact on oviposition. Findings are corroborated by Booker (1967) who found that the black eye cowpea is preferred by cowpea weevils. Fosu constructed a consumer choice model for the specific explanation and prediction of consumers choice among seed technology products. He used two varieties of cowpea to estimate the potential choice (likelihood of choice) at the household level of a new seed technology at specified potential prices of the new variety. His emphasis is on consumer utility via access to the most desirable combination of characteristics. The limitation is that the study does not consider the actual consumer demand with respect to that seed technology. Also, while he constructs an index of household preferences for the desirable traits and the distribution of same among different classes of households, he does not attach any monetary value to such preferences. As such, the consumer choice pattern was not linked with the actual market mechanism via demand prices, market supply and consumer demand. He however identified family life cycle, education of woman and husband as relevant socio-economic factors (Fosu 1984, op. cit).

The above however have yet to be empirically fitted into an appropriate model whereby their pattern of influence, their relative influences and the responsiveness of price to them can be estimated. Much of this has been achieved with respect to developed economies where consumer preference studies date back a long way. The aim in the current study is to assess to what extent the nature of the grains market in Nigeria conforms to these global perspectives. In this regard, the pioneering works of IRRI over two decades, Unnevehr et al (1985, 1986) Unnevehr 1992, Benero,1978, Raju et al,1990 etc are noteworthy in focusing on quality preferences for rice and cowpea.

An experiment by Raju to determine the best grade of rice for aroma, taste and appearance among available varieties in India took into account both agronomic and economic factors including grain yield, net returns, maturity period and consumer preference for grain quality. Unnevehr in 1986 analysed a consumer panel data in the Philippines and Indonesia to gain insight into how consumers choose and value rice grain quality. She also used retail surveys from Bangladesh, Malaysia, Thailand and the Philippines to give a comprehensive picture of the variance in rice quality and preference pattern across Asia. In addition, she addressed how preferences are translated into farm level incentives and how well the markets transmit quality signals as shown by studies of rice mills and rice markets . An earlier study (1985) in three Asian countries showed that significantly, better milling quality and aroma are ranked highest while preferences for shape and chemical attributes vary.

3.4 NON MARKET FACTORS INFLUENCING CHOICE: RELEVANCE OF BUYER PERCEPTION IN CONSUMER DEMAND

The above are components of the random movement of price which vary with the degree of demographical heterogeneity of a population. There are, however, certain innate population characteristics which are more difficult to perceive. This is because they are factors that are innately determined by the buyer at the point of purchase and may be unrelated to the usual determinants of demand. They, more than the presented market factors, account for the truly random movement of price. The profitability of investments in technologies has thus been linked to other non-market factors related to consumer demand (Henault, 1989).

This author argued that marketing strategies must depart from the principle that every product must respond to market demand. Owing to the diversity of populations in Africa, marketing strategies must consider factors such as the physical transformation of products, their distribution as well as price and cultural appreciation of the consuming population.Mainly for non-agricultural goods, many studies have advanced other factors that are important in product marketing and which need to be studied and built into pricing strategies of manufacturers and other sales companies. These are factors that relate to consumer choice with consumer perception or inclination which may not be directly discernible and are not easy to measure but are nonetheless important. Some of these parameters are:

(1) Shared Consumer Knowledge (SCK) which has been seen to have a positive effect on market decision and sales. SCK is seen to be positively related to sales level and negatively related to advertizing cost, especially in newer markets (Smith, 1989).

(2) Quality-Risk has also been found to affect price-quality relationship. Turley (1989) used products with different levels of quality risk to see to what extent price is used as a surrogate for quality.

(3) Familiarity of (product) or service is another independent variable.

Turley (1989) assessed the influence of quality risk and familiarity of service or production on price-quality relationship. Using three groups of (services) with varying levels of quality risk, familiarity with buyers and price in a 2 x 2 x 3 factorial anova design, he found that price as an index of quality was not significant in all of the designs, neither was quality risk significant. However, familiarity of service was significant in 2 out of 3 replications. He concluded that price-quality relationships may be lower for services than for products.

In the same vein as above, Butler (1990) noted that consumers evoke several information-search behaviour when selecting alternatives among brands of a product at various levels of perceived risk and at different levels of consumer product knowledge or SCK.

The usual option is that consumers search for and process information by brand name and by attribute or by recommended information. In order to test the effect of these on choice pattern for given products, Butler tested the consumer service at two levels of perceived risk to analyse the propensity to search for information and the types of information curves demanded from 142 subjects (consumers). He found that subjective knowledge has little effect on search recommendation; SCK interacts with perceived performance risk for total information curves; that majority of customers actively seek recommended information regardless of levels of perceived risk or consumer knowledge and friends are the most sought after sources of information.

Gray (1990) also found that the order in which sample prices are presented to consumers (for evaluation) affects their current and future price expectation i.e. when prices are presented in an ascending order, consumers expose a different choice behaviour than when prices are presented in descending order. This is a study in **Consumer Price Perception (CPP)** or subjective evaluation.

Earlier studies of CPP have focused on three conceptual framework to guide consumers internal reference pricing mechanism. These are:

(1) Adaptation Level Theory - which explains the formation of market price expectations

(2) Social Adjustment Theory - which explains threshold of acceptable prices and

(3) Trend extrapolation - which helps to approximate expected future prices.

The issue of externalities in attribute pricing also arises as additional utility (value) is perceived from the same product by different consumers with different transfer and socio-economic conditions. These additional attributes are seen as benefits from product's intrinsic attributes and determine the transaction value of the product. Grewal (1989) developed a model to test the market for certain manufactured products. The model's conclusions are based on the hypothesis that:

- If the perceived value (internal reference price) of the product is above (below) the price offer, consumers will chose to (not to) buy.

The perceived value is made up of the internal reference price and the additional value (transaction value). Since the perceived value has a positive effect on purchase intentions, the greater the transaction value, the less the search for a lower price offer since the internal reference price is fixed.

All the above have served to advance the focus of research into quality factors as they affect marketing performance. In other words, the degree of market coordination is hinged, not only on the space and time dimension but also on quality dimension. The conceptual framework of the current study has largely derived from these pioneer studies, as follows in the next section.

3.5 BACKGROUND CONCEPTS OF THE CURRENT STUDY

The underlying concept of the current study is that the introduction of desirable characteristics into crops via breeding, agronomic and post harvest technology systems is a necessary but insufficient condition for the development of the agricultural economy. Farmer welfare and inter alia greater production and productivity are hinged on the willingness of consumers to pay for the crops' induced characteristics, i.e. the price offer of the consumer for units of these induced characteristics. Crop improvement must therefore take full account of consumer preferences and relative prices paid for different crop samples.

Crop improvement programmes are a very significant aspect of agricultural development. In developing countries, huge sums of money have been utilized, mainly with the aim of improving food production and availability through higher yields of crops and greater inventory value at the post harvest stages.

Quality improvements, in particular focus on certain bio-chemical and morphological characteristics that are desirable to the extent that consumer utility is enhanced and that cost of improvement does not hike the final price beyond his/her reach.

Unnevehr (1986) states that products are demanded for the utility they provide and this utility is a function of the characteristics of the product. She and other authors (Lancaster, 1966, Lucas, 1975, Tomek and Robinson 1979) also postulate that the price paid and the quantity of each desirable characteristics demanded is determined by the expected utility from expenditure (income spent) on that characteristic. Thus marketers' supply function is a function of consumer demand pattern or consumer tastes and preferences. The income elasticity of demand is a major determinant of the final price of each product characteristic and bears a relationship to the ordinal scale of preference for different qualities (grades) of the same commodity (Ladd and Suvannunt, 1976, Henderson and Quandt 1980, Wold and Jureen 1953). The price and income elasticities of demand should be greatest (lowest) for the best (worst) grade, ceteris paribus. This underlies the Hedonic principle whereby quality changes are the basis of price differentials in input and output markets and in price determination among comparable products.

If the above holds true, the market is seen to be integrated with respect to quality. The implied market efficiency should encourage the development of modern marketing strategies, with a grading system as a prerequisite. Also if this holds true, it implies positive consumer surplus gain from consuming better grade of the same commodity and ample justification for greater development costs into crop quality improvement programs in resource poor developing countries.

The relevance of this to the agricultural market is as follows:

- The farmer must adopt a production program which will not only result in a crop of the size most suited to market conditions, but he must produce varieties and types which the market wants and for which it is willing to pay.
- The marketer must base his/her supply of commodities on the understanding of the market demand for different qualities especially where grading and packaging enhance the demand price.
- If it can be shown that there is a premium for certain qualities and types of products and if that premium is large enough to pay the increased cost of producing/processing that special type, then strategies of better production/processing etc will be adopted.

- A producer/processor/marketer can not control the size of the commodity with respect to those that will compete with his own, but to a large extent, he can control the quality of his own commodity.

Many problems in Nigeria, however, hamper the achievement of efficient production decisions and of the form of integration implied above.

First, the generally low real income has led to low income elasticity of demand for many food categories which may be classified as luxury goods. For staple foods, qualities with better characteristics fall into this category. Therefore the qualities mostly in demand may not be those for which consumers should pay the highest prices. In this regard, market signals as given, may be misleading.

Secondly, food prices are affected by myriads of other factors such as poor market infrastructure leading to high marketing costs. As a result, the price of quality may become an insignificant proportion of marketing costs. In this regard, development costs into quality improvement may seem irrelevant compared to other marketing problems. Hitherto, the relative importance of these two factors is uncertain in Nigeria.

Thirdly, differences in culture and dietary habits imply that preferences are not uniform within the population. These cultural variations and other socio-economic factors however affect choice pattern, and regional market demand function. These should not be overlooked in designing quality improvement programmes especially for producers. It is doubtful that this diversification has been adequately considered in agricultural policy or whether it has significantly streamlined technological packages for different segments of the population.

Fourthly, the consumer environment is largely income-constrained such that market share of food retailers remain highly dispersed among millions of small-holders. This gives the illusion of low concentration - a competitive market. But low market concentration has not been seen to be **synonymous** with high integration or market efficiency (Osuntogun, 1972, Adeyokunnu, 1973, Osuji, 1984). This implies an unstable pricing system, the absence of a predictive framework of pricing, poor price information flows and possibly, ineffective feedback for setting goals for crop improvement research.

All the above have stagnated the development of the market for agricultural products and have direct bearing on production efficiency and farmer welfare. Most importantly, it may imply that development costs into quality improvements are unjustified if consumers are not willing to pay for the result of such efforts or if there is no enhanced utility for consumers and producers. It has also precluded the development of a grading system and development of modern marketing strategies in Nigeria.

The summary thesis being forwarded here is that the interrelationship of the state of demand and supply with the nature of the product and of the population in price determination is the theoretical basis of marketing research. The extent to which theoretical underpinnings hold true dictate the level of development of any market. In situation of relative scarcity of essential product, unstable social and economic policy environment and technological backwardness, theory and practice may tend to diverge. However in more balanced and developed economies, the divergence is minimised. New theories evolve and are advanced based on research findings and other observation on the performance of the market.

The relevant theoretical underpinnings to validate the true state of the Nigerian grain market with respect to the above requisites centre around the theory of consumer behaviour in a characteristic frame. These theories of consumer behaviour and choice of product characteristics have developed over time from the classical theories of consumer demand. The theoretical models applicable to this study are hereby presented.

3.6 THEORETICAL FRAMEWORK

3.6.1 CONSUMER DEMAND MODELS

The first major consumer demand models are those of Marshall (1920) and Friedman (1949). The utility theory of demand is an offshoot of these earlier models which is called the classical demand model. This is often an optimisation problem where the consumer chooses the bundle of commodities that yield the highest level of satisfaction, subject to the usual income and budget constraint.

The relationship of the hedonic principle to the consumer demand theory has its premise in the cardinal utility principle. Early neo-classical economists like Leon Walras, Alfred

Marshall and Francis Edgeworth assumed that a consumer could assign a cardinal measure which can be attached to each commodity bundle. The total utility gained was simply the sum of the utilities derived from individual commodities. The concept of marginal utility therefore developed through the cardinal utility theorists. This is the additional utility gained by consuming one more unit of the good such that

$$M_{(q)} = \frac{DTU_{(q)}}{D_q} \qquad 3.1$$

where MU, TU and q are the marginal utility, total utility and quantity of a good. This $MU_{(q)}$ is the rate of change in TU which is a function of good already possessed and because it is introspectively assumed that the more of q is consumed, the less the additional utility gained, the well known law of diminishing marginal utility comes into being. This form of utility function is denoted as

$$U = U_1(q_1) + U_2(q_2) + \ldots\ldots + U_n(q_n) \qquad 3.2$$

The total utility U is the sum of individual utilities from each additional unit of a consumed goods.

Consumer choices are therefore made in response to this principle. A choice between the consumption of one given quantity of good A and that of good B is premeditated on comparison of the additional utility gained from trading off one more unit of A for one more unit of B and vice versa. The determining factor in cases of choice is the budget line.

Following this was the Becker's Models (1965) which is a household production model. It assumes that consumers transform market goods into commodities that generate utility through household resource allocation. This utility maximization problem results in commodity decision purchases that are optimal inputs used in a household production function (Becker,1965).

The characteristic model is the third major approach in consumer demand analysis which assumes that utility is derived from the physical properties which commodities possess rather than the commodities themselves as in the classical and household production models. Explicit incorporation of commodity characteristics into theoretical models that examine the utility maximisation models began with Houthaker (1951/52) and Theil in the same year. Lancaster (1966, 1971), however, developed what is the theoretical foundation for most research in characteristic model. Here, utility is desired exclusively from characteristic contrary to the general optimization problem where consumers choose the level of characteristics that will maximize utility, subject to a budget constraint.

Lancaster's modification of the Classical Consumer Demand Theories lies in breaking away from the traditional approach that goods are direct objects of utility but supposes that it is the properties or characteristics of the goods from which utility is derived. Thus, consumption itself is an activity in which goods are inputs and the collection of characteristics is the output. There is a consumption technology which leads to the production of the maximal utility or the best combination of characteristics. Preference ordering, in the known sense therefore ranks collections of characteristics rather than collection of goods whereby we may have nutritional characteristics, social characteristics, aesthetic characteristics and traditional characteristics (Quandt 1956) and so on.

While this holds, it goes that the simplest consumption activity produces joint outputs. Also, because classes of characteristics may be related, the same characteristics may be included among several joint output.

Similarly, characteristics possessed by a good or a combination of goods are the same for all consumers and are in the same quantities so that the personal element arises in choice alone and not in the allocation of characteristic to the good i.e. the characteristic matrix is deterministic (Lucas, 1975).

The relative quantities of a particular characteristic between unit quantities of a part of goods is therefore the same for all consumers.

The specific model relates to the relationship between the level of consumption activities and the goods consumed to be line as and objective so that if x_j is the jth commodity,

$$x_j = \Sigma a_{jk} Y_k \qquad 3.3$$

and the vector of total goods required for the activity is

$$x = AY.$$

The coefficients a_{jk} are determined by the intrinsic properties of the goods and the context of technological knowledge about its properties.

Each consumption activity produces a fixed vector of characteristic, in a linear relationship such that Z_i is the amount of the ith characteristic and

$$Z_i = b_{ik} Y_k \qquad 3.4$$

$$\text{or} \quad Z = BY$$

The coefficient b_{ik} are objectively determined by some arbitrary choice of units of Z_i.

Also the individual possesses an ordinal utility function U_Z on characteristic and will choose such as to maximize U_Z which is assumed to possess the convexity properties of a standard utility function.

The relationship which links Z and X is indirect through the activity vector of a and b (since Z is a function of his preferences and welfare state and X is a function of his relative position in the economy).

The relationship depends on the number of characteristic x, the number of activities m, and the number of goods, n. It is rare to have a situation such that r = m = n in which case the matrixes of A and B are square and the relationship between Z and X is a one to one relationship such that:

$$Y = A^{-1}x; \qquad 3.5$$

$$Z = BA^{-1}x \qquad 3.6$$

and $$U(Z) = f(x) = U(x). \qquad 3.7$$

We often have relations between vectors of different dimensions and there are several paths linking goods with characteristics. Hence a choice matrix which debunks the traditional analysis of a choice between x_1 collection and x_2 collection and replaces it with a choice between collection Z_1 or Z_2.

The optimization problem facing the consumer with a budget constraint then becomes:

$$\text{Max } U(Z) \;\; \text{ST } px < k \qquad 3.8$$

$$Z = BY$$

$$X = AY \qquad 3.9$$

$$X_1Y_1Z > = 0 \qquad 3.10$$

a non-linear programme.

This model is simplified as

$$\text{Max } U(Z) \;\; \text{ST } px < k \qquad 3.11$$

$$Z = Bx \qquad 3.12$$

$$Z,X > 0$$

The basic model now has 4 components

(1) U(Z) operating on characteristics and defined on C-space.

(2) Budget constraint $px < k$, defined on goods space G-space.

(3) The equation $Z = Bx$ which is a transformation between G-space and C-space.

(4) The non-negativity constraints $Z, X > 0$.

Difference between traditional consumer analysis is that in the former, both budget constraint and utility function are defined on G-space and can be directly related. In this latter, we can only relate the two after both have been transformed to the same space.

In the Lancaster model, therefore, there are three underlying assumptions (Lucas, 1975)

(1) Linear Consumption Technology (LCT) that there is a linear fixed ratio of characteristic to products. Therefore, increasing consumption of a product by X% leads to an increase in the amount of each characteristic by X%.

(2) Independent Utility Distribution of Characteristics (IDC) that utility depends only on the amount of a characteristic, and not the product sources.

(3) Non-Negative Marginal Utility (NNMU) that every characteristic yields non-negative marginal utility.

These three assumptions have been empirically examined. Lucas (1975), Hendler (1975) found that the IDC assumption is crucial and required to compare two levels of utility for the same level of characteristics. It requires that each bundle of characteristics must present a unique level of utility obtainable only with the given combination.

They also show that when the NNMU assumption is violated, indifference curves are not strictly convex and preferences must be explicit for optimization. They (Lucas) also found that the LCT assumption was crucial in determining the efficiency frontiers.

The Lancastrian Consumer Theory is linked with the hedonic-price function via the representative consumer's utility function whereby a linear consumption technology is assumed to relate the vector of characteristic totals to the quantity of commodity consumer. In the linear programming approach used, the price of characteristic is the shadow price of the dual of the price-minimisation problem.

The theoretical basis for this was further grounded through the recognition of earlier empirical works which attempted to quantify quality changes so as to make it a measurable variable in the ordinary demand model. These include the works of Court (1939), Houthaker (1951-2), Stone (1954), Quandt (1956), Griliches (1956), Adelman and Griliches (1961).

However, the Lancastrian theory suffered from some shortcomings despite its usefulness in putting in place the basis of the theory of characteristic demand. Its assumptions of a linear consumption technology, positive marginal utility and utility that was solely dependent upon amounts of characteristics, without regard for their distribution has been found inapplicable for most normal goods especially agricultural products.

The evolution of other models arose in response to these weaknesses after many years of evaluation of price-characteristic behaviours. Ladd and Martin, 1970; Martin, 1974; Horak, 1976; Perrin, 1980; Ethridge and Davis, 1982 served to establish the validity of an alternative characteristic demand model which had been forwarded by Waugh as early as 1928.

Perrin, in investigating the impacts of this component pricing mechanism noted its particular relevance to agricultural products that possess a high degree of quality heterogeneity. These 'hedonic' models have proliferated since, using both generalized and ordinary least square estimation procedures to analyse time effects and cross-sectional effects on price-quality relationships. The basic tenets lie in the principles of the price of pleasure and the quantification of quality change, discussed next.

3.6.2 Quantification of Quality Change: The Hedonic Model

The theory of Hedonics addresses the utility of pleasure and views pleasure (as derived from quality enhancement or some positive quality indicators) as a priced commodity (Chambers, 1983). The earlier proponents of the hedonic theory thus took into cognisance the measurement of the price of quality and derived an econometric relationship to achieve this and helps to rank quality traits by parametric estimates.

WEBSTER's definition of quality makes it synonymous with characteristic. Therefore, quality in this sense need not be ordinal i.e. good, better or best. It may only be different. Grades however connote a scale of varying qualities ranked according to some perceived order of preference. A grading system can thus aid in defining relative quality differences for the purpose of pricing.

According to Adelman and Griliches (1961), the quality of a commodity is regarded as a composite number of different characteristics it possesses. Also Houthaker (1951) in a study of compensated changes in quality, works on this assumption. For instance, milk is specified rather in terms of fat content, vitamin content and perishability than just milk; a grain crop is specified as units of its colour, size, milling quality, shape etc. Each characteristic is then measured by some weight assigned to varying specifications of that characteristic. In this process, the subjective notion of quality has been quantified by a specific combination of rankable traits. .For any commodity i, therefore, there will correspond n different quality dimensions αij.

The change in price dp_i of this ith commodity can be decomposed into two distinct additive component:

$$dp_i = dp_i + \sum \frac{\delta p_i}{\delta \alpha_{ij}} \quad d\alpha_{ij} \qquad 3.13$$

dp_i is the price movement which would have occurred in the absence of quality change. It is called the **polygenetic** price change.

$\Sigma(\delta p_i/\delta\alpha_{ij})\ \delta\alpha_{ij}$' represents the combined effect of all those changes due to quality variation alone.

For consumers in a state of equilibrium or in a perfectly competitive market, expenditures E on various quality characteristics are in proportion to the increase in satisfaction generated. In short, price extorted for quality improvements should generate a compensating change in consumer utility. The returns to quality improvement could therefore be measured in form of consumer surplus (Norton and Davis, 1981).

The mathematical term specified offers a scheme for converting small quality changes into corresponding price movements by estimating $dp_i/d\alpha ij$.

Court (1939) and Stone (1954) first tried this estimation by selecting one set of indicators for different quality dimensions. A multiple regression of cross-sectional data yields the partial coefficient of pi on each αij which depend on the form of the equation specified and estimates the relative value (price) of the jth characteristic of the ith commodity. This relationship is the basis of hedonic price functions in the econometric relationship between the demand and price of any given characteristic of a commodity (Southworth, 1961).

Hedonic price functions are generally are regression equations of the general class.

$$pi = p(\alpha il \ldots\ldots \alpha ij, Ui) \qquad 3.14$$

where pi = observed price of commodity

αij = amount of some intrinsic quality per unit of the commodity

Ui = a disturbance term.

3.6.3 Applications of the Hedonic Theory

The growing attention in hedonic price analysis derive from increasing study of consumer demand and commodity market pricing, mainly in developed economies. The focus on these analyses are based on five broad areas (1) demand for products and product characteristics (2) market pricing of products or characteristic embodied in commodities (3) input characteristics and the optimal production function (4) quality changes in the construction of consumer price index and (5) definition of crop grades.

Hedonic price functions are also applicable in the derivation of supply and demand functions in a 'characteristic' framework. Lucas (1975) shows this role of characteristics in determining prices as dependent on their influence on the demand and supply functions. Thus, hedonic-price function here focuses on the efficacy with which consumers select commodities, given the parametric prices and characteristics.

Other authors, Fisher, Griliches, Rosen discussed the use of hedonic-price functions in relation to production costs. The assumption is on an efficient firm's choice of production inputs to produce quantities of commodities such as to minimise cost, subject to a minimum level of revenue.

Adelman and Griliches (op cit) discussed four common approaches to the problem of quality adjustment to provide an index of quality change which can be used as a deflator of the ordinary consumer price index to make it reflect all relevant factors in a price change.

Ladd and Martin, Unnevehr, Ladd and Suvannunt (op cit) employed the hedonic function in the estimation of demand price of attributes of market good and of production input and input use efficiency.

In a neoclassic Input Characteristic Model (ICM), Ladd and Martin proved that differences in yield of input characteristics affect producers. They show that the price of an input equals the sum of the money value of the inputs characteristics to the purchaser; money value of each of an input characteristic equal the input's yield of the characteristic multiplied by the money value of one unit of the characteristic. They also show that demand for an input is affected by the inputs characteristic.

By regressing input prices (ri) on input characteristic (as measured by a term Xjih), they determined marginal implicit prices from the equation:

$$r_i = \sum_j T_{jh} * X_{jih} \qquad 3.14$$

to test the null hypothesis that ri is not linearly related to Xj where Tjh = marginal implicit price paid for the jth input characteristic.

X_{jih} = the total quantity of j that enters the production unit to produce the ith output.

The Consumer Goods Characteristic Model (CGCM) of Ladd and Suvannunt (1976) also adapts this multiple regression model in deriving the relationship between commodity characteristics and retail market prices paid.

The CGCM employs the method of utility functions of consumers where the market price is the dependent variable in the estimation of marginal bid functions i.e. the market equilibrium prices for the product and equilibrium utility levels for consumer such that:

i. the product is sold to the highest bidder;

ii. each consumer maximises her utility, subject to her budget constraint;

iii. all prices are positive.

Because hedonic functions have been applied more to urban 'luxury' goods where pleasure is an inherent choice, the marginal bid function is only useful in situations of 'auction' or stock pricing. Arimah (1990) however, demonstrated the importance of the micro-economic trade-off models in the housing sector and proved the relevance of hedonic models to Rosen's 2-stage model. His is the only known empirical work that estimates hedonic function for a market good in Nigeria. Arimah analysed the consumption relationship of housing in the private housing market in Nigeria. He aimed to determine whether or not housing sub-markets exist on the basis of the differentials in implicit price of housing attributes. He assessed the relative importance of three groups of housing attributes in determining housing value; estimated the demand function for different housing attributes and identified and explained the spatial variation in housing value as well as the inter-relationship between spatially variant attributes and various distance measures.

His findings revealed through estimates of hedonic function that the relative price of dwelling units can be explained by structural, neighbourhood and locational attributes for both renters and owners. He also tested the relative importance of each group of attributes and showed that spatial differentials in product value is not only due to market factors but also to non-economic taste shifters notably cultural and ethnic factors. Other hedonic workers in the urban luxury goods sector include Megbolugbe and Frank, 1987; Arimah, 1990; Witte et al, 1979, making the largescale adaptation of this theory in large metropolitan markets more rampant.

3.6.4 Specific Applications of the Hedonic Model in Agriculture

Hedonic price analysis and characteristic models are receiving increased attention in studies of consumer demand and commodity market pricing. These go beyond the analysis of consumer preference pattern to the ranking of these choice patterns as a means of determining their relative effect on product pricing. Although not all hedonic studies have linked their research to market mechanisms, they have generally set preference scales for characteristics or varieties of products.

Waugh (1928) conducted the first works on demand analysis that focused on product characteristics. His research examined the quality attributes of vegetables. Other studies by Waugh, 1929; Clark and Bressler, 1938; Fettig, 1963; Hyslop, 1970 and Watchel and Betsey, 1972 provide empirical test of characteristic equation. Waugh analysed the prices of vegetables and found for instance that each additional inch of green colour per stalk added 38.45C to the price of one dozen bunches of asparagus. Clark and Bressler studied strawberry and egg prices as functions of size, condition, uniformity, colour and variety. Fettig found that a large proportion of variance in prices of farm tractors could be explained by the horse power and type of engine. Hyslop analysed the prices of hard red spring wheat and found that a lot of the variation in price could be explained by a linear combination of percentage dockage, protein content, test weight, percentage damaged kernel, percentage foreign matter, percentage shrunken or broken kernels, area of origin; destination and transport mode.

Watchel and Betsey applied the same principle of quality to wage earning and found linear relationship between years of experience, race, age, sex, etc and wages. Durable goods have also been analysed from this perspective. Automobile prices have been expressed as linear functions of characteristics such as horse-power, weight, length and so on (Adelman and Griliches 1961; Fettig, 1963). This approach has also been used extensively in the housing market where housing attributes such as location, neighbourhood, living space and so on are examined in relation to the estimation of bid rent to estimate its hedonic function.

Similarly, Unnevehr (op cit) used the CGCM method to evaluate the implicit prices of rice characteristics and compared same in Thailand, Indonesia and the Philippines. These implicit prices were further used in evaluating rice-breeding goals and estimate returns to research via consumer surplus method.

All these show the importance of quality differences in the pricing of commodities, either inputs or outputs and justify multiple regression as one method of assigning monetary value to characteristics which applies to any production activity or consumption technology.

However, in developing countries, the hedonic principle has been applied in a more limited scope. This has been mainly in the technical production realm to test consumer preference patterns, with little or no economic linkages. Many authors in the food technology sectors have applied the principle in determining the preference scale for different crop cultivars, foods with varying chemical composition and biological properties and so on, based on some laboratory tests and by limited consumer panels (Ordonez, 1992; Goyle, 1992; Ferreira et al, 1990; Ejiofor et al, 1987; Vaidehi,1985). These include the following (i) tests of chemical composition and cooking quality of 2 sweet potato cultivars from Argentina,(ii) the sensory evaluation and acceptability trials of biscuits prepared from raw and malted wheat among 6-year old children in India,(iii) assessment of the level of hydrocyanic acid in processed bamboo shoots under different conditions and its consumer acceptability with respect to colour, taste and texture in Brazil,(iv) analysis of moisture and nutrient content of kernels of Irvinia gabonensis and comparative sensory evaluation of fresh and stored samples in Nigeria,(v) sensory evaluation of biscuits made either from conventional all-purpose flour or from an important millet specie (Ragi) with a view to promote its utilization in India. Most of these used 5 to 7 point hedonic scales or similar rating scales on consumer panels or cross-sections of consuming households.

With respect to the terminal quality of food products as rated by consumers, most available studies focus on processing qualities of crops or the agronomic performance of seeds in determining crop grades. For instance, Yetneberk (1991) studied consumer preference of seed quality for ease of processing for several food options from some widely cultivated food legumes in Ethiopia. The research became relevant in view of increases in cereal consumption during traditional fasting days of orthodox christians during which period there is total abstinence from meat and eggs.

Rheenen (1979) concluded that breeding programmes should rank characteristics such as disease and drought resistance higher than seed type in view of the high flexibility in consumer preference found in a study of 997 cowpea seed samples to prioritize goals of breeding programmes in Kenya. Rao (1987) on the other hand, identified that while factors such as 100 seed weight and seed size are important to rice producers in the evaluation of seedling growth and productivity, mainly the size and shape of grain is considered important to consumers.

Studies that attempted to link the market for products explicitly to consumer demand include Ega (1992), Scott, Scott and Yeap (1984), Fuglie (1991). In Tunisia, Fuglie carried out research on potato consumption and demand to shed light on consumer attitude and preference. He estimated income and price elasticities and constructed hedonic price models to determine how potato quality characteristics affect its pricing mechanism. Similarly in Northern Nigeria, Ega tested improved varieties of sorghum to determine the extent to which their agronomic performance translated into acceptable consumer tastes for 'tuwo' and 'akamu' with respect to colour, appearance, flavour, taste and texture. The author emphasised the need for quantitative techniques to monitor the combined effects of major factors such as yield and income which affect acceptance of crops among both producers and consumers.

3.6.5 Discriminant Analysis in Relation to Hedonic Models

Another applicable model in this study is the discriminant analysis of group functions. In determining the relevance of varied quality attributes or consumer preference patterns in demand analysis, this model has proved useful as an interpretative tool of group behaviour and a classification tool for discriminant cases in a given population.

Discriminant analysis is a statistical techniques that allows the study of differences between two or more groups of population samples with respect to several variables simultaneously.

It was first developed by Fisher (1936) in the field of physical anthropology. Other users in the social science fields include Klecka (1974), who analysed experimental data when assignment to a 'treatment' group is presumed to affect scores on several criterion variables in a study of sex role stereotypes in children; Other earlier works in Nigerian agriculture include Ogunfiditimi (1980, 1988), Orafidiya (1990), Olomola, (1992). Its application to assessment of quality differentials also exist. Sufian (1993) assessed living standard index based on 10 indicators of urban quality of life to discriminate three groups of cities in the worlds' largest metropolitan areas.

In direct application to hedonic analysis, Arimah (1990) estimated canonical discriminant coefficients for three groups of housing quality index in relation to the socio-economic determinant variables affecting demand for these hedonic (quality) indices.

In hedonic literature of agriculture, this method has not been tried to the best of the researcher's knowledge. If the results of this analysis prove consistent with a priori reasoning and with those of the hedonic function analysis, one would have gone one distinct step further by rating the relative importance of crop attributes across distinct populations with unique socio-economic and cultural characteristics. The findings become more meaningful for the Nigerian context with its heterogenous population, unlike those of earlier studies in more developed economies and with more homogenous groupings.

In particular, in relation to the goals of crop improvement, it should further streamline the research goals for different regions.

CHAPTER FOUR

METHODOLOGY

4.1 DESIGN AND SCOPE OF THE STUDY

The aim of the study is to analyse market prices and consumer preference for rice and cowpea as to how they interact for market coordination in Nigeria. According to the study design, data were collected from three geo-cultural locations in Nigeria which comprised one central market in each of 3 states. These are:

(i) Bodija Market in Ibadan, Oyo State representing the Yoruba cultural enclave;

(ii) Main market, Enugu,Enugu State representing the Igbo cultural enclave and

(iii) Central market, Nguru, Yobe State representing the Hausa/Fulani cultural enclave.

4.1.1 NOTES ON CULTURAL DIVERSITY AND FOOD HABITS

The premise for the choice of three cultural enclaves is that different cultural traits are exhibited in the commonly prepared dishes from rice and cowpea in Nigeria (William, 1985). These affect the preference of grain varieties. It must however be pointed out that a substantial proportion of other ethno-cultural groupings exist alongside these predominant groups. For instance, in Nguru many traders from the south take up semi-permanent residence and therefore influence the culture. Similarly in Bodija, Ibadan, many non-Yoruba women buy and sell to the extent that a mixture of cultural traits has occurred. In spite of these mixtures, the researcher is convinced that the culture of the main groups predominate. Data on the sample distribution by ethno-culture shown in Tables 4.1 and 4.2 of section 4.1.2 justify this assumption.

The Yorubas consume cowpea mainly as moinmoin, akara and gbegiri soup especially in the lower classes. In the middle and upper classes, beans is cooked as a main dish or to accompany boiled white rice or dodo (fried plantain) (Williams 1974, Fosu, 1984). Hence preference tends to be for white beans in the lower social classes as white beans is thought to dehull more rapidly than brown beans and to have better binding quality than the brown variety. The colour of brown beans, of uniform configuration is important for beans as a main meal or in presentation with white rice. Hence the preference is for brown beans among the middle and upper classes.

The Ibos mostly prepare akara with beans, and eat boiled beans to a lesser extent. The latter may be mashed with other carbohydrate foods like yam, sweet potato or plantain. The Ibos do not seem to have a particular preference for white or brown beans, as long as it mashes well.

The Hausa/Fulani prefer white beans to brown. The white varieties originated mainly from Northern Nigeria and have been culturally accepted. Brown varieties are mostly exotic with the germplasm from South Africa, South America etc. Brown beans is therefore cultivated mainly for the market especially the southern market. White beans is preferred for home consumption.

Rice finds a wider commonality in its food options compared to cowpea. While it is mainly consumed as boiled rice served with a wide array of side dishes like beans, dodo, vegetables etc in most ethno-cultures, the Hausa/Fulanis consume it predominantly as 'Tuwo', a mashed form of rice. In effect, preference for varieties depends largely on cooking time, on one hand to aid the mashing process of 'Tuwo' and on other chemical properties on the other hand to ensure minimum mashing for desirable presentation of boiled rice. Thus while in the latter case, characteristics like grain length and configuration, milling qualities etc are important, in the former case, these characteristics are not of strong consideration. But because rice has become a global and national staple across all cultures, one may find more commonalities of preferences which are based on global rather than ethnic tastes.

4.1.2 THE DATA

The data comprised:

(1) Samples of all available varieties of rice and cowpea at the central market location. The samples were purchased by the common local measure and at the prevailing price in all the three centres during the month of May 1993. The following was obtained:

- a collection of all varieties in demand during the period of study.
- the average price per specified measure at time T which was the average price over several months of the field exercise.

(2) Local names of all the collected samples. These were crosschecked both from the sellers and the buyers and later with plant breeders at the National Seed Service, Ibadan, IITA and NCRI to identify them by genetic names.

(3) Price series data (secondary data) from agricultural organisations involved in seed or grain production like NSPRI, NSS, ADPs as well as from statistical agencies such as CBN, FOS. These include:

a. Annual (historical) prices of cowpea and rice for about 10 to 20 years on an aggregate national level.

b. Detailed month to month data for three states which are represented within the same ecological zone by the three market centres identified above for the period 1992 to 1994.

c. Weekly retail prices of all available varieties of the crops in each market centre. The weekly prices were collected from May to November, 1993. The period covers the most of the period of critical price movement for these grains and most staple crops in Nigeria. Part of the low price season and the peak price season was thereby covered for both rice and cowpea. Limitations of resources did not permit the exercise to be effected for longer than this period.

(4) Preferences of random consumers with respect to crop characteristics and commonest food options for each grain crop among consumers (buyers of grains) at the market centres.

4.1.3 SAMPLING PROCEDURE FOR CONSUMER PREFERENCE SURVEY

Questionnaires were administered on at least 4 consumers of each varietal sample each week for at least 28 weeks.

The sample comprised buyers of any of the identified varieties of the grains in the market centres. Regardless of their sex, they were assumed to be consumers, homemakers or their representatives. The survey exercise was carried out on different days of the week and at different times of the day on each weekly round of survey exercise. This was with the aim of capturing a sample that adequately represents all social classes who may have different shopping patterns. With respect to the distribution of the sample from different income groups, a post-stratification was carried out based on the responses concerning their incomes. A systematic random sampling method was used to select buyers of five of the identified varietal samples in each of the three market centres. Each fifth person who approaches a seller of one of the samples was approached and interviewed to obtain responses on his/her household's socio-economic conditions, their primary considerations in deciding what variety to purchase and the cultural factors which may influence their choice of varieties. (See questionnaire in Appendix 4.1)

With the underlying assumption that each of the market centres will cater mostly to the demand of consumers from that cultural enclave, there was no purposive sampling of consumers of particular culture. Post stratification of the sample confirmed this as shown in Tables 4.1 and 4.2.

Table 4.1: Sample Distribution of Consumer Preference Survey (Cowpea)

Market Location	Total Sample Size	Gender of Respondent		Sample Distribution (Predominant Culture)			
		Male	Female	Yoruba	Igbo	Hausa/ Fulani	Others
Ibadan	228	46	182	105	61	24	38
Enugu	187	79	108	24	133	8	22
Nguru	161	101	40	25	12	76	48

Source: Field Survey, 1993

Table 4.2: Sample Distribution of Consumer Preference Survey (Rice)

Market Location	Total Sample Size	Gender of Respondent		Sample Distribution (Predominant Culture)			
		Male	Female	Yoruba	Igbo	Hausa/ Fulani	Others
Ibadan	233	22	211	143	38	4	48
Enugu	136	58	78	11	121	-	4
Nguru	225	133	92	51	13	145	16

Source: Field Survey, 1993

4.1.4 DATA/GRAIN-SAMPLE COLLECTION PROCESS

The original exercise (i) and (ii) were carried out by the researcher with the help of one field assistant in each sample area. A period of one week was spent in each location to complete the exercise and initiate the survey exercise. The chosen central market was visited every day for a week prior to the period of survey. During each visit, available varietal samples of rice and cowpea were identified. One unit measure (congo, cigarette tins, mudu) of each sample was purchased after normal bargaining with three to four retailers of the same sample. Care was taken to ensure that each sample obtained exhibited a visible difference over similar samples of the same or different varieties.

For exercise 3c and 4, five field assistants were recruited in each location. These comprised middle level officers of the Ministry of Agriculture and the ADP as well as some secondary school teachers in the towns. Each assistant was allotted one of the five selected samples for the survey exercise and for weekly price collection. The consumer preference survey was conducted by the researcher with the assistance of the fields staff.

4.1.5 DATA/GRAIN-SAMPLE PROCESSING

Grain Quality Tests

The samples of rice and cowpea were quantitatively assessed for their morphological and limited chemical characteristics. Grain quality tests based on these parameters was conducted at the Grain Quality Laboratory of the Grain Legume Improvement Programme (GLIP) at IITA. Appendix 4.2 shows the qualities tested as well as the methods and instruments used. Some of the tests were carried out at culinary level by the researcher at home and by research assistants of the grain utilization programme at IITA. Indicators were designed for these characteristics and methods based on some existing methods (IRRI standards for rice) while some were adapted from available resources.

4.1.6 LOCAL AND GENERIC IDENTIFICATION OF GRAIN SAMPLES

Very many varieties have been certified and released over the years both to the Ministry of Agriculture and Extension Services and to outreach farmers and seed production companies.

However, a cultural selection process takes place in different farming systems whereby farmers and consumers identify with certain varieties and tend to exhibit preference for them over time. As a result, although they continue to be produced in very minor proportion to others, most of the other varieties are found in small geographical enclaves or in adulterated mixes with the more popular ones.

The cowpea and rice varieties identified in different markets (study areas) are generally known by their local names. Farmers, sellers and consumers in each locality give names to each variety for cultural and marketing convenience. Attempts were made to identify the grains by their genetic names as used by the breeding and releasing organizations. We were partly successful,with respect to rice. The genetic identities arrived at are, in many cases those that most closely resemble the released improved seeds. Over successive planting periods, however post-harvest handling including market transfers, ensure that pure breeds of seeds released become highly adulterated. As a result, the market samples often bear little resemblance to the agronomic properties of the seed.

