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AGE 205

INTRODUCTION TO AGRICULTURAL ECONOMICS



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Course code: AGE 205

Course title: Introduction to Agricultural Economics

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Series 1: Scope and Methodology of Economics

- **Part 1.1: Meaning and Definition of Economics**

- Sub Part 1.1.1: Definition and key concepts of economics
- Sub Part 1.1.2: Agricultural economics as a branch of economics
- Sub Part 1.1.3: The problem of scarcity and choice

- **Part 1.2: Branches and Scope of Economics**

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- **Part 1.3: Methodology of Economics**

- Sub Part 1.3.1: The scientific method in economics
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- **Part 1.4: Basic Economic Concepts**

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Introduction

Economics is the social science that studies how individuals, households, firms, and governments allocate scarce resources among competing uses to satisfy human wants. In agriculture, these questions have immediate practical importance: how much land to allocate to maize versus cassava, how much fertiliser a farmer should apply to maximise profit, or what price the government should set for paddy rice are all fundamentally economic decisions. Understanding the scope and methodology of economics provides the analytical framework that underpins all subsequent topics in this course.

This Series introduces the definition and key concepts of economics, its major branches, the distinction between agricultural economics and general economics, the scientific method and modelling approach used by economists, and the basic concepts of opportunity cost, marginal analysis, and economic systems. These foundations are essential for applying economic reasoning to the production, marketing, and consumption problems faced by Nigerian farmers, agribusiness operators, and policymakers.

Series Learning Outcomes

Upon completing this Series, you should be able to:

- **SLO 1.1** define economics and agricultural economics and explain the central problem of scarcity and choice (Linked to Part 1.1),
- **SLO 1.2** distinguish between microeconomics and macroeconomics, and between positive and normative economics, and describe the scope of agricultural economics (Linked to Part 1.2),



- **SLO 1.3** explain the scientific method as applied in economics, describe the role of economic models, and identify sources of agricultural economic data in Nigeria (Linked to Part 1.3), and
- **SLO 1.4** define opportunity cost, explain the production possibility frontier, apply marginal analysis to simple agricultural decisions, and describe the main economic systems (Linked to Part 1.4).

1.1 Meaning and Definition of Economics

1.1.1 Definition and key concepts of economics

Economics has been defined in various ways by different schools of thought. Alfred Marshall (1890) defined economics as the study of mankind in the ordinary business of life; it examines that part of individual and social action which is most closely connected with the attainment and use of the material requisites of wellbeing. Lionel Robbins (1932) offered the most widely cited modern definition: economics is the science which studies human behaviour as a relationship between ends and scarce means which have alternative uses. Paul Samuelson defined economics as the study of how people and society choose to employ scarce productive resources that could have alternative uses to produce various commodities and distribute them for consumption, now or in the future, among various persons and groups in society.

Three key concepts run through all these definitions. Scarcity: resources (land, labour, capital, and entrepreneurship) are finite while human wants are unlimited; not everything that people desire can be produced. Choice: because resources are scarce, individuals and societies must choose which wants to satisfy and which to leave unsatisfied. Opportunity cost: every choice involves giving up the next best alternative; the cost of a decision is not only what is paid but what is sacrificed. In Nigerian agriculture, a farmer choosing to grow maize on a plot gives up the opportunity to grow cowpea on that same plot; the foregone cowpea output is the opportunity cost of the maize decision.

Fill in the blank: Lionel Robbins defined economics as the science which studies human behaviour as a relationship between _____ and scarce means which have alternative uses;



this definition highlights scarcity, choice, and opportunity cost as the central concerns of economics.

1.1.2 Agricultural economics as a branch of economics

Agricultural economics is the branch of applied economics that applies economic theory and methods to the analysis of agricultural production, marketing, consumption, and resource use. It focuses on farm-level decisions (input use, crop mix, technology adoption), market-level analysis (price formation, market structure, trade), and policy analysis (effects of subsidies, price controls, land reform, and trade policy on agricultural producers and consumers). Agricultural economics draws on microeconomics (the economics of individual firms and markets) and macroeconomics (national income, inflation, and trade) and applies them to the specific conditions of agriculture: biological production processes, seasonal variability, weather risk, and the special characteristics of rural markets.

In Nigeria, agricultural economics is particularly important because approximately 70 percent of the labour force is engaged in agriculture; the sector contributes approximately 25 percent of GDP (2022 estimates); and Nigeria is the largest producer of cassava, yam, and several other crops in the world. Agricultural economists advise on farm profitability, food policy, commodity pricing, rural credit, land tenure, and the economics of irrigation and mechanisation. The career opportunities in agricultural economics in Nigeria span federal and state ministries of agriculture, the Central Bank of Nigeria (Agricultural Credit Guarantee Scheme), commercial banks, agribusiness firms, international development organisations (FAO, IFAD, World Bank), and university research institutions.

Fill in the blank: Agricultural economics applies economic theory and methods to the analysis of agricultural _____, marketing, consumption, and resource use; it draws on both microeconomics and macroeconomics and applies them to the specific conditions of Nigerian agriculture.

1.1.3 The problem of scarcity and choice



The fundamental economic problem is scarcity: at any point in time, the resources available to an individual, firm, or nation are limited, while the wants that could be satisfied with those resources are virtually unlimited. Resources are classified as: land (all natural resources including farmland, water, minerals, and forests); labour (human effort, both physical and mental); capital (man-made resources used in production: tools, equipment, buildings, irrigation infrastructure); and entrepreneurship (the ability to organise the other factors of production, bear risk, and introduce innovation). Every use of a resource for one purpose makes it unavailable for another, creating the necessity of choice.

Societies face three fundamental economic questions arising from scarcity: (1) What to produce? (Which goods and services, and in what quantities?); (2) How to produce? (Which combination of inputs and which technology?); (3) For whom to produce? (How is the output distributed among members of society?). In Nigerian agriculture, these questions have concrete form: should a farmer plant maize or sorghum? Should a family use hand tools or hire a tractor? Should surplus output be sold in the local market or exported? Economic analysis provides a framework for answering these questions systematically and rationally.

Fill in the blank: The three fundamental economic questions arising from scarcity are: what to _____, how to produce, and for whom to produce; all economic systems must answer these questions through some combination of market forces, government planning, or tradition.

Pilot questions 1.1

1. State and explain Robbins' definition of economics and identify three key concepts it contains.
2. Define agricultural economics and state two ways in which it differs from general economics.
3. List the four factors of production and give one agricultural example of each in a Nigerian farming context.
4. Explain the concept of scarcity using an example from Nigerian smallholder farming.
5. State the three fundamental economic questions and give a Nigerian agricultural example for each.



1.2 Branches and Scope of Economics

1.2.1 Microeconomics and macroeconomics

Economics is conventionally divided into two main branches. Microeconomics studies the economic behaviour of individual decision-making units: households (as consumers), firms (as producers), and industries (as collections of firms). It analyses how prices are determined in individual markets, how consumers allocate their income, how firms decide how much to produce, and how resources are allocated among competing uses. Microeconomics is built on the principle of rational self-interest: consumers maximise utility (satisfaction) subject to budget constraints, and firms maximise profit subject to cost and technology constraints. In agriculture, microeconomics analyses farm-level production decisions, input demand, farm profit maximisation, and price determination in commodity markets.

Macroeconomics studies the economy as a whole, focusing on aggregate variables: gross domestic product (GDP), national income, employment, inflation, interest rates, and the balance of payments. It examines how governments use fiscal policy (taxation and government spending) and monetary policy (interest rates and money supply) to achieve broad economic objectives (stable prices, full employment, economic growth, and external balance). Agricultural macroeconomics considers how national economic conditions (exchange rates, inflation, credit availability) affect the agricultural sector, and how the agricultural sector contributes to national food security, rural employment, and export earnings.

Fill in the blank: _____ economics studies the behaviour of individual decision-making units such as households and firms, while macroeconomics studies the economy as a whole, focusing on aggregate variables such as GDP, inflation, and national employment.

1.2.2 Positive and normative economics



Positive economics deals with what is: it describes and explains economic phenomena as they actually are, based on observable facts and testable hypotheses. Positive statements can in principle be verified or falsified by empirical evidence. Examples: ‘When the price of maize rises, the quantity demanded of maize falls’; ‘Nigeria’s cassava output increased by 4 percent in 2022’; ‘Applying 60 kg N per ha increases maize yield by 800 kg per ha on average in the Guinea savanna’. These are factual claims that can be tested with data.

Normative economics deals with what ought to be: it involves value judgements about what economic outcomes are desirable or fair. Normative statements cannot be resolved by evidence alone because they depend on values and priorities. Examples: ‘The government should subsidise fertiliser for smallholder farmers’; ‘Food prices should be kept low to protect the poor’; ‘Agricultural land should be redistributed more equally’. Distinguishing positive from normative economics is important: agricultural policy debates in Nigeria (should the government subsidise rice imports? should farmers be taxed?) often confuse factual questions (what will happen if we do X?) with value questions (should we do X?). Economists can inform policy using positive analysis but cannot, on their own, decide what is right.

Fill in the blank: _____ economics deals with factual, testable statements about what is, while normative economics involves value judgements about what ought to be; the statement ‘the government should subsidise fertiliser’ is a normative statement because it depends on value judgements that cannot be resolved by data alone.

1.2.3 Scope of Agricultural Economics

Agricultural economics covers the application of economic principles to food production and farming. It includes **farm management economics**, which deals with resource allocation, enterprise selection, budgeting, and technology adoption, and **production economics**, which examines input–output relationships, production functions, costs, diminishing returns, and profit maximisation. It also covers **agricultural marketing**, including price formation, market structure, marketing margins, product distribution, and post-harvest losses, as well as



agricultural finance and credit, which studies farmers' credit needs, loan sources, interest rates, and repayment.

The field further includes **agricultural policy**, which evaluates government measures such as subsidies, tariffs, price support, land reform, and agricultural lending programmes. **Agricultural trade** examines exports, imports, tariffs, quotas, and trade agreements affecting farm products. **Natural-resource and environmental economics** studies the use and conservation of land, water, and forests, together with problems such as soil degradation and water pollution. **Rural development economics** focuses on poverty, inequality, employment, and livelihood diversification in farming communities.

Fill in the blank: Farm management economics applies economic principles to _____ decisions about resource allocation, enterprise combination, input levels, and technology adoption on individual farms; it involves tools such as budgeting, partial budgets, and enterprise analysis.

Pilot questions 1.2

1. Distinguish between microeconomics and macroeconomics with one agricultural example of each.
2. Classify each of the following as positive or normative: (a) 'Maize yields are higher under irrigation than rainfed conditions'; (b) 'Farmers should receive a minimum price for their produce'.
3. List four areas within the scope of agricultural economics and briefly describe each.
4. Explain why agricultural marketing is considered part of the scope of agricultural economics.
5. Name two Nigerian government agricultural policy instruments and state the economic objective of each.