One of the problems posed by this is that it becomes difficult for breeders and farmers to have any meaningful feedback on the problems and prospects of adoption of new varieties which can help to effectively redefine breeding goals.

To date, for instance, over 40 FAROX species of rice have been released in different parts of the country. Most of these are believed to still be in circulation. The predominant ones are those that are found in almost all major metropolitan markets across the country. They therefore mainly constitute our identified market samples. Appendix 4.3 and 4.4 show an average of 8 to 12 samples of cowpea per market, adding up to 35 samples in the three markets and 8 to 15 samples of rice per market. Further assessment of characteristics show that many have similar genetic properties but differing agronomic and handling properties. In effect, the sample size contains clones and adulteration of a smaller number of genetic breeds.

Secondly, the same variety of a crop has been found to bear a different name in each of the three study locations. Thus, the actual number of genetically different varieties in the sample is less than the total number of grain samples analysed. It will take a very comprehensive national study to come across the majority of varieties in circulation. This study has been limited in geographical scope. Hence the samples identified are not exhaustive. But because the study has been purposive in selecting very busy metropolitan markets (in two of the study areas), the varieties are, reasonably the most demanded. As a market port, Nguru, where a lot of bulking and debulking takes place and where many rural and urban market channels meet, constitutes our third sample area. The distribution of grain samples over the three markets is shown in Appendix 4.5.

The samples were selected and analysed based not only on breeding characteristics but also on those on-farm and off-farm induced characteristics which vary the final composition of characteristic values of each sample.

Unlike rice varieties which are mainly of exotic germplasm, virtually all the currently available cowpea varieties are either local materials or those whose exotic germplasm have been crossbred with local varieties for many decades. It is, therefore, hard to come by pure samples of brown cowpea.

An identification exercise was carried out to know the actual number of genetically different varieties and the number of 'clones' of the same variety among our samples.

The tables of cross-identity of rice and cowpea varieties (Appendix 4.6 and 4.7) show the emerging picture. In reality, there are seven main varieties of cowpea, four of which are genetic clones of the main ones (Drum, Sokoto, Kaura, Oloo). The rest are admixtures of the main varieties. There are eight varieties of rice, the rest being variants with different on-farm and off-farm properties.For instance, four different samples of the 'Drum' variety of cowpea and two varieties of the 'mokwa' variety of rice were purchased in Ibadan. The samples differed in terms of the milling, storage and other handling properties. Over the period of price data collection (about 28 weeks), any 'new' varietal samples that appeared on the market was added to the collection and its unit price for the week of entry recorded.

4.2 ANALYTICAL FRAMEWORK

4.2.0 Price Analysis in Agricultural Food Systems

According to the "classical model" in time series analysis, any series of prices can be decomposed into four component parts each of which is uniquely related to the actual observation as follows:

$\mathbf{P}_{ti} = \mathbf{T}_{ti}\,\mathbf{C}_{ti}\,\mathbf{S}_{ti}\,\mathbf{R}_{ti}$ where

$\mathbf{P}_{ti}$ = actual time series observation in month **t** of commodity **i.**

T$[_{ti}]$ = the trend component or the growth rate of the price series over the period t. This can be accounted for by storage costs over a production season. On an aggregate level, it is accounted for by the normal inflationary factors between one time period and the next. It is also expected to have a significant component between development periods in Nigeria.

C$[_{ti}]$ The cyclical component of price which is usually related to its production cycle. It may not have ant predictable pattern but appear with some regularity over a number of years. In food crop production, it is best symbolized by the cobweb theorem whereby price and production become mutually reinforcing based on perceived demand behaviour of consumers, subject to a preceding period's prices.

S$[_{ti}]$ = The seasonal component. It is essentially related to time factors. It is measurable by the seasonal index which estimates the month to month variation as the ratio of a given period's observed price and the moving average of prices over immediate preceding and past observations. It is usually related to biological or climatic cycles as they affect agricultural processes. It may be compounded by cultural events on the demand side such as festivals. In Nigeria, food grain prices were largely influenced by political factors such as industrial action, riots etc.

$\mathbf{R}_{ti}$ = The Random component which may be accounted for by factors such as location which impact as transportation costs, usually between the production area and the consumption areas which may be spatially differentiated because of resource endowments of different area. It is also accounted for by form or quality differentials which are a function of the physical properties of the crop as influenced by genetic, on-farm and off-farm (handling) production stages. (Lapin, 1978; Pindyck and Rubinfeld, 1981, Tomek and Robinson, 1979).

Other authors of classical price analysis have disaggregated the components by other classifications viz. temporal, spatial and form or quality differentials (Tomek and Robinson, op cit; Kohls and Uhl, 1985). The latter classification has been the most common criteria in price analysis.

Theoretically, it is possible to isolate each of these components perhaps with a view to assess the relative impact of each of them. To this end, effects of temporal and spatial price variation have been widely tested and found to be due in the main, to marketing factors like storage and transportation cost differentials. Price variations are also partly accounted for by differences in consumer preference pattern for the same commodity's attributes in the different social, economic and geo-cultural enclaves of the same population. This component is linked to personal tastes, shared consumer knowledge which dictate the internal reference price and vary with individual or group perceptions and orientations.

This segment of the analysis simply aims to present a bird'seye picture of the nature of market prices for grains from these three perspectives (time, space and form) in the last two decades which represent distinct policy eras in agricultural market development in Nigeria. The price-series data were analysed by simple statistical methods such as period means, coefficients of variation and percentiles, seasonal indices in graphical and tabular presentations to show:

- temporal variations including annual, monthly/seasonal variations;
- spatial variations across the three ecological zones represented by the market centres or their domicile states;
- form variation as shown by the price differentials between different varietal samples in each market centre.

4.2.1 MODEL SPECIFICATION FOR HEDONIC ANALYSIS: CONSUMER GOODS CHARACTERISTIC MODEL

The less restrictive estimation method of the Consumer Goods Characteristic Model has been employed to derive implicit prices of rice and cowpea characteristics.

Consumer Goods Characteristic Model (CGCM) looks upon a product as a collection of characteristics and that product heterogeneity results because different products contain different measures of the same characteristics while each product contains a measure of its own unique characteristics (Ladd and Suvannunt, 1976). Such measures of these characteristics are useful in determining grades and standards. Also the total amount of utility a consumer enjoys from his purchase of quantities of the product depends on the amount of the jth product characteristic purchased from all units of the product.

Therefore if X_{oj} is the total amount of the jth characteristic and X_{ij} is the quantity of the jth characteristic provided by one unit of i, the total consumption of each characteristic is a function of the quantity q_i and the consumption input-output coefficients. As follows:

Total quantity of X_{oj} is a function of the characteristic $X_{oj} = f_j (q_1 q_2 \ldots qn, X_{1j}, X_{2j} \ldots X_{nj}, X_{om+1})$ 4.1

where

X_{oj} = Total quantity of the jth characteristics

X_{1j} = quantity of the jth characteristic from one unit of i

q_1 = quantity of product i consumed

X_{om+1} = Total quantity of the unique characteristic in each unit of i

n = No of product i available in selected market location

m = No of product characteristic j

Consumer Utility function is

$$U = f(X_{o1}, X_{o2} \ldots. X_{om+1}) \qquad 4.2$$

But each X_{oj} is a function of the q_1, X_{1j} and X_{om+1}

$$U = f(q_1 q_2 \ldots q_n, X_{11}, X_{12}, \ldots X_{1m}, X_{21} \ldots X_{nm}, \ldots X_{mn+n}) \qquad 4.3$$

Only q_{is} can be varied. The X_{ijs} are unknown parameters (determined by the producer)

If U is subject to consumer income (I)

Then the consumer wants to maximise his utility subject to:

$$I = \sum_{i=1}^{n} P_i q_i \qquad 4.4$$

where I is equivalent to total expenditure on i

or selects values of X_{oj}, X_{om+n} and (q_i) that maximise the Lagrangian:

$$L = U(X_{01} \ldots X_{02} \ldots X_{om+1}) + \lambda (I - \Sigma p_i q_i) \qquad 4.5$$

To obtain the marginal rate of substitution between income and each choice characteristic, the function of a function rule is adopted because X_{ojs} are functions of q_{is}:

$$dL/dq = 0 = \Sigma(du/dx_{oj})(dx_{oj}/dq_i) + (du/dx_{om+1}\ dx_{om+1}/dq_i) - \lambda_i P_i \qquad 4.6$$

This is obtained by differentiating q_i with respect to X_{oj} and X_{om+1} and differentiating X_{oj} and

X_{om+1} with respect to q_i.

Maximizing the value of U from given income, we obtain

$$= du/dI \qquad 4.7$$

Substituting this into equation 4.6 and solving for P_i gives

$$P_i = (dx_{oj}/dq_i)\ \frac{(du/dx_{oj})}{du/dI} + (dx_{om+1}/dq_i)\ \frac{(du/dx_{om+1})}{du/dI} \qquad 4.8$$

or

$$P_i = (dx_{oj}/dq_i \times dI/dx_{oj}) + (dx_{om+1}/dq_i \times dI/dx_{om+1}) \qquad 4.9$$

dx_{oj}/dq_i = marginal yield of the jth characteristic of product i

dx_{om+1}/dq_i = marginal yield of the unique characteristic of i

du/dx_{oj} = marginal utility of the jth characteristic of i

du/dI = marginal utility of income.

The ratio of the last two terms is the marginal rate of substitution between income and the jth characteristic or the marginal implicit price of j. i.e. dI/dx_{oj} which is the income the consumer is ready to forgo for one unit of the jth characteristic.

(i) $P_i q_i = I$ = Expenditure (E) 4.10

(Ladd and Suvannunt pp 505, Unnevhr pp 63

(ii) One unit of i produces one unit of its unique characteristic i.e $x_{om+1}/dq_i = 1$ 4.1

Then equation 4.9 becomes:

$$P_i = (dx_{oj}/dq_i)\ (dE/dx_{oj}) + dE/dx_{om+1} \qquad 4.12$$

If the yield of each product characteristic is constant over the range of q units of i consumed, then:

dx_{oj}/dq_i = constant and denoted by x_{ij}

and if dE/dx_{oj} is a constant E_j for every unit of i, then:

$$P_i = \sum_{j=1}^{m} x_{ij}E_j + E_{m+1} \qquad 4.13$$

where

x_{ij} is the factor expressing characteristic change

E_j is the MRS between expenditure and the jth characteristic or Marginal Implicit Price of j

This satisfy hypothesis 2 if we reject the null hypothesis that price is not equal to the product of the quantity of the characteristic and its marginal implicit price or the marginal yield. Thus the final market price paid is the sum of the marginal value of **all** product characteristics.

The expected shape of the utility function which yields a unique solution to the consumption relationship between quantities of each characteristic and its marginal price are as shown in Figures 4.1 and 4.2. Figure 4.1 reflects the usual assumption in orthodox production economic theory. For the nonhomogeneous product, it is expected that increasing average returns (consumption) of quantities of X up to X_2 will be followed by decreasing average returns (consumption) beyond X_2. In the same vein, marginal utility of income or the marginal value product of each characteristic as given by the MIP is increasing up to X_1 i.e (B_1 0 and B_1 =0) and decreasing thereafter when average returns (utility) is increasing. The marginal utility (MIP) continues to fall at the point where average utility begins to decrease. Figure 4.2 shows the expected shape of the Logarithmic (Cobb Douglas) function specified for the hedonic functions.

4.2.2 EMPIRICAL TESTS

With respect to the hedonic (CGCM) model, all available production technologies are such that yield of most product characteristic (dx_{oj}/dq_i) is constant for each unit of any crop. The term is thus assumed equal to a constant X_{ij}. The marginal implicit price is also assumed constant over the range of X_{ijs} observed and is represented by B_{ij} - a parameter to be estimated.

The equation to be estimated becomes:

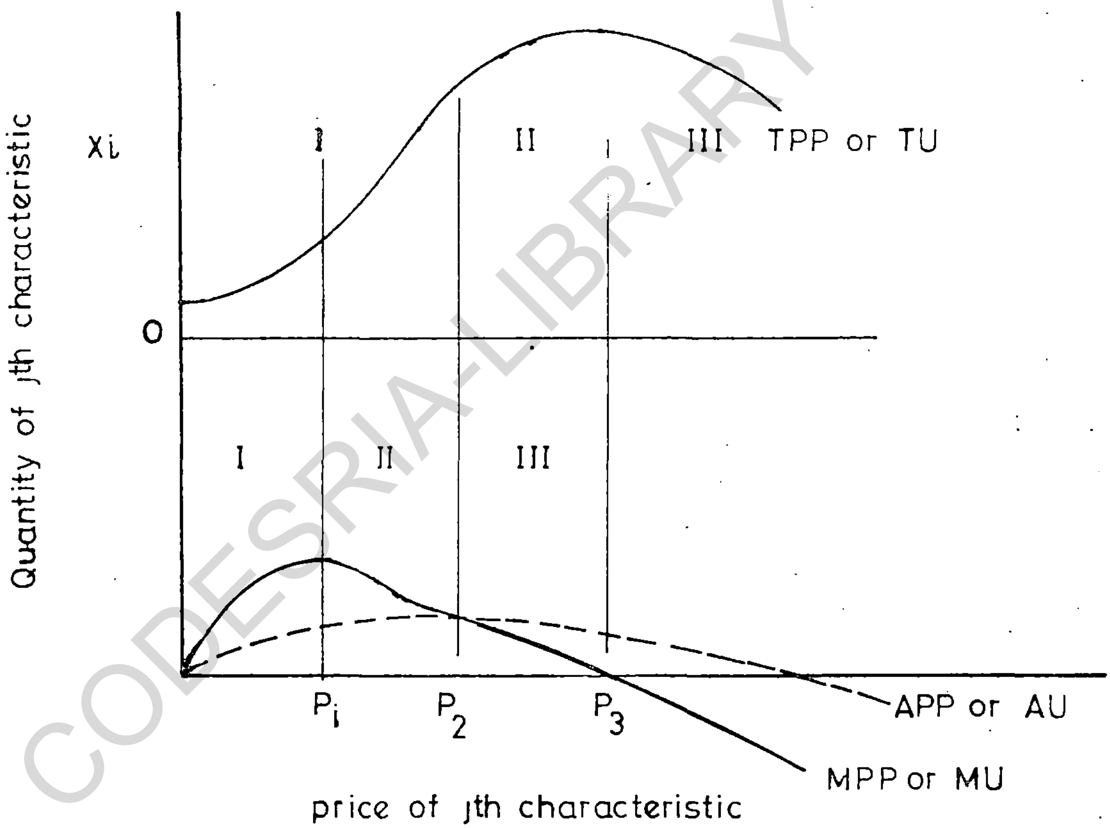
$P_R = X_{Rj} B_{Rj} + U$ for a product R e.g. Rice 4.14

where:

$P_R =$ retail price of a given lot or quality of market sample

$X_{Rj} =$ imputed value or attribute scores (explaining variance in cowpea or rice prices and based on predetermined characteristics as shown in section 4.2.5.)

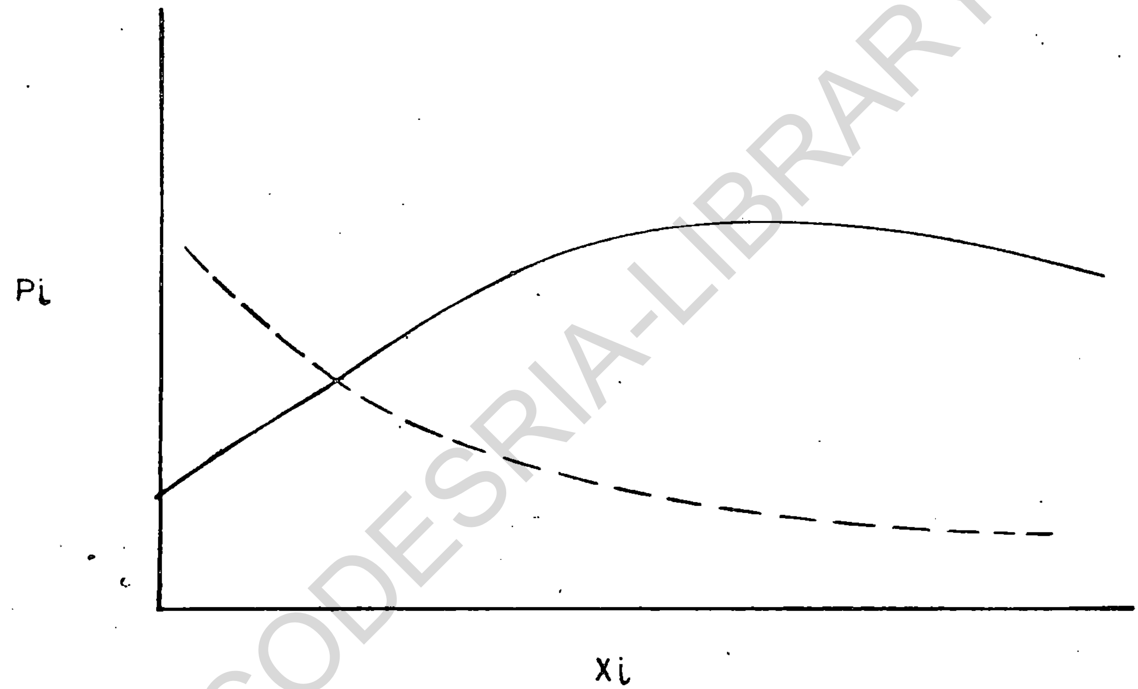
Fig. 4.1. Consumer Utility Function (showing total, aver[age] and marginal yield of expenditure on characteri[stic])



TU = Total Utility of Income or TPP

MU = Marginal Utility of Income or MPP

Fig. 4.2. Shape of the Logarithm Function



——— $P_i = b_0 \cdot X^{b_j}$, $(0 < b_1 < 1)$

- - - - - $P_i = b_0 X^{-b_j}$

U = Random error which are other factors affecting rice price.

Estimates of B_{Rj}, the marginal implicit prices are the regression coefficients with respect to each X_{Rj} that is under consideration in the analysis. The form of the equation is specified according to the expected relationship. The above (equation 4.11) holds if dx_{oj}/dq_R and $dE/dx_{oj} = E_j$ are constant for one given lot of the product i.e given that technological change to quality does not take place over the given period, such that:

$$P_R = X_{Rj}E_j + E_{m+1} \qquad 4.15$$

If these are not believed constant, then

$$P_R = X_{Rj}B_j + X_{Rj}^2B_{jj} \qquad 4.16$$

Then implicit price = (Bj + Bjj) for each X_{Rj}

Other variants of the function which have been used by earlier workers are:

$$P_R = \exp(\Sigma x_{Rj}B_j) \quad \text{(Semilog)} \qquad 4.17$$

$$P_R = \pi\, x_{Rj}B_j \quad \text{(Log)} \qquad 4.18$$

P_{is} are retail prices of one kg measure of available market samples of rice and cowpea which is found in selected markets of the study areas, over a relatively short period of time. This price is assumed to vary for each 'quality' (market sample).

X_{ijs} are characteristic values or rank scores inputed after quality analysis of the selected hedonic variables.

B_{ij}s are estimates of implicit price of all relevant characteristic

4.2.3 APPLICATIONS OF THE CGCM TO GRADES OF GRAIN CROPS

The evaluation of grades from implicit prices of characteristics has to consider two questions:

(i) What characteristics of the product are important enough to be included.

(ii) How should the information from different groups be condensed for reporting or what complement of characteristics should go together to form a given grade.

(iii) The issue of sign-optimality also has to be addressed i.e. what is the expected impact of a given characteristic (positive or negative) on quality? Does positive value imply good quality or otherwise? e.g. Negative or declining value for percentage broken should imply good quality while positive value for configuration also specify good quality.

The general rule of thumb used is, in consonance with Southworth (1961), as follows: If the list of characteristics having positive implicit value are those of same characteristics that raise grade, then a numerical grading of a descending order on the summation of all the implicit prices should yield a grading series. The same applies for negative implicit prices and quality lowering characteristics as well as zero implicit prices and no effect characteristics. The theoretical implication of the three conditions, according to our model is that for every characteristic, varying the yield per unit of characteristic has the same effect on grade as on per unit value of the commodity. If this holds in all cases, then the net marginal implicit price of each grade can be found where NMVP = $\Sigma \delta X_{ij}.B_{ij}$ which is the maximum price the consumer can afford to pay for one kilogram of the grain having the specified characteristic. The above method is more applicable for cross sectional data as is the case in this study.

For reliability of application, the use of a characteristic for quality identification on a basis of ordinal grades depends upon whether there is a consistent preference for this characteristic over another, for a long period of time such that buyers will consistently pay more for that characteristic than another i.e. B_{ij} is consistently highest. The same standard applies for one-shot cross-sectional data series obtained from a very wide sample covering varying socio-economic groups as representative samples of a given population. The level of consistency of the scale of value in all the samples helps in constructing a composite preference scale or grading scale.

The grading system to be derived here is useful for breeders, producers and processors in prioritizing investments on a range of crop improvement practices or in assessing the rate of adoption of varieties.

4.2.4 DEFINITIONS OF HEDONIC VARIABLES

The hedonic variables for the above model are selected based on the objectives of any grain improvement programmme. The final quality of a grain crop is the result of the **genetic composition** of the seed, the **agronomic performance** of the crop during production of 'grain' from 'seed' and finally the **handling properties** which are induced during harvesting, processing and storage. The choice of the most relevant variables within each group has been derived from earlier consumer preference studies on these two crops, and opinion surveys on determinants of consumers' preference prices in our study areas, the result of which are detailed in section 5.1. Three groups of hedonic variables are thus defined from the three technological processes outlined. These constitute the independent variables in the regression function where:

Dependent variable

P_i = market price of the ith variety of grain

Independent (Hedonic) variables for Rice are:

X11 - GLT = Grain length(mm)

X12 - GCF = Grain configuration or Length-breadth ratio

X13 - CTM = Cooking time (in seconds)

X14 - CHLK = Chalkiness : 1 to 5 for diminishing chalkiness

X21 - SW100 = Seed weight (mg)

X22 - GPT1 = Grain purity 1 or percentage mouldy grains

X31 - MLQ1 = Milling quality 1 or percentage foreign matter

X32 - MLQ2 = Milling quality 2 or percentage brokens

X33 - SWA = Swelling ability or volume yield per unit cm^2

X34 - ADT/GPT2 = Adulteration percentage which is also a grain purity index of a cooked grain

XL2 - LIDX = Location index: 1, 2, 3 for the three sample areas

The model to be estimated is:

$$P_r = f[(X_{11}, X_{12}\ X_{13}\ X_{14})\ (X_{21}\ X_{22})\ (X_{31}\ X_{32}\ X_{33}\ X_{34})\ (L, U)] \quad 4.19$$

For Cowpea

Y11 - STC = Seed testa colour

Y12 - GCF = Seed configuration or Length-breadth ratio

Y13 - CTM = Cooking time (in seconds)

Y21 - SW100 = Seed weight (mg)

Y22 - GPT1 = Grain purity 1 or percentage mouldy grains

Y31 - MLQ1 = Milling quality 1 or percentage foreign matter

Y32 - GPT2 = Grain purity 2 or percentage weevil infestation

Y33 - SWA = Swelling ability or volume yield per unit cm^2

Y34 - ADT/GPT3 = Grain purity or adulteration percentage

XL2 - LIDX = Location index: 1, 2, 3 for the three sample areas

The model to be estimated

$$P_c = f[(Y_{11}, Y_{12} Y_{13}) (Y_{21} Y_{22}) (Y_{31} Y_{32} Y_{33} Y_{34}) (L, U)] \quad 4.20$$

The X_{1n}, Y_{1n} are breeding characteristics

The X_{2n}, Y_{2n} are on-farm characteristics

The X_{3n}, Y_{3n} are post-harvest handling characteristics

U represents other market and non-market factors explaining temporal and spatial variations respectively.

For ease of interpretation of results, most of the characteristic scores were converted to index value to express their sign-positive forms. The following measures of negative attribute were converted to their sign-positive equivalents as follows:

$$I_{xi} = 100(1 - x_i)$$

where I_{xi} = Index value of the ith characteristic

x_i = characteristic score expressed as fractional proportion of 100

Hence for all the characteristics except cooking time, the expected sign of the coefficients is positive. For some breeding characteristic, notably seed colour the sign is non-deterministic because of widely varying preferences. The same condition applies to seed configuration.

Although, overwhelmingly for rice, the preference is for high length-breadth ratio, this global perspective still had to be verified within multi-cultural Nigeria.

4.3 THEORETICAL REQUISITES OF THE HEDONIC MODELS

4.3.1 Choice of functional form

Economic theory places few restrictions on the form of hedonic price function. Therefore, the goodness of-fit criterion has been used by most analysts. The caveat in this is that in order to value product attributes properly, the form of the function should most accurately approximate the net expected effect of each characteristic on market price via the estimated marginal characteristic prices. This also measures consumers willingness-to-pay for attributes and may directly measure small changes in quality levels.

Another important requisite here is that errors in valuation of marginal attributes should not bias the valuation of non-marginal attributes i.e. the basic characteristics that do not vary with quality preferences.

The need to refine estimates of marginal prices for the above purpose calls for the computation of error margins. Errors of this nature occur or are assumed to occur when the researcher observes all product characteristics without error and then leaves some characteristic unobserved or measured by proxy. This affects the form of the hedonic price function.

The general observation is that when all attributes are observed, linear and quadratic function of Box-Cox transformed variables provide the most accurate estimates of marginal prices. The goodness-of fit criterion (Rosen 1974) coincides with this scenario i.e. accurate measure of marginal prices. When certain variables are unobserved or proxied, a simple linear function performs better. Linear form of the Box-Cox function also performs well in the absence of specification error i.e. under a situation of perfect information.

Trials of linear, semilog, double log are common. Final choice is based on (1) interpretation of the implied relationship, explanatory power, significance and stability of hedonic coefficients and the use to which the hedonic function would be put.

When the regression estimates are implicit prices which will further be used in estimating demand function, the linear specification is contra-indicated. The coefficients are the implicit prices (direct estimate) whereas in the other function, the implicit prices are transformations of the coefficient. In the first case, the direct estimate when used directly makes the implicit price to be constant for all consuming households whereas in the log and semilog, the implicit price is obtained by differentiating the function with respect to the attribute in question. Thus the value varies with the quantity of each attribute consumed by each consuming household. The log functions further allows a simple interpretation of the hedonic coefficient as the percentage change in the quantity of characteristic given a unit increase in the attribute in question (Jud and Watts 1981, Megbolugbe and Frank 1987).

On the average, linear function of Box-Cox transformed variables produces the most accurate estimates of marginal prices of characteristics whether all attributes are observed without error or when important attributes are unobserved. It therefore might have been the functional form of choice. However, unavailability of programming models for this function precluded its use in this study.

All earlier hedonic studies on agricultural commodities were carried out outside Africa. The only known application in Nigeria is outside agriculture (Arimah, 1990). An experimental process is hereby called for. All the above functions have, therefore, been tested to see their appropriateness.

The essential computational steps towards the final choice of the hedonic functional model are outlined:

(1) Determining the variables that should enter the regression from groups of independent variables, Arimah for instance had three sets of independent variables: structural attributes, neighbourhood attributes and locational attributes in a housing market. Here, the relevant attributes evolve at different stages of supply: breeding, on-farm production and post-harvest handling stages. The characteristics are also analysed based on these three sets of independent variables. Batch regression methods and discriminant analysis were used to show the relative importance of these three sets of factors.

(2) Examining for each regression mode, the associated correlation matrix i.e. multicollinearity across variables and deleting one of any pair of variables having a pairwise correlation of 0.8 or greater. This is based on Hauser's (1974) rule of thumb that multicollinearity seriously affects the regression coefficients of higher than 0.8 coefficient. Checking the corresponding values of R^2, adjusted R^2 and standard error of parameter estimates also helped to eliminate this problem. Similarly, through the backward regression method, the most appropriate regressors were chosen.

(3) Examining absolute t-values of the regression coefficients based on a priori notion that t-values of less than 1.0 be deleted. The reason for adopting t-values of at least 1.0 is because it implies statistical significance at the 0.025 level of significance for a one-tail test. Hartovsky (1969) demonstrated that the adjusted R^2 is improved by retaining variables with t-value > 1.0.

(4) Deleting hedonic coefficients in the preliminary regression with 'unexpected' signs. However, some important variables with unpredicted behaviour are retained.

4.4 DISCRIMINANT ANALYSIS OF GROUP HEDONIC BEHAVIOUR

In order to test the submarket hypothesis, the method of discriminant analysis was employed to assess to what extent the selected hedonic variables truly discriminate or classify the grain samples obtained from markets centres in different geo-cultural areas.

The discriminant function is the linear combination of original variables which maximise the differences measured by the F Ratio of between-group mean sum of squares and within-group mean sum of squares of the discriminating variables. The functions derived in this are called canonical discriminant functions (CDF) with the following form

$$F_{km} = U_o + U_i X_{ikm} + U_z X_{zkm} + \text{-----} + U_p X_{pkm} \qquad 4.21$$

where

F_{km} = the score on the canonical discriminant function for case m in group K.

X_{ikm} = the score on discriminating variable X_i for case m in group K.

U_i = Coefficients which produce the desired characteristic in the function.

This function is analogous to the multiple regression function except that the coefficients here are derived in a way to maximise the difference between the group-means of the characteristic values. Subsequent functions exhibit the next highest differences among the group means and so on. Thus, within the first function, the coefficients (u) are determined in a way to explain the maximum possible differences in the scores of each variable, similar to the coefficients of the multiple regression function. But here the dependent variable bears the group number of the discriminant function which has a value of 0, 1, 2. In this study for the 3 sample areas, the number of canonical discriminant functions obtainable is g-1 where g = number of groups

The statistical method for measuring the degree of difference between the data cases obtains the (maximum) difference between the matrix of total sum of squares and cross-products of the discriminating variables (across the whole sample) (T) and the matrix of within-group sum of squares and cross-products (W). While T is obtained using the sample mean, W uses the group means such that a set of equations (T_{ij}) is obtained for each case on the basis of T, and (W_{ij}) on the basis of W, respectively where

$$t_{ij} = \sum_{k=1}^{g} \sum_{m=1}^{nk} (X_{ikm} - X_i)(X_{jkm} - X_j) \qquad 4.22$$

Where g = number of groups

k = number of cases in each group

n = total number of cases over all groups

X_{ikm} = mean value of the i[th] variable (X_i) for case m in

$$w_{ij} = \sum_{k=1}^{g} \sum_{m=1}^{nk} (X_{ikm} - X_{ik})(X_{jkm} - X_{jk}) \qquad 4.23$$

X_{ik} = mean value of X_i for all cases in group K.

X_i = mean value of X_i for all cases in the population

The difference between each t_{ij} and w_{ij} can be measured by a value b_{ij} while the solution to the b_{ij} matrix is B or the between group sum of squares and cross products. We can now relate B to W by a system of simultaneous equations to derive the canonical correlation coefficient (V) and a constant (X) which measures the maximum discriminating value of each variable between the groups.

With the values of X and V for each system of equations, the value of each of the discriminant functions are obtained and compared.

This is similar to estimating the predicted value of P in the multiple regression analysis based on the nominal scores on X_{is} and the desired hedonic coefficients.

In this analysis, what the discriminant analysis adds to our knowledge is that the coefficients of relative importance among the sets of characteristics yield a valid preference pattern across the submarkets. This represents the position of each characteristic value along an interface of a p-dimensional space, representing similar values from all other cases in the group and in the population. There is a probability score attached to the derived coefficients which the regression coefficient does not give and which reinforces the comparative assessment under focus.

4.5 STATISTICAL VALIDATION TESTS

4.5.1 KENDALL'S COEFFICIENT OF GROUP CONCORDANCE

In analysing the results of the consumer preference survey, simple frequency distribution method was applied to assess the nominal order of choice characteristics. In order to statistically verify the patterns shown by the choice order and assess the reliability of the results of opinion surveys which determine the choice of hedonic variables, the Kendall's coefficient of group concordance was employed.

The Kendalls coefficient allows us to see the degree of agreement in opinion between and within different classified groups, in this case geo-cultures and income classes across geo-cultures.

Kendalls statistics give coefficients of concordance of opinion among pairs of variables from K-related samples of the same population. Kendall's **W** is a measure of agreement among 'judges' where each case is a judge's rating of several scores for a given parameter. W runs from 0 to 1 where 0 signifies no agreement and 1 signifies perfect agreement.

Other related statistics used here are the Kendall's 'tau-a' which pairs and groups the variables for concordance (P) or discordance (Q). The higher the number of concordant pairs, the higher the value of 'tau-a' which gives the net number of concordant pairs as number of concordant pairs (P) less number of discordant pairs (Q) i.e. [P - Q] as a percentage of all the paired groups.

'Tau-a' values run from -n to +n. where n is the total number of possible pairs. Values ranging from negative to positive give the same general judgement as the relative magnitudes of W.

Kendalls 'tau-b' attempts to normalize the results of the whole population rather than sub-samples to reflect the sampling criterion that gives the highest disparity over all variables. In this case, for geo-populations, the constellation of agreements and discordance between groups is normalized for the whole population such that we can determine which submarket classification is more important in the analysis. Tau-b considers the possible combination of ties in any one of the three subsamples Tx, Ty, Tz (Ibadan, Enugu, Nguru) or (Low Y, Middle Y, High Y) without ties in the others, successively to arrive at a normalized coefficient of concordance as follows:

$$\text{tan-}b = \frac{P - Q}{\sqrt{(P + Q + T_x)\ (P + Q + T_y)\ (P + Q + T_z)}} \qquad 4.0$$

where:

$P + Q + T_t$ = Concordant + discordant + tied pairs in Ibadan

$P + Q + T_y$ = Concordant + discordant + tied pairs in Enugu

$P + Q + T_z$ = Concordant + discordant + tied pairs in Nguru

The same classification goes for low income, middle income and high income sub samples. Tau-a therefore interprets within-group patterns while tau-b interprets between group patterns with respect to a particular differential variable.

Other statistical validation procedures for our findings include the Kendall's Test of Group Concordance, Chow-Test of differences between sets of coefficients from two or more equations, the Standard Chi-Square and F-tests (Appendix 5 and 6) and the methods of correlation analysis.

4.6 LIMITATIONS OF THE DATA AND DATA ADJUSTMENTS

4.6.1 Variability in Market Standards

In the different locations a diversity of local measures are used in selling grains. These include the Kongo (about 1.8 kg for cowpea and 2.0 kg of rice in Ibadan); the cigarette tin (about 0.26 kg of cowpea and 0.29 kg of rice in Enugu) and the Mudu (about 2.7 kg of cowpea and 3.50 kg of rice in Nguru). See Table 4.3. Therefore observed prices were standardized to their 1 kg equivalent for uniformity.

The common measures and their weight equivalents in the three sample areas are as follows:

Table 4.3: LOCAL MEASURES AND STANDARD EQUIVALENTS OF GRAINS

Market Location	Local Measure	Standard Weight Equivalent	
		Cowpea	Rice
Ibadan	Kongo	1.8kg	2.0kg
	Milk Cup	0.18kg	0.20kg
Enugu	Cigarette cup	0.26kg	0.29kg
Nguru	Mudu	2.7kg	3.5kg

4.6.2 MISSING DATA

There were data gaps in the market price series mainly caused by the political disturbances of the second half of 1993 and periodic disappearance of some varieties of rice and cowpea from the market. In effect there were missing data for some varietal samples when they disappeared from the market and the preceding weeks before a 'new' varietal sample entered the market. Values of these missing data predicted by the OLS method are used in the analysis. This is in order to ensure adequate degrees of freedom in statistical tests of significance of the econometric behaviour. The predicted values based on linear trends are the expected value of P_t are given as follows:

$$E(P_t) = \alpha + \beta X_t$$

where $\alpha + \beta$ are estimators of the regressions of values of P_t on X_t. X_ts are the trend variable running from 1 to 28 weeks.

4.6.3 RANDOM PRICE FLUCTUATIONS

The data for this study are based mainly on market surveys. The market for food and other services in Nigeria have been very unstable such that year to year variations and seasonal patterns have not been consistent due to sporadic non-market factors affecting prices. The data were modified to take care of the effects of the non-market factors as follows:

(1) For price data used for the hedonic model - cross sectional prices of varieties at week 0, the price spread around the mean price of each variety over the whole study period was used. These vary positively and negatively around zero. In this way we have eliminated the effect of random price changes and are concerned only with price differentials or price premiums for varying qualities.

Hence $P = P_i - P_m$

where

P_i = price of a particular sample

P_m = mean price of rice or cowpea during week 0.

CHAPTER FIVE

RESULTS AND DISCUSSIONS

5.1 OVERVIEW OF PRICING STRUCTURE OF COWPEA AND RICE: TIME, SPACE AND FORM

The section therefore shows the pattern of price movement as influenced by the different components of price variation.

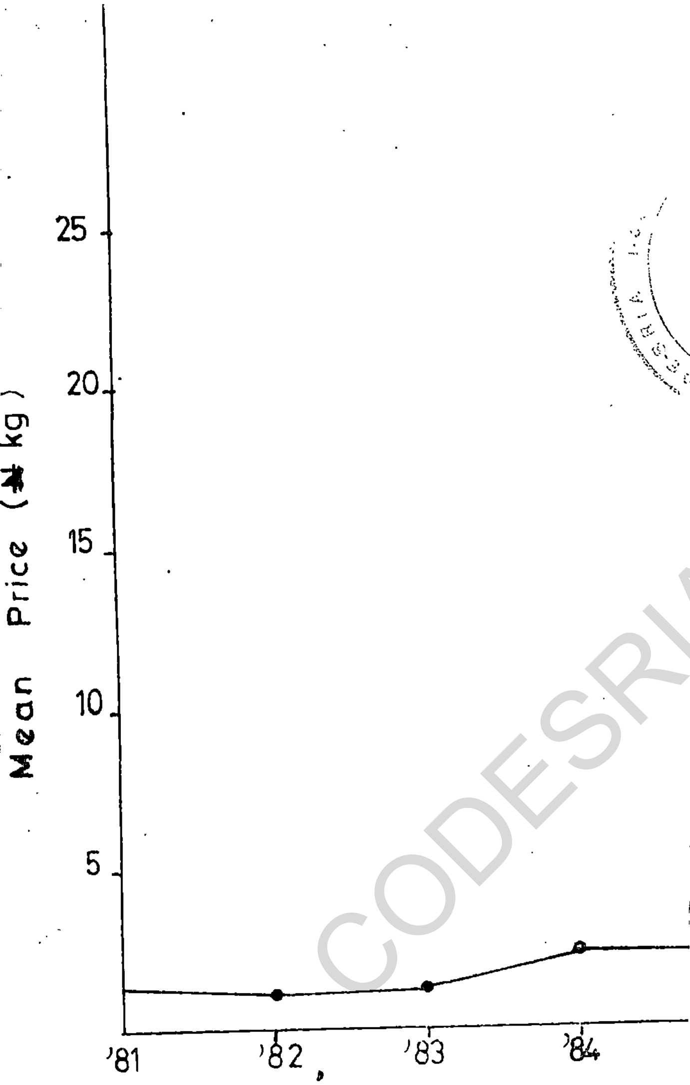
5.1.1 PATTERNS OF VARIATION IN COWPEA PRICES OVER TIME

The pattern of price movements for cowpea has been assessed for annual and month to month or seasonal trends. On a national scale there has been wide price variations, in line with trends in consumer price index. The mean [nominal price] between 1981 and 1994 ranged from ₦1.35 to ₦23.36 per kg with an annual growth rate of 2.43%. On a five yearly basis, it was found that the highest growth rate occurred in the 1991 to 1994 period with a trend value of 6.16 compared to 0.85 in the 1986 to 1990 period and only 0.29 in the 1981 to 1985 period (See Figure 5.1). The Consumer Price Index for the period 1981 to 1992 ranges from 58.88 in 1982 to 1091.59 in 1994, with 1986 as base year.

5.1.2 PATTERNS OF VARIATION IN RICE PRICES OVER TIME

Nominal price per kilogram of local rice ranged between #2.72 in 1986 to #24.34 in 1994. The year to year variation becomes more apparent when the mean prices are deflated by the CPI with 1986 as the base year.

Fig. 5.1. Temporal (Annual) Me



When analysed on the basis of development periods 1986 to 1989, 1990 to 1994, we observe the same pattern as with cowpea but the magnitude of change is less. The mean price for the entire period is N13.06. Between the two policy periods, there is a difference of N2.18 in period means. Figure 5.2 presents this pattern of yearly price movement.

5.1.3 SEASONAL VARIATION IN COWPEA AND RICE PRICES

Month to month variations are also very apparent within each yearly period. This is shown by the seasonal Index over the same period which varied from an average of 1.05 in January to 1.09 in April and 0.91 in December for cowpea and from 0.92 in January, 1.08 in April up to 1.21 in August for rice.