1.3 Methodology of Economics



1.3.1 The Scientific Method in Economics

Economics applies the scientific method to explain and test economic behaviour. The process begins with observing a real economic problem, such as low fertiliser adoption among smallholder farmers. The economist then formulates a testable hypothesis, collects relevant data from surveys, price records, experiments, or national statistics, and analyses the data using statistical or econometric methods. Based on the evidence, the hypothesis may be accepted, rejected, or modified, and repeated findings may contribute to the development of broader economic theories.

Unlike the natural sciences, economics faces difficulties because controlled experiments are often impractical and human behaviour is not always predictable. Economic variables are also closely related, making it difficult to isolate cause and effect while holding other factors constant. Economists must therefore avoid errors such as the fallacy of composition, where what is true for one individual is assumed to be true for everyone, and the post hoc fallacy, where correlation is wrongly interpreted as causation.

Fill in the blank: The Latin phrase _____ paribus, meaning ‘other things being equal’, is used in economics when analysing the effect of one variable on another while assuming all other relevant variables remain constant; it is a key device in economic hypothesis testing and model construction.

1.3.2 Economic Models and Assumptions

An economic model is a simplified representation of an economic process or relationship, presented in words, diagrams, or mathematical equations. It focuses on the most important variables while leaving out less relevant details. A common assumption is rationality, meaning that consumers, farmers, firms, and governments are expected to make choices that maximise objectives such as utility, profit, or social welfare within available constraints.



Other common assumptions include profit maximisation, perfect information, competitive markets, and **ceteris paribus**, which means holding other factors constant. These assumptions help economists analyse relationships clearly, although they may not fully reflect real conditions. Models may be adjusted to examine imperfect information, monopoly, oligopoly, or monopsony. Their value depends mainly on how well they explain economic behaviour, predict outcomes, and support decision-making and policy analysis.

Fill in the blank: An economic _____ is a simplified representation of a real-world economic process; it includes the most important variables and relationships while deliberately omitting less important details; its assumptions are evaluated by the accuracy of the predictions they generate.

1.3.3 Economic Data: Types and Sources in Nigeria

Economic data may be classified as time-series, cross-sectional, panel, or qualitative data. **Time-series data** record variables over successive periods, such as annual maize output or monthly food prices. **Cross-sectional data** describe many households, farms, or firms at one point in time, while **panel data** follow the same units over several periods. **Qualitative data** capture non-numerical information such as farmers' opinions, experiences, and reasons for adopting or rejecting agricultural technologies.

Major sources of agricultural economic data in Nigeria include the National Bureau of Statistics, the federal ministry responsible for agriculture, the Central Bank of Nigeria, research institutes, universities, and commodity-market surveys. International sources include FAOSTAT and the World Bank DataBank. These organisations provide information on agricultural production, prices, household welfare, credit, trade, technology adoption, and farm inputs for research, planning, and policy analysis.

Fill in the blank: The National Bureau of Statistics (NBS) is Nigeria's primary source of _____ data, publishing agricultural production estimates, consumer price indices, and the



General Household Survey Panel data used by agricultural economists for research and policy analysis.

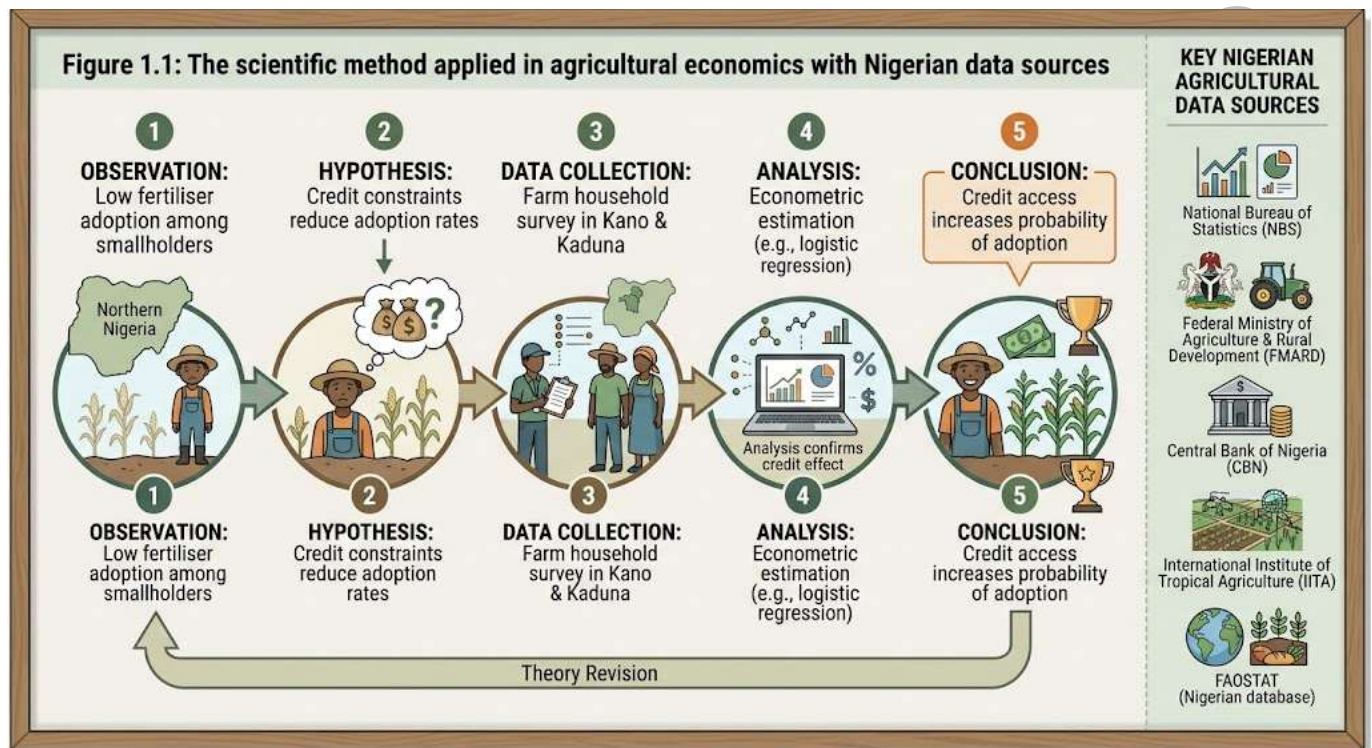


Figure 1.1: The scientific method applied in agricultural economics with Nigerian data sources

Pilot questions 1.3

1. List and briefly describe the five steps of the scientific method as applied in agricultural economics.
2. Explain two methodological challenges that make economics different from natural sciences such as chemistry.
3. Define an economic model and explain why economists use simplified models rather than trying to replicate all real-world complexity.
4. Distinguish between time series, cross-sectional, and panel data with one agricultural example of each from Nigeria.
5. Name three sources of agricultural economic data in Nigeria and state one type of data available from each.



1.4 Basic Economic Concepts

1.4.1 Opportunity cost and production possibility frontier

Opportunity cost is the value of the next best alternative foregone when a choice is made. It is the true economic cost of any decision, not merely the monetary payment. In Nigerian agriculture: if a farmer uses a hectare of land to grow maize, the opportunity cost is the cassava output that the same land could have produced. If a student spends a day attending lectures, the opportunity cost is the farm income that could have been earned working. Opportunity cost arises because resources are scarce and have alternative uses; recognising it is essential for rational resource allocation.

The production possibility frontier (PPF), also called the production possibility curve (PPC), is a graphical model showing the maximum combinations of two goods (or groups of goods) that an economy (or a farm) can produce with its available resources and technology, when all resources are fully and efficiently employed. Points on the PPF are productively efficient; points inside the frontier indicate unused resources (inefficiency); points beyond the frontier are unattainable. The PPF is typically bowed outward (concave to the origin) because resources are not equally suited to all uses: as production shifts from one good to the other, increasingly less suitable resources are transferred, so each additional unit of one good costs more of the other (increasing opportunity cost). Moving along the PPF illustrates the trade-off between two agricultural enterprises (e.g. maize and cowpea) given a fixed land area and budget.

Fill in the blank: The production possibility frontier shows the maximum combinations of two goods producible with available _____ and technology; it is bowed outward because of increasing opportunity cost as resources are reallocated from one enterprise to another.

1.4.2 Marginal analysis and rational decision-making



Marginal analysis is the comparison of the additional (marginal) benefit of an action with its additional (marginal) cost to determine whether the action should be undertaken or extended.

The marginal principle states: a rational economic agent should continue an activity as long as the marginal benefit (MB) exceeds the marginal cost (MC), and should stop when $MB = MC$.

This principle underlies virtually every optimisation decision in agricultural economics.

Examples: (1) Fertiliser application: a farmer should continue adding fertiliser as long as the value of the additional crop yield (marginal revenue product, MRP) exceeds the cost of the additional fertiliser (marginal factor cost, MFC); the optimal fertiliser rate is where $MRP = MFC$.

(2) Farm size: a farmer should continue expanding cultivated area as long as the marginal revenue from the additional hectare exceeds the marginal cost of farming it.

Marginal concepts: marginal cost (MC; the cost of producing one more unit of output); marginal revenue (MR; the additional revenue from selling one more unit); marginal product (MP; the additional output from employing one more unit of input); marginal utility (MU; the additional satisfaction from consuming one more unit of a good). Rational decision-making in economics involves: (1) identifying all available alternatives; (2) comparing marginal benefits and costs of each option; (3) choosing the option that maximises net benefit. This framework assumes rational agents with well-defined objectives, but in practice Nigerian farmers face incomplete information, risk, and social obligations that may lead them to deviate from the strict profit-maximisation model.

Fill in the blank: The marginal principle states that a rational agent should continue an activity as long as the marginal _____ exceeds the marginal cost; the optimal level is reached where marginal benefit equals marginal cost ($MB = MC$).

1.4.3 Economic Systems and the Role of Government in Agriculture

An economic system is the arrangement through which a society decides what to produce, how to produce it, and who receives the output. In a **market economy**, private individuals and firms own resources, while prices guide production and consumption. In a **command economy**, the



government controls resources and makes major production and distribution decisions. A **mixed economy**, such as Nigeria's, combines private market activities with government intervention.

Government supports agriculture through price policies, subsidies, research, extension services, rural roads, irrigation, land administration, and agricultural regulations. It also promotes food safety, seed quality, credit access, welfare programmes, and trade policies that protect or support domestic producers. Such intervention is necessary where markets fail because of inadequate information, environmental effects, high risks, or the under-provision of essential public services.

Fill in the blank: A _____ economy, such as Nigeria's, combines market mechanisms with significant government intervention; markets allocate most resources, but the government provides public goods, corrects market failures, and pursues food security and distributional objectives.

<u>Feature</u>	<u>Market Economy</u>	<u>Command Economy</u>	<u>Mixed Economy</u>
Resource Ownership	Privately owned by individuals and firms	Owned and controlled by the state	Shared between private sector and government
Decision-Making Mechanism	Driven by supply, demand, and price signals	Central planning by government authorities	Combination of market forces and government planning
Role of Government	Minimal; ensures legal framework and property rights	Extensive; directs production, distribution, and pricing	Moderate; regulates, provides public goods, and intervenes when necessary
Agricultural Example	Private farms producing crops for profit	State farms producing according to government quotas	Private farms coexisting with government-run agricultural schemes



Main Advantage	Efficiency, innovation, and consumer choice	Stability in resource allocation and social equity goals	Balance of efficiency with social welfare and regulation
Main Disadvantage	Inequality and risk of market failures	Inefficiency, lack of innovation, and shortages	Potential conflicts between market and state priorities

Box 1.1: Comparison of economic systems with agricultural examples

Pilot questions 1.4

1. Define opportunity cost and give two examples from Nigerian agriculture.
2. Explain what the production possibility frontier (PPF) shows and describe what a point inside the frontier indicates.
3. State the marginal principle and apply it to the decision of how much fertiliser a Nigerian maize farmer should apply.
4. Distinguish between the three main economic systems and state which system Nigeria operates under.
5. Give three examples of government intervention in Nigerian agriculture and state the economic justification for each.



Series Summary

This Series introduced economics as the study of how scarce resources are allocated among competing uses. Agricultural economics applies economic principles to farm production, marketing, consumption, finance, trade, natural resources, and rural development. Scarcity creates choice and opportunity cost, while the basic economic questions are what, how, and for whom to produce. Microeconomics studies individual farms, households, and firms, whereas macroeconomics examines the wider economy. Positive economics explains what exists, while normative economics considers what ought to be.

The Series also covered the scientific method, economic models, assumptions, and data sources. Important ideas include *ceteris paribus*, rationality, profit maximisation, opportunity cost, the production possibility frontier, and marginal analysis. Economic data may be time-series, cross-sectional, panel, or qualitative, with major Nigerian sources including NBS, FMARD, CBN, and IITA. Economic systems may be market, command, or mixed, and Nigeria operates a mixed economy. Government supports agriculture through pricing policies, public goods, regulation, redistribution, and trade measures, especially where market failures prevent efficient outcomes.

Glossary of Terms

- **Agricultural economics:** a branch of applied economics that uses economic theory and methods to analyse agricultural production, marketing, consumption, and resource use at the farm, market, and national policy levels.
- **Ceteris paribus:** a Latin phrase meaning ‘other things being equal’; used in economics when analysing the effect of one variable on another while holding all other relevant variables constant.
- **Economic model:** a simplified representation of a real-world economic process, expressed in words, diagrams, or equations; deliberately excludes less important details to focus on the key variables and relationships.



- **Economic system:** the set of institutions and mechanisms through which a society answers the three fundamental economic questions (what, how, and for whom to produce); main types are market, command, and mixed economies.
- **Macroeconomics:** the branch of economics that studies the economy as a whole, focusing on aggregate variables such as GDP, national income, inflation, unemployment, and the balance of payments.
- **Marginal analysis:** comparison of the additional (marginal) benefit and additional (marginal) cost of an action; the basis of rational decision-making; the optimal level of an activity is where marginal benefit equals marginal cost.
- **Marginal cost (MC):** the additional cost incurred by producing one more unit of output; a key concept in firm decision-making and pricing.
- **Marginal product (MP):** the additional output obtained by employing one more unit of an input, holding all other inputs constant; the basis of the law of diminishing marginal returns.
- **Microeconomics:** the branch of economics that studies the behaviour of individual decision-making units (households, firms, industries) and how prices are determined in individual markets.
- **Mixed economy:** an economic system combining market mechanisms with government intervention; characteristic of most real-world economies including Nigeria.
- **Normative economics:** the branch of economics that involves value judgements about what economic outcomes are desirable; statements cannot be resolved by empirical evidence alone.
- **Opportunity cost:** the value of the next best alternative foregone when a resource allocation decision is made; the true economic cost of any choice; arises because resources are scarce and have alternative uses.
- **Positive economics:** the branch of economics that describes and explains economic phenomena as they actually are; statements are in principle testable by empirical evidence.



- **Production possibility frontier (PPF):** a graphical model showing the maximum combinations of two goods that can be produced with available resources and technology; illustrates opportunity cost, efficiency, and the trade-off between alternative enterprises.
- **Scarcity:** the fundamental economic condition in which available resources are insufficient to satisfy all human wants; forces individuals and societies to make choices among competing alternatives.



Concept Check Questions [Series 1]

Objective Questions

1. Lionel Robbins defined economics as the study of human behaviour as a relationship between ends and _____ means which have alternative uses. (Linked to SLO 1.1)
2. _____ economics studies individual decision-making units such as farms and households, while macroeconomics studies aggregate economic variables. (Linked to SLO 1.2)
3. The statement ‘the government should subsidise fertiliser for smallholder farmers’ is an example of _____ economics because it involves a value judgement. (Linked to SLO 1.2)
4. The Latin phrase _____ paribus, meaning ‘other things being equal’, is used when analysing the effect of one variable while holding all others constant. (Linked to SLO 1.3)
5. The optimal level of fertiliser application is where the marginal revenue product equals the marginal _____ cost; beyond this point, additional fertiliser reduces profit. (Linked to SLO 1.4)

Short-Answer Questions

6. Define economics and agricultural economics and explain the relationship between them. (Linked to SLO 1.1)
7. Distinguish between positive and normative economics with one example of each from Nigerian agriculture. (Linked to SLO 1.2)
8. Describe the five steps of the scientific method as applied in agricultural economics. (Linked to SLO 1.3)
9. Define opportunity cost and use the PPF to illustrate the trade-off between two agricultural enterprises. (Linked to SLO 1.4)
10. State the marginal principle and explain how it guides a farmer’s fertiliser application decision. (Linked to SLO 1.4)

Long-Answer Questions



11. Define economics and its key concepts, describe the scope of agricultural economics, and explain the distinction between microeconomics and macroeconomics and between positive and normative economics. (Linked to SLOs 1.1, 1.2)
12. Explain the scientific method and the role of models in economics, describe the types and sources of agricultural economic data in Nigeria, and explain opportunity cost, the PPF, marginal analysis, and economic systems with their relevance to Nigerian agriculture. (Linked to SLOs 1.3, 1.4)



Answers to Concept Check Questions [Series 1]

Objective Questions

1. Scarce.
2. Micro.
3. Normative.
4. Ceteris.
5. Factor.

Short-Answer Questions

6. Economics studies how individuals and societies allocate scarce resources among competing uses (Robbins: relationship between ends and scarce means with alternative uses). Agricultural economics is a branch of applied economics that applies economic theory to agricultural production, marketing, consumption, and resource use. Agricultural economics uses the tools of general economics but applies them to the specific conditions of farming: biological production, seasonal variability, and rural markets.
7. Positive economics describes facts that can be tested (e.g. 'cassava yields increased by 3 percent after adopting an improved variety in Oyo State'). Normative economics expresses value judgements that cannot be resolved by data alone (e.g. 'the government should guarantee a minimum farm-gate price for cassava').
8. Observation (identify a phenomenon, e.g. low fertiliser use among smallholders). Hypothesis (state a testable proposition, e.g. credit constraints reduce adoption). Data collection (farm survey in target area). Analysis (econometric or statistical testing). Conclusion (accept, reject, or modify hypothesis based on evidence).
9. Opportunity cost is the value of the next best alternative foregone. On a PPF showing maize on the x-axis and cowpea on the y-axis, moving along the frontier from one point to another shows how much cowpea must be given up to produce more maize; the slope of the PPF at any point represents the opportunity cost of one good in terms of the other.
10. The marginal principle: continue an activity while marginal benefit exceeds marginal cost; stop at $MB = MC$. For fertiliser: a farmer should apply more fertiliser as long as the value of additional yield (MRP) exceeds the cost of the additional fertiliser (MFC); the



optimal rate is where $MRP = MFC$. Beyond that point, extra fertiliser adds more cost than value.

Long-Answer Questions

11. Economics (Robbins): science studying human behaviour as relationship between ends and scarce means with alternative uses. Key concepts: scarcity (resources limited; wants unlimited); choice (must select among alternatives); opportunity cost (value of next best foregone). Agricultural economics: applies economic theory and methods to agricultural production, marketing, consumption, and resource use; draws on micro and macroeconomics; important in Nigeria where agriculture contributes approximately 25 percent of GDP. Scope: farm management, production economics, marketing, finance, policy, trade, natural resources, rural development. Microeconomics: individual decision units (farms, households, firms; price determination in individual markets). Macroeconomics: aggregate economy (GDP, inflation, employment, trade balance; effects on agricultural sector). Positive vs normative: positive (factual, testable; e.g. 'yield increases with fertiliser application'); normative (value judgements; e.g. 'fertiliser should be subsidised'); policymakers need both but must distinguish which type of statement they are making.
12. Scientific method: observation (identify economic phenomenon); hypothesis (testable proposition); data collection (surveys, price series, national accounts); analysis (statistical, econometric); conclusion (accept/reject/modify hypothesis). Challenges: no controlled experiments; complex human behaviour; inter-related variables; ceteris paribus assumption. Models: simplified representations (words, diagrams, equations); rationality, profit maximisation, perfect information, ceteris paribus assumptions; evaluated by predictive accuracy. Data types: time series (annual maize production, NBS); cross-sectional (farm survey, 500 households); panel (same households tracked over 5 years); qualitative (focus groups). Sources: NBS (production estimates, CPI, household surveys); FMARD (crop production; subsidies); CBN (credit data, prices); IITA (adoption surveys); FAOSTAT (international comparisons). Opportunity cost: value of next best foregone alternative (land in maize foregoes cassava income). PPF: maximum combinations of two goods with available resources; bowed outward (increasing opportunity cost); points inside = inefficiency; outside = unattainable. Marginal principle: $MB = MC$ at optimum;



fertiliser example (add fertiliser while MRP exceeds MFC). Economic systems: market (price mechanism; private ownership; efficient but unequal); command (state planning; equitable but inefficient); mixed (Nigeria; combines both). Government role in Nigerian agriculture: price policy (fertiliser subsidy; Presidential

13. Fertiliser Initiative); public goods (research, extension, rural roads); regulation (seed certification; food safety); redistribution (Anchor Borrowers Programme); trade policy (rice tariffs; export bans); justified by market failures (externalities, public goods, information asymmetry).



Answers to Pilot Questions [Series 1]

Part 1.1

1. Robbins' definition: economics is the science which studies human behaviour as a relationship between ends and scarce means which have alternative uses. Three key concepts: scarcity (means are limited), choice (humans must choose among competing ends), and opportunity cost (choosing one use of resources means giving up another).
2. Agricultural economics applies economic theory specifically to agricultural production, marketing, and consumption; it focuses on farm-level decisions, commodity markets, and food policy, whereas general economics covers all sectors of the economy. Agricultural economics also addresses unique features of farming: biological production cycles, weather risk, and the role of rural markets.
3. Land (farmland used for maize cultivation in Kaduna State). Labour (family members weeding a cassava farm in Anambra State). Capital (irrigation pump purchased by a vegetable farmer in Kano State). Entrepreneurship (a farmer who organises a cooperative to market tomatoes collectively in Benue State).
4. In Nigerian smallholder farming, a farmer with one hectare of land and limited seed and fertiliser cannot plant all the crops he or she desires; the resources available (land, labour, funds) are insufficient to satisfy all production goals simultaneously, forcing a choice of which crops to grow and how much of each input to apply.
5. What to produce: should a Niger State farmer grow rice or soybeans? How to produce: should a Borno State farmer use a tractor or hand tools for land preparation? For whom to produce: should a Kwara State farmer sell cassava locally or to an agro-processor in Lagos?