Figures 5.3 and 5.4 show the month to month or seasonal price movement over a three year period (1992 to 1994). Although the figures show progressive price increase for both crops over the period 1992 to 1994, month to month variations seem to be fairly consistent from year to year.

This seasonal variation reflects the production cycle of both crops as well as other intra period variations. Such are the supply (and prices) of substitutes such as yam, maize and guinea corn which are likely to also influence the prices of cowpea and to a lesser extent, of rice. It is also difficult to isolate the effects of the timing of events such as the muslim fasting period, easter festival and so on which often occur in close succession.

Fig. 5.2 Temporal (Annual) Movement of Rice Prices (1986 - 1994)

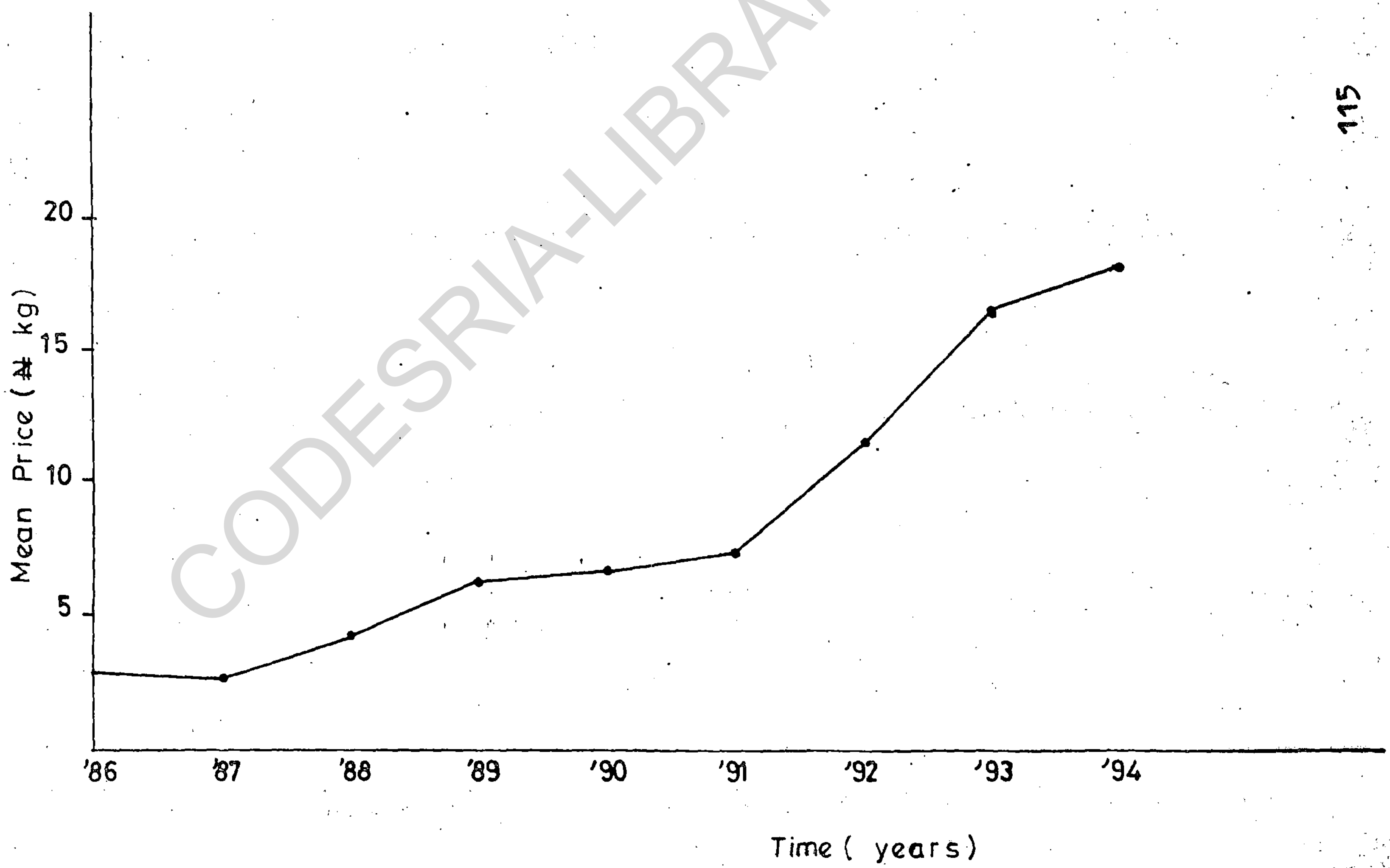


Fig. 5.3. Seasonal Index of Cowpea Prices in Selected Markets in Nigeria (1992-1994)

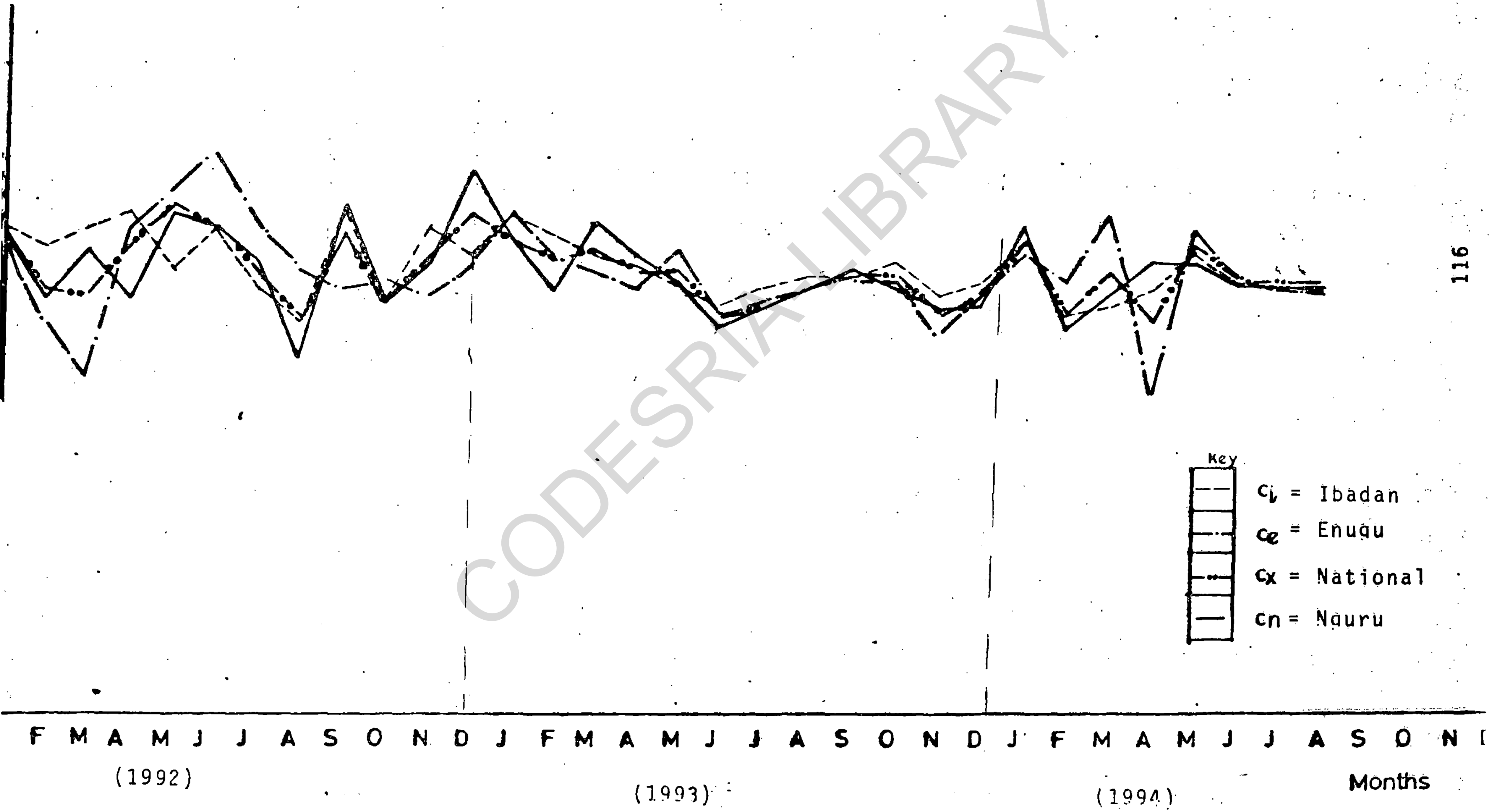
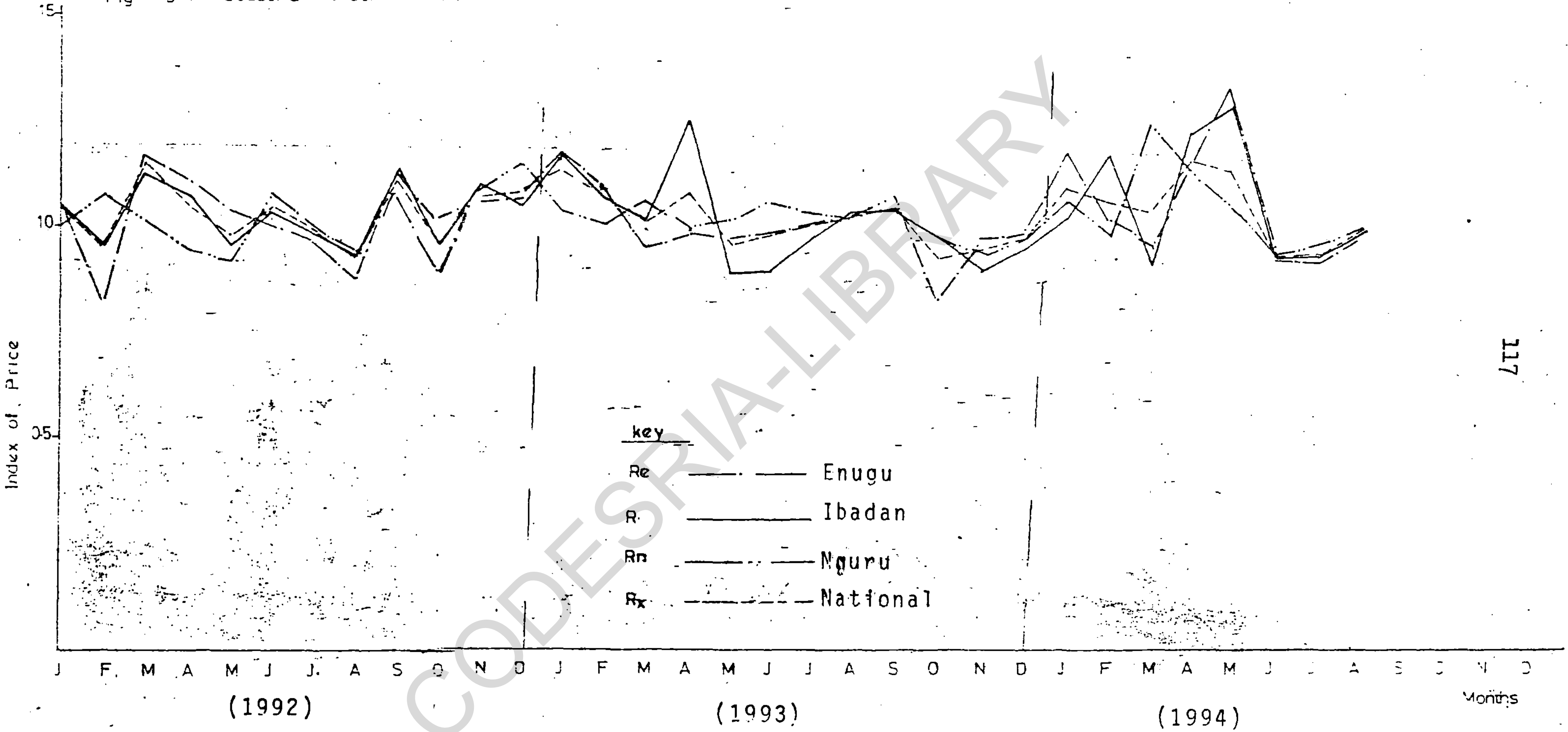


Fig 5.4 Seasonal Index of Rice Prices in Selected Markets (Nigeria, 1992- 1994)



This constitutes another factor of price fluctuation which can not be explained by normal trend analysis but which the seasonal index approximates in its frequent wave of price movements.

For cowpea, price is highest between June and October (the planting season) and lowest from November to February - the harvest season. Prices begin to rise in March. The seasonal price increase is at a slower rate between March and June than the next four months, indicating the pattern of stock movement or increasing storage costs which are generally more favourable just after the harvest season.

For rice, price is highest between April and July and starts falling in August to its seasonal lowest in January and February. Year to year variation is constantly high, in line with the trend in Consumer Price Index. However the annual growth rate has been generally highest between 1992 and 1993 for both crops and in all markets. The latter is more apparent for cowpea.

5.1.4 PATTERN OF VARIATION IN COWPEA AND RICE PRICES OVER SPACE

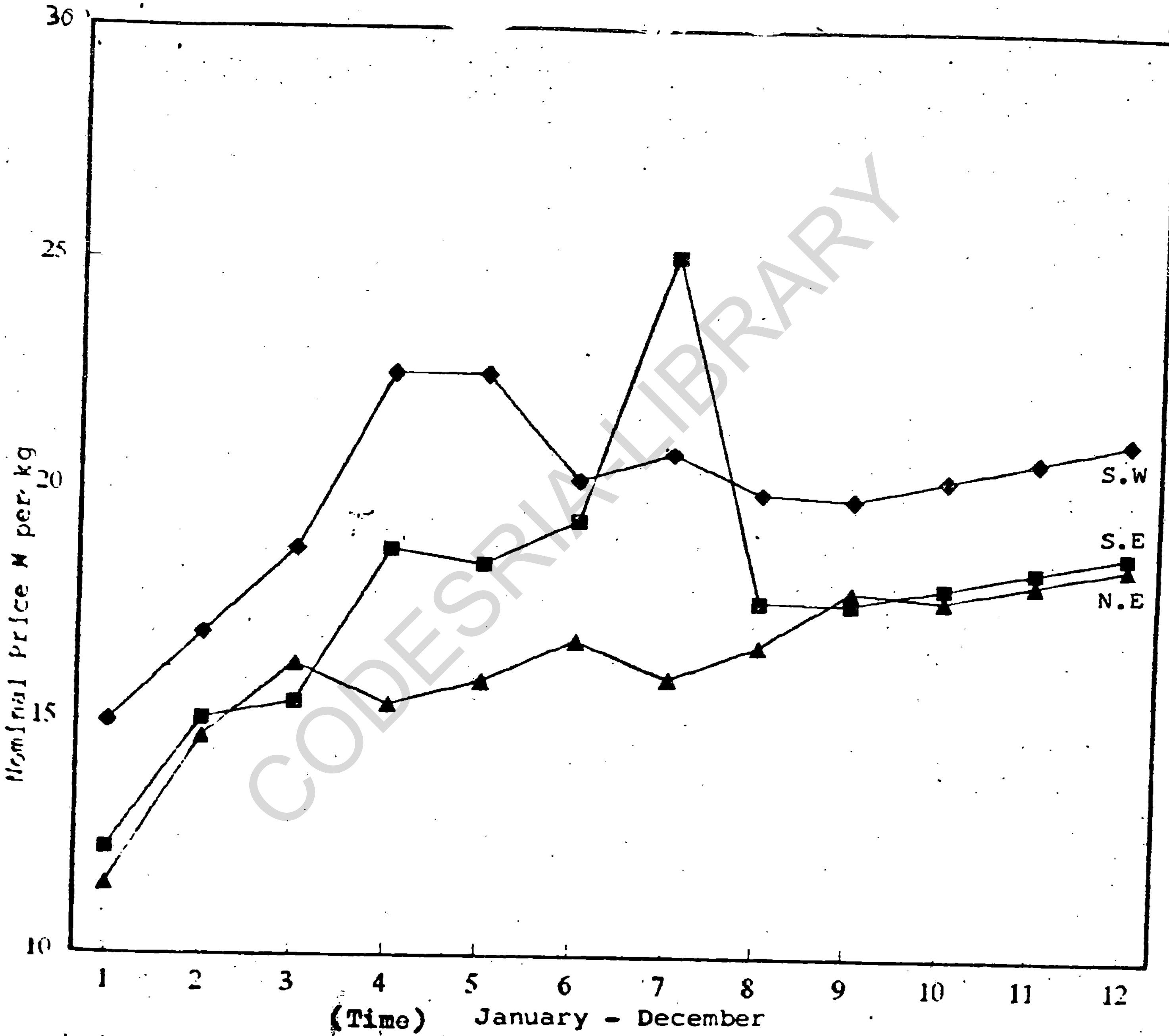
The analysis of price series above has also been carried out to compare the observed patterns between the three locations to show to what extent the general pattern applies or differs spatially. In other words to what extent are observed price variations accounted for by locational differences?

For cowpea, the mean price shows some spatial variation with nominal prices of N13.68 in the North East, N16.62 in South West and N19.05 in South East over the period 1980 to 1994 despite considerable year to year changes especially after 1985. Again while within group (location) coefficient of variation ranges between 26.3% in the South West to 31.7% in the South East, between group coefficients of variation is much higher at 74.9%.

While the mean price for rice did show considerable difference with values ranging from N16.20 in the North East to N18.49 in the South East, the annual growth rate of prices (trend) and within group is not significantly different for the three locations. Figures 5.5 and 5.6 which are the month to month movement in 1993 for all the three study regions give strong indication of spatial variation in the price movements. The pattern shown is that prices are generally highest in Ibadan and lowest in Nguru. For both crops, prices in Enugu and Nguru are closer except for a spurious hike in Enugu rice price in July. This could not be explained despite investigations. It is therefore presumed to be data error.

This spatial pattern of rice price movement reflects the "zone of production" and "zone of consumption". In the case of cowpea, the relative price levels in Nguru and Enugu may be explained by the observed apparent lack of strong varietal preferences in Enugu unlike the case in Ibadan. This would ensure a free flow of stock of all cowpea varieties to Enugu, while preferred varieties which command a higher price will flow more to Ibadan than less preferred ones.

Fig. 5.5 Spatial Price Movement of Rice (1993)
(Three Market Zones)

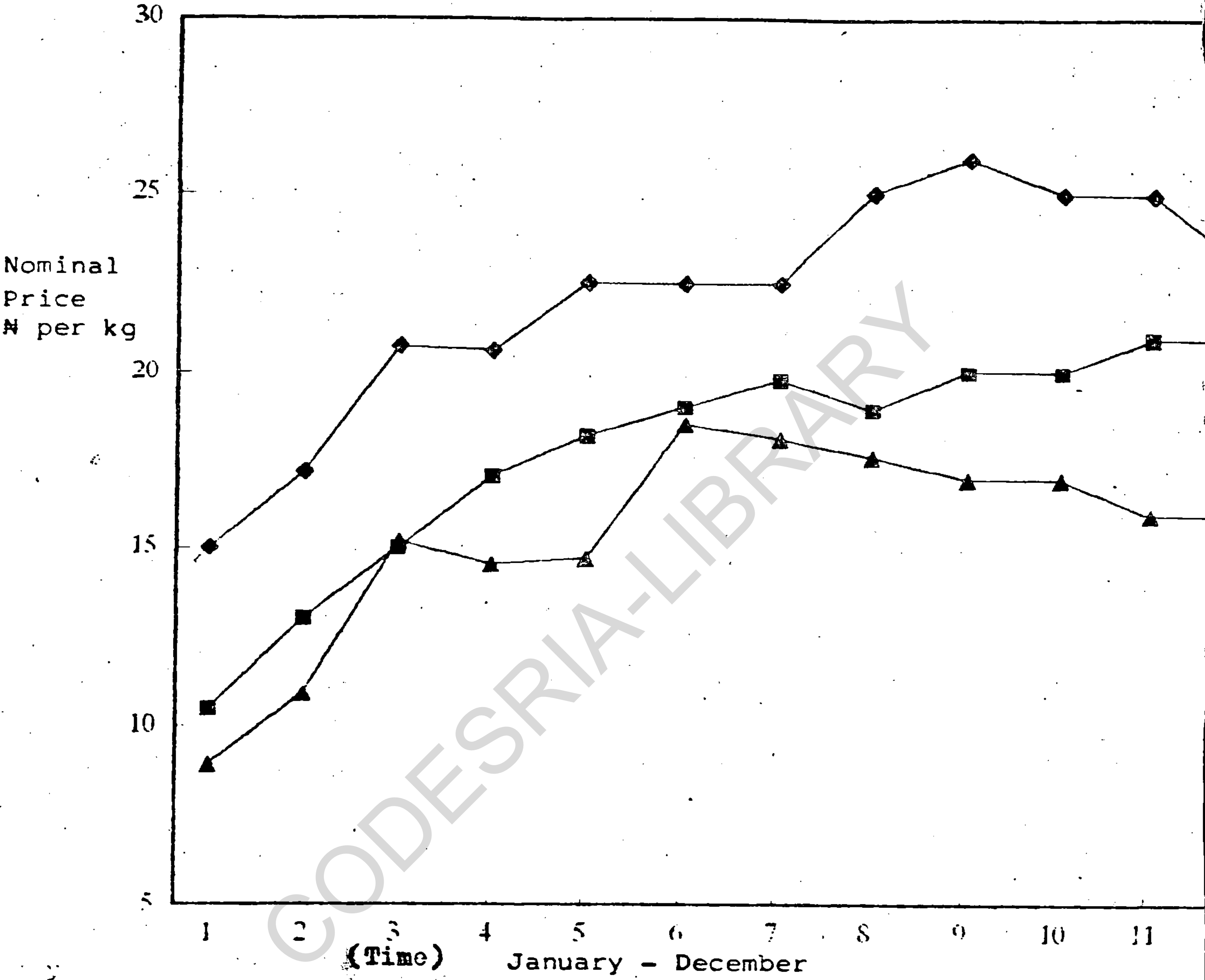


S.W - South West

S.E - South East

N.E - North East

Fig. 5.6 Spatial Price Movement of Cowpea (1993) Three Market Zones



S.W - South West
S.E - South East
N.E - North East

5.1.5 Pattern of Variation in Cowpea and Rice Prices Over Form

Apart from the general price variation discussed earlier, based on the finding of significant random variation in the prices, we proceeded to assess the pattern of price spread between different qualities of the grain crops. The analysis is termed the **hedonic** price variation as it assesses the extent of price variations between different qualities of the same crops over time and over space. This analysis is consistent with the works of Adekanye (1986) on observations of price spreads between rice varieties in Egbaland, Nigeria. The outcome as discussed below justifies further econometric analysis of the nature of price spreads on different crop varieties which is the focus of this study.

COWPEA

The prices for cowpea varieties as shown in Table 5.1 are generally in favour of white beans with mean price of N13.66 as against N13.36 for brown beans in the North East (price spread of 2.24%). In Enugu, the mean price spread is 4.56% in favour of brown beans. In Ibadan (South West) the mean price spread is 13.61% in favour of brown cowpea. This spatial variation in quality price relationship is not too different within each location for the three years studied. The coefficient of temporal variation within each variety ranges from 24.7% in the southwest to 32.4% in the South East. Coefficient of variation between varieties is 156.9% in South West, 44.8% in South East and 90.07% in the North East.

Table 5.1 Spatial Variations in Price Spread on Qualities of Cowpea (1992 - 1994)

	North East		Price Spread (%)	South East		Price Spread (%)	South West		Price Spread (%)	Mean		Price Spread (%)
	Mean Price (N)			Mean Price (N)			Mean Price (N)			Price Spread		
	Brown varie-ties	White varie-ties		Brown varie-ties	White varie-ties		Brown varie-ties	White varie-ties		Brown varie-ties	White varie-ties	
1992	6.83	7.81	14.35	11.61	10.66	8.91	8.29	8.40	1.32	9.06	8.75	3.54
1993	14.74	14.63	0.75	20.65	20.04	3.04	17.56	15.54	13.64	18.35	17.39	5.52
1994	18.52	18.56	0.21	26.19	25.19	3.96	25.57	21.03	21.59	24.39	27.47	8.55
Period Mean	13.36	13.66	2.24	19.48	18.63	4.56	17.45	15.36	13.61	17.27	16.20	6.61
Within Grp Coeff of Var.(%)	27.3	30.7		32.4	30.9		24.7	29.6				
Between Grp Coeff of Var.(%)	90.07			44.84			15.69					

Source: Annual Abstract of Statistics, various years.
Field Data, 1993 and 1994.

RICE

While the period mean for local rice is N10.27, that of the imported rice is N15.85 over the period analysed. The percentage price spread over the period is 28.5%. This percentage spread is observed to be on the increase over the years, despite increasing domestic production thus leading to phenomenal rise in the price of the imported rice. The coefficient of variation is also notable at 68.7 between the groups, compared to 23.7% and 35.6% within local and imported varieties (the latter is analysed for the 1990 to 1994 only).

Table 5.2: Pattern of Price Spread on Different Qualities of Rice (1986 - 1994)

	Mean Annual Price		Price Spread (%)
	Local Varieties	Imported Varieties	
1986	2.72	3.10	13.97
1987	2.57	3.06	19.07
1988	4.10	4.81	17.32
1989	6.46	7.81	20.89
1990	9.00	9.3	3.3
1991	13.96	18.7	27.5
1992	11.43	22.4	98.7
1993	17.85	32.1	66.7
1994	24.34	51.5	102.4
Period Mean	10.27	15.85	28.50
Within Group Coeff. of Var. (%)	23.7	35.6	
Between Group Coeff. of Var. (%)	68.7		

Source: Annual Abstract of Statistics, various years.
Field Data, 1993 and 1994.

5.1.6 Price Spread Between Grain Samples in the Study

Among the 34 samples of cowpea and 30 samples of rice, regardless of membership of the grouped pairs, certain varieties commanded greater premium over the mean grain price throughout the study period. The extent of seasonal price variation was also observed to be quite different. More importantly the observed variation again persisted across the study areas. The pattern of price spread between the samples in this study are shown in Figure 5.7 to 5.9 for cowpea and Figure 5.10 to 5.12 for rice.

For all the different varietal samples of cowpea and rice used in this study which are numerically detailed in Appendix 4, the figure indicate the movement of prices around the mean price for the period of study or the pattern of price premium across 'grades'.

For cowpea, the range of premium in Ibadan is from about N3.00 above the mean to about N4 below the mean i.e. N7.00 per kilogram. Premium between grades in Enugu is only about N3.00 per kilogram between grades. In Nguru, the range is widest at over N10.00 per kilogram above the mean and N5.00 per kilogram below the mean: This is consistent with the value of the coefficient of variations in Table 5.1.

Generally, the mean positive premium (deviation from the mean) for rice was highest in Ibadan and lowest in the East. The mean negative premium was also highest in Ibadan and, again lowest in Enugu.

Fig. 5.7 Pattern of Price Premium Across Grades of Cowpea in Ibadan.

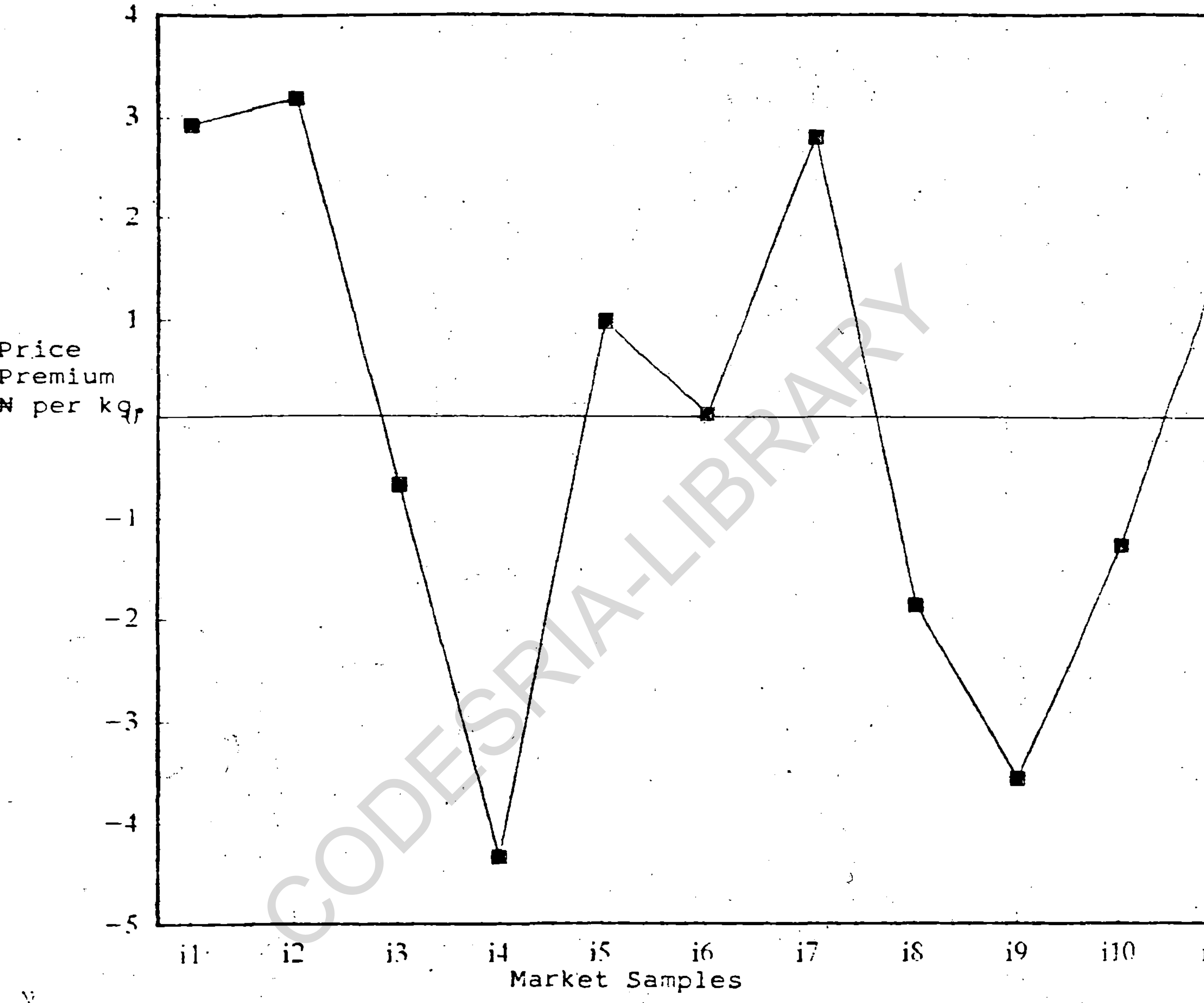


Fig. 5.8 Pattern of Price Premium Across Grades of Cowpea in Enugu

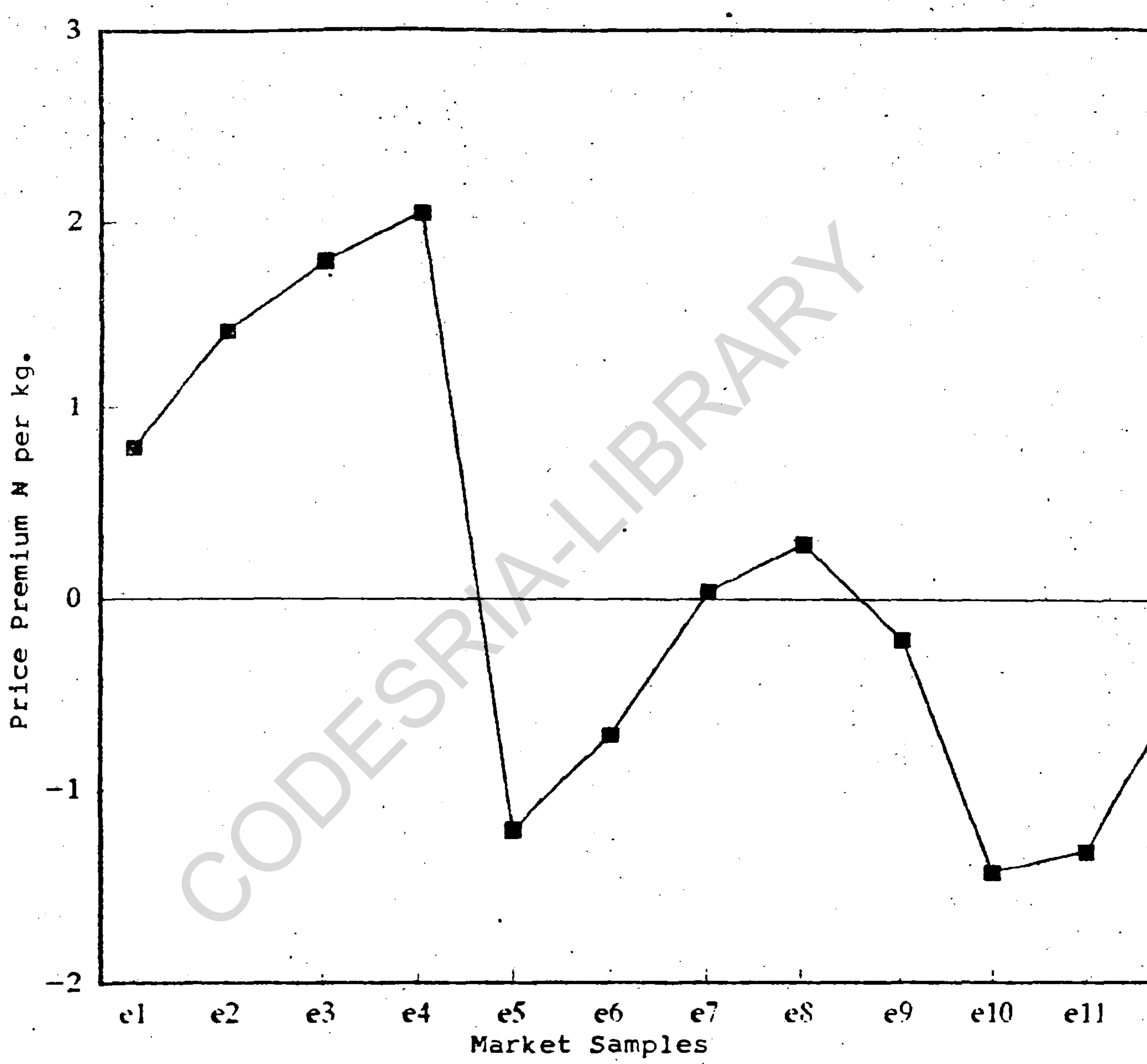


Fig. 5.9 Pattern of Price Premium Across Grades of Cowpea in Nguru.