Part 1.2

1. Microeconomics: studies individual decision units; example: analysis of how a single maize farmer in Plateau State decides how much fertiliser to apply to maximise profit. Macroeconomics: studies the aggregate economy; example: analysis of how Nigeria's exchange rate depreciation affects the country's total agricultural exports.
2. (a) 'Maize yields are higher under irrigation than rainfed conditions': positive statement; it is a testable factual claim that can be verified with experimental data. (b) 'Farmers



should receive a minimum price for their produce’: normative statement; it expresses a value judgement about what ought to be done and cannot be resolved by data alone.

3. Farm management economics (applying economic principles to farm-level resource allocation decisions). Agricultural marketing (studying how farm products move from producer to consumer and how prices are formed). Agricultural finance and credit (analysing farmers’ credit needs and sources in Nigeria). Agricultural policy (evaluating the effects of government interventions such as subsidies and price controls on producers and consumers).
4. Agricultural marketing determines how efficiently farm products reach consumers and how profits are shared along the value chain; price formation, market structure, and marketing margins directly affect farm profitability and consumer welfare, making it a central concern of agricultural economics.
5. Presidential Fertiliser Initiative (PFI; subsidises inorganic fertiliser to reduce input costs for smallholder farmers). Anchor Borrowers Programme (ABP; provides subsidised credit to smallholder farmers linked to large-scale processors; objective: increase crop production and reduce import dependence).

Part 1.3

1. Observation (identify a real-world agricultural problem). Hypothesis (formulate a testable proposition about the cause). Data collection (gather farm survey or market data). Analysis (statistical or econometric testing). Conclusion (accept, reject, or revise the hypothesis based on evidence).
2. Controlled experiments are impossible in economics (a national economy cannot be put in a laboratory), so economists must rely on observational data where many variables change simultaneously. Also, human behaviour is complex and not always rational or predictable, making economic relationships less stable than physical laws.
3. An economic model is a simplified representation of a real-world process. Economists use simplified models rather than full complexity because: (1) full complexity makes analysis impossible; a model captures the key relationships that matter most for the question at hand. (2) Models generate testable predictions; if predictions are accurate, the model is useful even if its assumptions are not perfectly realistic.



4. Time series: annual maize production in Nigeria from 2000 to 2023 (NBS data; shows trend over time). Cross-sectional: a 2022 farm survey of 500 households in Kano State (one point in time; many units). Panel data: following the same 500 Kano households annually from 2018 to 2022 (same units observed over multiple periods).
5. National Bureau of Statistics (NBS; agricultural production estimates and household survey data). Federal Ministry of Agriculture and Rural Development (FMARD; crop area and production estimates; fertiliser subsidy data). Central Bank of Nigeria (CBN; agricultural credit data and commodity price series).

Part 1.4

1. Opportunity cost is the value of the next best alternative foregone. Example 1: a farmer using land for maize gives up the cassava that the same land could have produced; the foregone cassava output is the opportunity cost. Example 2: a farmer spending N50,000 on a water pump gives up the N50,000 worth of improved seed that the money could alternatively have purchased.
2. The PPF shows the maximum combinations of two goods (e.g. maize and cowpea) that a farm can produce with its given resources and technology. A point inside the PPF indicates that the farm is not using its resources fully or efficiently; some land, labour, or capital is idle or being used wastefully, so output could be increased without sacrificing the other good.
3. Marginal principle: continue an activity while MB exceeds MC; stop at $MB = MC$.
Applied to fertiliser: a maize farmer should keep applying fertiliser as long as the value of the additional yield gained (marginal revenue product, MRP) exceeds the cost of the additional fertiliser (marginal factor cost, MFC). The optimal rate is where $MRP = MFC$; adding more fertiliser beyond this point costs more than it returns.
4. Market economy: resources are privately owned; prices allocate resources (example: US commodity markets). Command economy: resources are state-owned; central planners decide production (example: former Soviet collective farms). Mixed economy: combines market and government; prices allocate most resources but government intervenes in key areas. Nigeria operates a mixed economy.



5. Fertiliser subsidy (Presidential Fertiliser Initiative): justified by market failure due to imperfect information and credit constraints that prevent smallholders from purchasing optimal input quantities. Agricultural research and extension (FRIN, NASC, universities): public good; private firms under-provide it because they cannot recoup the benefits through sales. Import tariffs on rice: correct terms-of-trade distortions and protect domestic producers from subsidised foreign competition.



References and Attributions [Series 1]

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- Olayemi, J. K. (1998). Food security in Nigeria. Development Policy Centre, Research Report No. 2, Ibadan.
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Figures, Plates, Tables, and Boxes

- Figure 1.1: The scientific method applied in agricultural economics with Nigerian data sources. Attribution: AI generated. Suggested OER search string: “scientific method economics hypothesis testing agricultural data Nigeria diagram OER”.
- Box 1.1: Comparison of economic systems with agricultural examples. Attribution: AI generated. Suggested OER search string: “economic systems market command mixed economy comparison table agriculture OER”.



Course code: AGE 205

Course title: Introduction to Agricultural Economics

Course credit load: 2 Units

Series 2: Demand, Supply and Elasticity

- **Part 2.1: Theory of Demand**

- Sub Part 2.1.1: Definition and law of demand
- Sub Part 2.1.2: Determinants of demand
- Sub Part 2.1.3: Movement along and shifts of the demand curve

- **Part 2.2: Theory of Supply**

- Sub Part 2.2.1: Definition and law of supply
- Sub Part 2.2.2: Determinants of supply
- Sub Part 2.2.3: Movement along and shifts of the supply curve

- **Part 2.3: Market Equilibrium**

- Sub Part 2.3.1: Equilibrium price and quantity
- Sub Part 2.3.2: Effects of shifts in demand and supply on equilibrium
- Sub Part 2.3.3: Price controls in Nigerian agricultural markets

- **Part 2.4: Elasticity of Demand and Supply**

- Sub Part 2.4.1: Price elasticity of demand
- Sub Part 2.4.2: Income elasticity and cross-price elasticity of demand
- Sub Part 2.4.3: Price elasticity of supply and its agricultural significance



Introduction

Demand and supply are the twin forces that determine prices and quantities in agricultural markets. Understanding how buyers respond to price changes and how producers adjust their output in response to market signals is fundamental to analysing food price movements, forecasting commodity markets, and designing effective agricultural policies. In Nigeria, where most food is traded in open markets and food prices have a direct bearing on the welfare of both producers and consumers, demand and supply analysis is an essential tool.

This Series develops the theory of demand and supply, explains how the two forces interact to determine market equilibrium, and introduces the concept of elasticity, which measures the sensitivity of demand and supply to changes in prices and income. These tools are applied throughout to Nigerian agricultural commodities: maize, cassava, yam, rice, tomatoes, poultry, and cattle.

Series Learning Outcomes

Upon completing this Series, you should be able to:

- **SLO 2.1** state and explain the law of demand, identify the determinants of demand, and distinguish between a movement along and a shift of the demand curve (Linked to Part 2.1),
- **SLO 2.2** state and explain the law of supply, identify the determinants of supply, and distinguish between a movement along and a shift of the supply curve (Linked to Part 2.2),
- **SLO 2.3** define market equilibrium, show how equilibrium is determined, explain the effects of demand and supply shifts on equilibrium, and analyse price controls in Nigerian agricultural markets (Linked to Part 2.3), and
- **SLO 2.4** calculate and interpret price elasticity of demand, income elasticity of demand, cross-price elasticity of demand, and price elasticity of supply, and explain their significance for Nigerian agriculture (Linked to Part 2.4).



2.1 Theory of Demand

2.1.1 Definition and law of demand

Demand is defined as the quantity of a good or service that consumers are willing and able to purchase at various prices during a given period of time, holding all other factors constant. The word 'willing' distinguishes effective demand from mere desire; the word 'able' requires that buyers have sufficient income or purchasing power. A demand schedule lists the quantities demanded at each price level. A demand curve plots these price-quantity pairs on a graph, with price on the vertical axis and quantity demanded on the horizontal axis.

The law of demand states that, *ceteris paribus*, as the price of a good rises, the quantity demanded falls; and as the price falls, the quantity demanded rises. There is an inverse (negative) relationship between price and quantity demanded. Two explanations underlie this law: (1) the substitution effect (when the price of maize rises, maize becomes relatively more expensive than sorghum or cassava, so consumers substitute away from maize toward cheaper alternatives); (2) the income effect (when the price of a normal good rises, consumers' real purchasing power falls, so they can afford less of the good even at the same money income). The demand curve is therefore downward-sloping from left to right. Exceptions to the law of demand are rare: Giffen goods (inferior goods on which consumers spend a large share of income; theoretical) and Veblen goods (luxury goods where a higher price signals higher status).

Fill in the blank: The law of demand states that, *ceteris paribus*, there is an _____ relationship between price and quantity demanded; as the price of a good rises, the quantity demanded falls, because consumers substitute toward cheaper alternatives and their real purchasing power declines.

2.1.2 Determinants of demand



The demand for an agricultural commodity is determined by a set of factors that, when they change, cause the demand curve to shift. The main determinants are: (1) Price of the good itself (determines the position on the demand curve, not a shift; covered by the law of demand). (2) Consumer income: as income rises, demand for normal goods increases (demand curve shifts right); for inferior goods (e.g. certain low-quality staples replaced by preferred foods as income rises), demand falls when income rises. (3) Prices of related goods: if the price of a substitute rises (e.g. price of sorghum rises), demand for maize increases (demand curve for maize shifts right); if the price of a complement rises (e.g. price of cooking oil rises), demand for vegetables fried in oil may fall. (4) Consumer tastes and preferences: changes in dietary patterns, food safety concerns, or cultural trends shift demand; for example, growing urban demand for processed foods in Nigeria has increased demand for wheat flour, palm oil, and poultry.

(5) Population size: a larger population increases total market demand for food commodities; Nigeria's rapidly growing population (approximately 220 million; projected 400 million by 2050) is a major driver of increasing food demand. (6) Consumer expectations: if consumers expect the price of a commodity to rise in the future (e.g. ahead of the harmattan season when tomato supply falls), they may buy more now, increasing current demand. (7) Government policies: food subsidies (e.g. subsidised rice through FMARD) increase demand; taxes or rationing reduce demand. (8) Seasonal factors: demand for certain Nigerian commodities is highly seasonal (higher demand for yam and poultry at Christmas and Easter; higher demand for palm wine at local festivals).

Fill in the blank: A rise in consumer _____ increases the demand for normal goods, causing the demand curve to shift to the right; for inferior goods, rising income causes the demand curve to shift to the left as consumers switch to preferred alternatives.

2.1.3 Movement along and shifts of the demand curve

A crucial distinction in demand analysis is between a change in quantity demanded (a movement along the demand curve) and a change in demand (a shift of the entire demand curve). A change in quantity demanded occurs when the price of the good itself changes; the consumer moves to a different point on the same demand curve. For example, if the price of a bag of rice falls from



N35,000 to N28,000, the quantity of rice demanded per week increases; this is a movement along the existing demand curve.

A change in demand occurs when any determinant other than the good's own price changes; the entire demand curve shifts. An increase in demand shifts the curve to the right (more is demanded at every price); a decrease shifts it to the left. Examples: (1) An increase in consumer income shifts the demand for rice to the right (more demanded at every price). (2) A successful advertising campaign for poultry products shifts the demand for chicken to the right. (3) A rise in the price of a substitute (sorghum) shifts the demand for maize to the right. (4) A poor harvest season shifts the demand curve for cassava to the right as consumers compete for reduced supplies (this actually affects supply, not demand, but anticipatory buying can shift demand). Understanding this distinction is critical for policy analysis: government actions that change incomes (cash transfers) or change prices of related goods (import tariffs on rice) shift the demand curve, while price controls change the quantity demanded along an existing curve.

Fill in the blank: When the price of a good changes, the result is a _____ along the demand curve (change in quantity demanded); when any other determinant of demand changes, the entire demand curve shifts (change in demand).

Pilot questions 2.1

6. State the law of demand and explain the substitution and income effects that underlie it.
7. List five determinants of demand for maize in Nigeria and explain how each affects the demand curve.
8. Distinguish between a change in quantity demanded and a change in demand with one example of each from Nigerian agriculture.
9. Explain why the demand curve slopes downward and sketch a demand curve for tomatoes in a Nigerian market.
10. Give two examples of how government policy can shift the demand curve for a Nigerian agricultural commodity.

2.2 Theory of Supply

2.2.1 Definition and law of supply



Supply is defined as the quantity of a good or service that producers are willing and able to offer for sale at various prices during a given period, holding all other factors constant. A supply schedule lists quantities supplied at each price. A supply curve plots these pairs on a graph with price on the vertical axis and quantity supplied on the horizontal axis. The law of supply states that, *ceteris paribus*, as the price of a good rises, the quantity supplied increases; and as the price falls, the quantity supplied decreases. There is a positive (direct) relationship between price and quantity supplied.

The rationale for the law of supply: (1) higher prices increase profit margins, incentivising existing producers to expand output and new producers to enter the market; (2) higher prices justify the use of more costly inputs or less productive land that would not be profitable at lower prices; (3) at higher prices, producers are willing to supply larger quantities because higher revenue covers higher marginal costs as production expands (consistent with the law of diminishing returns). In Nigerian agriculture, a rise in the farm-gate price of maize encourages farmers to plant more maize in the next planting season, expand their cultivated area, or apply more fertiliser. The supply curve therefore slopes upward from left to right.

Fill in the blank: The law of supply states that, *ceteris paribus*, there is a _____ relationship between price and quantity supplied; as price rises, producers are incentivised to expand output because higher revenue covers the rising marginal costs of production.

2.2.2 Determinants of supply

The supply of an agricultural commodity is determined by factors other than its own price that shift the supply curve. (1) Input prices: rising fertiliser, seed, labour, or fuel costs increase production costs and reduce supply at every price level (supply curve shifts left); falling input costs increase supply (supply curve shifts right). The sharp rise in fertiliser prices following the 2022 Russia-Ukraine conflict significantly reduced the supply of cereals globally, including in Nigeria. (2) Technology: improved crop varieties (IITA improved cassava; NCRI improved rice varieties), mechanisation, and better pest management increase the quantity supplied at every price (supply curve shifts right); technology adoption is a major source of supply growth in



Nigerian agriculture. (3) Weather and climate: rainfall, temperature, pests, and diseases heavily influence agricultural output; the 2012 floods in Kogi, Anambra, and Delta states destroyed large areas of farmland, sharply reducing supply of food crops in those states.

(4) Number of producers: an increase in the number of farmers growing a crop increases market supply; the expansion of rice cultivation in Kebbi State under the Anchor Borrowers Programme increased national rice supply. (5) Government policies: input subsidies (Presidential Fertiliser Initiative) reduce production costs and shift supply right; export bans reduce the supply available to domestic markets (though they may discourage future production by lowering incentives); land reform policies affect the supply of agricultural land available for cultivation. (6) Expectations: if producers expect prices to fall next season, they may increase current supply to sell before the price drops; if they expect prices to rise, they may withhold supply. (7) Prices of related goods in production: if the price of cassava rises sharply relative to maize, some land may be switched from maize to cassava, reducing maize supply and increasing cassava supply.

Fill in the blank: A fall in _____ prices (fertiliser, seed, labour) reduces production costs, causing the supply curve to shift to the right as producers are willing and able to supply more at every price level.

2.2.3 Movement along and shifts of the supply curve

Parallel to demand analysis, a change in quantity supplied is a movement along the existing supply curve, caused by a change in the price of the good itself. When the price of tomatoes rises, tomato farmers supply more tomatoes; this is a movement up along the supply curve. A change in supply is a shift of the entire supply curve caused by a change in any non-price determinant. An increase in supply shifts the curve to the right (more supplied at every price); a decrease shifts it to the left.

Agricultural supply curves shift frequently because of seasonal variation, weather shocks, and changing input prices. In Nigeria, the supply of most food crops is highly seasonal: supply peaks at harvest (October to December for many northern crops; May to August for southern crops)



and falls sharply in the pre-harvest lean season (June to September in the north; January to April in the south). These seasonal supply shifts cause predictable seasonal price cycles: prices are lowest at harvest and highest just before the next harvest. Governments attempt to stabilise these seasonal price swings through strategic grain reserves, commodity boards, and storage subsidies, all of which are supply-side interventions that shift the effective supply curve in deficit periods.

Fill in the blank: A change in the price of a good causes a _____ along the supply curve; a change in any non-price determinant (technology, input prices, weather) causes a shift of the entire supply curve.

Pilot questions 2.2

6. State the law of supply and explain two reasons why quantity supplied increases when price rises.
7. List five determinants of the supply of rice in Nigeria and explain how each shifts the supply curve.
8. Distinguish between a movement along and a shift of the supply curve with one Nigerian agricultural example of each.
9. Explain why the supply of most Nigerian food crops is highly seasonal and describe the effect of seasonal supply variation on prices.
10. Explain how the 2022 rise in global fertiliser prices affected the supply of food crops in Nigeria.

2.3 Market Equilibrium

2.3.1 Equilibrium price and quantity



Market equilibrium is the price and quantity combination at which the quantity demanded by buyers exactly equals the quantity supplied by sellers, so there is no tendency for price to change. The equilibrium price (also called the market-clearing price) is where the demand curve intersects the supply curve on a price-quantity diagram. The equilibrium quantity is the amount traded at that price. At the equilibrium price: (1) There is no excess demand (shortage): quantity demanded equals quantity supplied, so buyers who wish to buy at that price can do so. (2) There is no excess supply (surplus): quantity supplied equals quantity demanded, so sellers who wish to sell at that price can do so.

If the market price is above equilibrium: quantity supplied exceeds quantity demanded; there is a surplus (excess supply). Sellers cannot sell all they wish at the current price; they compete by reducing price. Price falls toward equilibrium. If the market price is below equilibrium: quantity demanded exceeds quantity supplied; there is a shortage (excess demand). Buyers cannot get all they wish at the current price; they compete by offering higher prices. Price rises toward equilibrium. This self-correcting mechanism is called the market-clearing process or price mechanism. In Nigerian commodity markets (e.g. Dawanau grain market, Kano; Mile 12 market, Lagos), prices adjust relatively quickly through the competitive actions of many buyers and sellers, though not instantaneously and not without transaction costs.

Fill in the blank: At the equilibrium price, quantity _____ equals quantity supplied; if price is above equilibrium, a surplus develops and price falls; if price is below equilibrium, a shortage develops and price rises.

2.3.2 Effects of shifts in demand and supply on equilibrium

When demand or supply shifts, the equilibrium price and quantity change. The four basic cases are: (1) Increase in demand (demand curve shifts right): equilibrium price rises and equilibrium quantity rises. Example: rising urban incomes in Nigeria increase demand for chicken; poultry prices rise and quantity of chicken traded increases. (2) Decrease in demand (demand curve shifts left): equilibrium price falls and equilibrium quantity falls. Example: a health scare about aflatoxin in groundnut reduces demand for groundnut products; groundnut prices and quantities



traded fall. (3) Increase in supply (supply curve shifts right): equilibrium price falls and equilibrium quantity rises. Example: the adoption of improved cassava varieties increases cassava supply; cassava farm-gate prices fall and quantities traded increase. (4) Decrease in supply (supply curve shifts left): equilibrium price rises and equilibrium quantity falls. Example: floods in Benue State destroy yam farms; yam prices rise and quantities traded fall.

When both demand and supply shift simultaneously, the effect on equilibrium price and quantity depends on the relative magnitudes of the shifts. If demand increases and supply decreases simultaneously (e.g. population growth raises demand while drought cuts supply), price rises unambiguously but the effect on quantity is indeterminate (depends on which shift dominates). This combined scenario is frequently observed in Nigerian food markets during crisis periods (e.g. the 2016 to 2017 recession when demand for food remained high while supply was disrupted by farmer-herder conflicts in food-producing states), leading to sharp food price inflation.

Fill in the blank: An increase in supply (supply curve shifts right) causes equilibrium price to _____ and equilibrium quantity to rise; this is illustrated by improved cassava variety adoption in Nigeria, which increased supply and reduced farm-gate prices.

2.3.3 Price controls in Nigerian agricultural markets

Governments sometimes impose price controls that prevent the market price from moving to its equilibrium level. A price ceiling (maximum price) sets a legal maximum price below the equilibrium price. Purpose: to keep the price of a basic food affordable to consumers (e.g. the Nigerian government has at various times set maximum prices for garri, rice, and bread).

Consequences: at the controlled price (below equilibrium), quantity demanded exceeds quantity supplied; a shortage develops; goods may be rationed by queuing, favouritism, or the black market; suppliers lose incentive to produce; long-run supply falls. A price ceiling does not reduce scarcity; it merely transfers it from price rationing to non-price rationing.



A price floor (minimum price) sets a legal minimum price above the equilibrium price. Purpose: to guarantee producers a minimum income (e.g. a guaranteed minimum price for paddy rice; minimum wages for farm labour). Consequences: at the controlled price (above equilibrium), quantity supplied exceeds quantity demanded; a surplus develops; unsold goods accumulate; government may need to purchase and store the surplus (buffer stock policy). In Nigerian agricultural history, commodity boards (Cocoa Board, Groundnut Board, Cotton Board) operated as effective price floors by buying all produce offered at a fixed price; this generated surpluses that depressed export revenues and contributed to the boards' financial difficulties. Both types of price control create distortions; economists generally prefer price stabilisation through competitive markets and information provision over direct price controls.