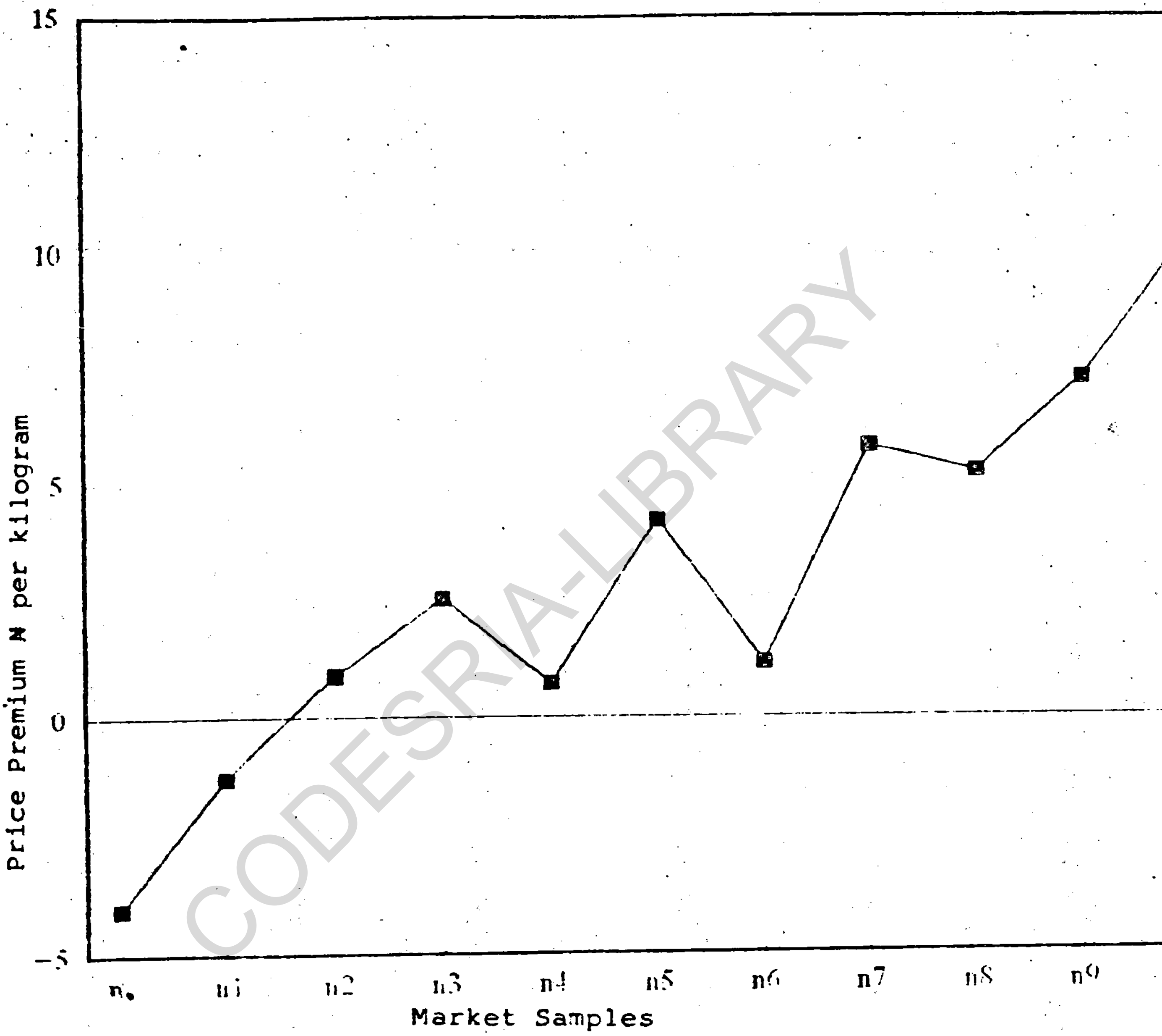


Fig. 5.10: PRICE SPREAD ON MARKET SAMPLES OF RICE IN IBADAN

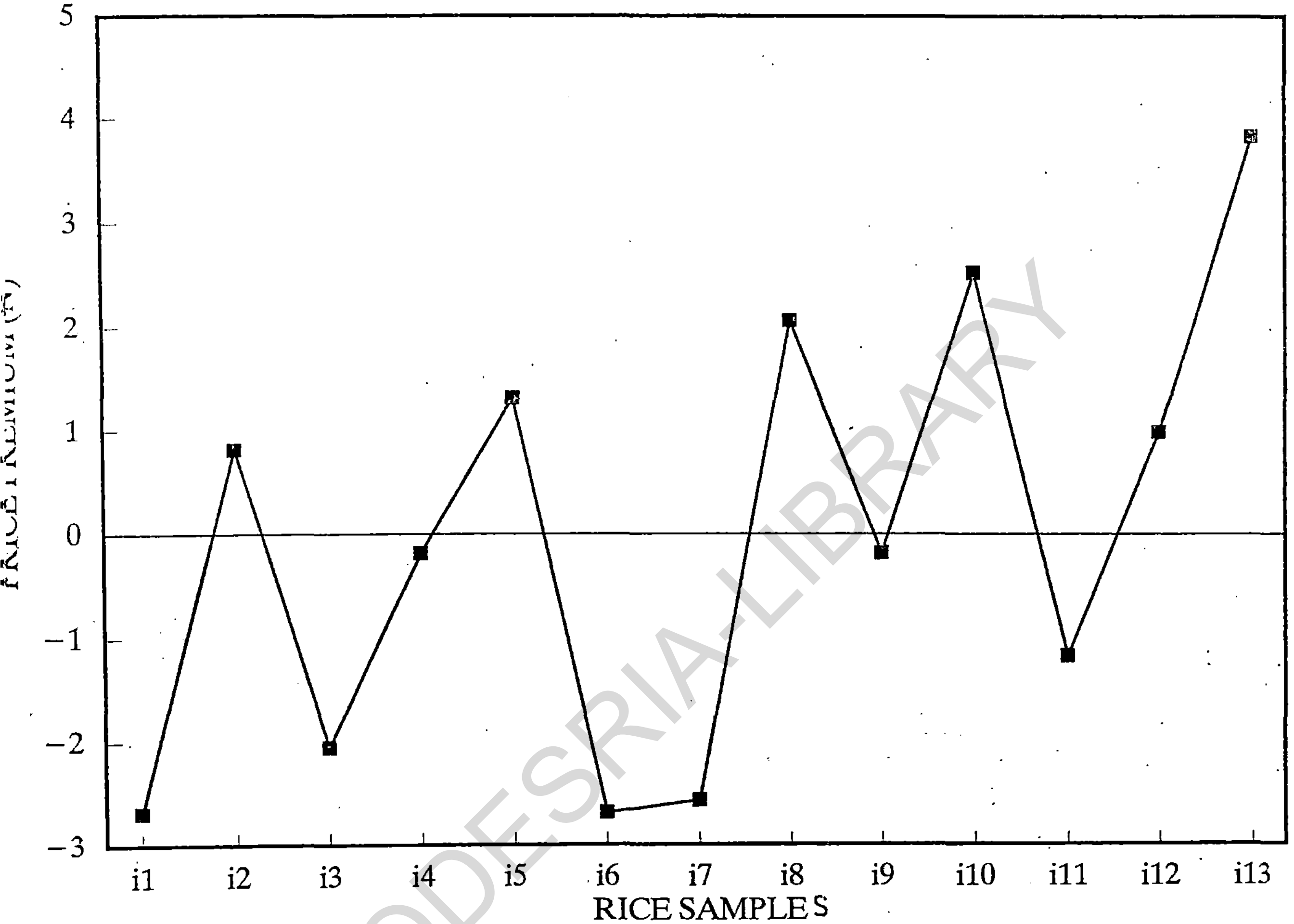
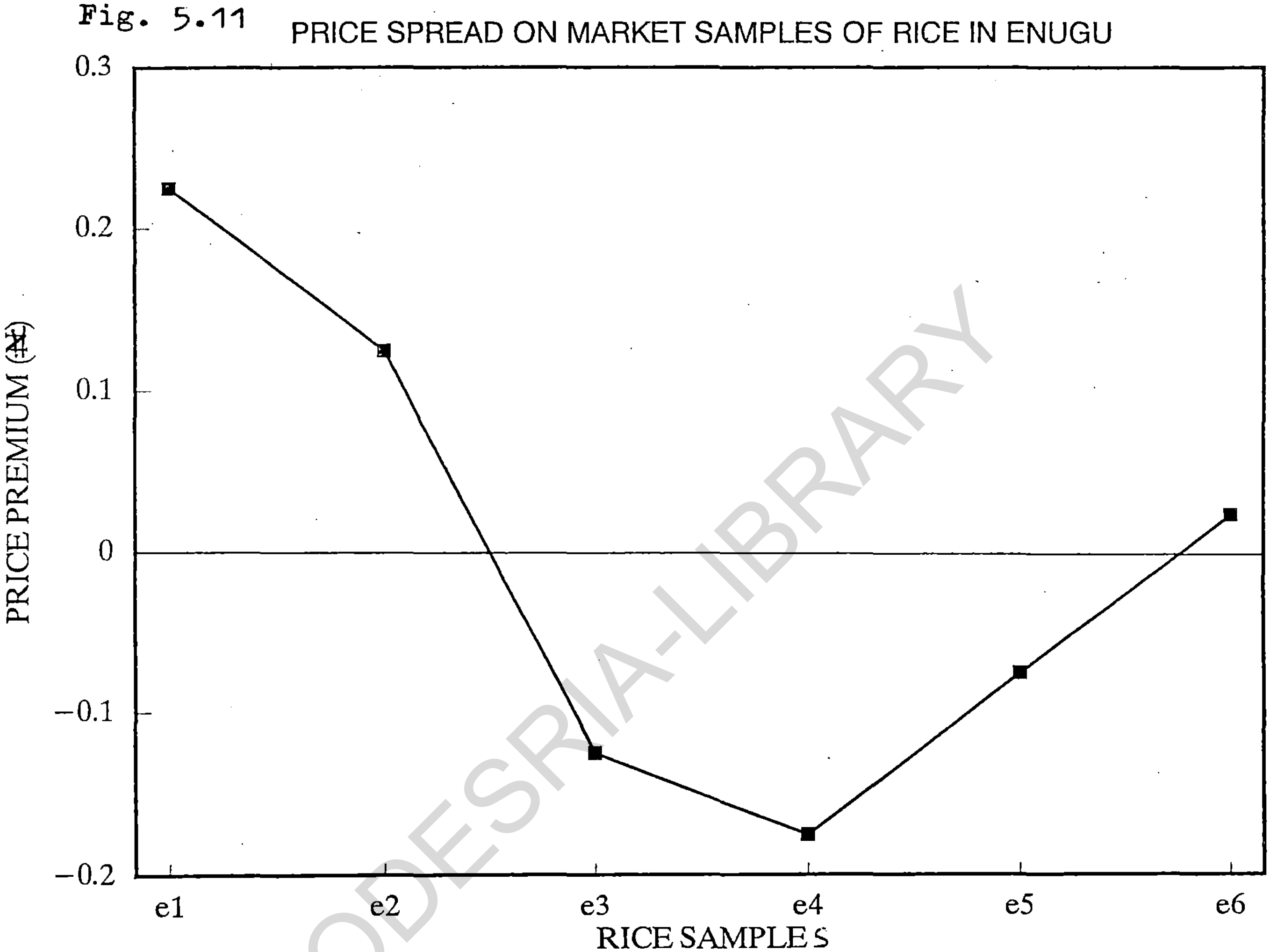
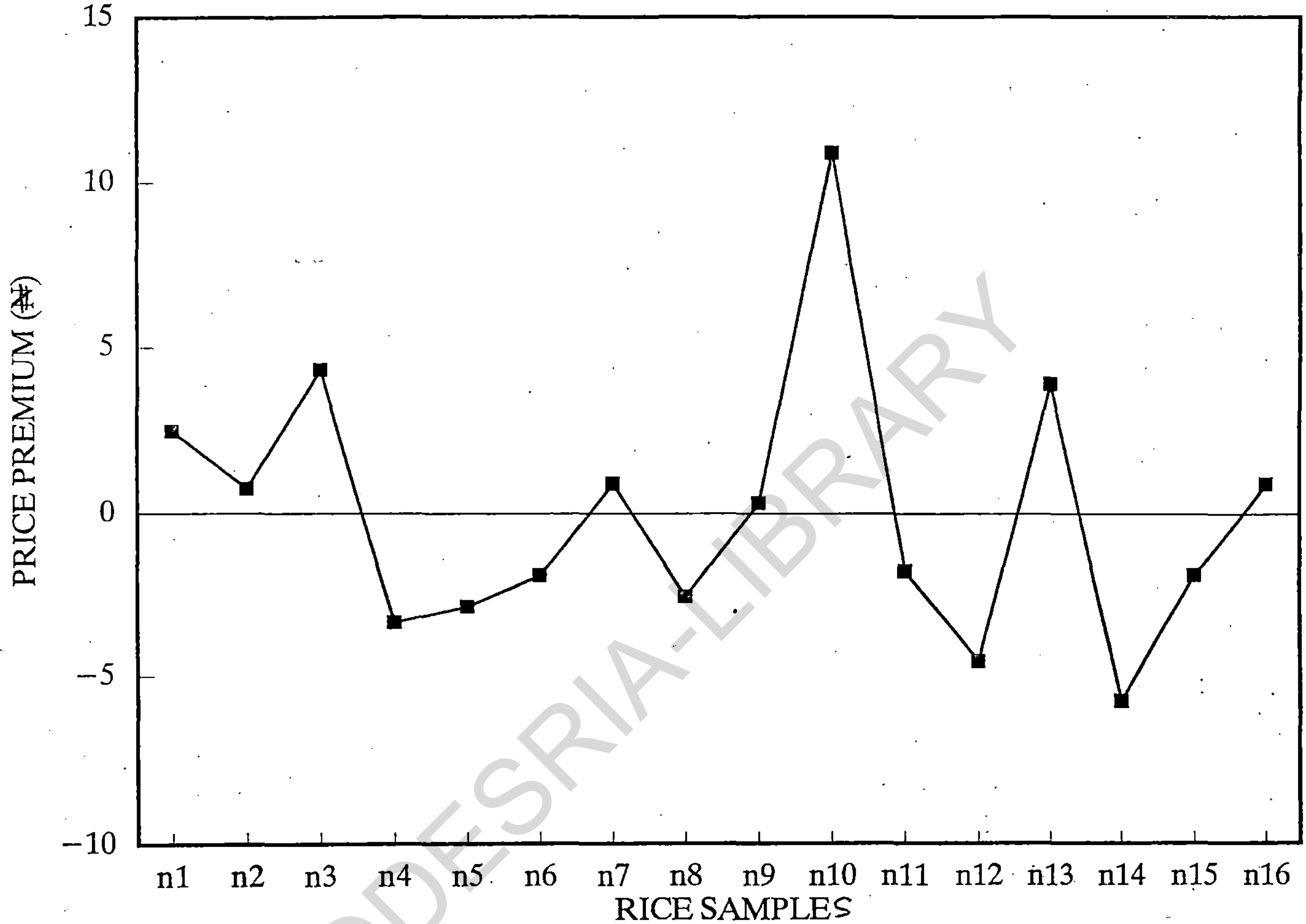


Fig. 5.11



PRICE SPREAD ON MARKET SAMPLES OF RICE IN ENUGU
0.3
0.2
0.1
0
−0.1
−0.2
PRICE PREMIUM (₦)
e1
e2
e3
e4
e5
e6
RICE SAMPLES

Fig. 5.12: PRICE SPREAD ON MARKET SAMPLES OF RICE IN NGURU



The reason for this pattern is that sensitivity to supply changes for different varieties is dulled by high availability in the North East and South East. The most distinctive array of varieties (exhibiting high characteristics scores) appears to be found in Ibadan. This is interpreted to mean that preferences in the Southwest are more reinforced and responsive to price (own-price as well as cross-price). Elasticity value thus tends to be highest. This may reflect the greater impact of urbanization in Ibadan.

In Enugu, the peculiar pattern shown is that price variation is very limited across varieties. The range of prices was only 0.95 with a mean price spread per variety of 0.005, compared to Ibadan where range was N10.23 and mean price spread was N26.34 over the 28 week-period. In Nguru, the same estimates were N8.67 and N25.52 respectively. Prices also tended to be relatively stable in Enugu during the whole study period. This implies the absence of strict preferences for characteristics unlike in the other areas.

It is tempting to conclude that consumer preference patterns are most distinctive across grades in Nguru and most uniform in Enugu. However, higher availability of many varieties in Nguru relative to other markets may be responsible for the wide range of prices. The pattern shown, irrespective, indicates that price differentials exist not only between varieties but also between different grades of the same variety of crop as shown by the identity of the different varietal samples in Appendix 4.1 and 4.2 as samples of similar variety appear to command different prices due to other quality parameters apart from the breeding characteristics that are reflected in varietal choices.

It has been shown in these analyses that price variations observed for cowpea and rice arise not only as a result of spatial and temporal fctors but also due to form differentials. More importantly it has been shown that the magnitude of premium between different grades also exhibit spatial differentials. This translates to the fact that consumer preferences may differ from place to place with respect to the quality characteristics of various grain crops. In the next section, this notion is further explored in order to identify the nominal order of preference for the predetermined characteristics. This has gone a long way in aiding the final choice of hedonic variables in the econometric analysis.

5.2 CONSUMERS' CHOICE OF HEDONIC VARIABLES

5.2.1 Expressed Characteristic Preferences For Cowpea

The preferred characteristics of consumers of cowpea and rice in the different market places are shown below. The rule of thumb is that for any characteristic to be considered relevant in the hedonic analysis, it must have been rated among the first three choices. The scale of preference is therefore indicated by the nominal order of the frequency scores. Tables 5.3 and 5.4 show the choice patterns for characteristics based on the most important attributes of grains among the respondents. Preference order for attributes vary for rice and cowpea just as there are identical as well as differing sets of attributes for different grains. The priority preferences cut across all the characteristics identified.

Table 5.3 Frequency Distribution of the nominal order of choice Cowpea characteristics across Markets (Most important cowpea characteristic to Consumers)

	Ibadan	Enugu	Nguru
Testa Colour	17.8[3]	8.7	64.0[1]
Seed Configuration	10.8	20.8[2]	23.3[2]
Swelling Ability	23.5[2]	9.8	2.7
Cooking Time	14.6	10.4	4.7[3]
Milling Quality	9.4	13.1[3]	4.7[3]
Grain Purity	23.9[1]	37.2[1]	0.6
N	228	187	161

Source: Survey data, 1993.
Superscript - Preference order of the three most important

Table 5.4 Frequency Distribution of the nominal order of choice Cowpea characteristics across Income Classes (Most important cowpea characteristic)

	Low Income	Middle Income	High Income
Testa Colour	29.46[2]	21.31[2]	12.74
Seed Configuration	16.76[3]	11.67	16.66[2]
Swelling Ability	32.14[1]	13.19[3]	4.40
Cooking Time	14.28	9.13	14.70[2]
Milling Quality	2.67	12.69	10.78
Grain Purity	4.46	24.87[1]	40.19[1]
N	75	210	95

Source: Field Survey, 1993.
Superscripts - preference order of three most important.

The tables show that the preferences vary fairly strongly with respect to geo-locations but less so with respect to income groups.

While the grain purity and swelling ability rank highest in Ibadan, (with 23.9% and 23.5% of the sample naming them as most important respectively), the grain purity is also the most important in Enugu with the grain configuration being of sufficiently high importance. In Nguru, grain colour is overwhelmingly the most important consideration.

Among different income groups, there are strong ties between low and middle income groups on some choice characteristic while the middle and high income show related preferences for some other characteristics. Notably, the low to middle income have highly related preferences for colour of grain and swelling ability (29.46%, 21.31% for testa colour and 32.14% and 13.19% for swelling ability). The middle and high income have closely related choice patterns with respect to grain purity (24.87% and 40.19% respectively). Regardless of income classes, there is fairly uniform choice order for the cooking time of cowpea varieties across income classes.

5.2.2. Expressed Characteristic Preferences for Rice

In Tables 5.5 and 5.6 the preference patterns for rice characteristics across markets and income classes are shown.

Table 5.5 **Frequency Distribution of the nominal order of choice Rice characteristics across Market Locations (Most important Rice characteristic)**

	Ibadan	Enugu	Nguru
Chalkiness	9.9[3]	4.4	51.6[1]
Seed Configuration	8.6	5.7	19.5[2]
Swelling Ability	35.2[1]	6.5[3]	7.6
Cooking Time	7.7	5.1	8.9[3]
Milling Quality	20.6[2]	47.8[1]	3.5
Grain Purity	2.1	26.5[2]	8.9[3]
N	233	136	225

Source: Field Survey, 1993.
Superscript - preference order of the three most important

Table 5.6 **Frequency Distribution of the nominal order of choice Rice characteristics across Income Classes (Most important Rice characteristic)**

	Low Income	**Middle Income**	**High Income**
Chalkiness	**40.9[1]**	15.1[3]	6.5
Seed Configuration	14.1	13.2	7.8[3]
Swelling Ability	15.7[2]	23.4[2]	7.8[3]
Cooking Time	6.3	11.2	2.6
Milling Quality	8.7	31.7[1]	48.1[1]
Grain Purity	14.2[3]	6.4	27.3[2]

Source: Field Survey, 1993.
Superscript - preference order of the three most important.

Like in the case of cowpea, preferences appear to vary but with some striking commonalities.

Across the southern geo-populations, the most important characteristic is milling quality which ranks highly both in Ibadan and Enugu. Twenty point six percent and 47.8% of respondents gave it first preference. On the other hand, grain colour, as expressed by chalkiness (which gives the rice grain either a whitish appearance for highly chalky grains or tendency to cream or yellow coloration for highly translucent grains) ranks upper-most in Nguru and quite low in the other locations! This is seen to be related to the common meal (Tuwo) which is favoured in the north and for which whitish, fast-cooking rice with high starch content is best. Swelling ability appears very important only in Ibadan and only next to milling quality among the high and middle income consumers. Chalkiness is rated highest among the low income groups only.

The general trend of the results is that in the south west (Ibadan), on the average, preference for slender grain (high score of grain configuration (GCF) or length-breadth ratio), low foreign matter content (MLQ1) and low brokens are highest (MLQ2).

In the south east (Enugu), preferences are highest for high grain length (GLT) high seed weight (SW100), high swelling (SWA) ability and low level of mould. In the north east (Nguru), preferences are highest for low cooking time and low level of adulteration.

5.2.3 COEFFICIENTS OF GROUP CONCORDANCE ON CHARACTERISTIC CHOICES

Table 5.7 Coefficients of Concordance of Subsamples on Choice of Cowpea Characteristics (Kendalls Coefficient (W) on Most Important Characteristics

Subsamples	N	W	X^2
Geo-Population			
Ibadan	228	0.83	190.0***
Enugu	187	0.67	124.59***
Nguru	161	0.33	53.16***
Socio-Economic Group			
Low Income	75	0.56	42.00***
Middle Income	210	0.33	69.76***
High Income	95	0.35	32.92***

Source: Field Survey, 1993.

Table 5.8 Coefficients of Concordance of Subsamples on Choice of Rice Characteristics (Kendalls Coefficient (W) on Most Important Characteristics

Subsamples	N	W	X^2
Geo-Population			
Ibadan	233	0.88	206.0
Enugu	136	0.78	105.48
Nguru	225	0.13	28.04
Socio-Economic Group			
Low Income	127	0.59	75.00
Middle Income	205	0.39	80.05
High Income	77	0.62	47.69

Source: Field Survey, 1993.

Results of Kendall's W interprete within group patterns .

Our results show that the concurrence of opinion is generally higher within geo-populations than within income classes. While W ranges from 0.33 to 0.83 for cowpea and from 0.13 to 0.88 for rice, the level of concordance is generally lower between income groups with the highest coefficient being 0.59 and 0.56 respectively among low-income consumers. Comparatively, concordance of opinion i.e. exhibition strong preferences is high in Ibadan and Enugu and very low in Nguru.

The implications of the findings may be interpreted from two perspectives. One is the viewpoint of the level of urbanisation of any market location. High metropolitan nature leads to heterogeneity of the population. Market supply thus has to be tailored to meet varied preferences. The result of this choice patterns over time is that availability (supply) of characteristics becomes more deterministic. This is believed to have influenced the choice pattern in Ibadan. Secondly in largely consuming populations like Ibadan and Enugu, only the market supply has been effective in streamlining the choice pattern around what varieties are available, whereas production factors which consumers can not control interplay in determining the availability and demand patterns in a location like Nguru. Hence within group concordance is higher in Ibadan and Enugu than in Nguru. The results may be a pointer to the need for more rigorous analysis of consumer preference among consuming populations vis-a-vis producing populations.

Current literature on cowpea preferences recognise tradition experience and religion, culture, degree of urbanization, educational attainment of homemakers and so on as strong influencing factors (Fosu (1986), Adrian and Daniel (1976). The latter factors of urbanization and education are more apparent in Ibadan and Enugu than Nguru.

Table 5.9 Kendall's tau-b for Group Concordance in the Whole Population [Most Important Grain Characteristics]

	Cowpea	Rice
	tau-b	tau-b
By Geo-Cultures	-0.316	0.589
By Socio-economic Classes	0.258	0.197

Source: Field Survey, 1993.

The results of Table 5.9 indicate that there is more concordance of opinion across income classes for cowpea and less so for rice. There is generally no agreement among the geo-cultures (market locations) with respect to cowpea characteristic choices but a high degree of agreement exists with respect to rice. In the latter (Rice) it is among income classes that the commonalities of opinion petter out.

This implies that economic factors become stronger in rice characteristic demand as income falls. At higher income levels, we may expect to find more commonalities in preference pattern. The opposite view applies to cowpea. It appears that regardless of income characteristic preferences tend to be more clearly defined within locations for this crop. Divergence of preferences across income classes is not very clearly defined.

5.2.4 RELATIONSHIP BETWEEN EXPRESSED PREFERENCES AND AVAILABLE CHARACTERISTICS

In relation to the average score of grain samples from specific markets, there are adequate reasons to accept the expressed opinions as having influenced the supply of crop characteristics (different qualities of crop sample) to different markets.

For rice the highest score for chalkiness appears in Nguru while the lowest cooking time is in that location also. The highest score for the milling quality parameters [brokens-free and adulteration-free percentages] occurred in Ibadan. But contrary to the expressed views, the highest score for swelling ability is found in Enugu and Nguru rather than Ibadan. The highest score for grain purity was found in Ibadan and not in Enugu as expressed. Enugu has the highest scores for foreign-matter-free percentage and grain length which are features usually associated with metropolitan areas. However this is consistent with the expressed opinions.

In the case of cowpea, the highest scores for weevil-free percentage and adulteration-free percentage are found in Nguru rather than Enugu and Ibadan as expressed. This can be explained by the relatively high availability of cowpea in Nguru compared with the southern location. As such, we expect, reasonably, that the best characteristic scores will be found there, not solely as a demand-pull factor but a supply-determined factor. The apparent preference for high purity cowpea in Ibadan and Enugu is only reflected in relatively high values of the other grain purity attributes i.e. mould and foreign matter percentage.

In Ibadan, importance of high swelling ability of cowpea is concurrent with the relative availability of that characteristic (2.39), compared to 2.19 and 2.23 in Enugu and Nguru. Also, the expressed views for testa colour are consistent with expressed opinion and normal expectations.

Table 5.10: Average Characteristics Scores of Cowpea Samples by Market Places

Characteristics	Ibadan	Enugu	Nguru	Pooled
Price Per Unit	24.49 (0.01)	26.25 (0.57)	24.62 (1.01)	25.15 (0.92)
Breeding				
Testa Colour (highest frequency)	2 (0.15)	1 (0.15)	1 (0.17)	2.27 (0.09)
Cooking Time (min)	44.93 (2.21)	39.21 (1.17)	44.15 (2.80)	42.68 (1.25)
Seed Configuration	1.74 (0.05)	1.69 (0.04)	1.76 (0.04)	1.73 (0.03)
On-Farm				
Seed Weight (mg)	16.17 (0.50)	17.33 (1.32)	15.26 (0.75)	16.31 (0.95)
Moulds (%)	97.46 (0.60)	76.83 (0.76)	94.45 (0.75)	96.35 (0.49)
Off-Farm				
Foreign Matter (%)	99.18 (0.28)	99.44 (0.14)	98.39 (0.30)	99.04 (0.16)
Weevil Infestation (%)	74.58 (0.70)	84.75 (3.14)	88.30 (2.64)	82.21 (2.86)
Swelling Ability	2.39 (0.08)	2.19 (0.11)	2.23 (0.08)	2.27 (0.05)
Adulteration (%)	68.11 (5.89)	66.74 (5.68(	78.44 (5.40)	70.67 (3.31)

* Standard Error in parenthesis.

Source: Laboratory Tests, 1993.

Table 5.11: Average Characteristic Scores of Rice Samples by Market Places

Characteristics	Ibadan	Enugu	Nguru	Pooled
Price Per Unit	27.68 (0.95)	28.28 (0.76)	24.53 (1.20)	26.31 (0.77)
Breeding				
CHLK Chalkiness	2.89 (0.12)	2.96 (0.11)	2.97 (0.08)	2.44 (0.06)
CTM Cooking Time (min)	26.77 (1.09)	30.67 (0.96)	26.48 (0.73)	27.31 (0.61)
GCF Seed Configuration	2.52 (0.08)	2.78 (0.09)	2.44 (0.06)	2.53 (0.05)
GLT Grain Length (mm)	6.08 (0.08)	6.44 (0.15)	6.16 (0.11)	6.18 (0.08)
On-Farm				
GPT1 Moulds (Grain Purity %)	99.39 (1.49)	99.26 (0.34)	99.05 (1.23)	99.21 (0.12)
SW100 Seed Weight	68.62 (0.87)	67.73 (0.58)	68.33 (0.24)	94.25 (0.81)
Off-Farm				
MLQ1 Foreign Matter (Grain Purity)	92.67 (0.09)	96.58 (0.22)	94.67 (0.24)	94.25 (0.81)
MLQ2 Brokens (Milling Quality)	85.38 (2.51)	84.26 (2.58)	78.34 (4.19)	81.96 (2.18)
SWA Swelling Ability	2.90 (0.43)	2.96 (0.76)	2.96 (0.90)	2.94 (0.46)
GPT2 Adulteration (%)	97.04 (0.21)	96.92 (0.31)	94.97 (0.21)	96.07 (0.21)

* Standard Error in parenthesis.

Source: Laboratory Tests, 1993.

When the characteristic choices and availability are grouped according to the three sets of attributes under focus, the pattern is equally inconclusive. More importantly, cultural factors stated earlier may hereby come into force as more important than socio-economic (income) factors, given the pattern of these preliminary findings. Hence the need for further econometric analysis to define these patterns more clearly.

The final choice of characteristics for the hedonic function derives largely from these preliminary findings, a priori reasoning and findings of early hedonic workers as well as crop acceptability studies (Waugh (1928), Adrian & Daniel (1974) Ladd & Martin (1976) Wilson (1982) Williams (1984) Unnevehr (1985, 1986).

The expected relationship of each of the characteristics with the dependent (price) variable is presented in Table 5.12. While for some, the expected pattern is rationally unidirectional, for some, the sign is not-deterministic. Cultural traits, diet prevalence as well as shared consumer knowledge affect the desirability or otherwise of certain varieties. Often judgement based mainly on the preferred breeding characteristics are affected by the state of some on and off farm characteristics. These make the choice function to be subjective and desiring of evaluation.

Table 5.12 Expected Relationship of Grain Characteristic with Price

Characteristics	Rice	Cowpea
Seed Weight	+	+
Grain Length	+	N.A
Grain Configuration	+	subjective
Mould %	-	-
Foreign Matter %	-	-
Brokens %	-	N.A
Weevil Infestation	N.A	-
Seed Colour	N.A	subjective
Chalkiness	-	N.A
Cooking Time	-	-
Swelling Ability	+	+
% Adulteration	-	-

N.A - Not Applicable

Source: Field Survey, 1993.

5.3 HEDONIC FUNCTIONS FOR RICE AND COWPEA MARKETS

The variables chosen for and used in the hedonic function are grouped into three categories. The grouping represents the main crop technological systems that contribute to the final characteristics of market samples as defined in Section 4.2.6

A full equation was estimated with respect to all the hedonic variables or crops characteristics. This was estimated for the pooled data of samples from all markets and also for disaggregated data of samples from Ibadan, Enugu and Nguru. Then each of the groups of characteristics were regressed on the price variable. This is in order to assess the relative importance of each set of characteristics in the determination of price.

5.3.1 CHOICE OF FUNCTIONAL FORM FOR THE HEDONIC ANALYSIS

Hedonic regression models enable us to estimate the relative price of units of grain characteristic i.e. the marginal implicit price and the price-responsiveness of each of the crop's attributes. The most appropriate functional form is expected to approximate as closely as possible a firm's production function.

The Log-Linear, Semi-Log, Power Function (double log) and a Second-Order Polynomial of the linear function were tried as consistent with earlier works in hedonic analysis both in agriculture and other fields. No known works exist in the Nigerian agricultural system to give a pioneer guide as to the most appropriate function. The final choice is therefore based on economic rationalization of the earlier methods as well as other statistical and econometric criteria which satisfy the hypotheses framework.

Economic Rationale

In most of the earlier studies, the linear function has been mostly used because of its simplicity of interpretation and lack of theoretical justification of any other forms [Waugh (1928), Ethridge and Davis (1976/77), (1977/78), Bronsen, Grant and Rister (1983) and so on]. In this study, as in more recent reviews (Cropper, Deck and McDonnell, 1951), it has been rejected for several reasons.

First, the linear function assumes constant marginal utility or each characteristic over the range of values in any situation. This constant utility approach has been explored further [Adrian and Daniel (1976), Eastwood (1989)]. They note that studies using this approach mostly focused on the analysis of demand for food nutrients which have little application to consumer choice or taste. For the types of products under study, the notion of constant marginal utility is not plausible, neither is a constantly increasing marginal utility consistent with rational economic behaviour in food-demand analysis.

Secondly, using the linear function in estimating implicit price was also ruled out because the implicit price which is the slope of the regression equation <u>is</u> the regression coefficient with respect to each characteristic. It therefore remains unchanged for all samples and all submarkets. This defeats the need to test our hypothesis of difference in consumer preference pattern and implies that the preference pattern is invariable within and across populations. However, the linear function has generally outperformed others in terms of the coefficient of determination R^2. Wilson (1984) experimented with the second order and third order polynomial of the linear model for the hedonic analysis of malting barley in Minnesota, USA. Mostly, he found the coefficient of the polynomial orders insignificant. Consistent with most other earlier workers, his models were mostly of the linear form. The outlined econometric problems and other economic reasoning precluded its adoption in this study.

For such normal goods as are being studied here, the form of the double-log function seems more appropriate. This is one of the most widely used in empirical studies approximating demand and production functions for normal goods. Its unique property of unitary sum of all the regression coefficients also makes it applicable to the analysis of relative price-responsiveness. Also, unlike the linear and semi-log function, there is diminishing marginal utility of each characteristic with progressively increasing characteristic values. In effect, the demand curve peaks after a point rather than growing indefinitely like the semi-log and linear functions.

Furthermore, the expected signs of the coefficients as specified in Table 5.12 is a major consideration especially for the 'deterministic' variables such as milling quality, grain purity, seed weight, cooking time and adulteration level. There were a number of variables whose direction can not be definitely stated because of expected taste differences. Since most of the X^s were expressed in sign-positive measures, the expected variation are also mainly with respect to the magnitude of the coefficients rather than the signs. The basic requirements of positive sign of the coefficients can be violated only if this helps to define lines of preference with variables such as seed colour, seed configuration, grain length etc.

The number of coefficients which exhibited the expected signs of the relationship are noted in Table 5.13. Of the nine variables regressed on price for the cowpea function, between 3 and 7 conformed with a priori expectation. The highest were for the double-log and the Log-linear functions.

Statistical Rationale

The absolute t-values of each of the regression coefficients from all the functions were examined for significance at the 0.01, 0.05, and 0.10 levels of significance for the one-tailed test. Equations with most of their coefficients having absolute t-values less than 1.0 were considered unsuitable ie not significant. The Log-linear function had the highest number of significant variables. However the confidence bounds were generally lower than for the double-log function.

Econometric Criteria

i. Cross-Correlation of Variables

Correlation matrix for all variables in the equation was examined in order to assess the extent of multicolinearity. For this, one of each pair of variables exhibiting a pairwise correlation greater than 0.8 was eliminated from the series (Hauser's (1974) rule of thumb). The occurrence of multicollinearity was very minimal in all the fitted equations. The highest correlation was between cooking time and milling quality (0.803). On economic grounds however, we chose to retain these very important variables.

ii. Analysis of Residuals

The magnitude of the error term in a regression function must conform to certain assumptions concerning the Ordinary Least Square estimation procedure. We therefore tested for the extent of conformity with some of these assumptions by assessing the residual values for each of the independent variables and the dependent variable.

a. Test of Homoskedasticity

The assumption of homoskedasticity implies that the variance of the residual around its zero mean does not depend on the values of the independent variable (Olayemi & Olayide (1981), Koutsoyannis (1977). We assessed for minimisation of variance of error in the different functions, irrespective of the values of the other variables. This was done by mapping the residuals. The maps of residuals show a general tendency to homoskedasticity although the minimum dispersion occurred with the log-linear function, followed by the double log function. (See Appendix 5.2)

b. Autocorrelation

The map of residuals also aided to assess the **degree of autocorrelation** of the residual. The maps show frequent change of signs of u, indicating tendency to negative autocorrelation in most of the functions.

c. Relative magnitude of the residual (error sum of squares)

Pairwise Chow-test of equality or otherwise of the residuals was first carried out for the two tailed test at 0.01, 0.05 and 0.10 levels of significance of the chi-square distribution at (23,7) degrees of freedom. (Appendix 5.3).

For the four functions, six different tests of differences of the SSE were carried out. We were able to reject the null hypothesis of equality of coefficients on five out of the six pairs of equations tested but we were unable to reject Ho with respect to equality between the double-log and log-linear functions. The relative magnitude of the sum of squared error is minimised for these two functions. Therefore the assumption of minimum variance of error is best met with these functions.

iii. Predictive Power of the function

a. Standard Error of Predicted Price (SEPRED)

The Standard Error of the predicted mean (P) is usually smallest when $X = X_o$ i.e. at the mean point of the actual value. The S.E of the predicted mean SEPRED provides further insight into the fit of a regression line. SEPRED is smallest for the double log formation at 0.0045.

b. The Predicted Price and Prediction Residuals

The mean predicted value also should be as close to the actual values as possible. The dependent variable in all the formations being assessed are the index of price premium (P_{mi}). where $P_{mi} = 100 + (P - P_i)$. The values for the cases ranged between 96 and 103 for discount values and premium values respectively of the price of different samples. The range is from 96.698 to 102.658 (5.959) for the Double Log formation, 96.96 to 102.96 (5.99) for the Log Linear, and 96.28 to 103.32 (7.08) for the Polynomial equation (second order). The range is minimised for the double log function. Prediction Residual is lowest for the double log.

iv. Coefficient of Determination (R^2)

Lastly, in assessing the normal parameters of the regression equation, the values of R^2, and its corresponding F-ratio were compared. This parameter expresses the goodness of fit of the actual observations to the adopted functional form. The coefficient is highest at 0.869 for the double -log function. Although the other functions exhibited relatively good fit, comparable with the above, their F-statistic showed that the highest significance of this coefficient is achieved with the D_L function.

Table 5.13: Analysis of the Appropriateness of Functional Forms of the Hedonic Equation (Cowpea)

	Semi Log	Double Log	Log Linear	Polynomial
Standard Error of Prediction (SEPRED)	0.0541	0.0045	0.0072	0.9425
Sum of Squared Error	35.953	0.013	00026	21.485
R^2	0.720	0.869	0.700	0.781
F-Ratio of R^2	0.965	13.27	4.676	2.640
No. of conforming signs of ß	4	7	7	5
No. of significant values of ß	6	5	8	4

Source: Data Analysis Outputs, 1994.

5.3.2 THE HEDONIC EQUATION

The same parameters for assessing the appropriateness of functional form were applied for both rice and cowpea. While the same tests of violation of assumption yielded favourable result with respect to the double log function, certain features of the log linear and the polynomial function (second order) makes them equally desirable for the rice equation. The polynomial function overall exhibited the best fit of the hedonic function with R^2 values of 0.85 and 0.86 for the normal and first-difference equations respectively.

The log-linear function exhibited lower absolute value of SSE than the equivalent double-log equation just as the polynomial function had minimum variance of error term compared to the semi-log function. It also had a greater number of statistically significant coefficient (ß) and coefficients conforming to the a priori direction of the signs.

Table 5.14 Analysis of the Appropriateness of Functional Forms of the Hedonic Equation (Rice)

	Semi Log	Double Log	Log Linear	Polynomial
SD Resid	0.033	0.0316	0.041	0.15
Standard Error of Predicted P (SEPRED)	1.734	0.017	0.015	1.56
SSE	161.64	0.016	0.012	34.71
SSR	145.64	.014	0.018	272.41
R^2	0.47	0.47	0.61	0.887
F-Ratio of R^2	1.46	1.46	2.19	3.27
No. of conforming signs of ß	6	6	5	6
No. of significant values of ß	5	6	5	6

Source: Data Analysis Outputs, 1994.

However, it is considered equally convenient to adopt the same functional form for the two crops for more realistic comparison. One would be tempted to posit that cowpea is a normal good whose demand responds at a declining rate after a particular level of consumption and price, in response to more affordable substitute food, while rice is likely to exhibit some of the properties of luxury good whose (responsiveness) slope remains constant (inelastic) over successive levels of consumption and price. In this case the form of a semi-log or linear function is more plausible. But given the present economic conditions in Nigeria with attendant income levels relative to food prices, this economic behaviour remains unlikely. Also the samples comprise only locally produced varieties and none of the imported varieties which are more likely to be demanded for some unique characteristics resulting in low price elasticity. The local varieties compare favourably with cowpea in the common basket of food options for the average as well as low income-earning households. For the above reasons we retain the double log formation for the estimation of the rice hedonic function.

The expected form of the demand equation for cowpea and rice characteristics is shown by the graph in Figure 5.1. It shows that for a unique solution, the characteristic curve (TPP) as well as the marginal yield of additional units of grain characteristics or the Marginal Physical Product curve (MPP) exhibit decreasing marginal utility.

Since we have imposed a restriction on the form of the hedonic behaviour to the price of most food, as in all normal demand and consumption models, our choice is considered appropriate.

On the strength of all the above validations, the hedonic functions took the double-log formation for both crops with the following model specifications:

For Cowpea

$$\begin{aligned} LnP_{ci} = {} & Lnb_o + b_1(LnSW100_i) + b_2(LnGCF_i) + b_3(LnMLQ_i) \\ & + b_4(LnGPT1_i) + b_5(LnGPT2_i) + b_6(LnPRG_i) + b_7(LnSTC_i) \\ & + b_8(LnCTM_i) + b_9(LnSWA_i) + b_{10}(LnADT_i) + Lne_i \end{aligned} \quad 5.1$$

For Rice

$$\begin{aligned} LnP_R = {} & Ln\alpha_o + \alpha_1 Ln(SW100_i) + \alpha_2(LnGLT_i) + \alpha_3(LnGCF_i) \\ & + \alpha_4 L_n MLQ1_i + \alpha_5 L_n GPT1_i + \alpha_6 L_n MLQ2_i + \alpha_7 L_n PRG_i \\ & + \alpha_8 L_n CHLK_i + \alpha_9 L_n CMT_i + \alpha_{10} L_n SWA_i + \alpha_{11} L_n MLQ3_i \\ & + Lne_i \end{aligned} \quad 5.2$$

where:

$Ln\ P_{ci}$ = Natural log of price of the ith sample of cowpea

$Ln\ P_{RJ}$ = Natural log of the price of the jth sample of rice from the pooled data.

b_o-b_{10} = Regression coefficients of the characteristic variables of cowpea equation.

α_n-α_{11} = Regression coefficient of the characteristic variables of rice equation.

$Ln\ e_i + L_n\ e_j$ are the disturbance terms for cowpea and rice equation respectively.

V_2 - V_{14} are the variables in the equation as defined in section 4.2.

5.3.3 SOME PROBLEMS OF THE ESTIMATION PROCEDURE

For the disaggregated data, the problem of degrees of freedom was looked into. This was especially in cases where the samples/size was less than 10 in any one location. The affected data were those of submarkets 2 and 3 for rice and cowpea respectively. We could therefore not obtain a full equation. Some variables had to be deleted through a backward regression method. Because the Enugu rice equation could not tolerate more than 4 variables, the implicit price was estimated from the batch regression while for cowpea in Nguru, MIP for two deleted variables could not be obtained. We were however able to establish the presence or otherwise of submarkets for all locations by the analysis of the performance of Dummy variables (D1 and D2) included in the full (pooled sample) equation by the method of Analysis of residuals, Chow Test of difference between equations with and without dummy variables, as well as the assessment of regression coefficient of the dummies.

5.4.0 THE IMPLICIT PRICES OF COWPEA CHARACTERISTICS

For the double log function fitted, the coefficient is a measure of price responsiveness to characteristic changes or the price elasticity of demand with respect to each characteristic X_j. The implicit price therefore becomes the first-differential of the equation with respect to each X_i i.e.

$$\frac{dP}{dx_i} = b_i\frac{X_i}{P_i} = \textit{marginal implicit price of ith characteristic}$$

where b_i = coefficient of the ith characteristic

X_i = mean score of the ith characteristic

P_i = mean price of the grain

The values of the hedonic coefficients, t-ratios and estimated marginal implicit prices from the pooled sample and the three markets are presented in Table 5.15.

Since P_i and X_{ij} vary within each sub-market, the expected variation in implicit price is obtained across the samples.

5.4.1 Test of Constancy of Implicit Prices Across Varieties From Pooled Sample Hedonic Function

The estimated coefficients describe the pricing structure for cowpea in all the three markets (n = 34).

The MIPs of the pooled data indicate that the unit price for (grain configuration) GCF and (seed testa colour) STC are the highest while those of seed weight (SW100) and weevil-free percent (GPT2) are the lowest of the characteristics which improve grade in the pooled data. Of the value-discounting characteristics, ADT is more influential on price than CTM.

'able 5.15 Hedonic Regression Coefficients and Estimated Marginal Implicit Prices of Cowpea Characteristics

Varia-bles	Pooled Sample			Submarket 1			Submarket 2			Submarket 3		
	Reg Coeff	T-value	MIP	Reg Coeff	T-value	MIP	Reg Coeff	T-value	MIP	Reg Coeff	T-value	MIP
SW100	0.0283	2.524	0.040	0.005	-0.002	0.008	0.258	63.026	0.390	-	-	-
GCF	0.0069	0.234	0.100	0.032	1.420*	0.450	-0.131	-8.678	-2.030	0.1467	0.01	2.050
MLQ1	-0.4081	-1.094	-0.100	0.031	1.024*	0.008	-3.976	-13.748	-1.049	0.445	1.78	0.110
GPT1	0.1854	1.950	0.048	0.068	0.902	0.017	0.072	1.730	0.019	-	-	-
GPT2	0.0193	2.265	0.005	0.014	3.552*	0.004	0.400	37.450	0.120	0.036	-0.129	0.129
STC	0.0048	0.582	0.085	-0.059	-1.236	-1.034	0.031	6.078	0.002	0.012	0.001	0.205
CTM	-0.0200	-1.267	-0.012	0.040	1.430	0.020	0.430	28.097	0.287	-0.103	-0.18	-0.050
SWA	-0.0172	-0.913	-0.190 -	0.069	1.718	0.707	-0.221	-44.220	-2.645	-0.003	0.0002	-0.033
ADT-	-0.0048	-1.629	0.004	-0.044	1.573	-0.034	-0.092	-55.560	-0.073	+0.00	0.004	0.005
MLQ2	0.86									5		
R^2	13.27									0.36		
F-RATIO												

Source: Survey Data, 1993

However, the sign of the price of MLQ1 and SWA came out negative, implying that one unit increase in foreign matter - free percentage will reduce the price of cowpea by 10 kobo while increase in swelling ability reduces the price by 19 kobo.