Fill in the blank: A price _____ set below the equilibrium price causes a shortage because the quantity demanded exceeds the quantity supplied at the controlled price; goods are rationed by queuing or the black market rather than by price.

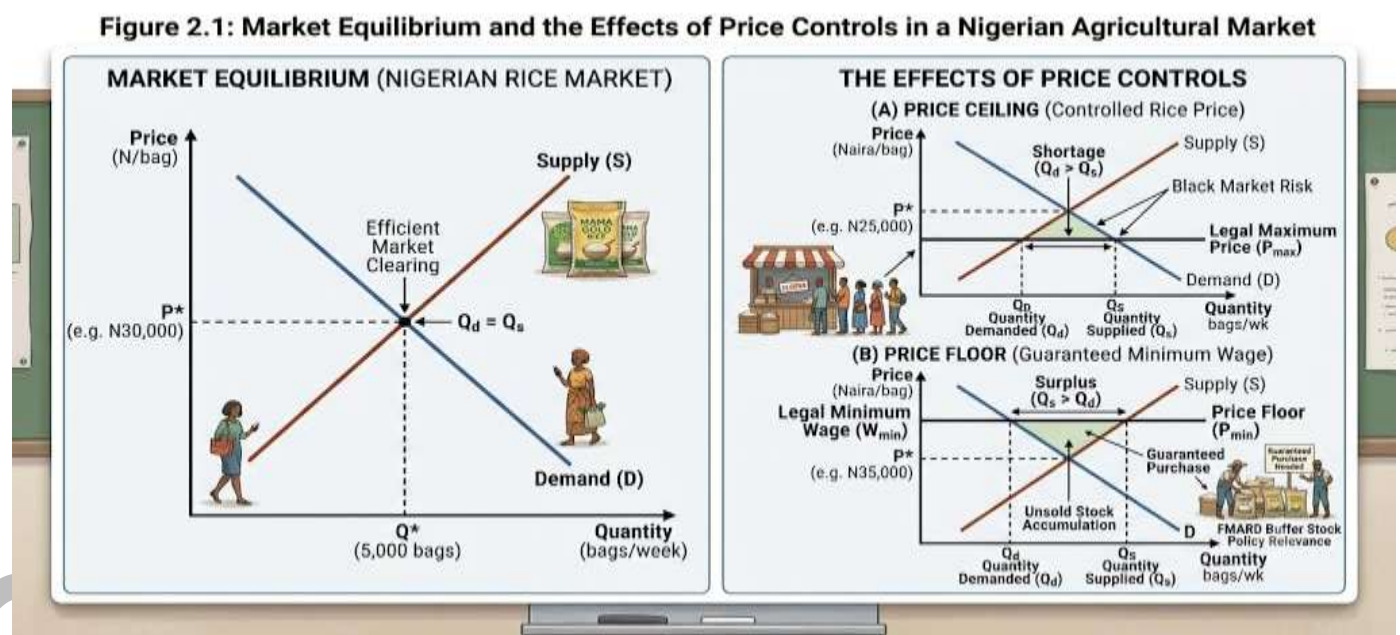


Figure 2.1: Market equilibrium and the effects of price controls in a Nigerian agricultural market

Pilot questions 2.3



6. Define market equilibrium and explain the market-clearing process when price is above equilibrium.
7. Using a supply and demand diagram, show and explain what happens to equilibrium price and quantity when (a) consumer income rises for a normal food good and (b) input costs fall.
8. Distinguish between a price ceiling and a price floor, giving one Nigerian agricultural example of each.
9. Explain why a price ceiling set below the equilibrium price leads to a shortage rather than solving the problem of high food prices.
10. Explain how simultaneous increase in demand and decrease in supply would affect the equilibrium price and quantity of maize in Nigeria.

2.4 Elasticity of Demand and Supply

2.4.1 Price elasticity of demand

Price elasticity of demand (PED) measures the responsiveness of quantity demanded to a change in the price of the good itself. It is defined as: $PED = (\text{percentage change in quantity demanded}) / (\text{percentage change in price})$. Since the law of demand implies a negative relationship between price and quantity demanded, PED is normally negative; by convention, the absolute value $|PED|$ is used. If $|PED|$ exceeds 1, demand is price elastic (a 1 percent price rise leads to more than 1 percent fall in quantity demanded; consumers are responsive to price changes). If $|PED|$ is less than 1, demand is price inelastic (a 1 percent price rise leads to less than 1 percent fall in quantity demanded; consumers are relatively unresponsive). If $|PED|$ equals 1, demand is unit elastic. If $|PED|$ equals 0, demand is perfectly inelastic (a vertical demand curve; quantity demanded does not change when price changes). If $|PED|$ equals infinity, demand is perfectly elastic (a horizontal demand curve; consumers will buy any quantity at the current price but none at a higher price).

Factors determining PED in agricultural markets: (1) Availability of substitutes: commodities with many close substitutes (e.g. one brand of refined sugar) have elastic demand; staple foods



with few substitutes (e.g. garri in rural southern Nigeria) tend to have inelastic demand. (2) Proportion of income spent on the good: food staples absorb a large share of income for poor Nigerians; their demand tends to be inelastic because there are no alternatives. (3) Necessity vs luxury: necessities (basic food staples) have inelastic demand; luxuries (imported wine, premium beef) have more elastic demand. (4) Time period: demand is more elastic in the long run than the short run because consumers have more time to adjust consumption patterns, find substitutes, and change habits. Empirical estimates for Nigerian food commodities typically show PED values of -0.3 to -0.7 for basic staples (inelastic), indicating that price increases raise total expenditure on these goods for consumers.

Fill in the blank: Price elasticity of demand equals the percentage change in quantity _____ divided by the percentage change in price; a value of -0.5 means that a 10 percent price increase causes a 5 percent fall in quantity demanded (inelastic demand).

2.4.2 Income elasticity and cross-price elasticity of demand

Income elasticity of demand (YED) measures the responsiveness of quantity demanded to a change in consumer income: $YED = (\text{percentage change in quantity demanded}) / (\text{percentage change in income})$. A positive YED indicates a normal good (demand rises with income). A negative YED indicates an inferior good (demand falls as income rises). YED greater than 1 indicates a luxury good (demand rises proportionately more than income). YED between 0 and 1 indicates a necessity (demand rises less than proportionately with income). In Nigeria, as incomes rise, demand for rice, wheat bread, processed foods, poultry, and dairy increases (positive YED; normal goods), while demand for very low-quality cassava products or cheap sorghum-based beverages may fall (negative YED; inferior goods). YED is critical for food demand projections: combining population growth with income growth allows agricultural economists to forecast total food demand over a 5 to 20 year horizon.

Cross-price elasticity of demand (XED) measures how the quantity demanded of one good responds to a change in the price of another good: $XED = (\text{percentage change in quantity demanded of good A}) / (\text{percentage change in price of good B})$. A positive XED indicates that A



and B are substitutes (when the price of B rises, consumers buy more of A). A negative XED indicates that A and B are complements (when the price of B rises, consumers buy less of A). Examples from Nigerian agriculture: maize and sorghum are substitutes in animal feed; a rise in maize prices increases demand for sorghum (positive XED). Tomatoes and vegetable oil are complements in Nigerian cooking; a rise in vegetable oil prices reduces the quantity of tomatoes demanded in stew preparation (negative XED). Knowing XED helps forecast how price changes in one market spill over into related markets.

Fill in the blank: Income elasticity of demand (YED) is positive for _____ goods (demand rises with income) and negative for inferior goods (demand falls as income rises); a YED greater than 1 indicates a luxury good whose demand rises more than proportionately with income.

2.4.3 Price elasticity of supply and its agricultural significance

Price elasticity of supply (PES) measures the responsiveness of quantity supplied to a change in price: $PES = (\text{percentage change in quantity supplied}) / (\text{percentage change in price})$. PES is positive (supply and price move in the same direction). If PES exceeds 1, supply is elastic (producers can readily expand output in response to price rises). If PES is less than 1, supply is inelastic (producers cannot quickly expand output even when price rises). Perfectly inelastic supply ($PES = 0$) means a fixed quantity regardless of price (vertical supply curve; e.g. supply of farmland in a specific location in the short run). Perfectly elastic supply ($PES = \text{infinity}$) means producers will supply any quantity at the going price but none below it.

Factors determining PES in Nigerian agriculture: (1) Time period: supply is more inelastic in the short run (farmers cannot immediately expand planted area, purchase new equipment, or switch crops once the season has started) and more elastic in the long run (new land can be brought under cultivation; farmers can adjust enterprise mix). (2) Availability of inputs: if fertiliser, improved seed, and irrigation water are readily available, farmers can expand output quickly in response to higher prices (more elastic). (3) Nature of the production process: tree crops (cocoa, palm oil, rubber) have very inelastic short-run supply because trees take years to mature; annual crops (maize, cassava) have more elastic medium-run supply. (4) Storage capacity: if farm-gate



storage is available, farmers can vary the timing of sales in response to price changes, increasing effective supply elasticity. Agricultural supply in Nigeria is generally inelastic in the short run, which means that a sudden reduction in supply (drought, flood) causes a large price increase rather than a small one.

Fill in the blank: Price elasticity of supply (PES) is typically _____ in the short run for tree crops such as cocoa and palm oil because it takes several years for trees to mature; supply cannot be quickly expanded even when prices rise significantly.

<u>Elasticity Type</u>	<u>Formula</u>	<u>Value Ranges & Meaning</u>	<u>Nigerian Agricultural Example</u>
Price Elasticity of Demand (PED)	% change in quantity demanded ÷ % change in price	PED > 1: elastic (consumers sensitive to price); PED < 1: inelastic (consumers less sensitive); PED = 1: unitary	Demand for rice — price increase reduces consumption significantly among low-income households
Income Elasticity of Demand (YED)	% change in quantity demanded ÷ % change in income	YED > 1: luxury goods; 0 < YED < 1: necessity goods; YED < 0: inferior goods	Poultry meat — demand rises as household income increases in urban Nigeria
Cross Elasticity of Demand (XED)	% change in quantity demanded of good A ÷ % change in price of good B	XED > 0: substitutes; XED < 0: complements; XED = 0: unrelated goods	Maize and sorghum — if maize price rises, demand for sorghum (a substitute) increases
Price Elasticity of Supply (PES)	% change in quantity supplied ÷ % change in price	PES > 1: elastic supply; PES < 1: inelastic supply; PES = 1: unitary	Tomato farming — supply is inelastic in the short run due to perishability and production cycles

Box 2.1: Summary of elasticity concepts with Nigerian agricultural examples



Pilot questions 2.4

6. Define price elasticity of demand (PED) and calculate the PED if a 20 percent rise in the price of tomatoes causes a 10 percent fall in quantity demanded.
7. Explain four factors that determine the price elasticity of demand for food staples in Nigeria.
8. Define income elasticity of demand and distinguish between normal goods, inferior goods, and luxury goods with one Nigerian food example of each.
9. Define cross-price elasticity of demand and explain whether maize and sorghum are substitutes or complements in Nigerian animal feed markets, giving a numerical example.
10. Explain why the price elasticity of supply is low for cocoa but higher for maize in Nigeria, and state the policy implication of inelastic agricultural supply.



Series Summary

This Series explained demand, supply, and market equilibrium. Demand is the quantity consumers are willing and able to buy at different prices, while supply is the quantity producers are willing and able to offer. A change in a product's own price causes movement along the demand or supply curve, whereas changes in income, related-goods prices, tastes, technology, input costs, weather, expectations, government policy, or the number of buyers and sellers shift the curves. Market equilibrium occurs where quantity demanded equals quantity supplied. Prices above equilibrium create surpluses, while prices below equilibrium create shortages. Price ceilings may cause shortages and black markets, whereas price floors may create surpluses.

The Series also covered elasticity, which measures how strongly demand or supply responds to changes in price, income, or related-goods prices. Price elasticity of demand may be elastic or inelastic, while income elasticity distinguishes normal, inferior, and luxury goods. Cross elasticity shows whether goods are substitutes or complements, and price elasticity of supply measures producers' response to price changes. Agricultural supply is often inelastic in the short run, especially for tree crops, because production cannot be increased quickly. This helps explain the strong seasonal and price fluctuations often observed in Nigerian food markets.

Glossary of Terms

- **Change in demand:** a shift of the entire demand curve caused by a change in any determinant other than the good's own price (income, prices of related goods, tastes, population, expectations); distinguished from a change in quantity demanded.
- **Change in quantity demanded:** a movement along the existing demand curve caused by a change in the good's own price; not a shift of the curve.
- **Cross-price elasticity of demand (XED):** the percentage change in quantity demanded of good A divided by the percentage change in price of good B; positive for substitutes; negative for complements.
- **Demand:** the quantity of a good or service that consumers are willing and able to purchase at various prices during a given period, ceteris paribus.



- **Equilibrium price:** the price at which quantity demanded equals quantity supplied; the market-clearing price at which there is neither a surplus nor a shortage.
- **Income elasticity of demand (YED):** the percentage change in quantity demanded divided by the percentage change in consumer income; positive for normal goods; negative for inferior goods; greater than 1 for luxuries.
- **Law of demand:** as the price of a good rises (*ceteris paribus*), the quantity demanded falls; the demand curve slopes downward because of the substitution and income effects.
- **Law of supply:** as the price of a good rises (*ceteris paribus*), the quantity supplied increases; the supply curve slopes upward because higher prices cover rising marginal costs and attract new producers.
- **Price ceiling:** a government-imposed maximum price set below the equilibrium price; intended to keep goods affordable; causes a shortage (quantity demanded exceeds quantity supplied).
- **Price elasticity of demand (PED):** the percentage change in quantity demanded divided by the percentage change in price; negative for normal goods; $|PED|$ greater than 1 = elastic; $|PED|$ less than 1 = inelastic.
- **Price elasticity of supply (PES):** the percentage change in quantity supplied divided by the percentage change in price; positive; PES less than 1 = inelastic supply (common for agricultural commodities in the short run).
- **Price floor:** a government-imposed minimum price set above the equilibrium price; intended to guarantee producer income; causes a surplus (quantity supplied exceeds quantity demanded).
- **Supply:** the quantity of a good or service that producers are willing and able to offer for sale at various prices during a given period, *ceteris paribus*.
- **Surplus (excess supply):** the situation where quantity supplied exceeds quantity demanded at the prevailing price; occurs when price is above equilibrium; eliminated as price falls toward equilibrium.
- **Shortage (excess demand):** the situation where quantity demanded exceeds quantity supplied at the prevailing price; occurs when price is below equilibrium; eliminated as price rises toward equilibrium.



Concept Check Questions [Series 2]

Objective Questions

1. The law of demand states that there is an _____ relationship between price and quantity demanded; the demand curve slopes downward from left to right. (Linked to SLO 2.1)
2. When the price of a good rises (and no other factor changes), there is a movement _____ the demand curve rather than a shift of the demand curve. (Linked to SLO 2.1)
3. The law of supply states that, ceteris paribus, there is a _____ relationship between price and quantity supplied; the supply curve slopes upward. (Linked to SLO 2.2)
4. At the equilibrium price, quantity demanded _____ quantity supplied; neither a surplus nor a shortage exists. (Linked to SLO 2.3)
5. A price _____ set above the equilibrium price causes a surplus because quantity supplied exceeds quantity demanded at the controlled price. (Linked to SLO 2.3)

Short-Answer Questions

1. State the law of demand and explain the two effects that underlie it, using a Nigerian food example. (Linked to SLO 2.1)
2. List four non-price determinants of the supply of maize in Nigeria and explain how each shifts the supply curve. (Linked to SLO 2.2)
3. Explain what happens to equilibrium price and quantity when the supply of tomatoes in a Lagos market falls due to flooding of farms in Kaduna State. (Linked to SLO 2.3)
4. Define price elasticity of demand (PED) and calculate PED if price rises by 25 percent and quantity demanded falls by 10 percent. State whether demand is elastic or inelastic. (Linked to SLO 2.4)
5. Distinguish between income elasticity and cross-price elasticity of demand with one Nigerian agricultural example of each. (Linked to SLO 2.4)



Long-Answer Questions

1. Explain the law of demand and law of supply, identify the determinants of each, and distinguish between movements along and shifts of demand and supply curves. Use Nigerian agricultural examples throughout. (Linked to SLOs 2.1, 2.2)
2. Explain market equilibrium and how it is disturbed by demand and supply shifts. Describe price ceilings and price floors with Nigerian examples, and explain the concept of elasticity of demand and supply with calculations and agricultural significance. (Linked to SLOs 2.3, 2.4)

Answers to Concept Check Questions [Series 2]

Objective Questions

1. Inverse.
2. Along.
3. Positive.
4. Equals.
5. Floor.

Short-Answer Questions

1. Law of demand: ceteris paribus, as price rises, quantity demanded falls (inverse relationship). Substitution effect: when rice price rises, consumers substitute toward cheaper alternatives like garri or yam. Income effect: when rice price rises, real purchasing power of consumers falls, so they can afford less rice even at the same money income.
2. Input prices (rising fertiliser cost shifts supply left). Technology (adoption of improved IITA varieties shifts supply right). Weather (good rainfall shifts supply right; drought or flooding shifts it left). Government policy (fertiliser subsidy through Presidential Fertiliser Initiative shifts supply right by lowering production costs).
3. A flood reducing tomato supply from Kaduna farms shifts the supply curve to the left. At the original equilibrium price, quantity supplied is now less than quantity



demand; a shortage develops. Price rises until a new, higher equilibrium is reached with lower quantity traded. Both equilibrium price rises and equilibrium quantity falls.

4. $PED = \text{percentage change in } Q_d / \text{percentage change in } P = -10\% / 25\% = -0.4$.
 $|PED| = 0.4$, which is less than 1, so demand is price inelastic; a 25 percent price rise causes only a 10 percent fall in quantity demanded.
5. Income elasticity (YED): measures demand responsiveness to income change; e.g. YED for chicken in Nigeria is positive (normal good); as urban incomes rise, chicken demand increases. Cross-price elasticity (XED): measures demand responsiveness to price change of another good; e.g. maize and sorghum are substitutes in animal feed; if maize price rises, quantity demanded of sorghum increases (positive XED).

Long-Answer Questions

1. Law of demand: inverse price-quantity relationship (downward-sloping curve); substitution effect (higher price makes good relatively expensive; consumers switch to alternatives); income effect (higher price reduces real purchasing power; less can be bought at same income). Demand determinants (shift factors): income (normal goods: demand rises with income); prices of substitutes (higher price of sorghum raises demand for maize); prices of complements (higher oil price reduces demand for vegetables fried in oil); tastes (dietary shifts toward processed foods increase wheat demand); population (Nigeria's growing population continuously raises food demand); expectations; government policy (subsidies increase demand). Movement along: change in own price (e.g. maize price falls; quantity demanded of maize rises on same curve). Shift: change in any other determinant (e.g. income rises; demand curve for rice moves right). Law of supply: positive price-quantity relationship (upward-sloping); higher prices cover rising marginal costs; attract new producers; justify less productive resources. Supply determinants: input prices (fertiliser, seed, labour); technology (improved varieties, mechanisation); weather (rainfall, floods, pests); number of farmers; government policy (subsidies, export bans); producer expectations; relative crop prices. Movement along: change in own price (e.g. yam price rises; farmers



supply more yam). Shift: change in non-price factor (e.g. flood destroys farms; supply curve shifts left).

2. Equilibrium: quantity demanded = quantity supplied at the equilibrium price (P^*) and quantity (Q^*); no surplus or shortage. Above equilibrium: Q_s exceeds Q_d ; surplus; sellers cut prices; market moves back to P^* . Below equilibrium: Q_d exceeds Q_s ; shortage; buyers bid up price; market rises to P^* . Shifts: demand right (income rises for normal good): P rises, Q rises. Supply left (flood): P rises, Q falls. Both shifts simultaneously: if demand rises and supply falls, price rises unambiguously; effect on quantity indeterminate. Price ceiling (below equilibrium): shortage (Q_d exceeds Q_s); black markets; disincentive to produce; Nigerian examples include controlled garri and bread prices. Price floor (above equilibrium): surplus (Q_s exceeds Q_d); government must purchase excess; Nigerian commodity boards set effective price floors for cocoa and groundnuts. Elasticity: $PED = \% \Delta Q_d / \% \Delta P$; $|PED|$ greater than 1 elastic (responsive); less than 1 inelastic. Staples inelastic (-0.3 to -0.7 in Nigeria). YED positive = normal (chicken, rice); negative = inferior (low-quality cassava products with rising income). XED positive = substitutes (maize and sorghum); negative = complements (tomatoes and vegetable oil). $PES = \% \Delta Q_s / \% \Delta P$; positive; inelastic in short run (tree crops: cocoa PES approximately 0.2; annual crops more elastic in medium run). Inelastic supply: supply shocks cause large price swings; Nigerian food price inflation volatile.

Answers to Pilot Questions [Series 2]

Part 2.1

1. Law of demand: ceteris paribus, as price rises, quantity demanded falls (inverse relationship). Substitution effect: a higher price makes the good relatively expensive compared to substitutes; consumers switch to cheaper alternatives. Income effect: a higher price reduces real purchasing power; consumers can afford less of the good at the same income.



2. Income (rising incomes increase demand for maize; shift right). Price of sorghum (a substitute; if sorghum price rises, demand for maize rises; shift right). Population growth (more people increase total demand; shift right). Consumer preferences (dietary shift toward maize-based snacks; shift right). Government food subsidy (subsidised maize increases effective demand; shift right).
3. Change in quantity demanded: when the price of garri falls from N800 to N600 per kg, the quantity demanded rises; this is a movement along the existing demand curve. Change in demand: when urban incomes rise in Lagos, demand for rice increases at every price; the entire demand curve for rice shifts to the right.
4. The demand curve slopes downward because higher prices trigger both substitution (consumers switch to cheaper alternatives) and income effects (real purchasing power falls). A Nigerian tomato demand curve would have price (N/kg) on the vertical axis and quantity (kg/week) on the horizontal axis, sloping downward from upper left to lower right.
5. Fertiliser subsidy (Presidential Fertiliser Initiative): reduces the price of fertiliser to farmers, effectively lowering input costs; supply of crops increases. Import duty on rice: makes imported rice more expensive, shifting demand toward locally produced rice; domestic rice demand increases.