Judging from this result, we estimate that consumers' marginal price offers consist of a relatively high offer for mould-free percentage at 10 kobo for each unit of the characteristic. This is followed by marginal offer price of about 8 kobo for each unit of seed colour, about 5 kobo for each unit of mould-freeness, 0.5 kobo per unit of weevil-free percent. STC and GCF are characteristics of **undefined rational preference** which are not expected to conform to any pattern. Therefore, we may infer from their positive signs that generally, consumers do like very rounded cowpea seeds as found in the 'Mala' specie in Ibadan or the 'Isiocha' specie in Enugu! There is also preference for browner varieties than the whiter ones.

The inference from the positive score on STC is that consumers prefer lighter colouration of cowpea grains as in the speckled and white varieties - since the scores are rated from 1 to 3 for brown, speckled and white varieties respectively. Predictably, consumers will pay a lower price (or reduce their price-offer or willingness-to-pay) for varieties that take longer to cook. The bid price reduces by about 3 kobo pr unit increase in cooking time. Adulteration induces the lowest change in price offer (-ve) i.e it is the least influential of the characteristics.

It is difficult to rationalize the negative sign of the MLQ1 variable which implies that consumers will pay more for more foreign matter! This may be due to misspecification of function. However, one tenable explanation is as follows:

Freshly harvested and threshed cowpeas usually have a high residue content of the seed coat. These chaffs reduce in volume as they dry out during storage and are devoured by weevils as the season wears out. Often times therefore, the presence of seed coat is an indication that grains are freshly threshed and relatively free from storage weevils. Consumers may trade-off swelling ability and foreign matter-freeness for grain purity in this context. In view of this plausible explanation, we may accept the pattern as truly exhibited rather than a spurious dimension of the analysis. Furthermore, negative implicit price is consistent with the CGCM Model (Ladd & Suvannut, 1976).

In order to verify the consistency or otherwise of these patterns towards the thesis of differentials in preference pattern, the pricing structure for these characteristics in the different markets (Ibadan, Enugu and Nguru) were next examined.

Analysis of significant difference to test the appropriateness of pooling the data from all three markets was carried out, following (Wilson 1984, Crabtree 1982).

Hypotheses were posed that the slope and intercept terms were equal across 'grades'.

This determines whether the implicit prices estimated from the pooled data are statistically different from those obtained from the submarkets.

The null hypothesis of no significant difference between the b_{is} was rejected mainly at $p<0.1$, 0.05, and only at $P<0.01$ for cowpea in Ibadan and Enugu and at all levels for rice. The hypothesis of no difference in the intercept (α) of the different equations was also rejected (see Appendix 5.1). The value of F-ratio calculated from the estimates exceeded the tabulated value with respect to only one of the three pairwise tests that were carried out i.e.

H_o: $\alpha_1 = \alpha_2$; H_1: $\alpha_1 = \alpha_2$

H_o: $\alpha_1 = \alpha_3$; H_1: $\alpha_1 = \alpha_3$

H_o: $\alpha_2 = \alpha_3$; H_1: $\alpha_2 = \alpha_3$

On the strength of the validity of the F-test for the b_i s, the preference pattern exhibited for characteristics in the three sub-markets **are accepted** to be significantly different. The result from the different markets are hereby interpreted.

5.4.2 Implicit Prices of Cowpea Characteristics

In Ibadan, the implicit prices that exhibited discount values are the seed testa colour (STC) and the adulteration percent (ADT). All others characteristics enhance the price of the crop (with positive implicit price).

The highest positive offer price goes for the swelling ability (SWA) followed by grain configuratione (GCF) and the foreign matter-free percentage (MLQ1) at 70 kobo, 45 kobo and 2 kobo per unit increase in the characteristic values respectively. Longer-cooking cowpea also commands premium price, perhaps due to higher swelling ability.

The price offer for the other characteristics range from 0.8 kobo per unit for seed weight to 0.7 kobo for mould-free percent (MLQ1).

For each unit increase in the value of cooking time the price increases by 2 kobo and for each unit change (increase) in adulteration level, price is lowered by 3 kobo. As cowpea changes colour from brown to white, price falls by 103 kobo.

The tentative explanation is that certain brown varieties have lower swelling ability than the white varieties. Hence, there is a trade-off between the volume yield and the colour preference to give this negative implicit price. An example is the popular 'Oloyin' which has low swelling ability despite other desirable properties (colour, palatability, low cooking time). This explanation may be justified as there is a negative correlation (-0.124) between STC and SWA in Ibadan!!

In Enugu, the pattern is quite different. Seed testa colour is also a value adding characteristic rather than one which discounts price, but with a marginal price of only 0.2 kobo. GCF, MLQ1, ADT and SWA all have negative marginal price. The highest MIP goes for

SW100, followed by CTM. The lowest premium goes for GPT1 and STC respectively.

The price of CTM is unexpectedly positive! We may infer that the normal preference for quick cooking time does not apply in Enugu. Among the Enugu consumers, results of our consumer survey shows that boiled beans, served with rice is the commonest dish prepared from cowpea. This usually is preferred if the beans is unmashed as it gives a better presentation with the white rice. 20.3 per cent of respondents indicated boiled beans with rice as their commonest food option. Presumably, the consumers do not want the beans mashed and therefore pick varieties that cook longer and stay whole in the dish.

In Nguru, because of the relatively small size of samples, we encountered degrees of freedom problem in estimating the full equation. We therefore carried out a backward elimination procedure to reduce the number of variables to the maximum that the function can tolerate. Seed weight (SW100) and foreign matter-free per cent (GPT1) were eliminated.

The pricing structure exhibited for the characteristics is as follows:

The highest MIPs are for GCF and STC and the lowest, for MLQ1 and ADT respectively. Positive implicit price for STC implies that consumers prefer white seed colour (higher characteristic score) to brown one. They, rationally, would pay higher for quick-cooking varieties. Unlike in Enugu market, the commonest food option is mashed beans in Nguru with 32.3% of respondents naming it as most preferred cowpea dish.

The rank order of marginal implicit prices for sign positive (value-adding characteristics) and sign-negative (value discounting characteristics) for each of the nine characteristics in the three markets are summarised in Table 5.16 to 5.19.

Table 5.16 Order of Magnitude of the Value- Adding and Value Discounting Cowpea Characteristics [Implicit Prices (N)]

Pooled			
Sign-Optimal Characteristics	MIP (#)	Sign-Negative Characteristics	MIP (#)
GCF	0.100	ADT	-0.004
STC	0.085	MLQ1	-0.100
GPT1	0.050	CTM	-0.012
SW100	0.040	SWA	-0.190
GPT2	0.005		

Source: Survey Data, 1993

Table 5.17 Order of Magnitude of the Value Adding and Value Discounting Cowpea Characteristics [Implicit Prices (N)]

Ibadan			
Sign-Optimal Characteristics	MIP(#)	Sign-Negative Characteristics	MIP (#)
SWA	0.710	STC	-1.034
GCF	0.450	ADT	-0.034
CTM	0.020		
GPT1	0.017		
SW100	0.008		
MLQ1	0.007		
GPT2	0.004		

Source: Survey Data, 1993

Table 5.18 Order of Magnitude of the Value Adding and Value Discounting Cowpea Characteristics [Implicit Prices (N)]

Enugu			
Sign-Optimal Characteristics		Sign-Negative Characteristics	MIP (#)
SW100	0.390	SWA	-2.645
CTM	0.290	GCF	-2.030
GPT2	0.120	MLQ1	-1.049
GPT1	0.019	ADT	-0.073
STC	0.002		

Source: Survey Data, 1993

Table 5.19 Order of Magnitude of the Value Adding and Value Discounting Cowpea Characteristics [Implicit Prices (N)]

Nguru			
Sign-Optimal Characteristics	MIP (#)	Sign-negative Characteristics	MIP (#)
GCF	2.050	CTM	-0.050
STC	0.205	SWA	-0.033
GPT2	0.129		
MLQ1	0.110		
ADT	0.005		

Source: Survey Data, 1993

5.4.3 IMPLICIT PRICE OF RICE CHARACTERISTICS

The marginal implicit price for rice characteristics are also derived from the equation specified in Section 5.2.2.

There is a considerable variation indicated by the order of magnitude of the prices. However, unlike in the case of cowpea, there are many characteristics that appear to discount the price of rice rather than enhance it because many of the signs of the coefficients are negative, contrary to a priori expectation.

The hedonic function in Enugu however exhibits a radical departure from what is shown in the other markets. There is a larger number of sign-negative variables although their absolute magnitudes are lower and show a fairly consistent order. The hedonic coefficients in Enugu largely conform to a priori expectation but the interpretation has to be very cautiously made due to the fact of a very small sample size (n=6) in Enugu. Indeed a stepwise elimination of variables had to be done to reduce the number of independent variables to a maximum of 4 in any equation. The implicit prices are estimated from the batch regression equation rather than the full equation. It will be unrealistic to draw serious inferences from this function in comparison with other markets.

The explanation being put forward is that of possible functional misspecification or omission of some very important variables representing chemical properties are essential for the functional estimation. In Unnevehr 1986, Gel consistency and amylose content which reflect the starch content and cooking quality are important rice attributes. None of these have been specified here. Further transformation of the independent variable may be required also. This is however a subject for future research. The estimation results are shown in Table 5.20 while the price enhancing characteristics and price discounting characteristics are highlighted with their corresponding implicit prices in Tables 5.21 to 5.24.

Table 5.20 Hedonic Regression Coefficient and Estimated Marginal Implicit Prices of Rice Characteristics

Varia-bles	Pooled Sample			Submarket 1			Submarket 2			Submarket 3		
	Reg Coeff	T-value	MIP	Reg Coeff	T-value	MIP	Reg Coeff	T-value	MIP	Reg Coeff	T-value	MIP
SW100	-0.071	-0.545	-0.18	0.3976	1.338	0.98	0.068	4.274	0.16	-0.627	-0.212	
GLT	0.142	1.315	0.03	0.8625	2.290	0.19	0.017	0.947	0.04	0.238	1.347	
GCF	-0.099	-1.279	-0.01	-0.4747	-2.316	0.04300.	0.002	0.173	0.0002	-0.206	-0.923	
MLQ1	0.1852	1.774	0.69	0.266	2.219	95	0.112	2.203	0.39	0.1272	0.536	
GPT	-0.6651	-0.838	-2.38	-5.350	-2.318	-0.17	-0.0007	-0.012	-0.002	-0.2334	-0.164	
MLQ2	-0.2081	-0.752	-0.65	-0.0598	-0.722	-0.18	0.017	5.044	0.05	-0.029	-0.718	
CHLK	-0.0902	-1.910	-0.009	-0.0125	-0.170	0.001	-0.0003	-0.018	-0.0002	-0.136	-0.712	
CTM	-0.0717	-1.675	-0.07	-0.0066	-0.168	-0.01	0.009	0.521	0.01	-0.1055	-0.525	
SWA	0.0065	0.691	0.001	-0.0092	-0.722	-0.001	0.0005	0.998	0.00005	0.00085	0.045	
ADT-	-0.0238	-1.350	0.004	-0.0248	-0.093	0.003	-0.003	-1.877	0.0003	0.03	0.503	
MLQ3												
TREND												

Source: Survey Data, 1993

TABLE 5.21 **Order of Magnitude of the Value-Adding and Value-Discounting Rice Characteristics (Implicit Prices (#)).**

Pooled			
Sign-Optimal Characteristics	MIP (#)	Sign-negative Characteristics	MIP (#)
MLQ1	0.69	GPT	-2.38
GLT	0.03	MLQ2	-0.65
SWA	0.001	SW100	-0.18
MLQ3	0.004	CTM	-0.07
		GCF	-0.01
		CHLK	-0.009

Source: Survey Data, 1993

TABLE 5.22 **Order of Magnitude of the Value-Adding and Value-Discounting Rice Characteristics (Implicit price (#)).**

Ibadan			
Sign-Optimal Characteristics	MIP (#)	Sign-negative Characteristics	MIP (#)
SW00	0.98	MLQ2	-0.18
MLQ1	0.95	GPT	-0.17
GLT	0.19	GCF	-0.04
MLQ3	0.003	CTM	-0.01
		SWA	-0.001
		CHLK	-0.001

Source: Survey Data, 1993

TABLE 5.23 Order of Magnitude of the Value-Adding and Value-Discounting Rice Characteristics (Implicit Prices (#)).

Enugu			
Sign-Optimal Characteristics	MIP (#)	Sign-Negative Characteristics	MIP (#)
MLQ1	0.39	GPT1	-0.002
SW100	0.16	CHLK	-0.0002
MLQ3	0.003		
MLQ2	0.05		
CTM	0.01		
GLT	0.004		
GCF	0.0002		
SWA	0.0001		

Source: Survey Data, 1993

TABLE 5.24 Order of Magnitude of the Value-Adding and Value-Discounting Rice Characteristics (Implicit Prices (#))

Nguru			
Sign-Optimal Characteristics	MIP (#)	Sign-Negative Characteristics	MIP (#)
MLQ1	0.51	SW100	-1.75
GLT	0.05	GPT	-0.90
SWA	0.001	CTM	-0.11
MLQ3	0.007	MLQ2	-0.09
		GCF	-0.02
		CHLK	-0.017

Source: Survey Data, 1993

The most definite pattern that emerged is that irrespective of location, grain length and foreign matter-free percentage of rice are price enhancing characteristics. This is consistent with the findings of Unnevehr (1985), (1986). Unnevehr's study reflected that consumers in certain countries (Philippines, Indonesia and Thailand) show preferences for very long grain rice and high milling quality although this is especially significant in Thailand - the world's largest exporter of rice, reflecting the importance of export demand. The study also showed that apart from GLT and milling quality (MLQ), preferences for shape (GCF), chalkiness and other chemical attributes vary across the countries.

Based on the expressed opinions in 5.2 and known patterns in Nguru, cooking time and chalkinėss are value-discounting properties in all markets. Contrary to expectations grain purity (mould free percentage) and brokens-free percentage (MLQ2) are also value discounting.

The marginal offer price and the marginal discounts however vary in magnitude across location. One unit increase in the value of MLQ1 attracts a premium of 69 kobo, 95 kobo, 39 kobo and 51 kobo in the pooled sample and the different markets respectively.

A unit increase in grain length attracts a marginal premium of 3 kobo, 19 kobo, 0.4 kobo and 5 kobo respectively. Adulteration free percentage commands a hedonic price of 0.4 kobo, 0.3 kobo, 0.03 kobo and 0.7 kobo respectively while a unit increase in the volume yield (swelling ability) attracts a marginal price increase of 0.1 kobo in the Pooled data and Nguru and 0.001 kobo in Enugu. This characteristic attracts a discount price in the Ibadan market!

The summary pattern is as follows-

* Preference for foreign matter-free rice in highest in Ibadan.
* Preference for long grain rice is about highest in Ibadan.
* Preference for Unadulterated rice is highest in Nguru
* Preference for fast cooking rice is highest in Nguru and lowest in Ibadan.

The preference pattern in Ibadan can be explained by the highly metropolitan nature of the city and the ready availability of several varieties of imported rice with very high milling quality and the globally desired long grain. With respect to cooking time, this property is highly associated with stickiness of the cooked rice. This trait is usually assessed via the amylose content, a chemical property which could not be assessed in this study. It is known to be very undesirable and inconsistent with the high preference for highly rated imported breeds like Uncle Benz, Arozo and so on in this market.

The relative preference for fast cooking rice in Nguru is consistent with the commonest dish prepared from rice in most of the North - "Tuwo" which is best prepared with rice of low amylose content which does not harden after cooking and therefore tends to be easily mashed. Also, the relative scarcity of fuelwood in the Northern part of the country would support the observed desire for quick-cooking rice varieties, as an energy saving strategy.

It's noteworthy that the patterns exhibited here are not radical changes from a priori expectation. In particular, the preferences with respect to high grain length and high milling quality (Foreign-matter free percentage) are consistent across all markets.

The negative value of broken's free percentage MLQ2 may be a reflection of the economic situation whereby consumers are not as selective as before as long as the rice is clean. We also need to research further the relative awareness and preference for the once popular "alabere" rice in Nigeria - rice with high length-breadth ratio (GCF). Can we infer from current patterns that as long as the rice has long grains, it becomes immaterial if the grains are slim or not? Again, this might be interpreted to mean that economic considerations tend to supersede cultural and other personal preferences in today's Nigeria.

CHAPTER SIX

CONSUMER PREFERENCE PATTERN IN SPATIALLY DIFFERENTIATED MARKETS

6.O THE SUB-MARKET HYPOTHESIS FOR COWPEA AND RICE

The results of the multiple regression (hedonic function) analysis presumes that the sets of grain characteristics in each market induce varying patterns of demand for characteristics in each region. That is, the set of attributes demanded on the Southwest is (significantly) different from those demanded in the Southeast and the North. We are therefore saying that the three groups of grain samples represent the taste determining variables which predict the research demands for characteristics improvement in each region. If this hypothesis is true then regional objectives must be defined for grain improvement programmes so as to maximise the effective supply of desirable attributes and maximise returns to marketing and research. In order to further verify this notion of the presence of submarkets for variety demand, several statistical procedures were employed to verify if submarkets truly exist for crop characteristics and to interpret the manner in which the groups differ in the above regard.

First, we performed a Chow test on the hedonic coefficients B_i, the SSEs and the R^2,to test for significant differences. We estimated separate (pooled sample) equations to specify dummy variables for each market also and compared the parameters of both equations. Most importantly, we employed the method of Discriminant Analysis to test for the relative positions of each set of variables from each market in a discriminant space. Here we discriminate between the submarkets on the basis of those sets of attributes to assess which characteristics are the powerful discriminators on the basis of which the region's crop improvement programmes objectives should be ordered.

6.1 CHOW TEST OF SIGNIFICANT DIFFERENCE IN RESIDUALS AND REGRESSION COEFFICIENTS

This is a statistical validation procedures to test the null hypothesis that there is no significant difference between consumer preference in three study areas via analysis of residuals, and comparison of regression parameters of pooled and disaggregated data.

Normally, when there is segmentation of a sample, there is expected reduction in sample variance from the pooled sample (Olayemi and Olayide, 1981). The total unexplained variance (SSE) in the hedonic function for the disaggregated data were therefore compared with the total unexplained variance of the pooled data function at (n-k-1) and (N-n-1) degrees of freedom. This tested the null hypothesis that there is no significant difference between the coefficients of the submarkets and the pooled data (Arimah, 1990) at the specified degrees of freedom

where:

n = total number of coefficients in the pooled data

K = total number of coefficients in the sub-sample

N = Total sample size of pooled sample

Total unexplained variance of different groups equals

SSE_1 Unexplained variance of group 1 ...... (1)

SSE_2 Unexplained variance of group 2 ...... (2)

SSE_3 Unexplained variance of group 3 ...... (3)

SSE_t Unexplained variance of the pooled sample (4)

(See Appendix 6.1 and 6.2)

The null hypotheses of no significant difference between the submarket equations was rejected (at $p < 0.05$). We therefore submit that the market for cowpea characteristics in Nigeria is segmented. Consumer preferences differ significantly in the three markets representing three distinct geo-populations of the country.

6.2 ADJUSTING THE POOLED SAMPLE FUNCTION FOR SUBMARKET EFFECTS

The next section further tests the null hypothesis of the presence of sub-markets for the demand for crop characteristics. This was done by specifying dummy variables which adjust for locational effects by estimating constant terms for the different categories of sample observations. If the estimates, as given by the coefficient of the dummy variables are statistically significant, then separate functions exist for the different sub-samples [Rao and Miller,(1971),Kmenta (1971)].

The Dummy Variables D_1 and D_2 specified for two locations are examined for the level of significance of their coefficients, the equality or otherwise of the coefficients of the equation with dummy variables and equation without dummy variables; the magnitude of the constant terms for each location's function.

6.2.1 Cowpea Functions

On the strength of the computed F-ratio for equality of all coefficients of the two equations, the null hypothesis was rejected ($p < 0.1$). That is

$$b_1 = b_{1\alpha} \quad \ldots\ldots \quad b_{11} = b_{11\alpha}$$

where $b_1, b_2, \ldots\ldots b_{11}$ are hedonic coefficients of the equation with dummies

$b_{1a}, b_{2a}, \ldots\ldots b_{11a}$ are hedonic coefficients of the equation without dummies.

Test of significant difference between the two sets of coefficients yielded F-calc = 0.556 which is also less than F-tab (2.22) d.f. The null hypothesis of no significant difference between the equations with and without dummy variables was rejected ($p < 0.05$). (See Appendix 6.3 and 6.4).

The coefficients of D_1 and D_2 are both significant at 0.25 and 0.05 probability for the two-tailed tests. Although the confidence bound for D_1 is relatively low, the fact of possible differences in the location can not be discarded on this strength since one of the dummies exhibited high level of significance. What has been established is that the constant terms of the three equations which are the demand shift parameters are different.

6.2.2 Rice Functions

Only one of the coefficients of the dummy variables are significant with respect to rice. This implies that two of the three markets are similar in hedonic behaviour. However, the results also show that there is significant difference between the functions with and without dummy variables at 5% level of significance, indicating that there is some degree of market segmentation.

6.3 DISCRIMINANT ANALYSIS OF GRAIN CHARACTERISTICS DEMAND BETWEEN MARKETS

The discriminating variables are the X_i^{js} - the characteristics identified in Section 4.2 and used in the multiple regression analysis of section 5.3.

In this analysis, our focus is only on interpretation of the discriminant function and not classification of the samples into groups. The normal grouping of samples is by market locations. By looking at the residual discrimination value - Wilk's Lambda there may be justification for obtaining canonical discriminant functions (CDFs).

Wilk's Lambda, the multivariate measure of group difference is given by

$$\Lambda = \pi^q \left(\frac{1}{1 + \lambda_i}\right)$$

where:

^ is the eigen value

π is the multiplicative sign ...runs from 0 to 1. The lower the value, the higher the effects of discrimination on group behaviour.

6.3.1 Discriminant Analysis for Cowpea Sub-markets

Eigen value for this set of variables is 0.021. The low value implies that there are strong factors of discrimination between the groups. Justification is also given on the strength of the distribution of characteristic scores, for estimating a discriminant function.

In interpreting the results of this analysis, the relative position of the data cases and group centroids were examined and the relationship between individual variables and the functions was also studied via the relative magnitude of the canonical coefficients. The unstandardized coefficient gives the absolute contribution of a variable to the total discriminant score of the CDF. The standardized coefficient actual gives the relative position or magnitude of the variable. The transformation from unstandardized to standardized is obtain as follows:

$$c_i = u_{ii}\sqrt{\frac{w_{ii}}{n - g}}$$

where $w_{\underline{ii}}$ = sum of squares error for the ith variable

n = total no. of cases

g = no. of groups

The group variable is the market location (with value of 1, 2, 3). The samples from Ibadan, Enugu and Nguru constitute the three discriminant groups with these values respectively.

Since the group averages differ on all measures as shown in Table 6.1, we expect considerable discrimination between the three study locations with respect to the characteristics of both crops.

TABLE 6.1 GROUP AND TOTAL MEAN OF COWPEA CHARACTERISTIC SCORES

Variable	1	2	3	Total Mean
PRICE	24.9	26.25	24.62	25.15
CW100	16.16	17.33	15.26	16.31
GCF	1.74	1.68	1.76	1.73
MLQ1	99.17	99.43	98.39	99.04
GPI	97.46	96.82	94.44	96.34
GPT2	74.58	84.75	88.30	82.20
STC	1.417	1.417	1.5	1.44
CTM	44.93	39.21	44.15	42.68
SWA	2.39	2.19	2.23	2.27
GPT3	31.89	33.25	21.56	29.33

Source: Field Data, 1993.

Table 6.2 **Relative magnitude of the discriminant functions. [Eigen Values and Measures of Importance]**

CDF Score	Wilk's Lambda	Eigen Value (^)	Relative Percentage	Canonial Corr.	X2	Sign.
0	0.2021	2.0915	77.69	0.8225	10.7	.017
1	0.6247	0.6007	22.31	0.6125	1.99	0.36

Source: Field Data, 1993.

The substantive utility of the CDF can be seen from the values of the Wilk's Lambda and the Canonical correlation coefficient (CCC). The magnitude of the coefficient of the first function (0.8225) indicates that there is strong discrimination between the groups on the basis of the discriminating variables. CCC of the second function is also high (0.6125). P-coefficients of the X_i^s in each function which were used to estimate the values of D, and D_2, the discriminant scores of the two functions are shown below:

The associated P-coefficients in each function yield the values of D1 and D2 (Eigen values in Table 6.2) as follows:

$$D1 = 0.640V1 - 0.2112V2 + 1.6195V3 + 0.8508V4 - 0.0016V5 - 0.0386V6 - 0.5986V7 - 0.0359V8 + 1.5534V9 - 0.0335V10 - 0.0123V11$$

$$D2 = 0.2914V1 + 0.4259V2 - 2.3915V3 + 0.4178V4 - 0.1067V5 - 0.0256V6 - 0.0551V7 - 0.0642V8 - 1.3302V9 - 0.0258V10 - 0.0394V11$$

D1 accounts for 77.69% of the total discriminant variance while the second function D2 accounts for 22.31. Chi-squared test for significant difference between the variables for the first and second function are however significant only for the first function. Standardized canonical coefficients also given in Table 6.3 indicate the relative contribution of each of the variables to the discriminant behaviour between the groups. This is comparable with the relative values of the beta coefficients of the multiple regression analysis and should be related to the relative values of their marginal implicit prices. These are discussed in the next chapter.

Table 6.3 Unstandardised and Standardised Discriminant Coefficient of the X Variables

Variable	Unstandardised		Standardised	
	Function 1	Function 2	Function 1	Function 2
PRICE	0.6402	0.2914	1.141	0.519
SW100	-0.2112	0.4259	-0.931	0.496
GCF	1.6195	-2.3915	0.707	-0.451
MLQ1	0.8508	0.4178	0.645	-0.415
GPT1	-0.0016	-0.1067	-0.621	-0.413
GPT2	-0.0386	-0.0256	0.490	-0.364
STC	-0.5986	-0.0551	-0.310	0.347
CTM	-0.0359	-0.0642	0.253	-0.285
SWA	1.5534	-1.3302	0.246	-0.188
GPT3	-0.0335	-0.0258	-0.044	-0.029

Source: Field Data, 1993.

Furthermore, the Canonical Discriminant Functions are evaluated at group centroids to indicate their relative position with respect to central tendencies of all the discriminating variables.

Table 6.4. Discriminant Functions for Cowpea Evaluated at Group Centroids

Groups	Function 1	Function 2
1	1.128	-0.799
2	0.636	0.842
3	-2.115	-0.171
Distance between group Centroids		
Group 1 + 2	0.490	1.741
Group 2 + 3	1.479	0.942
Group 1 + 3	3.241	0.628

1 - Ibadan; 2 - Enugu; 3 - Nguru

Source: Survey Data, 1993

The mean discriminant function scores in relation to the centroid, or the relative position of each groups variables with respect to the others are expressed in Table 6.4 with their relative distances. The range shows considerable disparity between the three groups both for the first and second function, although as expected, the first function shows the widest (range) disparity in group positions. This disparity is widest between Ibadan and Nguru, followed by Enugu and Nguru.

All the above corroborate our thesis of the presence of submarkets for cowpea in Nigeria. That is, the demand patterns are significantly different in the three regions. It supports the earlier statistical (Chow) test results of significant difference in the Regression Coefficients (hedonic functions) or the hedonic-price behaviour in the three markets.

6.3.2 Discriminant Analysis for Rice Sub-markets

For Rice, we employed a stepwise discriminant analysis to select the most relevant variables for the analysis. The Wilks method used is to eliminate variables which are possibly linear combinations of other independent variables and which minimize the Value of Wilk's Lambda. This is done by checking the tolerance of the variable before it is entered.

Tolerance is measure as: $1-R^2$ where R^2 is the coefficient of determination when the ith independent variable is regressed on other independent variables. Small tolerance values indicate a strong linear relationship. Therefore, variables with less than 0.001 tolerance were removed from the equation in steps, which depends on the number of variables and possible linear combinations of the variables. The value and significance of Lambda also changes (via the significance of its F statistic) when a variable is entered or removed.

The current analysis took eight steps and the successive values of Lambda ( ) on Table 6.5 to arrive at the final variables to be estimated.

The mean values and grand mean for the variables selected for the analysis are shown on Table 6.6. The Canonical Discriminant Function parameters are shown on Table 6.7.

Table 6.5 Stepwise Selection of Discriminant Variables for Rice

Steps	Wilk's Lambda	Equivalent F-ratio	Significance Level	Variables Entered
1	0.627	9.506	.0006	GPT 3
2	0.458	7.4006	.0001	PRICE
3	0.3512	6.873	.000	TREND
4	0.285	6.329	.000	CTM
5	0.235	5.927	.000	MLQ 1
6	0.197	5.617	.000	SW 100
7	0.167	5.382	.000	GCF
8	0.140	5.214	.000	GPT 2

Source: Field Data, 1993.

Table 6.6 ESTIMATES OF GROUP MEAN FOR VARIABLES IN THE ANALYSIS

Variables	Group 1	Group 2	Group 3	Grand mean
PRICE	27.522	28.275	24.469	26.343
SW100	68.621	67.733	68.326	68.342
GCF	2.493	2.781	2.458	2.528
GLT	6.022	6.443	6.216	6.177
GPT 2	92.872	96.575	94.613	94.253
TREND	6.105	7.583	9.641	7.874
GPT 3	97.796	97.843	96.600	97.296

Source: Field Data, 1993.

Table 6.7 Relative magnitude of the Rice Discriminant functions. [Eigen Values and Measures of Importance]

Function	Wilk's Lambda	Eigen Value (X)	Percent of Variance	Canonical Correlation	X2	Sign.
1	0.1404	3.465	85.35	0.881	55.9	.000
2	0.6270	0.595	14.65	0.611	13.3	.065

Wilk's Lambda was estimated to be 0.1404 with a chi-squared value of 55.946 implying significance at 0.001%. This, again implies the presence of strong discriminating factors between markets for Rice. The Eigen Values of the two functions indicate that the first function account for 85.35% of group discriminant variations, reinforcing our findings of the estimate of Wilk's Lambda. The canonical correlation coefficient shows a high relationship between the discriminating factors with respect to both CDFs. From the p-coefficients in Table 6.8, the values of the CDF (eigen values) are obtained for both functions.

Table 6.8 Unstandardized and Standardised Discriminant Coefficient of the X Variables

	Unstandardized		**Standardised**	
	Function 1	Function 2	Function 1	Function 2
PRICE	-0.377	0.0678	1.182	0.214
SW100	2.312	0.379	1.028	0.169
GCF	-2.766	1.916	0.716	0.496
MLQ1	0.0853	0.0826	0.405	0.393
GPT2	-0.0421	-0.0152	-0.528	-0.191
TREND	0.214	0.0152	0.903	0.064
CTM	0.0005	0.271	0.0014	0.906
GPT3	0.634	0.423	0.246	-0.188
Constant	5.301	24.201		

Source: Field Data, 1993.

The value of D, the group discriminant function at the group centroid is shown in Table 6.9.

The centroid distribution with respect to the first function shows that disparity is widest between Ibadan and Enugu in terms of characteristics demand while both Ibadan and Enugu show wide disparity from Nguru. Reasons adduced for this pattern is that the dietary patterns in Ibadan and Enugu are not very different in terms of rice food options. While Nguru consumers prefer 'Tuwo' to rice, the former two groups prefer boiled rice served with beans or other vegetables. Also, energy (fuelwood) shortages in the north might reinforce the preference for certain fast-cooking varieties but which have other undesirable characteristics such as chalkiness, high brokens percentage and low swelling ability - another manifestation of the trade-off theory.

Table 6.9. Discriminant Functions for Rice Evaluated at Group Centroids

Group	Function 1	Function 2
1	- 1.705	- 0.563
2	- 1.127	- 1.553
3	- 2.042	- 0.096

Source: Field Data, 1993.

Table 6.9a: Relative Position of Grouped samples of Rice on Discriminant Space

Paired Groups	Distance on discriminant space
Ibadan and Nguru	3.7471
Enugu and Nguru	3.1693
Ibadan and Enugu	0.5779

Source: Field Data, 1993.

CHAPTER SEVEN

RELATIVE IMPORTANCE OF HEDONIC VARIABLES AND GROUPS OF CHARACTERISTICS

Consumer preference studies serve to prioritize among a menu of crop attributes in order to reflect the relative position of each attribute on the consumers preference list.

This perspective unlike the implicit prices does not take account of the sign of the effect on price. Rather, the absolute value indicates the magnitude of effects. High relative value indicates that consumers react very strongly. As such, that characteristic becomes of strong priority attribute to which attention must be given over and above the next characteristic.

The relative importance of the available characteristics of rice and cowpea can therefore be gleaned:

1. From an ordinal scale of the marginal implicit price of each characteristic in which case the issue of relative discounts and relative premium comes up. We wish to differentiate between desirable and undesirable traits and order them sequentially.
2. From the relative magnitude of the absolute values of the **standardised** hedonic coefficient or the degree of their price-responsiveness - the price-elasticity of demand with respect to each X_{ij}.

The ordinal scale of characteristic price as shown by the implicit prices obtained from the regression coefficients in Tables 5.13 and 5.18 is different from the relative order of price responsiveness as given by the standardised coefficients. For instance, while STC ranks top in Ibadan in terms of the implicit price, it does not possess the highest absolute value of the regression coefficient.

In order to compare effectively, several classification procedures have been used to define as best as possible the order of importance of each attribute and of the effects of contributing technological processes to crop improvement.

First the magnitude of the standardised values of the hedonic coefficients (i.e coefficient normalized to standard deviation units of each characteristics scores) were assessed to define the responsiveness of price to each characteristic (since in the double-log formation, the regression coefficient is an estimate of elasticity or price responsiveness). The order of importance of variables in this respect for the pooled data and the sub-markets is adapted from the magnitude of the Beta coefficients.

The relative importance of groups of attributes were also obtained from separate hedonic functions estimated with respect to each set of attributes. The regression parameters were compared for the submarkets. This indicates the influence of each of the groups of attributes on price.

7.1.1 RELATIVE IMPORTANCE OF GROUPS OF COWPEA CHARACTERISTICS

It is expected that if a particular group of variables adequately explain the variations in the dependent variable (price), the fit of the hedonic function with respect to this set of variables only will be good and significant and the parameters will be maximised relative to other sets of variables. The relative magnitude of the coefficient of determination, the statistical significance and the pattern of residual as shown by the SSE and Durbin-Watson statistic for the pattern of the residual were therefore assessed.

Generally, the results indicate that no single set of attributes singularly account for price variation on the strength of the R^2 values. The values are generally lower than those of the full equation in all markets.

In the pooled sample, the off-farm characteristics outperform the other groups of attributes. However, it explains only 38% of the variation in price premium between different varietal samples while the on-farm and genetic characteristics explain 34% and 35% respectively. The full equation indicates that together, the three sets of characteristic best explain 86% of the price variation due to quality. Other market factors i.e. temporal and spatial effects also influence the pattern of differentials in price premium, accounted for by 14%.

In Ibadan, the same pattern is repeated. However, the off-farm characteristics show increasingly important influence ($R^2 = 0.80$) followed by the genetic characteristic ($R^2 = 0.64$) and on-farm characteristic ($R^2 = 0.39$).

In Enugu, on-farm characteristics appear to be more important than genetic characteristics ($R^2 = 0.52$ and 0.33 respectively) although off-farm characteristics retains the lead.

In Nguru, the pattern is very different. The most important seems to be the on-farm characteristics ($R^2 = 0.69$), followed by genetic characteristic ($R^2 = 0.62$) and lastly the off-farm characteristic. (Tables 7.1 to 7.4)

In all three markets, again as in the pooled sample, the full equation outperforms the batch equations. This points to the fact that no single set of characteristics accountS for quality differentials or singularly affect the consumers price judgement about cowpea quality.

Overwhelmingly, however, we can say that consumers react most strongly to the off-farm characteristics of cowpea.

Table 7.1 Relative Importance of Groups of Cowpea Characteristics in the Pooled Sample

	Pooled Sample			
	R^2	F-Ratio	SSE	D-W
Genetic Characteristics	0.35	2.12	.01	2.16
On-Farm Characteristics	0.34	3.56	0.01	2.25
Off-Farm Characteristics	0.38	2.71	0.012	2.22
All Characteristics	0.86	3.27	0.0004	2.16

Source: Field Data, 1993.

Table 7.2 Relative Importance of Groups of Cowpea Characteristics in Ibadan

	IBADAN			
	R^2	F-Ratio	SSE	D-W
Genetic Characteristics	0.64	3.26	0.001	3.13
On-Farm Characteristics	0.39		0.002	2.81
Off-Farm Characteristics	0.80	4.602	0.006	2.79
All Characteristics	0.96	2.531	0.0001	2.13

Source: Field Data, 1993.

Table 7.3 Relative Importance of Groups of Cowpea Characteristics in Enugu

	ENUGU			
	R^2	F-Ratio	SSE	D-W
Genetic Characteristics	0.33	2.04	0.0025	2.06
On-Farm Characteristics	0.52	0.69	0.01	1.56
Off-Farm Characteristics	0.61	2.86	0.01	1.88
All Characteristics	0.99	27.23	0.0025	2.08

Source: Field Data, 1993.

Table 7.4 Relative Importance of Groups of Cowpea Characteristics in Nguru

	NGURU			
	R^2	F-Ratio	SSE	D-W
Genetic Characteristics	0.62	2.09	0.0001	1.91
On-Farm Characteristics	0.69	4.95	0.001	1.45
Off-Farm Characteristics	0.36	0.47	0.002	2.17
All Characteristics	0.56	0.36		

Source: Field Data, 1993.

7.1.2 RELATIVE IMPORTANCE OF GROUPS OF RICE CHARACTERISTICS

As in the case of cowpea the R^2 value is higher for the fully specified function than for any of the sets of variables. However, unlike in the case of cowpea, the hedonic function with respect to different sets of characteristics is less efficient in describing the quality - price behavior in the submarkets than in the pooled data. The findings are shown in Tables 7.5 to 7.7)

R^2 values are much lower than in the cowpea function with values of 0.22, 0.43 and 0.98. The same values in the submarkets ranges between 0.30 and 0.80 in Ibadan, 0.11 and 0.87 in Nguru. Again, these values are higher for either the off-farm or genetic characteristics in all the submarkets and lowest for on-farm characteristics. This, like in the case of cowpea emphasizes the importance of off farm characteristics. Additionally here, genetic characteristics have shown some strength of influence.

The results of the discriminant analysis do not perfectly corroborate this although the absolute values of Beta and the characteristic ordering show some agreement with this.

In the former analysis, whereas the variable GCF has a relatively high CCC (0.716), the other genetic characteristic selected for the analysis (CTM) has a value of only 0.0014. This result implies that not all genetic characteristics strongly discriminate the markets. Analysis of within-group relative importance in the next section highlights those traits that exert the greater impacts.

Table 7.5 Relative Importance of Groups of Rice Characteristics (Pooled Sample)

	Pooled Sample			
	R^2	F-Ratio	SSE	D-W
Genetic Characteristics	.19	1.32	.024	2.01
On-Farm Characteristics	.05	0.56	0.28	1.74
Off-Farm Characteristics	.20	1.46	0.23	2.16
All Characteristics	.83	1.26	0.018	2.16

Source: Field Data, 1993.

Table 7.6 Relative Importance of Groups of Rice Characteristics (IBADAN)

	IBADAN			
	R^2	F-Ratio	SSE	D-W
Genetic Characteristics	.23	0.232	0.004	1.43
On-Farm Characteristics	.046	0.160	0.002	2.11
Off-Farm Characteristics	.45	1.32	0.003	1.73
All Characteristics	.90	1.69	0.0005	1.44

Source: Field Data, 1993.

Table 7.7 Relative Importance of Groups of Rice Characteristics (NGURU)

	NGURU			
	R^2	F-Ratio	SSE	D-W
Genetic Characteristics	.81	7.61	.004	2.65
On-Farm Characteristics	.14	0.591	0.02	2.10
Off-Farm Characteristics	.74	5.26	0.006	2.00
All Characteristics	.88	2.03	0.003	2.39

Source: Field Data, 1993.

7.2 PRICE-RESPONSIVENESS OF GRAIN CHARACTERISTIC IN DIFFERENT MARKETS

The regression coefficients in the double-log function are the elasticity estimates with respect to each characteristic **Xij** as follows:

$$E_{pij} = dp/dx_{ij} * x_{ij} /p_i = b_{ij}$$

Therefore the hedonic coefficients allow a comparison of the responsiveness of price to a unitary change in each **Xij**. Here, the ways and manner in which consumers in different locations respond to changes {increasing or declining values} of a characteristic were assessed through the relative magnitude of the price-elasticity. The standardized (beta) coefficients were used in comparing the relative importance of attributes between markets. First, by considering not each characteristic but groups of characteristics as defined in our hedonic model, it was possible to discuss within-group order of importance. Next, the composite preference scale for all characteristics was obtained from the standardised price-elasticity measures from the full equation for each sub-market.

7.2.1 ORDER OF IMPORTANCE OF COWPEA CHARACTERISTICS

Although it would appear that off-farm characteristics are relatively more important than others in most markets, it is useful to identify the relative influence of these genetic traits for the purpose of prioritizing improvement objectives for different regions of the country. The high importance of on-farm attributes in some markets also calls for closer assessment.

In Table 7.8 within-group order of importance is indicated by the absolute value of the standard coefficient (Beta) from the hedonic function for the sets of characteristics. In all markets (except Enugu), GPT2, indicating per cent of weevil infestation is the most price-responsive of the off-farm characteristics. This is followed by GPT3, (per cent adulteration) which is rated second in the pooled sample and two out of three markets. MLQ1, percent of foreign-matter is rated third in all markets while SWA is rated least in two of the three markets.

Of the genetic characteristics, the order of importance is less defined. Traits preferred seem to vary widely between the markets, implying that differentials in preference pattern are unique with respect to genetic breeds of cowpea in different markets. While the seed colour is rated highest in Ibadan, the cooking time (CTM) is most important in Enugu and least important in Nguru. GCF (grain configuration) is rated second in Ibadan and Nguru and rated least in Enugu.

On-farm characteristics appear to be generally of lesser importance in all markets except Nguru. Perhaps because the post harvest crop is the most acceptable turn-out in physical characteristics that the agronomic (production) process can offer. However, although consumers are well known to react to the level of mould-infestation of the grains (these appear as discoloured or disfigured grains that detract from the physical appearance of the market product and affect the price) in all markets and the pooled data (with the exception of Enugu) the seedweight (SW100) is rated higher than the grain purity (mouldiness). It becomes of particular interest to relate this otherwise obscure characteristic (SW100) to some more important (visible) characteristics.

Table 7.8 Within-Group Relative Importance of Cowpea Attributes as shown by Standardized Coefficients

	Pooled Sample	IBADAN	ENUGU	NGURU
Genetic Characteristics				
GCF	0.1344	0.4600	0.019	0.341
STC	-0.1135	-0.9254	-0.311	-0.074
CTM	-0.4254	-0.0989	-0.402	-0.818
On-Farm Characteristics				
SW100	0.3894	0.4365	0.194	0.751
GPT1	0.2700	0.0498	0.642	0.089
Off-Farm Characteristics				
MLQ1	0.0764	-0.2604	0.3165	-0.051
GPT2	0.3504	0.8694	0.454	-0.738
SWA	0.081	0.1498	-0.313	0.468
GPT3	-0.2955	-0.3191	-0.471	0.021

Source: Field Data, 1993.

Table 7.9 (Standardized) Price Elasticity of Demand for Cowpea Characteristics

	Pooled Sample	Submarket 1	Submarket 2	Submarket 3
SW100	0.4102	-0.00063	0.9633	-
GCF	0.0348	0.01824	-0.1549	0.630
MLQ1	-0.2200	0.0182	-0.2714	0.243
GPT1	0.3257	0.8522	0.0284	-
GPT2	0.3787	0.4298	0.7575	0.194
STC	0.0960	-1.2466	0.1573	-0.242
CTM	-0.1919	0.401	0.6490	-1.140
SWA	-0.1442	0.6706	-0.572	+0.018
ADT-MQ2	-0.2646	0.04015	1.230	-0.268
LOCATION-20	-0.3003			

Source: Field Data, 1993.

Table 7.10 Preference Scale for Cowpea Characteristics (in descending order of price-responsiveness)

Pooled	Submarket 1	Submarket 2	Submarket 3
1. SW100	STC	MLQ2	CTM
2. GPT2	GPT1	SW100	GCF
3. GPT1	SWA	GPT2	MLQ2
4. MLQ2	GPT2	CTM	STC
5. MLQ1	CTM	SWA	MLQ1
6. CTM	MLQ2	GPT1	GPT2
7. SWA	MLQ1	MLQ1	SWA
8. STC	GCF	STC	-
9. GCF	SW100	GCF	-

In general interpretation of these findings, the pattern of responsiveness in Table 7.10 is different from that expressed by the implicit prices. While the actual elasticity estimates are seen in Tables 5.13, the latter table orders the responsiveness in order of importance, going by the absolute value of the beta (standardised) hedonic coefficient. From these values, it is noted that prices in Ibadan are very responsive to STC while in Enugu, price change very slowly if at all in response to changes in STC. In Nguru the importance of STC is neither high nor low. It implies that consumers have very strong preferences for specific varieties of given testa colour only in Ibadan. Consumer responsiveness is similarly high for GPT1 and GPT2 and SWA in Ibadan. There are equally positively responsive to improvements in GPT2 and in MLQ2 in Enugu and to MLQ1 and GPT2 to a lesser extent in Nguru. This interpretation is still consistent with our conclusion of the high relative importance of the off-farm characteristics. The specific rates of change in price per unit change in each characteristic are discussed next.

7.2.2. ON-FARM CHARACTERISTICS OF COWPEA

i. Seed weight

This characteristic is an indication of the density or the total biomass of the seed. It is expected to be sign positive. High (biomass) density is an important agronomic index which reflects efficiency of nutrient utilization by the plant during growth. Although the storage processes can greatly affect this score, essentially the characteristic is induced on-farm. The price responsiveness to SW100, the seed weight of cowpea was unexpectedly negative in Ibadan {sub market 1}. It is highest in Enugu where one percent increase in seed weight leads to an increase of about 25kobo. In the pooled sample, only about 3 kobo increase in price may be expected to accompany one percent increase in this property. In Ibadan, elasticity of 0.0053 indicates that a 0.5 kobo drop in price may be expected for one percent increase in seed weight. The observation is however not significant.

ii. MOULD-FREE PERCENTAGE

This characteristic assesses the level of mouldiness and other grain malformation caused by diseases and pests during growth. Although, handling operations such as storage in moisture laden environment can also cause mouldiness, this aspect of the study emphasizes the effects of only on-farm pests on grain quality. The responsiveness is highest in the pooled sample with 19 kobo expected price increase for each percent increase in grain purity {mould-freeness}. In individual markets, responsiveness dropped to about 7 kobo in both measures of on-farm attributes. The responsiveness has largely conformed to expectation.

7.2.3 GENETIC CHARACTERISTICS OF COWPEA

These include the Seed Tests Colour (STC), the cooking time (CTM) and the grain configuration (GCF).

i. STC has been one of the most important of these characteristics in literature. And as indicated by opinion surveys in 5.1, the sign of STC is subjective since there appears to be distinctly varied preferences for cowpea varieties by seed colour. The values of STC in this study range from 1 for brown, 2 for speckled and 3 for white varieties. The elasticity of price for STC is about 5 kobo price increase per unit increase in colour change {increase in value from 1 to 3} in the pooled sample. In Ibadan the responsiveness is almost the same but with negative value i.e price drops by 6 kobo for one percent change from brown to whiter colours (white, specked).

In Enugu, there is about 3 kobo price increase for one percent increase in value {as we move from brown to white varieties}. The coefficients are very significant in Ibadan and

Enugu { $p < 0.1$, $p < 0.01$ respectively} while it is not significant in the pooled sample.

ii. COOKING TIME

For cooking time CTM, it was expected that in all cases, preference will be for low cooking time, for reasons of economics of time and energy costs. However, the sign is negative only in the pooled sample {$p < 0.10$}. The elasticity coefficient is positive in both Ibadan and Enugu {$p < 0.10$, $p < 0.001$ respectively}. The price responsiveness is 4 kobo per cent in Ibadan and 43 kobo per cent in Enugu!!.

One reason for this is that the type of dish to be prepared influences choice. When predominant dish is boiled bean to be eaten with rice or another dish, the consumer may not want the beans to be too soft {mashed} Preference will be for firm, boiled beans. In this case, there may be preference for longer cooking varieties.

iii. GRAIN CONFIGURATION

This is measured as length-breadth ratio of the grain. For higher values, the cowpea seed is not very rounded. It may be big or small for lower values but the seed is very well-rounded. There is no clear reference as to the preferences in these regards. The coefficients are positive in all markets except in Enugu where the preference seems to be significantly for smaller-flatter grains, as in the Isiocha variety and there is 13 kobo fall in price for one percent increase in GCF score. In the pooled sample, there is about 0.7 kobo price increase per cent increase in GCF while in Ibadan, there is 3.2 kobo increase percent change. It would imply that consumers in Ibadan prefer rounded grains.

7.2.4 OFF-FARM CHARACTERISTICS OF COWPEA

The identified characteristics in this category are MLQ 1 {foreign-matter-free %}, GPT2 {weevil-free %}, GPT3/ADT {percentage adulteration} and SWA {swelling ability}.

i. FOREIGN MATTER-FREE PERCENTAGE

This measure is expressed as 100% **less** percent of foreign matter. In the pooled sample, the signs are unexpectedly negative although it conforms to expectations in the sub-markets. The responsiveness to MLQ1 is highest in Enugu with #3.97 price change for each percentage increase in MLQ 1. In Ibadan the elasticity is 0.03 i.e 3 kobo price increase accompanies one percentage increase in the MLQ 1 score.

ii. WEEVIL-FREE PERCENTAGE

This is expectedly a very important quality of cowpea. It is perhaps the most obvious characteristic of the market grain after the seed colour that consumers infer price around. The responsiveness is positive as expected in all sub-markets and the pooled sample while the pooled sample exhibits a 20 kobo price change per 1% improvement in weevil free percent. The elasticity in Ibadan is 14 kobo percent and 40 kobo percent of GPT 2 increase in Enugu. All are significant at $p < 0.01$.

iii. SWELLING ABILITY

This is an important economic property of grains while consumers identify with. The signs are all positive and the coefficients are significant at the sub-market level but not in the pooled sample. Price responsiveness is #0.17, #0.05 and #0.22 increase for each one percent increase in swelling ability. Again the responsiveness is highest in Enugu.

iv. ADULTERATION-FREE PERCENTAGE

For one percent increase in adulteration, price of cowpea will drop by #0.05, #0.005, #0.07 and #0.09 in the pooled sample, Ibadan and Enugu sub-markets respectively. Again the coefficients are highly significant {$p < 0.10$, $p < 0.001$}.

7.2.5 RESPONSIVENESS OF RICE PRICES TO CHARACTERISTIC CHANGES

The absolute values of the standardised coefficients (Beta) for the pooled and disaggregated samples show the following pattern.

In the pooled data, the genetic characteristics of GCF, GLT and CTM are the most importance. The milling qualities are next in importance. The lowest rating is attributed to CHLK, GPT and SWA respectively while SW100 is the least important.

The patterns exhibited within the sub-markets are not markedly different in the pooled data. The implied order of importance is defined in the next table and shows considerable consistency that allows ease of assessment. The most obvious pattern is that of conglomerate movement of related groups of attributes. While the genetic characteristic (excluding CTM) rate highest in Ibadan and Enugu, the milling characteristics MLQ1 to MLQ3 are grouped next in importance in Nguru. Although they also move together in Ibadan, they are rated below the on-farm characteristics (GPT and SW100). In Enugu, they are rated above all the genetic characteristics.

This grouping compares fairly closely with what is shown with respect to within-group order of importance. This clearly reinforces the earlier patterns that there is close association within the characteristics groups while the association between group is not as marked. This pattern is most obvious with respect to the off-farm characteristics. Within this group of characteristics, swelling ability ranks consistently low in all markets.

Among the genetic characteristics grain length and cooking time consistency rank higher than grain configuration in two of the three markets while chalkiness or degree of translucency of grain is highly price-responsive (positively) only in Nguru.

Table 7.11 Within-Group Relative Importance of Rice Attributes as shown by Standardized Coefficients

	Pooled Sample	IBADAN	ENUGU	NGURU
Breeding Characteristics				
GLT	0.2668	0.2715**	0.624	0.3529**
GCF	-0.2051	-0.0195**	0.120	0.3529**
CTM	-0.2877	0.0349	0.456	-0.2651*
CHLK	-0.2214	0.4915	-0.017	-0.2651*
On-Farm Characteristics				
SW100	-0.1057	0.0119*	0.930	-0.2105
GPT1	-0.1688	-0.2236	-0.003	-0.2286
Off-Farm Characteristics				
MLQ1	0.2944**	0.3691*	0.629	0.1892
MLQ2	-0.2131**	0.3603*	0.792	-0.2939*
SWA	-	-	0.242	-
MLQ3	-0.0153	-0.2112	-0.683	0.3452**

Source: Field Data, 1993.

Table 7.12 Standardized Hedonic Coefficient (Beta) Showing Between Group Relative Importance of all Rice Characteristics

	Pooled Sample	Submarket 1	Submarket 2	Submarket 3
SW100	-0.164	0.9138*	0.930	-0.0873
GLT	0.3584**	3.475**	0.624	0.3793
GCF	-0.3688*	-2.760**	0.120	-0.4528
MLQ1	0.330**	0.7945**	0.629	0.1576
GPT	-0.1594	-0.8810**	-0.003	-0.0544
MLQ2	-0.1478	-0.3406	0.792	-0.2034
CHLK	-0.1594	-0.9176	-0.017	-0.344
CTM	-0.3324**	-0.052	0.456	-0.2671
SWA	0.1593	-0.2487	0.242	0.0171
MLQ3	+0.342*	+0.5180*	+0.683	0.2067
TREND	0.2742	0.9838*		0.5121

Source: Field Data, 1993.

Table 7.13 Preference Scale for Rice Characteristic (in descending order of price-responsiveness)

Pooled	Submarket 1	Submarket 2	Submarket 3
1. GCF	GLT	SW100	GCF
2. GLT	GCF	MLQ2	GLT
3. CTM	CHLK	MLQ3	CHLK
4. MLQ1	SW100	MLQ1	CTM
5. MLQ3	GPT	GLT	MLQ3
6. CHLK	MLQ1	CTM	MLQ2
7. GPT	MLQ3	SWA	MLQ1
8. SWA	MLQ2	GCF	SW100
9. MLQ2	SWA	CHLK	GPT
10. SW100	CTM	GPT	SWA

7.2.6. GENETIC CHARACTERISTICS

The genetic properties of rice consist of the grain length (GLT), the grain configuration (GCF), the cooking time and the translucency/chalkiness which is measured by the proportion of chalky section of the grain (CHLK).

GRAIN LENGTH

Of these properties, price elasticity is highest for the **grain length** in the pooled samples as well as across the submarkets. Thirty five kobo price increase accompanies one per cent increase in grain length in the pooled sample ($p < 0.20$). In Ibadan, the expected price increase is N3.5 ($p < 0.01$), in Enugu the expected increase is 62 kobo ($p < 0.25$) while in Nguru, it is about 40 kobo. The latter is however not significant.

COOKING TIME

In all markets except Enugu between 45 kobo and 5 kobo drop in price may be expected to accompany one per cent increase in cooking time ($p < 0.001$ in all cases).

GRAIN CONFIGURATION

Price response to GCF is negative except in the pooled sample ($p < 0.20$). This negates the general notion of high preference for slender grains or 'Alabere' which characteristic is the unique property of a local breed that was popularly grown in the savannah ecologies. This trend was also observed with the implicit price of GCF.

CHALKINESS

Chalkiness is usually a very undesirable property which shows as whitish core of the endosperm. It reduces the translucency and is associated with high amylose content (starchiness), uneven softening of the grain and often, very low water absorption capacity. The scores on chalkiness runs from 1 for low chalkiness to 5 for high chalkiness. Thus the negative price response is as expected in all the markets. Responsiveness is highest in Ibadan and lowest in Enugu, (again not at all significant in the submarkets).

7.2.7 ON-FARM CHARACTERISTICS

The **seed weight (SW100)** and the grain purity - mould free percentage - (GPT1) are the on-farm properties assessed. As in cowpea, these are indication of agronomic performance.

Reduction in seed weight could be induced during storage if the temperature is unsuitable. Most crops have been known to experience weight loss during storage. However, filling of the endosperm which determines the normal weight of the grain is induced during the production phase. The price elasticity of demand for seed weight is relatively higher in Nguru and Ibadan than in other markets. One percent change in SW100 leads to 62 kobo and about 40 kobo change in the price of rice.

The observed high positive responsiveness in Ibadan and Nguru was not indicated in section 5.1. It may point to the fact that consumer price offers implicitly take account of this through the effect of weight loss on other properties. One of such is whitish coating of rice which in Nigeria, results when rice which has not been properly dried stays in storage due to the suboptimal processing methods. On the other hand, the whitish coating may be an indication of the likelihood of high swelling ability as it also occurs due to long storage. 'Old Rice" as this is often called on the market is preferred to 'new rice' or newly harvested grains which still has a relatively high moisture content. The total biomass per unit weight of 'new' rice therefore tends to be lower than that of the same weight of 'old rice'.

For the average buyer/seller, the visible measure of seed weight is not the laboratory measure as has been used in this study, but measures of related effects like whitish coating of grains. The observed difference in response in the markets is seen as a two directional reaction to 'old rice' and 'new rice' whereby the former would induce a positive reaction to moisture-free 'old' rice while the latter is a positive response to the cleanliness of 'new' rice. It is noteworthy that the positive elasticity values are high 91 kobo and 93 kobo respectively while the negative elasticity values are low 11 kobo and 8 kobo respectively. This implies that responsiveness is lower to purity of grain than to swelling ability.

7.2.8. OFF-FARM CHARACTERISTIC

These include the milling quality variables MLQ1 - foreign matter free percentage, MLQ2 - brokens-free percentage, MLQ3 or GPT2 - the adulteration-free percentage and the swelling ability (SWA). The milling qualities are the most important characteristic which differentiate the local and imported rice varieties.

As expected, the price responsiveness is positive with respect to MLQ1, MLQ3 and SWA in most of the samples (except SWA in Ibadan).

FOREIGN-MATTER FREE PERCENTAGE (MLQ1)

This is a unique property of rice which commands very high premium. Consumers often associate this with the high quality found in the imported varieties. The responsiveness is again highest in Ibadan with 79 kobo price increase associated with one per cent increase in the score for MLQ1. The same parameter is 63 kobo in Enugu and 16 kobo in Nguru.

BROKENS-FREE PERCENTAGE (MLQ2)

Broken grains are generally undesirable in rice varieties. Exceptions are where the rice is to be used as milled rice (flour) for certain dishes like 'Tuwo' or kouskous in the North, and in some ethnic cultures in the West African sub-region. The negative price elasticity indicating a 20 kobo reduction in price for one per cent reduction in broken grains in Nguru and corresponding figures of 79 kobo and 34 kobo in Enugu and Ibadan can not be explained as it negates the a priori expectation.

ADULTERATION LEVEL (MLQ3 OR GPT2)

The (positive) responsiveness to MLQ3 is higher in Enugu than Ibadan and lowest in Nguru. Price of rice is enhanced by 68 kobo, 52 kobo and 21 kobo respectively for each percentage reduction in adulteration. This preference for very pure varieties ensures maximum utility from desired characteristics of a particular sample variety. High adulteration level or mixture of different varieties may cause unequal softening of rice, reduce the overall swelling ability or other chemical properties which may not be physically expressed when grains of different genetic, on-farm and off-farm characteristics are mixed.

SWELLING ABILITY

Swelling ability is generally a highly favoured characteristic. It denotes the volume yield per unit volume of the grain that is measured for cooking. It is a strong economic property of most grain crops. The amount of this characteristic mainly depends on the post-harvest handling processes. The score of SWA may similarly be expected to be higher for 'old rice' than for 'new rice' due to loss in moisture content over the storage period. Again, like for seed weight, this property may be accompanied by other undesirable properties like the whitish coating and discoloration of grains. As such, while most consumers, for economic reasons would demand very dry grains - usually tested by biting the raw grain of displayed samples, more affluent consumers may trade off the dryness or SWA for other more visible physical properties related to the presentation of the dish. Most often, the milling quality and translucency (chalk-free percentage) are the trade-off characteristics.

Responsiveness to SWA is positive in all markets except in Ibadan where one per cent increase in this property discounts price by about 25 kobo! We posit again that because of the metropolitan nature of Ibadan city, there are many more imported alternatives to local rice varieties. Consumers buying local rice would predominantly offer a higher price for such characteristics as the milling qualities which are closest to those of the imported rice varieties. Hence the trade-off hypothesis is the most likely reason for this trend.

CHAPTER EIGHT

APPLICATIONS OF FINDINGS TO GRADING

8.1 EFFICIENCY OF THE HEDONIC MODEL: TESTS OF MARKET INTEGRATION

In this section, the efficiency of the parameters of our hedonic functions is assessed vis-a-vis their uses in drawing inferences about crop grades and crop improvement programmes in the study areas.

In generalizing the results of the relative importance (price responsiveness) of characteristics for crop improvement objectives, the parameter estimates (B_{ij}) of the hedonic function must be efficient. Also, in generalizing the relative magnitude of MIPs in the submarkets into a national or regional grading system, the market must be seen to be integrated with respect to quality. That is, the magnitude and relative order of price premiums of the actual and estimated prices of the different 'qualities' in the three markets must be statistically related.

If the error of estimation of the Net Marginal Value Product (NMVP)is minimised, then the current pricing structure is a valid grading system and further infers marketing efficiency.

Hitherto, there has been considerable debate on the use of market integration measures to infer market efficiency. Some of these are the works of Jones (1968, 1972), Gilbert (1969), Thodey (1969). Several authors have supported the methodology, especially in determining the efficiency of price transmissions between physical markets and over time [Ravallion (1985, 1986), Heyten (1986), Dittoh (1994). In the absence of known pioneering works or counter-opinions on the use of quality-price integration measures, this study has applied the same principle as in spatial and temporal integration studies.

8.1.1 THE EXPECTED PRICE OF RICE AND COWPEA (NMVP)

The null hypothesis tested is that the sum of the marginal value product does not equal the price of the jth crop variety.

Ho: The market price of the ith variety of grain is significantly different from the sum of the marginal implicit prices of each product characteristic j multiplied by its average yield of the characteristic.

i.e.

$$\hat{P}_{ij} = \sum b_{ij} X_{ij} \qquad 4.3$$

The magnitudes of the implicit prices for the different crop characteristics differ, both within sample and between samples. The implication is that while individual attribute values differ between consumers, the final price aggregates the varying levels of marginal prices into net marginal scale of value (NMVP) which should be related to the relative magnitude of premium on the market prices of our samples.

We compared some parameter estimates obtained from these parallel values for the different markets to assess the relative efficiency (price-quality integration) of each market, and inter alia, the efficiency of the hedonic function to estimate accurately, the price of product qualities. These parameter estimates from the hedonic function are as follows:

R^2 - Coefficient of Determination of the hedonic function

RESID-Expected value of error term of the hedonic function

SEPRED- Standard Error of the estimated Price

MAHAL- Mahalanobi's distance which estimates the net disparity of the independent variables from their mean values

Correlation Coefficient- Correlation between the actual and estimated price

T-value -indicating significant difference between the two mean values to test the null hypothesis indicated earlier.

The results presented in Table 8.1 and 8.2. show that all the sub-markets for cowpea display a higher degree of integration than the pooled sample. The reverse is the case for rice. With respect to cowpea, the highest level of integration is seen in Ibadan and the lowest in Enugu. For rice, market efficiency is lower than in the cowpea markets, judging by most of the integration measures. R^2 is high but not significant in the submarkets. It is significant in the pooled market ($P<0.05$). The pooled rice market is therefore more efficient than the rice submarkets. This result corroborates the findings of more segmentation of cowpea markets than rice markets. For rice the segmentation of markets is less defined especially with the genetic characteristics which mostly discriminate between the cowpea markets. Also, the off-farm attributes appear to be of importance in all the markets. Hence, the pooled market is more integrated than individual markets.

To further test the specific null hypothesis stated, the statistical association between the actual and estimated prices are compared via the significance of their t-ratio and by graphical illustration.

Table 8.1 TEST OF PRICE QUALITY INTEGRATION IN THE MARKETS (COWPEA)

TEST PARAMETER	IBADAN	ENUGU	NGURU	POOLED
R^2	0.962	0.618	0.776	0.587
RESID	0.0072	0.000	0.0205	0.028
MAHALANOBI'S DISTANCE	9.167	73.025	4.500	9.706
SEPRED	0.0106	-0.403	0.0165	0.0123
CORRELATION COEFF.	0.84	-0.07	0.337	0.67
T-VALUE	2.222	0.802	1.287	1.202
SSE	0.0001	0.001	0.0003	0.0052

Source: Survey Data, 1993

Table 8.2 TEST OF PRICE QUALITY INTEGRATION IN THE MARKETS (RICE)

TEST PARAMETER	IBADAN	NGURU	POOLED
R^2	0.9030	0.881	0.376
RESID	0.174	0.0243	0.0065
MAHALANOBI'S DISTANCE	10.2143	10.2667	10.6857
SEPRED	0.0238	0.0275	0.0164
CORRELATION COEFF.	0.94	0.95	0.
T-VALUE	1.487	0.958	1.024
SSE	0.0005	0.0028	0.0186

Source: Survey Data, 1993

(Enugu not reported due to degrees of freedodm problem)

The findings for the former also in the same tables show the highest correlation coefficient of 0.84 in Ibadan and 0.337 in Nguru. T-values allow us to reject the null hypothesis in Ibadan,($p<0.001$), in Nguru ($p<0.05$). In Enugu, we can only reject at probability higher than 0.25. The figures present the same trend in the results in terms of relative association of the two values. In the rice market, although R^2 values are high, the values are significant in Ibadan and the pooled market but not in Nguru. The rice market in Enugu could not be reported on due to very low sample size

Figures 8.1 to 8.3 show the relationships in the three cowpea markets while Figures 8.4 and 8.5 are for Ibadan and Nguru's rice markets. These show sufficiently high degree of association.

8.2 CONSUMER PREFERENCE PATTERN FOR GRAIN CHARACTERISTICS: AN IMPLICIT GRADING SYSTEM

Derivation of a grading system from marginal implicit price and characteristic values have been achieved by Hyslop (1970) who condensed the numerical score on crop characteristics into a composite grading system. Also Knapp (1969) achieved the same from a linear programming approach of corn-blending and marketing operations of Iowa regional grain market using cooperatives. Martin (1974) has also derived grades from the estimates of implicit price of quality grading in the corn market.

Their methods are summarised:

Figure 8.1: Observed and Estimated Price Premium on Cowpea Samples (Ibadan)

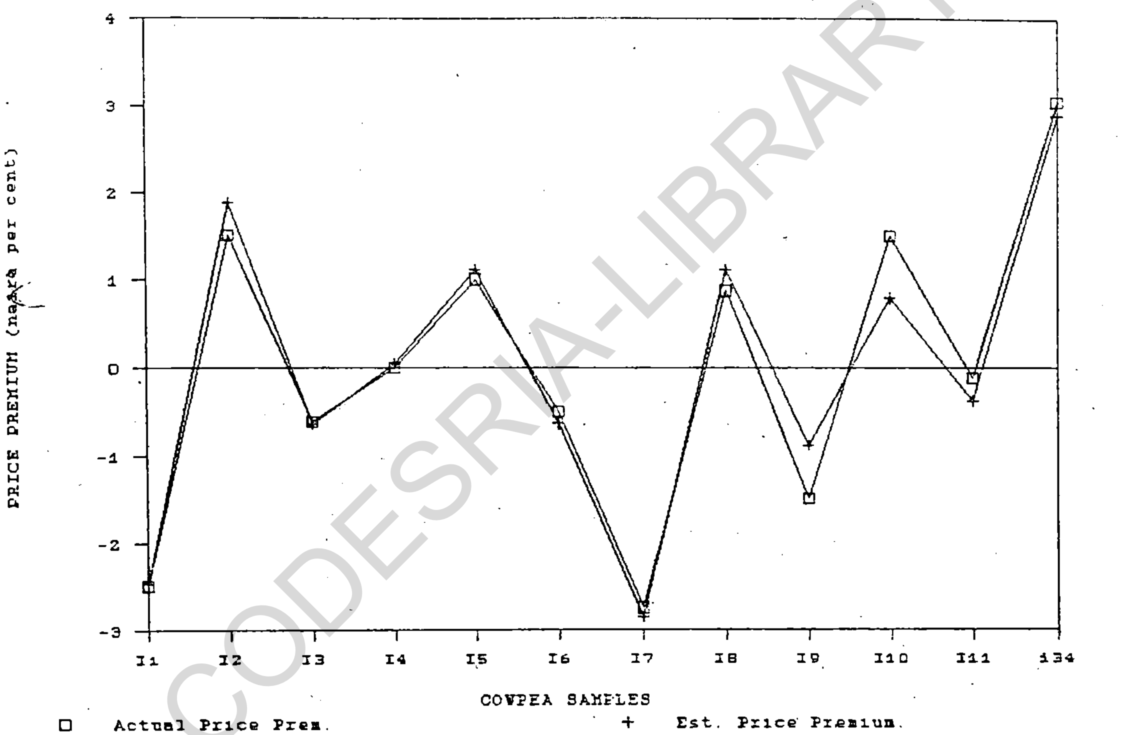


Figure 8.2: Observed and Estimated Price Premium on Cowpea Samples (Enugu)

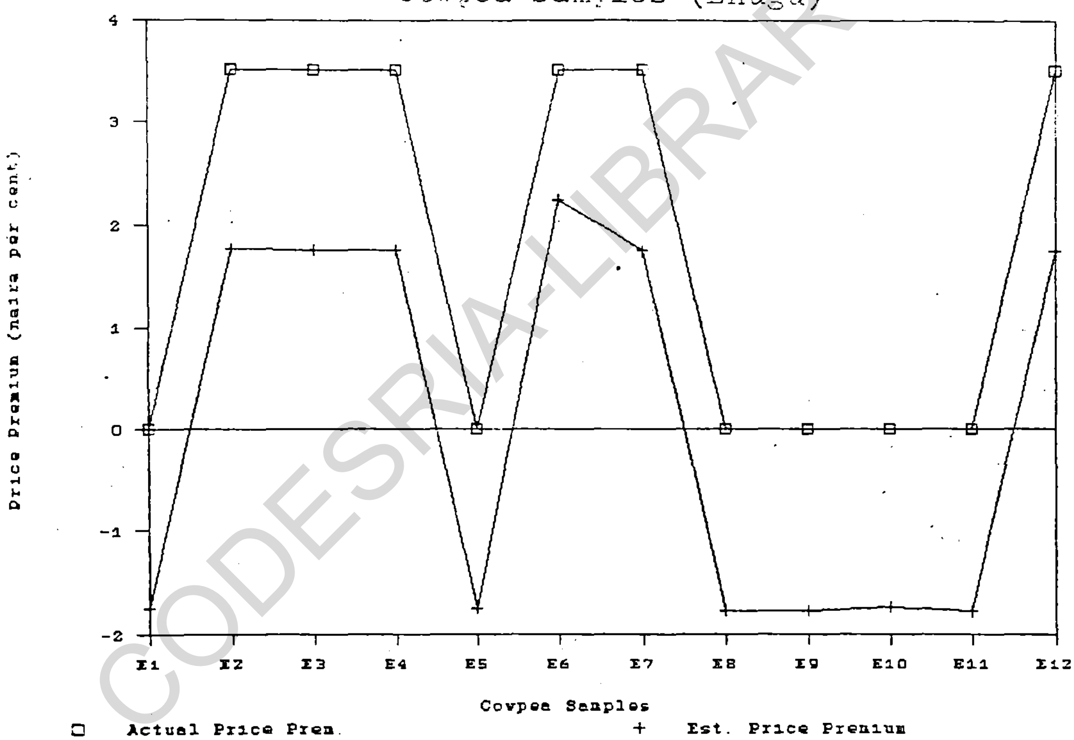


Figure 8.3: Observed and Estimated Price Premium on Cowpea Samples (Nguru)

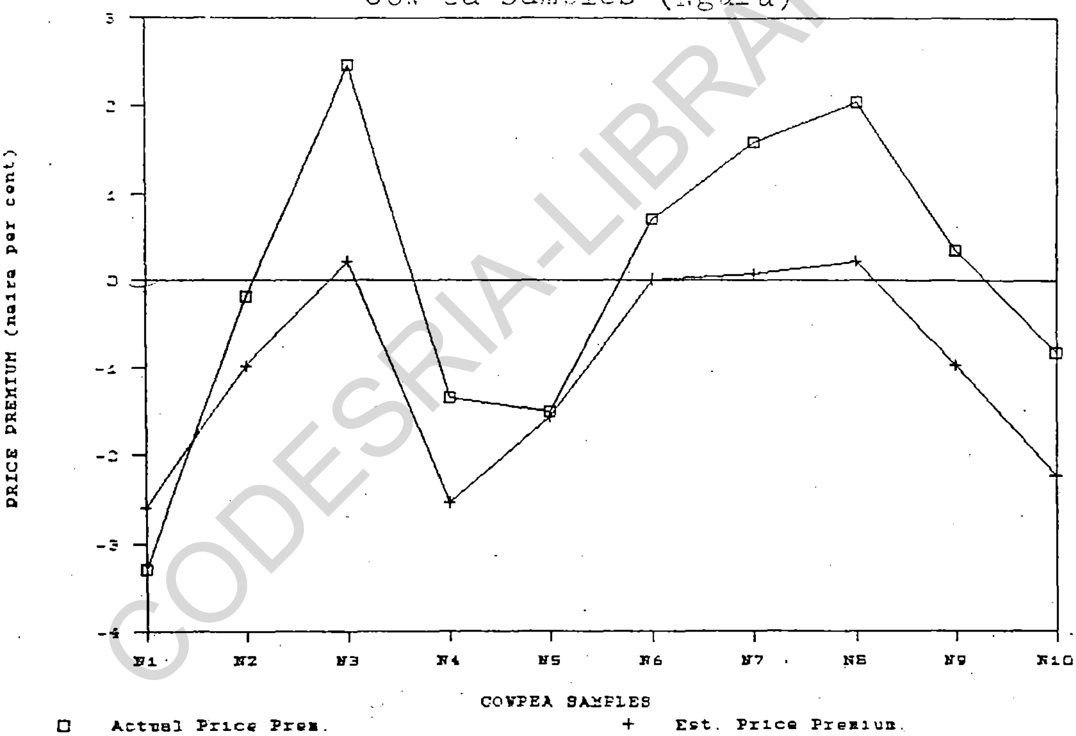


Figure 8.4: Observed and Estimated Price Premium on Rice Samples (Ibadan)

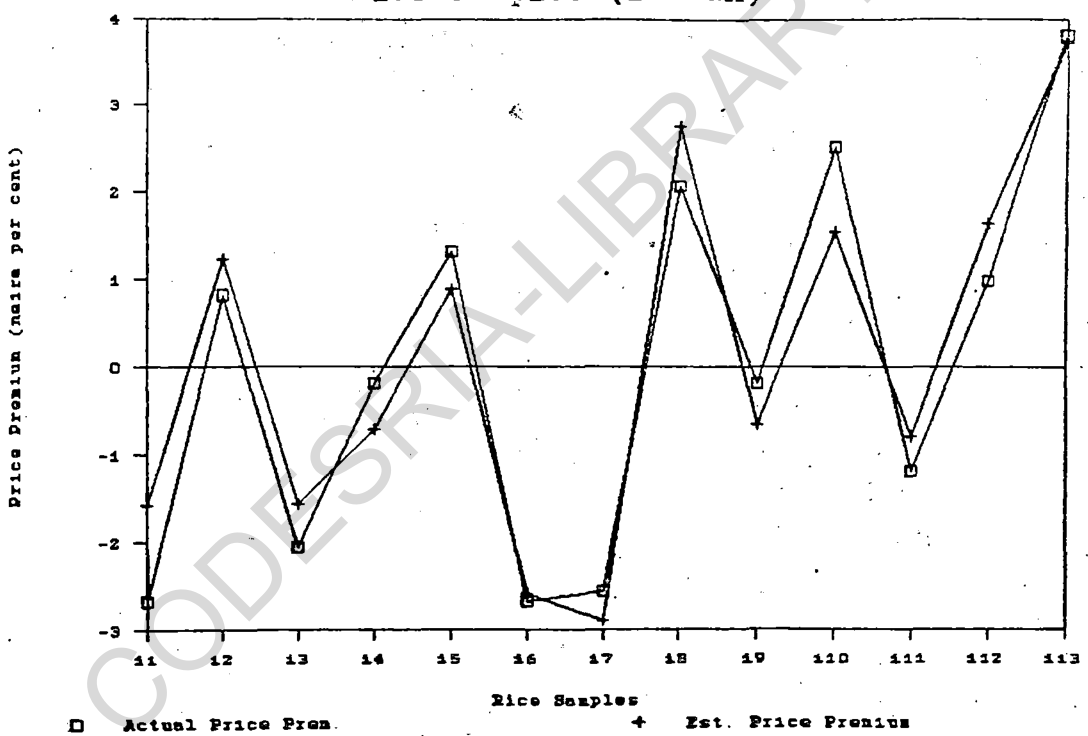
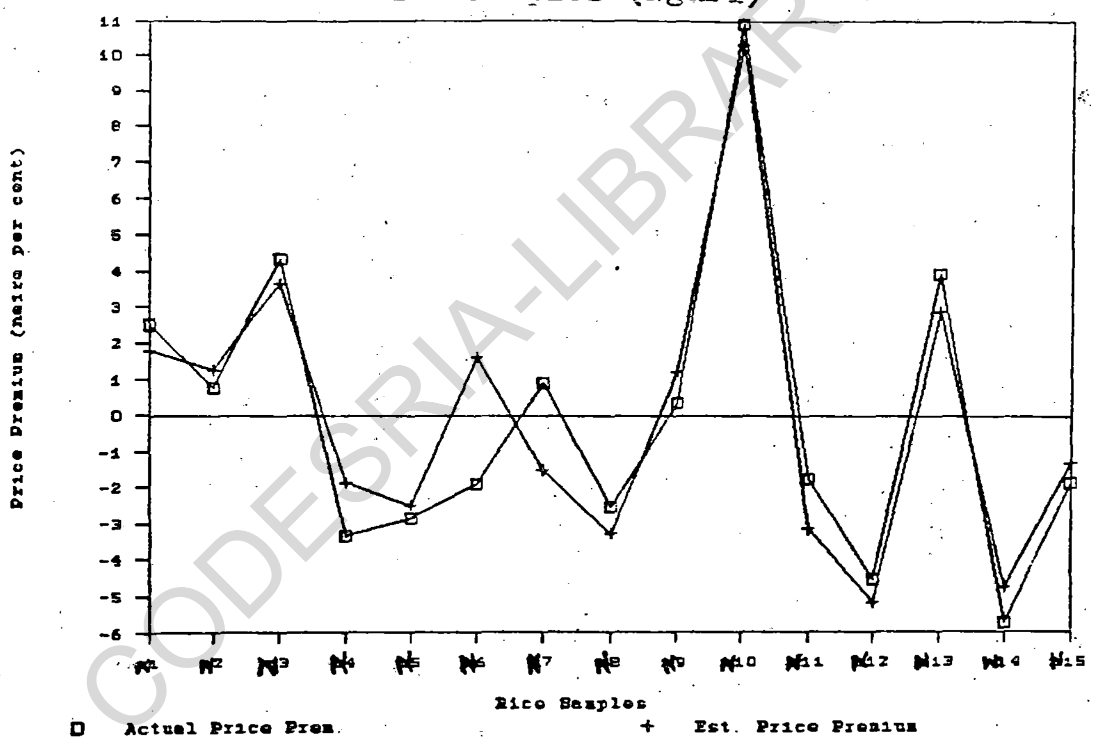


Fig. 8.5: Observed and Estimated Price Premium on Rice Samples (Nguru)



Knapp estimated net marginal value product (NMVP) as excess of the MVP over the actual price in the market, given the total value yield of each characteristic. The price order applicable to grading is the total value for each grades (P + NMVP), a measure of price premium which can be used to order the prices of grades in descending order.

where:

MVP = P-predicted P

NMVP = P - P

Martin simply used a rank correlation method to obtain scores of relative importance of characteristics among different firms for an available range of corn in country elevation (stores). He applied the Kendall's coefficient of concordance (W) (Kendall, op. cit) to test the independence or otherwise of the rank scores. He was able to reject the null hypothesis of independence at 1% level of significance and therefore used the composite rank scores as grades of corn in Iowa State which compared favourably with existing grading system in Iowa State in the USA. Since there is really no existing grading system in Nigeria, we have simply formulated an experimental design for the Nigerian Grain Market following (Ladd & Martin, 1976) and deriving from these earlier empirical works.

The Hyslop's method (hereby referred to as Hyslop Hedonic Scale) was used in defining a hedonic scale for the attributes of rice and cowpea in the three markets. The rank order defined should be appropriate in defining an order of priority for crop improvement and for grading specifications. The composite scores are useful in prioritising programming objectives in the country.

The Martins grading scale can be derived directly from Hyslop hedonic scale by identifying the characteristics whose value (scores) need to be defined as marketing specifications for intending consumers. The characteristics having the highest rank scores on the hedonic scale are hereby referred to as Premium Attributes (PAs) and need to be defined in the specified-order method for market price formation since preferences may vary between different groups of consuming population e.g wholesale markets, industrial firms and even retail markets. It is expected that a consumer from any geo-culture would be able to find a minimum number of specified characteristics which comprise his/her most favoured attributes. It is also useful in futures marketing where specification of products, rather than the products are the commodities being sold.

Although all the three methods are applicable to the current study, the Knapp grading method is the most directly relevant here because it is based on estimates of implicit price, albeit using a different estimation procedure - the Linear Programming technique.

Predicted prices of the samples under study are easily compared with the actual prices via the magnitude of the NMVP which is in fact related to prediction residual error term

(SEPRED) or the inequality coefficient derived in the previous section. Since predictor residual is minimized, the estimated prices (P) can be ordered sequentially to derive a grading scale nationally or regionally.

Because of the statistically significant differences between markets, we have not been able to successfully derive a foolproof grading system for the whole country. We have only proposed the basis for a national grading system and presented a tentative formation from this pioneering effort. The three methods have been used to derive a framework for grading of grain crops in Nigeria. The framework has the following properties.

(1) It takes account of and reports the predominant characteristics in one lot of a product rather than the numerical grading in a composite sense - after the method of Martin (1974),Ladd & Martin (1976).

(2) The current grades defined by the market were compared with what our study defines (for the pooled sample and the submarkets) by comparing the estimates of net implicit prices and actual market price, according to the method of Knapp (1969).

(3) The method of numerical grading was also attempted by the summation of net characteristic scores (after Hyslop (1970).

In order to be able to compare the values for characteristics measured in varying units, we converted the values to scores on a rating scale of 1 to 5 based on the range of values exhibited in the grain samples in the study.

8.2.1 Grades of Cowpea Characteristics (Hyslop-Martin Scale)

The Hyslop Grading scale for cowpea characteristics is presented in Table 8.3. It would seems plausible to conclude that, for cowpea, the five most important characteristics hereby referred to as Prėmium Attributes (PA) for the Martin Scale are as follows:

1. Seed Configuration
2. Cooking Time
3. Weevil-free per cent
4. Seed Weight
5. Seed Testa Colour/Swelling Ability.

It implies that genetic characteristics are the most important for cowpea. However, this order is different in the individual market places and therefore, we will not base any strong judgement on a generalised preference for the whole country. Rather it opens up very relevant questions about preference pattern and calls for more fundamental research into other attributes which have been omitted in this study. Moreover, it confirms some of the earlier acceptability study reports which imply that genetic qualities such as seed testa colour, cooking time, swelling ability are the most important characteristics of cowpea.

Because breeders of this crop are currently more concerned with agronomic performance such as pest resistance, photoperiodicity and biological adaptations within farming systems in order to maximise yield of cowpea rather than the physical properties, we may have cause to explore further the notion that the genetic properties that affect or improve physical appearance have taken a backseat in research and thereby in their palpable effects on the consuming population.

Regardless of these, the market remains the most critical barometer of acceptability. What the market indicates should therefore dictate the priorities for crop improvement. The fact that the off-farm characteristic of weevil- free percent has ranked very highly among the others is a pointer to the need to pay greater attention to post-harvest handling which may be more important to consumers than on-farm characteristics, given currently available breeding and agronomic characteristics. The consumer may have less choice in the selection of varieties, but he/she has a very wide ambience to select acceptable 'grades' based on their processing and storage properties. If this is enhanced, demand on their economics of production and motivation thereof is also enhanced.

Crop breeding and production may therefore be a necessary but insufficient condition for the enhanced performance of the market for grain crops like cowpea.

Table 8.3. Implicit Hedonic Scale for Cowpea Characteristics in Nigeria (Hyslop Scale)

	Ibadan	Enugu	Nguru	Composite Score	Rank Order
Genetic Characteristic					
- Seed Configuration	8	2	9	6.33	1
- Seed Testa Colour	1	5	8	4.67	5
- Cooking Time	7	8	3	6.0	2
Mean Score					
On-Farm Characteristic					
- Seed Weight	5	9	(1)	5.0	4
- Mould Free (%)	6	6	(2)	4.67	5
Off-Farm Characteristics					
- Foreign Matter Free (%)	4	(3)	6	4.33	8
- Weevil Free (%)	3	7	7	5.67	3
- Swelling Ability	9	1	4	4.67	5
- Adulteration Free (%)	2	4	5	3.67	9

( ) = Scores are assumed related to the order of the other characteristics.

Source: Survey Data, 1993

8.2.2 Grades of Rice Characteristics (Hyslop-Martin Scale)

The composite characteristic scores for rice are obtained from the scores in Ibadan, Nguru and the pooled sample. This is because, although the results from Enugu are derived from batch regressions and not a full equation, the sample size makes the findings statistically inappropriate. Most of the estimates are also not significant. Apart from this, there appears to be congruency of rating scales in the other markets. This reinforces the statistical validity of the statistical tests (Chow Test) from which we could not reject the null-hypothesis of equality of coefficients in most of the markets. The indication, from the discriminant analysis results and analysis of relative importance of attributes does not give justification to a notion of strongly defined submarkets.

The Hyslop hedonic scale derived for rice (Table 8.4) shows that overwhelmingly, milling quality (MLQ1) is the premium attribute (P.A) in all the markets with a composite score of 9.67. This is followed, also with high consistency by the grain length (GLT) with 8.67. Swelling ability appears to be more important for rice than for cowpea. This characteristic has a composite score of 7.33. On the other hand characteristics like cooking time, mould-free percentage, brokens free percentage have the lowest composite scores.

The premium attributes applicable to the Martin Hedonic Scale are:

- Foreign matter free percentage
- Grain length
- Swelling ability
- Adulteration free percentage
- Chalkiness.

Review findings on consumer preferences for rice characteristics are consistent with this choice of PAs - perhaps the rank order may need to be further researched to establish a clearly defined preference scale. According to Martin marketing specification indicating the score on each of these PAs should be sufficient for consumers reference pricing and market price formation.

While the emerging pattern does not depart very radically from global trends, some highly contestable findings appear with respect to the hedonic scores and relative implicit price (and responsiveness) of chalkiness percentage and brokens percentage.

This calls for further analysis, perhaps in a larger sample covering many more markets in the regions of this study.

Table 8.4 Implicit Hedonic Scale for Rice Characteristics in Nigeria (Hyslop Scale)

	Ibadan	Enugu	Nguru	Pooled	Composite Score	Rank Order
Genetic Characteristic						
- Grain Length	8	5	9	9	8.67	2
- Grain Configuration	3	4	5	5	4.33	7
- Cooking Time	4	6	3	4	3.67	8
- Chalkiness	6	2	6	6	6.0	5
On-Farm Characteristic						
- Seed Weight	10	9	1	3	4.67	6
- Mould Free (%)	2	1	2	1	1.67	10
Off-Farm Characteristics						
- Foreign Matter Free (%)	9	10	10	10	9.67	1
- Brokens-free (%)	1	7	4	2	2.33	9
- Swelling Ability	6	3	8	8	7.33	3
- Adulteration Free (%)	7	8	7	7	7.0	4

Source: Survey Data, 1993

8.3 IMPLICIT GRADES OF GRAIN SAMPLES (THE KNAPP'S SCALE)

This is based on the values of NMVP obtained for each sample. The samples listed and graded are those which are found in every submarket or which are predominant in particular markets throughout the study period.

The results confirm that preferences are unrelated in different markets since premium rates and premium orders differ. Only a few varieties consistently command high premium in all markets. Predominantly, differentials in premium which are induced by the off-farm characteristics appear to subsume those induced by breeding and other characteristics, for both rice and cowpea (Table 8.5 and 8.6).

The samples having superior grades are those which combine desirable genetic traits with high score of off-farm characteristics. Examples of cowpea are Drum II in Ibadan and Isiocha in Enugu. For rice, the grades are less uniform because premium grades in Ibadan are poorly rated in Nguru and vice versa. There is need to further identify the premium attributes of each of the grades to determine if it conforms with the derived order in the other scales. This is because the final sample combines all three groups of attributes. The most preferred attributes seem to be the milling quality. Thus, better milling quality of the same variety of rice between two locations could change the premium order radically. This calls for further analysis which is currently beyond the scope of the study.

Table 8.5 IMPLICIT GRADES OF COWPEA SAMPLES

VARIETY	IBADAN		ENUGU		NGURU	
	PREMIUM (N/KG)	GRADE	PREMIUM (N/KG)	GRADE	PREMIUM (N/KG)	GRADE
OLOYIN	2.9	1	1.76	5	-0.23	7
DRUM II	1.88	2	1.76	4	-0.65	8
MALA	1.12	3	1.78	2	2.04	1
SOKOTO II	1.12	4	-1.77	6	1.22	3
KAURA I	0.04	5	-1.75	8	0.58	5
OLOO	-0.63	6	1.77	3	0.07	6
SOKOTO I	-0.64	7	-1.74	9	1.83	2
DRUM I	-0.88	8	-1.75	7	0.98	4
KAURA II	-2.86	9	-	-	-1.02	9
ISIOCHA	-	-	2.25	1	-	-

Source: Survey Data, 1993.

Table 8.6 IMPLICIT GRADES OF RICE SAMPLES

VARIETY	IBADAN		VARIETY	NGURU	
	PREMIUM (N/KG)	GRADE		PREMIUM (N/KG)	GRADE
ITA 150	3.74	1	FARO 2	10.32	1
FARO 11	2.75	2	FARO 24	3.65	2
IMESI	1.65	3	LOCAL	2.85	3
EX CHINA	1.55	4	FARO 29	1.77	4
FARO 15	1.23	5	FARO 15	1.60	5
ITA 257	0.89	6	FARO 15	1.24	6
LOCAL	-0.10	7	LOCAL	1.23	7
FARO 11	-0.65	8	LOCAL	-1.32	8
FARO 36	-0.71	9	LOCAL	-1.51	9
FARO 35	-0.79	10	GLABERRIMA	-1.87	10
FARO 15	-1.57	11	GLABERRIMA	-2.51	11
ITA 150	-1.58	12	EX CHINA	-3.16	12
FARO 29	-2.60	13	LOCAL	3.29	13
FARO 9	-2.90	14	ITA 257	-4.77	14

Source: Survey Data, 1993.

CHAPTER NINE

SUMMARY OF FINDINGS, POLICY IMPLICATIONS AND CONCLUSION

9.1 SUMMARY OF FINDINGS

This thesis set out to carry out a quality-price analysis of selected grain crops in Nigeria. This is by deriving the hedonic-price functions of the demand for the characteristics of rice and cowpea with a view to estimating the marginal implicit prices of the relevant physical characteristics. The pattern and magnitude of differences in consumer preference for cowpea and rice characteristics in three market locations were also assessed. A null hypothesis of no segmentation in the market for characteristics or no significant differences in consumer preference pattern for the crops under study was tested.

The level of integration of the markets for rice and cowpea with respect to quality of products was assessed and thereby the efficiency of the hedonic model in deriving grades of grain crops in Nigeria. This was achieved via the determination of the statistical significance of the parameter estimates of the hedonic functions.

The major findings are hereby presented under different subheads representing each of the main study themes.

9.1.1 Consumer Choice of Crops Characteristics

The most important crop characteristics from preliminary opinion surveys and the available choice of characteristics in each location helped to identify the most relevant hedonic variables for the econometric analysis. The following patterns emerged:

(a) Preference patterns appear to vary strongly across geo-locations but less so across income classes for both crops. In the rice market, although unique preferential patterns are apparent, there are a few striking commonalities across geo-locations and socio-economic groups.

For both rice and cowpea, the grain purity and milling quality consistently rank among the most important characteristics in the southern markets. In the north, the preference appears to be dictated by other factors related to genetic characteristics - seed colour of cowpea and chalkiness of rice. Across income classes, the preference patterns exhibited in the southern states are concurrent among the middle and high income classes. The low-income classes exhibit fairly strong preference for genetic characteristics in cowpea. The picture is not as remarkable in the case of rice.

The results of tests of concordance of opinion show that, although there are strong ties in opinion within geo-cultural groups and within socio-economic groupings, the variations are stronger between the geo-cultural group than between socio-economic groups.

An important conclusion is that there are more commonalities in preference pattern among the high and middle income classes which indicate strong preference for certain off-farm characteristics. These strong preferences petter out and economic factors become stronger with low income earners as shown by no remarkable preference patterns especially for rice (except chalkiness).

9.1.2 Implicit Prices of Grain Characteristics

The general inferences drawn here relate to how the magnitude and especially sign of implicit prices conform to expectation about preference patterns.

For cowpea, cooking time is, as expected a price discounting characteristic in all markets except Ibadan. But contrary to expectations, foreign matter free percentage also discounts value in Enugu while swelling ability discounts price in Ibadan.

As expected, seed testa colour discounts price in Nguru. The higher the colour score, the lower the price. This is consistent with the high preference for white beans over brown bean in this market.

In all markets, weevil-free percentage is one of the greatest value-adding characteristics. In the rice market, the pattern exhibited is mostly against a priority expectations. But a strong pattern of occurrence is that milling qualities with respect to foreign matter and adulteration move conglomerately and in at least two of the markets, it consistently had premium value.

Swelling ability of grain also appears more relevant (and mostly sign optimal) in the rice market than in the cowpea market. Chalkiness discounts price in all markets while high cooking time also discounts price in all markets except Enugu.

We were able to proffer possible reasons for the unexpected hedonic behaviour in some cases while some could not be justified. For instance, we relate the preference for long cooking rice and cowpea in Enugu as consistent with the nature of the commonest food option (rice and beans served together) from these two grains, for which better presentation and eating quality is obtained from unmashed forms of the cooked grains. We also related the premium value of foreign matter in cowpea to the prevalence of broken pod coats in freshly threshed cowpea with very low weevil-infestation.

9.1.3 Test of Market Segmentation

All our statistical procedures to test the sub-market hypothesis for cowpea indicated that the hedonic functions estimated for the different markets are significantly different. There are strong discounting variables between the markets as shown by the dispersion of group centroid in the discriminant analysis, the low value of Wilk's Lambda and the high value and significance of the canonical discriminant function. The Chow test also showed decreasing value of residuals between pooled and disaggregated market samples.

For rice, again the picture is not as distinctive. For instance, we were unable to reject the hypothesis of no difference in the intercept of the hedonic functions and unlike in the case of cowpea, fewer variables are seen to discriminate between the markets. These few variables include the seed weight and grain configuration. The former is seen to be valid only if we relate the attendant weight loss of 'old rice' to the preference for 'old rice' with higher swelling ability in more conservative markets (of the north) and relate the weight of 'new rice' to the preference for new-rice with lower swelling ability in the southern metropolitan markets . The relative position of group centroid show that there is greater dispersion between each of the southern markets and the northern markets than between the two southern markets alone.

We draw a conclusion of a more unified market for rice which has been largely influenced by the ready availability of imported rice varieties with some globally desirable properties especially long grains and high milling quality (foreign matter-free percentage).

9.1.4 Relative Importance of Hedonic Variables and Groups of Attributes

With respect to groups of attributes, it is difficult to draw an inference on the supremacy of one single set of characteristics because the hedonic function defined with each group of attributes did not in any case outperform the hedonic function specifying all the characteristics.

This implies that no single set of attributes singularly account for the quality-price variations of rice or cowpea. For cowpea, the off-farm characteristics, especially GPT, appear to have a stronger influence on price than the genetic and on-farm characteristics. The only exception to this is in Nguru market where genetic characteristics (seed colour) appeared to outperform the off-farm characteristics. This last finding corroborates many of our earlier results which indicate the higher preferences for certain genetic properties of cowpea. Better price-responsiveness of genetic variables (especially grain length) was observed in the rice markets' equations, consistent with most of the earlier findings. There was conglomerate movement of off-farm properties in all markets and relatively high importance of the milling qualities of rice in Ibadan and Enugu. Reasonably consistent with these are the ordering of the elasticity parameters (Beta) of all variables in the full hedonic function for all markets and both grains.

Grain length is one of the most important genetic attributes of rice which is believed to markedly influence its price (Adekanye, 1986). It is directly related to the grain configuration which is another regressor in this batch of attributes. One would have expected a stronger performance of genetic variables in the group hedonic function, surpassing that of milling quality in the more metropolitan markets.

The summary finding is that for rice in Nigeria, the milling qualities are more likely to influence prices more than even grain length. As long as rice is clean, its genetic qualities will be enhanced, whereas good genetic qualities may be marred by poor processing methods.

The relative responsiveness of price to the hedonic variables is assessed by the value of the standardized coefficient. Therefore, looking beyond the value of the implicit price, we are able to note to what extent which factors elucidate the largest changes in price (positive or negative). For cowpea, we were able to conclusively infer the inelastic hedonic response to seed testa colour in Ibadan and Nguru i.e. fixed colour preferences and price elastic hedonic response to many of the milling qualities and grain purity attributes (especially MLQ1, MLQ2 and GPT2) in the three markets. The latter is more apparent in Ibadan and Enugu than in Nguru.

For rice, we found a consistently high responsive for grain length and grain configuration in Ibadan and Nguru as well as the pooled data while GLT is highly price elastic, GCF is highly price inelastic. While brokens free percentage MLQ2 is price inelastic, MLQ1 and GPT2 are highly price elastic. This interprets that consumers will change preferences, regardless of other properties if there is improvement in the grain cleanliness and low adulteration. They will however tend to retain their preference pattern regardless of improvement in brokens-free percentage. Only in Enugu would the increased percentage brokens elucidate significant increase in price or preference pattern.

9.2.0 POLICY IMPLICATIONS AND RECOMMENDATIONS

The major policy implications of these findings derive from the findings of significant differences in consumer preference patterns for cowpea and rice across geo-cultures in Nigeria. The main implication of this for policy is that crop improvement scientists i.e crop breeders, producers (farmers), processors and marketers need to take cognisance of these patterns in making investment decisions that border on technological change.

9.2.1 Crop Breeding and Production Technology

Despite current orientations to grain improvement research with focus almost exclusively on high agronomic performances to the negligence of physical properties, it has been shown that consumers can dictate the production pattern and influence market performance with their hedonic behaviour. The manifestations are not strong on many of the tests unlike similar studies in developed countries. The economic climate is responsible for this because the market structure is unfavourable to competition and free information flows that should accompany an efficient market. Therefore, buyers are price takers in most instances. However, the pattern is clear and justifies a rethink of research orientation.

It is believed that the subtle signals given by the findings of this study should be taken as the dynamic workings of the Nigerian grains market which should not be ignored.

Consumers do respond to crop physical qualities and change their price offers in response to them.

(i) Attempts should be made to carry out more comprehensive research into the patterns of preferences in many more markets whereby generalization of the findings will be possible to dictate research objectives into quality improvement. In future research, there is need to monitor changes or consistency in patterns of consumer behaviour. Action can only be based on the findings with more confidence if the patterns are consistently expressed either across a larger population and over a longer period of time.

(ii) Acceptability studies or responses of consumers are hardly ever returned to scientists mainly because such studies, if at all done, are not sustained. This is because of the notion, above, that scientists have about the higher importance of meeting scarcity of supply rather than tastes and preferences. The study has shown that producers can maximise their profit, have higher production motivation and achieve greater production level and productivity if they produce for target population and target price regimes. But for this, there is need for perfect market information flows between farmers, marketers and scientists.

Marketer's demand which is a reflection of demand patterns will be reinforced by farmers demand for seed, for on-farm technological inputs and for processing methods to inform scientists of the priority preferences in given areas.

iii) The study revealed that grains are identified by local names which vary across the population and with which breeding research scientists are not familiar at all. Most scientists and institutions encountered in this study have little or no knowledge of and show little or no interests in the local identities of grain varieties. As a results, feedback from local populations will be meaningless if scientist can not relate reports to specific breeds. This knowledge gap needs to be bridged and this study is one step in that direction. A network should be set up among breeders, seed production companies and farmers whereby a catalogue of cross-identities will be obtained and updated regularly for this purpose.

With respect to on-farm technologists and scientists, the results here provide easily usable information on the orientations that should be considered in crop management technologies. While current efforts into pest resistance and high agronomic performance can not be underrated, the on-farm hedonic variables identified here have some potential in informing such technologies. It should be noted, however, that the findings in this respect are not very significant, compared to those for genetic and off-farm properties.

9.2.2 Crop Processing Technology

One of the most important findings of this study is with respect to the high responsiveness of consumers to milling quality and purity of grain crops. These have been shown to supercede the importance of even genetic properties especially in the case of rice. For cowpea, the very significant place of the effect of weevil-attack on stored grain has been amply shown.

There is the need to gear more efforts into development of acceptable technologies which will enhance the value of the inbred and farm-induced physical properties. The latter properties stand a risk of yielding very little returns if the off-farm processes which dictate the final market form of grams are sub-optimal.

The lessons here, therefore, concern to a great extent, scientists in the area of processing and storage technologies. The preference patterns and implicit price estimates are useful parameters for market handlers and this class of scientists to use in investment decisions into crop handling methods. If consumers are expected to pay a higher marginal cost of improved processing and storage for better value of specific characteristic does not exceed the marginal implicit price of that characteristic, then market decisions and technological improvement research costs which should yield significant returns to such investments can be incurred.

9.2.3 Implications for Grading

Grades in the Nigerian grains market have immense uses:

(i) Grades can encourage the development of modern retail outlets and specialised bulk/wholesale market where market search is limited and less costly for consumers. Although bargaining appears to be part and parcel of Nigerian marketing culture, these can be minimized and in fact made more constructive if both buyers and sellers have relatively good knowledge of the expected premium that a certain lot of crop should command, below and beyond which there is no integration in marketing activities i.e. costs of marketing, price offers and consumer utility.

(ii) Presence of grades allows industrial users of crops to purchase or place orders for purchase of grains with precision. This aids production planning and optimises production efforts via appropriate pricing of inputs and outputs.

iii) Grades are essential for reducing interpersonal dealing as it applies in cross border trades and commodity stock markets. Nigeria has established a Commodity Exchange Market which should essentially function in the framework of proper commodity grading. Yet no standardized grades exist for most crops traded on this market.

It has been amply demonstrated that to a large extent, the estimated net marginal values of crop varieties approximate the current structure of prices. This implies marketing efficiency via high price-quality integration.

Although the practical importance of deriving grades have been shown in the previous chapter, the attempt is tentative. What has been established is that there exists some methodology for deriving grades of these grain crops in Nigeria, which methods should be explored further for this purpose. It is equally important to note that the presence of sub-markets or market segmentation for cowpea and to some extent for rice implies that the establishment of uniform grades across the country may be unrealistic. However, this notion can only be fully accepted if indeed, future studies maintain this findings over time and across space. In this case the Martin-type scale will be most appropriate as a unified scale in Nigeria. Here the priority preference factors or premium attributes will be detailed with scores of each Premium Attribures (PAs) on packaged grains. Consumers from any part of the country can then place their orders based on the desirable levels or values of these P.As.

While we can repose a fair degree of judgement on the econometric study, inferences must only be drawn from the results to guide future research of this kind in Nigeria. The different methodologies for grading hereby derived from the hedonic functions should, however, give the required flexibility of interpretation.

Also because of the statistically significant differences between markets, we cannot derive a single foolproof grading system for the whole country. Only the basis for a national grading system has been presented from this pioneering effort.

The practical importance of deriving grades have been shown in this study. It has been established that there exists some methodology for deriving grades of grain crops in Nigeria. It is equally important to note that the presence of sub-markets or market segmentation for cowpea and to some extent for rice implies that the establishment of uniform grades across the country may be unrealistic.

Although this study has shown that the markets exhibit varying degree of quality-price integration, the absence of standardized grades will continue to leave the performance of the grains market in doubt.

9.3 CONCLUSIONS AND RESEARCH PRIORITIES

The application of hedonic analysis to product marketing in Nigeria and other developing economies has far-reaching implications for marketing improvemnt. However, this can not be successfully achieved unless the models and their assumptions are tailored towards the specific consumer behaviour in these aras, as different from what holds in more developed economies. This study has demonstrated that to a large extent, the global models of consumer behaviour can be successfully applied to the Nigerian grain economy. But the study, in its understandable limitations fell short of observing and measuring all requisite quality factors. Emphasis has been on physical, market-observable attributes, whereas earlier studies have shown that chemical properties do contribute to the physical form, cooking quality and palatability of these grain crops. They also show that knowledge of these factors are shared by consumers and that shared consumer knowledge (SCK) influences their internal reference pricing of commodities.

There is therefore the need to pursue this line of analysis further by including those other factors which affect quality-price response. This would involve the participation or active collaboration with scientists in bio-chemistry, human nutrition and home-economics to identify the relevant properties, their measurement and appropriate laboratory tests.

Some other tests could not be carried out in this study because they needed to be carried out on paddy (unmilled) rice or on vegetative parts of the plant. The latter is most important in separating breeding lines of grain varieties in the assessment of adulteration levels. The design of the study could not accommodate the type of extensive field work and farm experimentation designs required.

Future studies need to take into consideration these limitations so that they can be designed with a more comprehensive focus or specifically focused to add this highlighted research priority to its objectives in order to revalidate the outcomes of the current study.

As a further step towards analysis of influence of consumer preference on demand and price of food grains, a more rigorous theme should in future be focused on testing the second important theme of hedonic analysis by specifying appropriate demand functions for different qualities of crop commodities in each peculiar population. This second stage Rosen's framework (Rosen 1974) has been tested successfully by earlier researchers in the field of hedonic analysis. If this can be tested in Nigeria, it will help to identify the compelling socio-economic factors that influence demand and price of crop characteristics.

Another important research need is to quantitatively assess the benefits from research costs into crop improvement programmes, using the parameters derived from the current study or similar ones as well as using the magnitude of shifts in demand function between grades to estimate the consumer surplus. This is important for assessing the real impact of research in measurable terms.

More importantly in this study, it has been possible to derive grades for the market samples of grain crops from a one-short assessment (cross-sectional data). In order for this framework to be acceptable, repeated studies over the same population and other sub-populations in Nigeria is called for to test the consistency of the framework over time and space.

In addition, the current framework needs to be balanced along international lines such that African standards for crop grades can be derived for the purpose of international trade relations. As such, repeated studies in other African populations are needed so that all related funding can be amalgamated into a single acceptable standard for related economies of Africa.

In conclusion, this study has underscored the need for marketing standards, in commodity marketing by demonstrating that there is quality responsiveness among consumers. It has also emphasised the need for a two-way feedback system between crop improvement scientists and producers and consumers of agricultural commoditis. Another crucial point is the need for a universal and culturally adaptable system of nomenclature for crop varieties which have been released to farmers and which have been accepted by consumers. It has focused on and shown the relevance of off-farm handling processes on the form and prices of marketed commodites, perhaps much more than the other properties. In spite of all the limitations, the study has shown that there is considerable marketing efficiency and coordination with respect to quality-price relationships in food marketing.

If policy attention is directed to the implications of the findings, it should pave way for even better coordination of the Nigerian Grains Markets.

REFERENCES

Adekanye, T. O. (1987): Agricultural Marketing and Small Farmers in Nigeria. **(In) Nigerian Small Farmers: Problems and Prospects for Integrated Rural Development.**

--------- (1986): Readings in Agricultural Marketing (ed) Longmans Nigeria.

Adelman Irma and Griliches Zvi (1961): "On an Index of Quality Change" Journal of American Statistical Association Vol. 56 pp. 535.

Adeniyi, J. P. (1987b): Costs and Returns in Rice Production Enterprises: An Empirical Study. Journal of Economics and Business Environment Vol. 5, No. 1 - 2 pp. 12 - 23.

Adrian, J. and Daniel, R. (1976): Impact of Socio-Economic Factors on Consumption of Selected Food Nutrients in the U.S.A American Journal of Agricultural Economics, Vol. 58(i), pp. 31 - 38.

Adeyokunnu O. T. (1973): Marketing Margins for Rice in Egba Division in Nigeria (1954 - 1965). Bulletin of Rural Economics & Sociology, Vol 8(2).

---------- Some Remarks on Research into Food Marketing and Food Consumption in Nigeria (Mimeo).

Aken'Ova M.E & Anthonio Q.B.O (1968): The Marketing of Ofada Rice in Ibadan City: A Pilot Survey. Bull. of Rural. Econ & Sociology, Vol. 3.

Akingbohungbe, A. E. (1976): A Note on the Relative Susceptibility of Unshelled Cowpea to the Cowpea Weevil. Tropical Grain Legume Bulletin. No. 5, pp. 11 - 13.

Akinpelu, M. A. (1974): Consumer Preference in Grain Quality of the Cowpea. Samaru Agricultural News 16(1) 7 - 8, 1974.

Aligbe V. E. (1977): The Effects of Some Socio-Economic Factors on Food Nutrient Consumption in Oyo State. M. Phil Thesis, Department of Agric. Econs, U.I.

Allen, R.G.D.(1979) Mathematical Analysis for Economists: The English Language Book Society and McMillan, 1979.

Andrews P. F. (1974): "A Robust Method for Multiple Linear Regression" Technometrics 16, 1974 (523-531).

Anthonio, Q. B. O. (1966): Food Consumption and Income Relationship in Nigeria: Engel's Curve Function. Bulletin of Rur. Econ. & Sociology 2(1) 1966.

---------- (1967): The Supply and Distribution of Yams in Ibadan Markets. N.J.E. Soc. Stud. vol. 9(1) pp. 33 - 49.

---------- (1968) Marketing of Staple Food Crops in Nigeria: A Study in Pricing Efficiency. Ph.D Thesis University of London.

---------- (1984) Marketing Development in Nigeria: A Review of Government Policies in Crop Marketing and Input Distribution in Nigeria, FACU, 1984.

Anthonio Q.B.O. & Adeyokunnu O. T. (1974): The Changing Pattern of African Diets in Relation to Income. Bull of Rural Econ. & Sociology vol. 6, 1971.

Anthonio Q.B.O. & Oni S. A. (1974): An Empirical Analysis of Food Consumption Expenditure in Nigeria: A Case Study of Ibadan. Nig. Journal of Agric, vol. 11, No. 1, 1974.

Arimah, Benedict Chukwuka (1990): An Analysis of Urban Housing Marketing in a Developing Country: Case of Ibadan. Ph.D Thesis, U.I.

Ashraf, M Palada, M. C.; Masajo, T. M. and Wakatsuki, T. (1988): Rice Based Cropping Systems for Inland Valleys and Their Improvement Possibilities in Nigeria. National Farming Systems Research Workshop, Jos, Nigeria, 1988.

Ayoola, G. B. (1987) The Optimal Time Path for Self Sufficiency in Grains: A Production Control Approach. Second Seminar Paper, Department of Agricultural Economics, University of Ibadan.

Bass, Frank J., Pessemer E. A., Lehmann D. R. (1972): An Experimental Study of Relationship Between Attitudes Brand Preference and Choice. Behavioural Science No. 17, pp 532-541.

Bateman, D. I. (1972). **Marketing Management in Agriculture.** Department of Agricultural Economics, University College of Wales, Aberystwyth.

Baumer, S. M. (1978): Development: Why Not Stop the Transfer of Technology, Inter-economics, 1978.

Becker G. S. (1965): A Theory of the Allocation of Time: The Economic Journal Vol. 75.

Beckman, Theodore N. and Buzzell, Robert D. (1955). What is the Marketing Margin for Agricultural Products? J. Market. 19, 166-168.

Belsley D. A, Kuh E, Welsch R. E. (1980): Regression Diagnostic: Identifying Influential Data and Sources of Collinearity. John Wiley and Sons, New York, 1980.

Bender B., Gronberg T. J. & Hwang H.S. (1980): Choice of Functional Form and the demand for Air Quality Rev. of Econs & Stat. Vol. 62. pp 638 - 643.

Benero J. , Gonzales M. A. (1978): The Cooking Characteristic, Eating Quality and Preference of some rice varieties. Journal of Agric of the Univ. of Puerto Rico.

Blackenburg P.V (1962): Rice Farming in Abakaliki Area: A Study of the Process of Introduction of New Crop. NISER Preliminary report.

Bliss G. A.. Lectures on the Calculus of Variations, Chicago Press, 1946.

Bobade O.T. and Fagade S.O (1981): Studies in the Grain quality of some Promising Rice Varieties in Nigeria. N. Journal of Agronomy Vol No 3.

Booker R. H. (1967): Observations on Three Brucchids associated with Cowpea in Northern Nigeria. Journal of Stored Products Research 3 (1967) pp. 1-15.

Box G.E.P. & Tidwel P. (1962): Transformation of the Independent Variables, Technometrics, 1962.

Box G and Cox D (1964): An Analysis of Transformation. Journal of the Royal Statistical Society series B, vol. 26, pp. 211 - 252.

Bressler R. G. (1988) Pricing Raw Products in a Complex Milk Market. Agric. Economics Research 10(4).

Briggs R, Leonard W. A. (1977): Empirical Implications of Advances in Canonical Theory. Canadian Geographer vol. 21.

Brorsen, B. W., W. R. Grant, and M. E. Rister. "A Hedonic Price Model for Rough Rice Bid/Acceptance Markets" **Am. J. Agri. Econ.** 66(1984): 156-163.

Brown A. and Deaton, A. (1972) Models of Consumer Behaviour: A Survey. Econ. J. 82, 1145-1236.

Bucklin, L. P. (1977): Improving Food Retailing in Developing Asian Countries. Food Policy Vol. 2, 1977 pp. 121.

Burk M. C. (1967): Survey of Interpretations of Consumer Behaviour. Journal of Farm Economics, vol. 49, No. 1, 1967.

Butler D. D. (1990): The Effects of Perceived Risk and Subject Knowledge on the search for Consumer Service. Ph.D Thesis Univ. of south Carolina U.S.A.

Buzzell, R. D. (1964) **Mathematical Models and Marketing Management**. Harvard.

Carpenter, E. M., Hinks, C. E. and Perkins, R. J. (1968) **Price Premiums for Quality Beef Steaks**. Department of Agricultural Marketing, University of Newcastle upon Tyne.

Chheder H.R (1972): "Physio-Chemical Properties of Vigna Unguiculata L. (Walp) Influencing Varietal Differences in Culinary Values. Journal of W. African Science Association No. 17 (1972).

Chiang A. C. (1974) Fundamental Methods of Mathematical Economics, McGraw-Hill Book Company, New York, 1974.

Chow, G. C. (1960) Test of Equality Before Sets of Coefficients in Two Linear Regression. Econometrica Vol. 28.

Clark, C. B., and R. G. Bressler. **Prices as Related to Quality on the Connecticut Strawberry Auction**. Bulletin 227, University of Connecticut Agricultural Experiment Station, 1938.

Cooley, W. W. and Lohnes (1971) Multivariate Data Analysis, New York, John Wiley Press.

Court, A. T.(1939): "Hedonic Price indexes with Automotive Examples" **The Dynamics of Automobile Demand**. New York: General Motors, 1939.

Darlington, R. B., Weinberg S. L. & Walberg H. J. (1973): Canonical Variate Analysis and Related Techniques. Review of Educational Research. Vol. 43.

Day, Ralph L. and Parsons, Leonard J. (1971) **Marketing Models: Quantitative Applications**. Intext Educational Publishers.

Delgado, C. L., "Seasonal Price Spreads in Burkina Fasso: Their Predictability and Related Issues", IFPRI/FAO/AID Workshop on Seasonal Causes of Household Food Insecurity, Policy Implications and Research Needs", Annapolis, Maryland, December 10-13, 1985 (Draft).

Dittoh Saa (1994):Market Integration: The Case of Dry Season Vegetables in Nigeria. African Rural Social Sciences Research Networks. Issues in African Rural Development:2 Winrock International Institute for Agric. Dev. Steven A. Breth (ed).

Dovlo, Florence Effue (1974): Preliminary Study of Consumer Preference for Cowpea Variety in the Volta Region of Ghana. The Food Research Institute, Ghana.

Dovlo F. E., Williams C. E. & Zoaka L. (1976): Cowpea: Home Preparation and Uses in West Africa, IDRC 055e 1976.

Dhrymes, P(1971): Price and Quality Change in Consumer Capital Goods: An Empirical Study. in Price Indexes and Quality Change:Studies in New Methods of Measurement. Z. Griliches (ed), Cambridge Harvard Press.

Eastwood, D. "Testing for Constant Marginal utilities of Food Nutrients" **Handbook of Behavioural Economics**, Vol. 2. New York: JAI Press, 1989.

Eastwood, D., M. Gray, and J. Brooker. **Socioeconomic Factors Affecting the marginal Implicit Prices of Food Nutrients.** The University of Tennessee Agricultural Experiment Station, Bulletin 649, 1986.

Eastwood, D. B., J. R. Brooker, and D. E. Terry. "Household Nutrient Demand: Use of Characteristics Theory and A Common Attribute Model" **S. J. Agr. Econ. 18(1986): 235-243.**

Ebong U. U. (1971): Strategies for Cowpea Improvement in Nigeria. Samaru Agricultural Newsletter 13 (1971).

Edgeworth, F.Y (1881): Papers Relating to Political Economy. London: Macmillan.

---------- (1925): Mathematical Physic.

Ega L.A, Olatunde A.F, Nwasike C.C (1992): Acceptability of improved Varieties of sorghum for Consumption in Northern Nigeria. Food and Nutrition Bulletin (U.N). Vol 14 (4). pp. 357 - 361.

Ejiofor M.A.N, Onwubuike S.N, Okafor J,C. (1987): Developing Improved Methods of Processing and Utilization of Kernels of Irvingia Gabonensis. International Tree Crop Journal (UK). Vol. 4 (4).pp 283 - 290.

Elsgoltts L, (1980) Differential Equations and the Calculus of Variation. English Translation Mic Publishers, Moscow.

Engel, James F., Fiorillo, Henry F. and Coyley, Murray A. (1972) **Market Segmentation: Concepts and Applications.** Holt, Rinehard and Winston.

Epple, D.(1987):"Hedonic Prices and Implicit Markets: Estimating Supply Functions for Differentiated Products" **J. Political Econ.** Vol 98 pp. 59-81.

Eppright E.S. (1947): Factors Influencing Food Acceptance, J. Am. Dietetics Ass. Vol 23.

Ethridge D.E and Davis B.(1982) Hedonic Price Estimation for Commodities: An Application to Cotton. The West J. Ag. Ec. Vol 7.

Ezekiel, Mordecai and Karl A. Fox (1959):Methods of Correlation and Regression Analysis, 3rd Edition, John Wiley and Sons, Inc.

FACU (1985): Rice Production in Nigeria. Proceedings of the National Workshop on Rice Production Strategies in Nigeria (ed) Oputa C. O., Nanda J. S, Chaudhary R. C, FACU.

FAO Grain Legumes (1979): Processing and Storage Problems. Food and Nutrition Bulletin (UN) Vol. 1(2).

FAO (1977): Critical Issues on Food Marketing Systems in Developing Countries. Report of the OECD/FAO Joint Seminar. pp. 18 - 22.

Faruk M. O. (1972) The Structure and Performance of the Rice Marketing System in East Pakistan. Cornell Inst. Agric. Bulletin No. 23 New York.

Ferreira V.L.P, Moraes M.A.C, Sales A.M, Carvalho C.R.L (1990): Bamboo Shoots: A food Option. Processing an Acceptability. Coletaneas - Instituto - de - Almentos (Brazil) Vol 20 (2). pp 129 - 143

Fettig L. P. (1963): Adjusting Farm Tractor Prices for Quality Changes. Journal of Farm Economics Vol. 45, pp. 599.

Filani, M. O. (1980): Rice in the Nigerian Economy: A Geo-Economic Analysis. Nigerian Journal of Social and Economic Studies Vol. 22, No. 1.

Fisher, R.A (1936): The Use of Multiple Measurements in Taxonomic Problems. Annals of Eugenics Vol 7.

Friedman, M.(1949): The Marshallian Demand Curve. J. Pol. Econ. Vol.LVII

Follain J. R. (1985a): The Demand for Housing Characteristics in Developing countries. Urban Studies Vol. 22.

---------- (1985b): Estimating the Demand for Housing Characteristics: A Survey and Critique. Regional Science and Urban Economics Vol. 15.

Foote, R. J. and K. A. Fox, (1952): "Seasonal Variation: Methods of Measurement and Tests of Significance", Agriculture Handbook No. 48, USDA, Washington.

Fosu, Kofi Yerfi (1984): Product Characteristics, Socio-Economic Factors and Consumer Choice Among a Class of Seed Technology Products: The Case of Cowpea in Kwara State, Nigeria. M.Phil. Thesis, University of Ibadan.

Fuglie K.O (1991): The demand for Potatoes in Tunisia. social Science Working Paper Series No. 6. International Potato Centre, Peru.

George P. S. (1980): The Changing Pattern of Consumer Demand for Food Grains in India. Indian Journal of Agric. Econs. Vol. 35(1).

Goetz Stephen and Weber Michael T. (1986):Fundamentals of Price Analysis in Developing Countries' Food System: A Training Manual to Accompany the Microcomputer Software Program "MSTAT", Working Paper No. 29.

Goyle A, Gujral S.(1992): Sensory Evaluation of and Acceptability Trials on Biscuits Prepared from Raw and Malted Wheat - Bengal Gram Mixes with or without a Green Leafy Vegetable. Plant Foods for Human Nutrition Vol. 42 pp 291 - 296.

Gray, J. I. (1990): An Experimental Examination of the Effects of order of Presentation on the Formation of Internal Reference Price, Ph.D. Univ. of South Carolina.

Grewal, Dhruv (1989): The Effects of Intrinsic, Extrinsic Cues and Reference Prices on Buyers Perception of Quality and Value. Ph.D Thesis Virginia Polytechnic Institute and State University.

Griliches, Z.(1968): "Research Costs and Social Returns: Hybrid Corn and Related Innovations". J. Polit. Econ. Vol 66 pp 419-431.

-------- (1971): Price Indices and Quality Change. Harvard University Press, Cambridge.

-------- (1971): "Hedonic Price Indexes for Automobiles: An Econometric Analysis of Quality Change" Chpt. 3 in Griliches (ed.) op cit.

-------- (1971):" Hedonic Price Revisited" (in) Price Indexes and Quality Change" Z. Griliches (ed) Cambridge, Mass.

Gifft H. H, Washbon M. B. & Hamson G. G. (1972): Nutritional Behaviour and Change. Prentice Hall, New Jersey pp. 26.

Gusten R. (1967): Studies in the Staple Food Economy of Western Nigeria. NISER, 1967.

Haitovsky Y.(1969): A note on the Maximisation of R^2. The American Statistician Vol.23, pp.20-21.

Hardcastle E. Y. The Development of Rice Production and Research in the Federation of Nigeria Tropical Agriculture Vol. 36, 1959.

Hauser D.P.(1974):Some Problems in the Use of Stepwise Regression Techniques in Geographical Research. Canadian Geographer, Vol. 18, pp. 148-158.

Hays H.M.(1975):The Marketing and Storage of food Grains in Northern Nigeria. Samaru Miscellaneous Paper No. 5 IAR, Nigeria: Ahmadu Bello University.

Hays H.M and McCoy J.H (1978): Food Grain Marketing in Northern Nigeria:Spatial and Temporal Performance. Journal of Development Studies (UK) Vol 14(2) pp 182 - 192

Hays H.M and Rahaja (1977): Economics of Sole Crop Cowpea Production in Nigeria at the Farmers' Level Using Improved Practices Samaru Research Bulletin 286. IAR, ABU, Zaria.

Henault G. M. (1989): The Profitability of Local Food Products: Some Experiences and the Potentiality of Marketing Strategies for Africa (in) Cereals en regions chaudes: Conservation et transformation E.

Henderson, J. M. and R. E. Quandt.(1980): Macroeconomic Theory. McGraw-Hill International Book Co. London.

Hendler, R.(1975): "Lancaster's New Approach to Consumer Demand and Its Limitations" Am. Econ. Review 65: 194-199.

Hjorth-Anderson, C.(1984): "The Concept of Quality and the Efficiency of Markets for Consumer Products" **J. Consum. Res.** 11: 708-718.

Horak J.D (1976): Cotton Pricing according to Fiber Properties. Natural Fibers Economic Research. The University of Texas at Austin, Research Report No 110.

Houthaker H. S. (1951-52): Compensated Changes in Quantities and Qualities Consumed. Rev. Econs Stud, No. 19.pp. 155 - 162

Hyslop S. D. (1970): Price-Quality relationships in Spring Wheat. Min. Agric. Exp. Sta. Technical Bulletin 267.

IITA (1982): IADP Cowpea Acceptability Survey. Unpublished Report.

IITA (1981 - 1984):Grain Legume Improvement Programme. IITA Research Highlights.

IITA (1991): Varietal Improvement of Cowpea Crop Production Training Series.

IITA (1993): Grain Legume Improvement Programme Archival Report 1988 - 1992.

Ilori C. O. (1967): Economic Study of Production and Distribution of staple Foodstuffs in Western Nigeria. Ph.D Dissertation, Food Research Inst. Stanford.

International Grain Legume Information Centre: Cowpeas (Virgna Unguiculata L. Walp) Abstracts of World Literature Vol. 5. 1983 - 1985, IITA.

Iracema Costa Magalhaes (1987): Cowpeas: Abstracts of Brazilian Literature 1903 - 1987. International Grain Legume Information Centre.

IRRI (1991): Rice Grain Marketing and Quality Issues: Selected Papers from the International Rice Research Conference, 1990. South Korea ISBN 971-22-0012-4.

Jones W. O. (1968): The Structure of Staple Food Marketing in Nigeria as Revealed by Price Analysis. Food Research Inst. Studies Vol. 2.

Jordan, J. L., R. L. Shewfelt, S. E. Prussia, and W. C. Hurst (1985):"Estimating Implicit Market of Quality Characteristics of Tomatoes" So. J. Agr. Econ. 17: 139-145.

Jud, G.D and watts J.M (1981):Schools and Housing Value. Land Economics Vol. 57.

Kendall M.G.(1955): Rank Correlation Methods 2nd Ed. Charles Griffin, London.

Kendall M.G. (1968): A Course in Multivariate Analysis. New York, Hagner Publishers.

Bowman Kenneth (1991): Hedonic/Characteristics Price Analysis in Agricultural Economics: Progress, Issues and Needs. Proceedings of an Organized Symposium at the American Agricultural Economics Association Meetings. Kansas State University.

Klecka William R. (1980) Discriminant Analysis: Quantitative Applications in the Social Sciences. Sage University Paper, Sage Publications Series No. 7-19.

Knapp, R.C (1969): A Linear Programming Application to Corn Merchandising M.S. Thesis, Iowa State University.

Kohls R.L and Url J.N (1985):Marketing of Agricultural Products. Sixth Edition. Collier/Macmillan

Koutsoyiannis J. (1973) Theory of Econometrics: An Introductory Exposition of Econometric Methods. The Macmillan Press, London pp. 208.

Ladd, G. W. and Martin, B. M. (1976): Prices and Demands for Input Characteristics. American Journal of Agricultural Economic Vol. 22.

Ladd, G. W. and Suvannunt, V. (1976): A Model of Consumer Goods Characteristics. American Journal of Agricultural Economics.

Ladd, G. W.(1978):Research on Product Characteristics: Models, Applications, and Measures. Iowa State Univ. Agric. and Home Econ. Exp. Sta. Res. Bull. 584. Ames, IA.

Ladd, G. W. (1983) "Survey of Promising Development in Demand Analysis in Economics of Product Characteristics" (in) New Directions in Econometric Modelling and Forecasting in U.S. Agriculture, G.C. Rauser, ed. New York: Elsevier Publishing Co., pp. 17-53.

Ladd, G. W. and M. Zober.(1977):"Model of Consumer Reaction to Product Characteristics" J. Consumer Research 4: 99-101.

Lancaster K. (1966): A New Approach to Consumer Theory. Journal of Pol. Econ. Vol. LXXIV, No. 2. pp. 134-57.

--------- (1966): Change and Innovation in Technology of Consumption. American Economic Review Papers and Proceedings.

Lapin, Lawrence L. Statistics for Modern Business Decisions 2nd edition, Harcourt Brace Jovanovich, Inc, New York. 1978.

Larson A. O.and Fisher C. K. (1938): The Bean Weevil and the Southern Cowpea Weevil in California, U.S.A Tech Bill No. 593.

Lele U. J.(1971): Food Grain Marketing in India: Private Performance and Public Policy. Cornell Univ. Press.

--------- (1967): Market Integration: A Study of Sorghum Prices in Western India. J.F.E. vol. 49(1).

Leontiff W. (1971): Theoretical Assumptions and Non-Observed Factors. Am. Econ. Rev. No. 61.

Lerbenstern H. (1950): Bandwagon, Snob and Veblen Effect in the Theory of Consumer Demand. Quarterly Journal of Economics No. 64.

Lucas, R. E. B. (1975): Hedonic Price Functions. Economic Inquiry 13. pp. 157-78.

Luqman, M. and Quraeshi, Z. A. (1984): Planning for Market Coordination in LDCs: The Role of Channel Participants. Food Policy Vol. 9, No. 2.

Mahalanobis, P. C. (1936) "On the Generalized Distance in Statistics" Proceedings of the National Institute of Science, India 12: 49-55.

M.A.N.R/IDRC (1974/75): Consumer Preference Network Study for Cowpea in West Africa.

Mangahas, M. et. al (1966) Market Relationships for Rice and Corn in the Philippines. Journal of Farm Econs. Vol. XLVIII.

Margolius, A. and D. S. Tiley (1982):"Implicit Prices for Juice and Drink Characteristics" Paper Presented at AAEA Annual Meetings, Logan, Utah.

Marshall, A(1920): The Principles of Economics:An Introductory Volume. Macmillan.

Martin, M.B.(1974): An Economic Analysis of Quality Grading in Corn Marketing. Ph.D Thesis, Iowa State University.

Maureen L. Cropper, Leland B. Deck, and Kenneth E. McConnell (1987):On the Choice of Functional Form for Hedonic Price Functions (Discussion paper QE87-08), Resources for the Future. Washington, D.C.

Mayo S.K and Malpezzi S.(1984): A Comparative Analysis of Housing Demand in Developing Countries. World Bank Water Supply and Urban Development Dept. Discussion Paper No. 41.

Megbolugbe I and Frank J.(1987): The specification of Hedonic Indexes for Housing in Florida (Mimeo) Dept of Urban and regional Planning, Florida State Univ. Tallahassee.

Michael, Robert T. and Baker, Gary S. (1973): On the New Theory of Consumer Behaviour. Swedish Journal of Economics No. 75.

Mijindadi, N. B. and Njoku, J. E. (1985): Adoption of New Farm Technologies by Agric. Cooperative Societies in Kano, Nigeria" International Journal of Dev. Tech. Vol. 3 pp. 211 - 216.

Morrison D. G. (1974) On the Interpretation of Discriminant Analysis. Journal of Marketing Research.

Nanda J.S and Chaudhary R.C (1985):Overview of the Special Rice Production Programme and Role of ADPs in Nigeria. (in) Rice Production in Nigeria. Oputa C.O, Nanda J.S and Chaudhary R.C (eds) FACU.

NCRI Annual Reports (1988 - 1990).

NCRI (1995): Rice Research programme Report, Annual Review Meeting.

NCRI (1995): Oilseed Research Programme, Annual Review Meeting.

Nie N. et. al (1975) SPSS Statistical Package for the Social Sciences, New York, McGraw Hill.

Federal Min. of Agriculture (1980):The Green Revolution: A Food Production Plan for Nigeria. Study Conducted by Food Strategies Mission.

Nigeria, Green Revolution Committee.(1983): Achievements of the Green Revolution Programme 1980 - 1983.

NISER (1985): Nigerian Food Balance Sheet. Fed. Min. Of Agric.

Njoku, J. E. (1988): Costs and Returns of Rice Production Under Alternative Production Systems: Paper Presented at the National Farming Systems Workshop.

Norton G. W. and Davis, S. S. (1981): Evaluating Returns to Agricultural Research: A Review American Journal of Agricultural Economics

Nwanze K. F. and Horker C. W. (1975): Evidence for Oviposition Preference of Callosobruchus Maculatus for Cowpea Varieties. Environmental Entomology No. 4

Nyanteng, V. K. (1987): Rice Situation in West Africa: Consumption, Inputs and Production Projections to the Year 2000. WARDA, Monrovia.

Ogunfitidimi, Titus Ola (1986): Analysis of Factors Limiting Agricultural Extension Services in Ghana and Nigeria. African Journal of Agric. Sciences, Vol. 13 (no. 1 & 2).

Ojomo O. A. and Chheder H. R. (1968): Criteria for Consumer Acceptance of Cowpea in Western Nigeria, Western State Agric. Research Memo 50.

Olayemi J. K. & Olayide S. O. (1981):Elements of Applied Econometrics, CARD Publishers.

Olayemi J. K. (1973) Rice Marketing and Prices: A Case Study of Kwara State of Nigeria. Bulletin of Rural Economic and Sociology, Vol. 8(2).

-------- (1975) A Statistical Analysis of Price Spreads for Some Nigeria Food Commodities. W. A. Journal of Agric. Econs. Vol. 3(2).

Olomola, A. S. (1990) Loan Transaction Costs and Repayment Performance of Small Scale Farmers in Ondo State of Nigeria. Ph.D Dissertation, University of Ibadan.

Olufokunbi B. (1984) Food Prices and Inflation in Nigeria: Implication for Self Reliance in Agricultural Production (in) Self Reliant Strategies for National Development, Nigerian Economic Society 1984 (2 volumes).

Oni S.A and Ikpi A.E (1980):Rice Production, Marketing and Policy in Nigeria. WARDA Occasional Paper No. 3.

Onyemelukwe J. O. (1970): Staple Food Trade in Onitsha: An Example of Urban Distribution function. Ph.D Thesis, Ibadan.

Ordonez, C. R., Camdessus M. C. et. al. (1992) Chemical Composition and Cooking Quality of Sweet Potato. Journal of Agriculture of the University of Puerto-Rico Vol. 76 (3-4)

Osifo D. E.(1971): Economics of the Rice Industry of the Western State of Nigeria, NISER.

Osuji, L. O. (1974) Analysis of Rice Marketing Margin in Egba Division of the Western State of Nigeria. M.Sc. Dissertation, University of Ibadan.

Osuntogun A. (1972):Improving the Marketing of Food Crops in West Africa Through the Development of Farmers Cooperatives. W. A. Journal of Agric. Econs, Vol. 1(1).

Palmquist, R. B.(1984):"Estimating the Demand for the Characteristics of Housing" Review Econ. and Stat. 66: 394-404.

Perrin, R. K.(1980):"The Impact of Component Pricing of Soybeans and Milk" Am. J. Agri. Econ. 62: 445-55.

Pindyck, R. S. and D. L. Rubinfeld (1981):Econometric Models and Economic Forecasts McGraw-Hill Book Company, New York, 2nd Edition, 1981.

Puttock, G. D., D. M. Prescott and K. D. Meilke: Stumpage prices in South-western Ontario: A Hedonic Function Approach, Dept. of Agricultural Economics and Business, University of Guelph.

Quandt Richard E. (1956): "A Probabilistic Theory of Consumer Behaviour" Quarterly Journal of Economics, pp. 507-36.

Raju V.R, Jagannathan A, Rao R.S (1990): Performance of Scented Rice (Oryza sativa) Varieties under Different Levels of Nitrogen in Andhra Pradesh. Ind. Journal of Agr. sciences Vol 60 (10) pp 694 - 696.

Rao, C. R. (1965) Linear Statistical Inference and Its Applications. New York: John Wiley.

Rao S.P (1987): Grain Grades in Relation to Seedling Growth and Productivity. IRRI Newsletter Vol 12 (1) pp. 6

Rasmussen D. W. and Zuehlke T. W. (1987): "On the Choice of Functional Forms for Hedonic Price Function. Research Paper, Department of Economics, Florida State University, Tallahassee.

Rheenen H. A. Van (1979): The Diversity of Food Beans in Kenya. Economic Botany (USA) Vol. 33(4) pp. 448-454.

Rizvi, Munear Ah Sha (1990): Analysis of Structure, Conduct and Performance of Date Marketing System in Sund-Pakistan. Ph.D. Thesis Queens University, Belfast.

Rosen, S. (1974): Hedonic Prices and Implicit Markets: Product Differentiation in Pure Competition. Journal of Political Economy, 82 pp. 34 - 55

Samuelson Paul. A. (1948): "Consumption Theory in Terms of Revealed Preference" Econometrica No 15: pp. 243-53.

Singh B.n and Ibrahim T.S (1991): Survey of Rice Quality Preferences and Use in Bida and Environs, Niger State, NCRI, Nigeria.

Scobie, G. M.(1976):"Who Benefits from Agricultural Research?" Review of Marketing and Agric. Econ. 44: 197-202.

Scott F. S., Osman G & Kanda M. (1984): Characteristics of Consumer Demand for Roasted Macadamia Nuts. Research Series, Hawaii Inst. of Trop. Agric. & Human Resources No. 034.

Scott F. S., Yeap T. C. (1984): Characteristics of Consumer Demand for Bananas in Honolulu. Research Series, Hawaii Inst. of Trop. Agric. & Human Resources No. 031.

Shepherd, G. S.(1963):Agricultural Price Analysis, Iowa State University Press, Ames, Iowa, 5th Edition.

Singh A.S.R and Emechebe A. M. (1986) World Cowpea Research Conference: Country Reports. Tropical grain Legume Bulletin No. 32 IGLIC, IITA.

Smirl C. A. and L. Zoaka (1987a): Consumer Preference for Cowpea in Maiduguri.

Smith D. C. (1989): Creating Synergy Across Product Lines: The Roles of Shared Marketing Operating Resources (SMOR) and Brand Reputation or shared Consumer Knowledge (SCK) Ph.D Thesis, Univ. of Pittsburgh.

Southworth Hermann (1961): Discussion: The Function of Grades in an Affluent, Standardized Quality Economy. Journal of Farm Economics Vol. 43.

Stigler, G. J. (1966): The Theory of Price. Collier Macmillan Press.

Stone, R (1954):The Measurement of Consumer's Expenditure and Behaviour in the United Kingdom, 1920 - 1938. Cambridge University Press.

Sufian A.M (1993): A Multivariate Analysis of the Determinants of Urban Quality of Life in the World's Largest Metropolitan Areas. Urban Studies. Vol. 30, No. 8.

Sutcliffe J.P (1984): Role of Rice Production in the Phased ADP Programme. Mimeograph.

Tatsuoka, M. M. (1971) Multivariate Analysis. New York: John Wiley.

Tatsuoka, M. M. and Tiedeman, D. V. (1954) Discriminant Analysis. Review of Educational Research 25: 402-20.

Taylor, F. (1916): "Relation Between Primary Market Prices and Qualities of Cotton" USDA Bull. No. 457, Nov. 24.

Terry, D. E., J. R. Brooker, and D. B. Eastwood(1985): "Characteristics Theory and Household Demand for Food Nutrients" University of Tennessee Agricultural Experiment Station, Bulletin 639, Oct. 1985.

Theil, M. (1952-53): Qualities, Prices and Budget Enquiries. Review of Economic Studies No. 19 pp. 129-47.

Timmer, C. Peter,(1974):"A Model of Rice Marketing Margins in Indonesia", Food Research Institute Studies, Vol, XIII, No. 2, pp. 145-167.

Tomek, W. C. and Robinson K. L. (1979): Agricultural Product Prices: Cornell University Press.

Turley, l. W. (1989): An Empirical Analysis of Price-Quality Relationship in Services. Ph.D Thesis Univ. of Kentucky.

United States Department of Agriculture, Federal Grain Inspection Service.(1978):The Official United States Standards for Grain. Washington, D.C. pp 3.1-3.11.

U.N. FAO (1975): FAO Rice Report 1974/75. Rome.

Unnevehr L. J. (ed)(1992): Consumer Demand for Rice Grain Quality: Terminal Report of IDRC Projects. National Grain Quality (Asia) and International Grain Quality Economics (Asia) IRRI, Manila.

Unnevehr L. J., Juliano B. O., Perez C. M. & Marciano E. B. (1988): Consumer Demand for Rice Grain Quality in Thailand, Indonesia and the Philippines, IRRI Research Paper Series.

Vaidehi M.P, Bharat P, Reddy L. (1985): High Protein Biscuits Made With Ragi Flour and Seed Flour Blends. Food and Nutrition Bulletin (UN) Vol 7 (4) pp. 61 - 64.

Veeman, M. M.(1987):"Hedonic Price Functions for Wheat in the Work Market: Implications for Canadian Wheat Export Strategy". Can. J. Agric. Econ. 35: 535-52.

Van De Geer (1971) Introduction to Multivariate Analysis for the Social Sciences. San Francisco W.H. Freeman.

Wachtel, H.M and Betsey C.(1972):Employment at Low Wages. Rev. of Econ. and Statis.

Walras, Leon (1954): elements of Pure Economics. Homewood Ill.: Irwin Press.

Waugh, F. V. (1928): Quality Factors Affecting Vegetable Prices. Journal of Farm Economics, Vol. 1.

---------- (1929): Quality as a Determinant of Vegetable Prices. New York Columbia University Press.

Welsch D.(1965):Response to Economic Incentives by Abakaliki Rice Farmers in Eastern Nigeria. J. F. E. Vol. 47.

----------(1963): Rice Marketing in Eastern Nigeria, Food Research Institute Studies.

Weston, H.(1976):"The Estimation of Marketing Efficiency", European Journal of Marketing, Vol. 10, No. 5, pp. 218-239.

Williams C. E. (1974): A Preliminary study of Consumer Preferences in the Choice of Cowpea in Western and Kwara States Headquarters and Areas of Nigeria. Department of Agric. Economics and Extension, Univ. of Ibadan.

Wilson, W. W.(1984): "Hedonic Prices in the Malting Barley Market" West J. Agri. Econ. 9: 29-40.

Wilson, W. W. and J. Crabtree. "Price/Quality Relationships in the Malting Barley Market" Agricultural Economics Report No. 168, Department of Agricultural Economics, North Dakota State University, Fargo, June 1983.

Witte A. D, Sumka H. J. and Erekson H. (1979): An Estimate of a Structural Hedonic Price Model of the Housing Market: An Application of Rosen's Theory of Implicit Markets. Econometrica Vol. 47.

Weymar, F. H. (1966): The Study of Storage Revisited. American Economic Review.

Wold H. and Jureen L.(1953): Demand Analysis: A Study in Econometrics. Wiley Publications in Statistics. John Wiley and Sons Publishers.

Ya-Lun Chou (1975): Statistical Analysis with Business and Economic Application. Holt, Rinehart & Winston.

Yetneberk S. (1991): Uses of Chick Pea, Lentil and Faba bean in Ethiopia (in) Uses of Tropical Grain Legumes. Proceedings ICRISAT.

APPENDIX 4.1

SURVEY SCHEDULE

CONSUMER DEMAND SURVEY 1993

I GENERAL INFORMATION Date: . . . .

1. Name of enumerator . . . .

2. Name of market .... 3. Location (town) . . . .

4. Crop . . . .

5. Crop Variety . . . .

5a. Price per Mudu/Kongo/Tin . . . .

II BUYER'S PERSONAL DATA

6. Gender/Sex ....Male (0) ....Female(1)

6a. Age . . . .

7. Literacy Level:

State highest qualification .... or Highest number of years of western education

0 None
2 Between 6 and 10 years
1 Less than 6 years
3 Greater than 10 years

8. Occupation . . . .

or Please indicate to which of these groups you belong (Tick one)

1 Office worker in Government Sector

(includes Teachers,Lecturers, Researchers)

2 Office worker in private sector

3 Self employed professional

(e.g Lawyers, Doctors, Accountants, Engineers, etc)

4 Trader/Business Man-Woman

5. Artisan (Tailor, Carpenter, Mechanic, Journeyman, etc)

6. Farmer

7. Others (specify) . . . .

9. Position at work . . . .

(State specific post held or indicate which cadre you belong)

1. Lower/Junior Staff Cadre

2. Middle/Intermediate Cadre

3. Top Management/Senior Staff Cadre

10. Name of working place . . . .

11. Location of working place (Distance from home km) ....

12. Personal Income [#] (Per wk/mth) ....

State Grade level of Govt. Employee ....

or which income bracket you belong (Tick One)

1 #500 and below per month

2 #500 - #1000 per month

3 #1000 - #2000 per month

4 #2000 - #5000 per month

5 Greater than #5000 per month

III HOUSEHOLD DATA

13. Position/Status of Buyer within household . . . .

(Tick one of the following)

1 Housewife

2 Male/Head of Household

3 Female Head of Household

4 One of the Children or Relations of Household

5 Paid Househelp

14. Spouse's Age . . . .

15. Spouse's Literacy Level: State Highest Qualification .....

or number of years of Western Education.

0 None

1 Less than 6 years

2 Between 6 and 10 years

3 Greater than 10 years

16. Spouse's Occupation ....

Indicate which of these groups your spouse belongs (Tick one)

1 - Office worker in government sector (Teachers, Lecturers, researchers, etc)

2 - Office Worker in Private Sector

3 - Self employed Professional (Lawyer, Doctor, accountant, engineer, etc)

4 - Trader/Business Man-Woman

5 - Artisan (Tailor, Carpenter, Mechanic, Journeyman, etc)

6 - Farmer

7 - Others (specify) ....

17. Spouse's Position at Work ....

Or State specific post held or indicate which cadre you belong

1 - Lower/Junior Staff Cadre

2 - Middle/Intermediate Cadre

3 - Top Management/Senior Staff Cadre

18. Spouse's income [#] (Per wk/mth) . . . .

(tick beside your own Q 12)

19. Average amount Spent on Food [#] (Per wk/mth) .... by the household.

Fresh and dry foodstuff [#] . . . .

Meats, Fish, Eggs, Etc [#] . . . .

Provisions (sugar, tea, bread, milk, etc) [#] . . . .

Others [#] . . . .

OR

Gross estimate of food budget . . . .

(Per week/Month)

20. Number of children and adults: . . . .

(Please give names, sex and age of members of the household)

Name	Sex	Age	Name	Sex	Age

OR

Indicate number of people belonging to each of these categories

Adults (Males) above 18 years . . . .

Adults (Females) above 18 years . . . .

Children between 10 and 18 years . . . .

Children between 5 and 10 years . . . .

Children below 5 years . . . .

OR

No. of people in the household: Adults .... Children . . . .

Age of youngest child . . . .

Age of oldest child . . . .

Age of youngest Adult (above 18) . . . .

Age of oldest adult . . . .

21. Ethnic group of husband (i) . . . .

wife (ii) . . . .

22. Length of Residence in Present City (yrs) ....

23. Commonest food options for crop (i) . . . .

(ii) .... (iii) . . . .

24. Which of the ethnic cultures above influences your food habit most. (Tick one)

1 - Husband's

2 - Wife's

3 - Culture of our place of residence

IV **MARKETING DATA**

25. Quantity of grain purchased today . . . .

26. Price paid today per measure . . . .

27. Price of next preferred grain type . . . .

28. How long will this stock last? ....weeks/months/days 29. Mention the 3 most important characteristics of this crop to you which you look out for when purchasing, in order of importance:

(Enumerator should please identify the characteristics being mentioned from the list below and number in order of importance to this respondent)

Number	Characteristics
-	Grain Colour
-	Grain Shape
-	Grain size
-	Dryness/swelling ability
-	Cooking time (Time taken to soften)
-	Absence of dirt/foreign matter
-	Absence of Moulds or Pest infected grains
-	Degree of broken grains
-	Grinding/Blending ability

APPENDIX 4.2

Evaluation Process for Grain Quality

(Adapted From IRRI Grain Evaluation System)

I. Grain Shape

(a) Configuration or Length-Width Ratio (mm)

(b) Grain Length -The distance from end to end of panicle of milled grain (**applicable only to Rice**) (mm)

Instrument: Micrometre Gauge.

II. Grain Size

Average weight (mg) of 10 randomly selected 100-seed samples from each grain lot. (SW100)

Instrument: Analytical Balance.

III. Grain Colour

Rice: The indicator is the degree of translucency or chalkiness of the grain. (CHLK). This estimates ranked proportions of chalkiness parts of randomly selected grains selected from one kilogram lot of each grade. The equation used is based on ranked grades of 9, 5, 3, 1, 0 which expresses, in decreasing order, the chalky portions as follows:

$$\frac{9n + 5m + 1j + 0k}{n + m + j + k} \times 100\%$$

where n, m, j, k are the number of grains falling into each rank (above).

The standard instrument is a Kette's Whiteness matter, an Optical instrument.

COWPEA

The indicator is the testa colour (STC), which is scored as follows:

Brown	**Light Brown**	**White**	**Speckled**	**Variable**
1	3	5	7	9

IV. Grain Purity

Degree of Mouldiness (GPT1) is the indicator which expresses the percentage of mouldy grains in about 10 random 100-grain samples selected from one kilogram lot.

Degree of Pest Infestation (GPT2) is measured as the percentage of grains in about 10 randomly selected 100-grain samples from one kilogram lots which have signs of weevil attack. (Applicable only to cowpea).

Adulteration Level (ADT or GPT3) is the percent of impure grains in the sample. (Applicable to cowpea).

V. Milling Quality

A mechanical Grain Separator/Grader which works on centrifugal mechanism is used in separating 100gm samples of rice or cowpea into whole grain, broken grains and foreign matter.

MLQ1 - Foreign matter content. The weight of the foreign matter component is expressed as a percentage of the weight of the 100gm lot.

MLQ2 -Percentage Brokens

The same principle as above is used except that instead of working with the foreign matter, we now work with the broken grains. (Applicable only to rice).

VII. Swelling Ability

The indicator for this is the moisture content percentage. A heat application process helps to get differential weight of normal sample and moisture component of the sample.

In this study, a culinary method was adapted. A given volume of each sample was cooked over uniform heat of 150° until the grain just disintegrates under a one kilogram lead-weight. The volume yield expresses the swelling ability of the sample.

VIII. Cooking Quality

Cooking Time: For cowpea, this is determined by the time it takes (secs) for the grain to soften from the above operation.

APPENDIX 4.3

Local and Generic Identity of Rice Samples in the Study Area

Serial No	South West		South East		North East	
	Local Name	Genetic Name	Local Name	Genetic Name	Local Name	Genetic Name
1	Agric	ITA 150	Lafia	FARO 35	Dan Nguru	FARO 29
2	Otukpo I	FARO 15	Akaeze I	FARO 11	Dan KuduI	FARO 15
3	Otukpo II	FARO 15	Lafia	FARO 26	Dan Turai	FARO 24
4	Kotangora I	FARO 36	AkaezeII	FARO 11	Dan Gashua I	Glaberrima
5	Gongola	ITA 257	AkaezeIII	FARO 11	Dan Gashua II	Glaberrima
6	Ilesa	FARO 29	Mass	FARO 8	Dan KuduII	FARO 15
7	Donga	FARO 9			Dan Gashua III	Glaberrima
8	Ofada	FARO 11			Dan Gashua IV	Glaberrima
9	Mokwa	FARO 11			Dan Biu	FARO 2
10	Zaria	EX CHINA			Yari Cameroon	EX CHINA
11	Minna	FARO 35			Dan Gashua V	Glaberrima
12	Imesi	FARO 11			Dan HausaI	LOCAL
13	Kotangora II	FARO 36			Gongola	ITA 257
14					Dan Jajimaji	LOCAL
15					Yari kashi	FARO 36
16					Dan HausaII	LOCAL

Source: Field Survey, 1993

APPENDIX 4.4

Names of Cowpea Samples in the Study Areas (Local Names only)

	South West	South East	North East
e1	Drum I	Brown I	Jango
e2	Drum II	Iron	Farin Wake
e3	Sokoto I	Isiocha I	Adapo
e4	Kaura I	Potiskum	Aloka I
e5	Mala	Oloka	Aloka II
e6	Oloo	Isiocha II	Dan Gargajiya
e7	Oloo	Brown II	Dan Chad
e8	Sokoto II	Sokoto	Dan Racha
e9	Kaura II	Brown III	Dan Karadua
e10	Sokoto III	Ak'n'ukwa	Dan Gololo
e11	Mala I	Ak'n'ukwa Mesuga	Jagua

Source: Field Survey, 1993

APPENDIX 4.5

Distribution of Grain Samples

	Total Sample Size	No. of Genetic Breeds	Clones	Other Variants
Cowpea				
Ibadan	11	6	4	1
Enugu	12	7	3	
Nguru	11	6	4	1
Rice				
Ibadan	13	6	-	7
Enugu	6	3	-	4
Nguru	16	4	-	12

Source: Field Survey, 1993

APPENDIX 4.6

Cross-Identity of Rice Varieties

Genetic Name	South West Local Name	South East Local Name	North East Local Name
ITA 150	Agric	-	-
ITA 257	Gongola	-	Gongola
FARO 15	Otukpo	-	Dan Kudu
FARO 35	-	Lafia	-
FARO 29	Ilesha	-	Dan Nguru
FARO 11	Ofada	Akaeze	-
FARO 36	Kotangora	-	Yari Kashi
FARO 8	-	Mas	-

Source: Field Survey, 1993

APPENDIX 4.7

Cross-Identity of Cowpea Varieties

South West Local Name	South East Local Name	North East Local Name
Drum	Brown I	Dan Gargajiya
Drum II (Botoro)*	Brown II	Dan Racha
Sokoto I	Sokoto I	Dan Sokoto I
Sokoto II*	Sokoto II	Dan Sokoto II
Sokoto III*	Ak'n'ukwa	Adapo
Kaura (White)	Oloka I	Aloka I
Kaura I (Dark)	Oloka II	Aloka II
Oloo I	Potiskum I	Jangua
Oloo II*	Potiskum II*	Dan Karadua
Oloyin	Mesuga	Dan Chad
Mala	Iron	Dan Gololo
Drum III	Brown III*	-
-	Isiocha	-

Source: Field Survey, 1993

* Additional lots of the same variety with very different handling properties. Usually highly adulterated with a mixture of its original sample varieties or some other variety. Sokoto III is usually a high mixture of the 2 Sokoto varieties (smaller seeds) and brown varieties.

APPENDIX 5

STATISTICAL VALIDATION OF RESULTS

TEST OF CONSTANCY OF IMPLICIT PRICES ACROSS SUB-MARKETS

This employs the Chow-Test and compares values of ß and intercept between paired groups using the F-Contingency Table to assess their SSEs as follows:

$$\text{F-calculated} = \frac{(SSE_F)/K}{(SSE_n)/n_1+n_2-2K}$$

where $SSE_F = SSE^* - SSE_n$

SSE^* = Pooled sample variance of error

$SSE_n = SSE_1 + SSE_2$ from 2 paired functions

K = No of parameters (independent variable

N_1 = Sample size of first market

N_2 = Sample size of second market

F-tabulated is compared at $(n_1 + n_2 - 2K)$ $(n_1 + n_2 - K)$ d.f at 1%, 5% and 10% level of significance.

Reject Ho if f-calc < f-tab.

RESULTS

Cowpea

Ibadan and Enugu

$SSE^* = 0.0041$

$SSE_n = (0.00012 + 0.000099)$

$= 0.00012$

$SSE_F = 0.00379$

$$F\ calc = \frac{0.000379}{0.00012/3} = 9.475$$

F-tab at (3, 13) d.f = 27.05 at 1% L.S
8.75 at 5% L.S
5.22 at 10% L.S

F-calc < F-tab only at 1% L.S

Ibadan and Nguru

$SSE_n = 0.00012 + 0.0000$

$= 0.00012$

$$F\ calc = \frac{0.000379}{0.00012/2} = 6.3166$$

F-tab at (2, 12) d.f = 99.42 at 1% L.S
19.41 at 5% L.S
9.41 at 10% L.S

Enugu and Nguru

SSE_n = 0

F calc = 0

This is less than 1 which is the lowest of all tabulated values of F

RICE

Ibadan and Nguru

SSE* = 0.00856

SSE_n = 0.00826

SSE_F = -0.0064

$$F^* = \frac{-0.0064/11}{0.00826/7} = 0.4930$$

F-tab at (7, 18) d.f = 6.16 at 1% L.S
3.34 at 5% L.S
2.59 at 10% L.S

CONSTANCY OF INTERCEPTS

COWPEA

Ibadan and Enugu

b_o* = 5.5725

$b_o n$ = 0.0069 + 17.6943

F calc = $\frac{5.5725}{17.7012}$ = 0.3148

Ibadan and Nguru

$b_o n$ = 0.0069 + (-7.0561)

= 0.7905

Enugu and Nguru

$b_o n*$ = 17.6943 - 7.0561

F calc = 0.5238

F-tab at (4, 23) d.f = 13.39 at 1% L.S
5.77 at 5% L.S
3.83 at 10% L.S

Ibadan and Nguru

b_o* = 7.3598

$b_o n$ = 25.4469 + 5.5816

F calc = 0.2372

F-tab at (3, 17) d.f = 26.87 at 1% L.S
8.66 at 5% L.S
5.18 at 10% L.S

APPENDIX 6

STATISTICAL VALIDATION OF RESULTS

APPENDIX 6.1

CHOW TEST OF DIFFERENCES IN RESIDUALS OF POOLED AND DISAGGREGATED DATA

$$F += \frac{\frac{(SSR_A - SSR_B)}{(A-B)}}{\frac{SSE_A}{(N-A)}}$$

where:

SSR_A	=	Regression sum of squares from pooled equation
SSE	=	Residual sum of square of the pooled equation
SSR_B	=	Sum of SSR from the disaggregated data
N	=	Number of sample
n	=	Number of submarkets
A	=	Number of variables
B	=	Number of non-dummy variables

COWPEA MARKETS

$$Computed\ F = \sum \frac{unexplained\ var\ of\ pooled}{unexplained\ var\ of\ 1,\ 2,\ 3}$$

The total unexplained variance from the sub market equations

= 0.001 + 0.0025 + 0.0018

The total unexplained variance of the pooled market equation

= 0.004

Computed F-Ratio $= \frac{0.004}{0.0053} = 0.755$

Tabulated F at (N-k-n)(n+1) d.f on standard F-Contingency table Tabulated F-Ratio at (4,20) d.f = 2.87 at $P < 0.05$

3.17 at $P < 0.10$

Computed F < Tabulated F. We reject H_o i.e. there is significant difference between the unexplained variance of the pooled and disaggregated data.

RICE MARKETS

The total unexplained variance from the sub market equations

= 0.00286 + 0.00001 + 0.00054

= 0.00341

The total unexplained variance of the pooled market equation

$$= 0.01856$$

$$\text{Computed F-Ratio} = \frac{0.01856}{0.00341} = 5.4428$$

Tabulated F at (35-3-1, 35-n-1) d.f on standard F-Contingency table Tabulated F-Ratio at (4,22) d.f = 2.87 at $P < 0.05$

3.17 at $P < 0.10$

Computed F < Tabulated F. We reject H_o i.e. there is significant difference between the unexplained variance of the pooled and disaggregated data.

APPENDIX 6.2

TESTING OVERALL SIGNIFICANCE OF THE COEFFICIENT OF THE DUMMY VARIABLES (F-TEST)

The computed F-ratio for this test is

$$F* = \frac{(SSR_A - SSR_B)/A-B}{(SSE_A)/(N-A)} = \frac{R_A^2 - R_B^2}{(1-R_A^2)} \cdot \frac{(N-A)}{(A-B)}$$

where

SSR_A	=	Regression sum of squares of equation with dummy
SSR_B	=	Regression sum of equation
SSE_A	=	Error sum of squares of full equation
A	=	Total number of variables
B	=	Number of non-dummy variables only
N	=	Number of observations of entire sample with F-distribution having (A-B), (N-A) d.f.

The results are shown below.

APPENDIX 6.3

PARAMETER ESTIMATES OF FUNCTIONS WITH AND WITHOUT DUMMY VARIABLES (COWPEA)

	Equation With Dummy D_1 & D_2	Equation Without Dummy Variables
R^2	0.785	0.869
Coefficient of D_1	0.133*	
Coefficient of D_2	0.099**	
Intercept	4.556***	4.663***
SSE	0.0415	0.01129
SSR	0.0065	0.0086
DF	(2,22)	

Calc F-Ratio = 0.556
Tab F-Ratio = 4.05 ($P < 0.05$)
= 7.43 ($P < 0.01$)

APPENDIX 6.4

PARAMETER ESTIMATES OF FUNCTIONS WITH AND WITHOUT DUMMY VARIABLES (RICE)

	Equation With Dummy D_1 & D_2	Equation Without Dummy Variables
R^2	0.47	0.90
Coefficient of D_1	0.214	-
Coefficient of D_2	-0.508***	-
Intercept	380.36	439.14
SSE	0.017	0.026
SSR	0.0316	0.003
DF	(2,21)	

Calc F-Ratio = 3.676
Tab F-Ratio = 4.30 ($P < 0.05$)
= 7.95 ($P < 0.01$)

APPENDIX 8.1

STANDARD ERROR OF PREDICTION

The standard error of the predicted values of the dependent variable (SEPRED) is estimated as

$$S_{\hat{p}} = S\sqrt{\frac{\frac{1}{N} + (X_o - \bar{X})^2}{(N - 1)S_x^2}}$$

where:

S	=	Standard Error of P form all cases
N	=	Number of observation
X_0	=	Mean value of X at 0 value of P

APPENDIX 8.2

MAHALANOBI'S DISTANCE

This parameter (D) measures distance of cases from average values of the independent variables' residuals (absolute values). it is estimated as the square of standardized value of the variance of the variable as follows:

where

$$D = \sum \frac{(X_K - \bar{X})^2}{S*}$$

X_K = Value of the independent variable for case K

X = Average value of the variable over all cases

$S*$ = Standardized variance of the variable

Values obtained for the cowpea and rice markets are indicated in Tables 8.1 and 8.2.