Part 2.2

1. Law of supply: *ceteris paribus*, as price rises, quantity supplied increases (positive relationship). Reason 1: higher prices increase profit margins, incentivising existing producers to expand output and new producers to enter the market. Reason 2: higher prices justify use of more costly inputs (more fertiliser, hired labour) that would be unprofitable at lower prices.
2. Input prices (rising fertiliser and fuel costs reduce supply; shift left). Technology (adoption of improved rice varieties from NCRI increases supply; shift right). Weather (good rainy season increases rice supply; shift right). Number of producers (Anchor Borrowers Programme expansion of rice farmers in Kebbi State increases supply; shift right). Government policy (fertiliser subsidy reduces costs and shifts supply right; export ban reduces supply to domestic market; shifts effective supply right for domestic consumers).



3. Movement along: when the price of tomatoes rises from N400 to N600 per basket, tomato farmers supply more baskets per week; this is a movement up along the existing supply curve. Shift: good rainfall in Kaduna State tomato-growing areas in 2023 increases tomato supply at every price; the entire supply curve shifts to the right.
4. Nigerian food crop supply is seasonal because crops grow and mature at specific times of year; supply peaks at harvest and falls sharply in the pre-harvest lean season. This causes predictable seasonal price cycles: prices are lowest at harvest when supply is highest and peak just before the next harvest when stored supplies run low.
5. The 2022 rise in global fertiliser prices (linked to the Russia-Ukraine conflict disrupting potash and urea supply) sharply increased production costs for Nigerian farmers. Higher input costs reduced supply at every price level, shifting the supply curve for food crops leftward. This contributed to higher food prices and food insecurity in Nigeria in 2022 to 2023.

Part 2.3

1. Market equilibrium is the price at which quantity demanded equals quantity supplied; no surplus or shortage exists. When price is above equilibrium: quantity supplied exceeds quantity demanded; a surplus accumulates; sellers compete by lowering prices; price falls until equilibrium is restored.
 - (a) Consumer income rises for a normal food good (e.g. poultry): demand curve shifts right; at the original price, Q_d now exceeds Q_s ; price rises to a new higher equilibrium; quantity traded also increases.
 - (b) Input costs fall (e.g. fertiliser subsidy reduces costs for maize farmers): supply curve shifts right; at original price, Q_s now exceeds Q_d ; price falls to a new lower equilibrium; quantity traded increases.
2. Price ceiling: a maximum price set below equilibrium; example: government setting a maximum price for a bag of rice below the market price causes a shortage. Price floor: a minimum price set above equilibrium; example: commodity board setting a guaranteed purchase price for cocoa above the open market price causes a surplus that the board must purchase.



3. A price ceiling reduces the incentive for producers to supply (they receive a lower price) while increasing quantity demanded (consumers want more at the lower price); the result is a shortage rather than lower scarcity. The underlying supply constraint is not addressed; goods are rationed by queuing or the black market rather than price.
4. Demand increases (curve shifts right): at original equilibrium, Q_d exceeds Q_s ; price rises. Supply decreases (curve shifts left): at original equilibrium, Q_s falls short of Q_d ; price rises further. Price rises unambiguously. The effect on equilibrium quantity is indeterminate: it depends on which shift is larger. If the supply decrease dominates, quantity falls; if the demand increase is larger, quantity may rise.

Part 2.4

1. $PED = \text{percentage change in quantity demanded} / \text{percentage change in price} = -10\% / 20\% = -0.5$. $|PED| = 0.5$, which is less than 1: demand is price inelastic; a 20 percent price rise causes only a 10 percent fall in quantity demanded.
2. Availability of substitutes: staples like garri with few close substitutes have inelastic demand; branded foods with many alternatives have elastic demand. Proportion of income: low-income Nigerians spend a high share of income on food staples; demand is inelastic because cutting back is difficult. Necessity vs luxury: food staples are necessities; demand is inelastic. Time period: short-run demand for staples is more inelastic than long-run demand because consumers need time to adjust eating habits.
3. $YED = \text{percentage change in } Q_d / \text{percentage change in income}$. Normal good (YED positive): demand rises with income; example: chicken (YED approximately +0.7 in Nigerian urban areas). Inferior good (YED negative): demand falls as income rises; example: low-quality ogi powder replaced by richer foods as income rises. Luxury good (YED greater than 1): demand rises more than proportionately with income; example: imported wine or premium beef.
4. $XED = \% \Delta Q_d \text{ of A} / \% \Delta P \text{ of B}$. Maize and sorghum are substitutes in animal feed (both can replace the other as energy sources for poultry and cattle). If maize price rises by 20 percent and quantity demanded of sorghum increases by



12 percent: $XED = +12\% / +20\% = +0.6$ (positive, confirming substitutes). Feed manufacturers switch from maize to sorghum when maize becomes more expensive.

5. Cocoa supply is very inelastic in the short run (PES approximately 0.2) because cocoa trees take 3 to 5 years to mature; farmers cannot quickly expand production even when prices rise sharply. Maize supply is more elastic in the medium run (PES approximately 0.5 to 0.8) because farmers can expand area planted and increase input use within one or two seasons. Policy implication: inelastic agricultural supply means that any disruption (weather shock, input shortage) causes large price increases rather than small ones; buffer stock policies and improved storage infrastructure help dampen price volatility.

References and Attributions [Series 2]

Textual References (Books and External Sources)

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Figures, Plates, Tables, and Boxes

- Figure 2.1: Market equilibrium and the effects of price controls in a Nigerian agricultural market. Attribution: AI generated. Suggested OER search string: “supply demand equilibrium price ceiling floor shortage surplus diagram Nigeria agriculture OER”.
- Box 2.1: Summary of elasticity concepts with Nigerian agricultural examples. Attribution: AI generated. Suggested OER search string: “price elasticity demand supply income cross-price formula values Nigerian agriculture summary table OER”.





Course code: AGE 205

Course title: Introduction to Agricultural Economics

Series 3: Consumer Behaviour and Utility Concepts

- **Part 3.1: The Concept of Utility**
 - Sub Part 3.1.1: Definition and types of utility
 - Sub Part 3.1.2: Total utility and marginal utility
 - Sub Part 3.1.3: The law of diminishing marginal utility
- **Part 3.2: Consumer Equilibrium: Cardinal Utility Approach**
 - Sub Part 3.2.1: Cardinal measurement of utility
 - Sub Part 3.2.2: Consumer equilibrium with one good
 - Sub Part 3.2.3: Consumer equilibrium with two goods: the equimarginal principle
- **Part 3.3: Indifference Curve Analysis**
 - Sub Part 3.3.1: Indifference curves: definition and properties
 - Sub Part 3.3.2: The budget line
 - Sub Part 3.3.3: Consumer equilibrium: ordinal utility approach
- **Part 3.4: Factors Influencing Consumer Behaviour**
 - Sub Part 3.4.1: Income and substitution effects revisited
 - Sub Part 3.4.2: Consumer behaviour in Nigerian food markets
 - Sub Part 3.4.3: Behavioural economics and deviations from rationality



Introduction

Consumer behaviour theory asks a fundamental question: how do individuals allocate a limited budget among competing goods to maximise their satisfaction? The answer shapes our understanding of the demand curves introduced in Series 2 and explains why consumers respond as they do to price and income changes. Two analytical frameworks have been developed: the cardinal utility approach (which assumes satisfaction can be measured in numerical units called utils) and the ordinal utility approach using indifference curves (which requires only that consumers can rank combinations of goods in order of preference).

This Series develops both approaches, explains the conditions for consumer equilibrium in each, derives the demand curve from consumer theory, and examines the specific factors that shape food consumption behaviour in Nigeria. An introductory discussion of behavioural economics rounds out the Series by examining ways in which actual consumer choices sometimes deviate from the predictions of the standard rational model.

Series Learning Outcomes

Upon completing this Series, you should be able to:

- **SLO 3.1** define utility, distinguish between total and marginal utility, and state and explain the law of diminishing marginal utility (Linked to Part 3.1),
- **SLO 3.2** explain consumer equilibrium using the cardinal utility approach with one and two goods, and apply the equimarginal principle (Linked to Part 3.2),
- **SLO 3.3** define indifference curves and their properties, describe the budget line, and determine the consumer equilibrium using the ordinal utility (indifference curve) approach (Linked to Part 3.3), and
- **SLO 3.4** explain the income and substitution effects of a price change, describe key factors influencing food consumer behaviour in Nigeria, and explain common deviations from rational consumer behaviour (Linked to Part 3.4).

3.1 The Concept of Utility



3.1.1 Definition and types of utility

Utility is the satisfaction or pleasure that a consumer derives from consuming a good or service. It is a subjective concept: the same good may provide very different levels of satisfaction to different individuals, or to the same individual under different circumstances. Utility cannot be directly observed or measured like physical quantities; economists use either cardinal measurement (assigning numerical utils) or ordinal measurement (ranking preferences) to analyse it. It is important to note that utility in economics is not the same as usefulness in the everyday sense: a consumer derives positive utility from anything he or she chooses to consume, even if it has no nutritional or practical value.

Types of utility: (1) Form utility: the satisfaction derived from a good being in a form suitable for consumption (e.g. garri processed from cassava has higher utility than raw cassava tubers for most consumers; milled rice has higher utility than paddy). (2) Place utility: the satisfaction derived from a good being in the right location (e.g. maize transported from a farm in Kaduna to Mile 12 market in Lagos has higher utility to Lagos consumers than maize still at the farm gate). (3) Time utility: the satisfaction derived from a good being available at the right time (e.g. stored yam available during the lean season has higher utility than the same yam available at harvest when supply is abundant). (4) Possession utility: the satisfaction derived from owning or having the right to use a good (e.g. a farmer who owns a tractor derives possession utility independent of whether the tractor is currently in use).

Fill in the blank: _____ utility refers to the satisfaction derived from a good being available at the right time; stored grain available during Nigeria's lean season commands a price premium because its time utility is higher than the same grain at harvest.

3.1.2 Total utility and marginal utility

Total utility (TU) is the total satisfaction a consumer obtains from consuming a given quantity of a good over a specified period. It is the sum of the utilities derived from each unit consumed. As a consumer consumes more units of a good, total utility initially increases but at a diminishing



rate, eventually reaching a maximum and potentially declining if the consumer is forced to consume beyond the saturation point. Marginal utility (MU) is the additional utility obtained from consuming one more unit of a good, holding consumption of all other goods constant. Algebraically: $MU = \text{change in TU} / \text{change in quantity consumed}$ ($MU = \Delta TU / \Delta Q$). When MU is positive, TU is still rising. When MU equals zero, TU is at its maximum (the satiation point). When MU is negative, TU is falling.

Example: consider a hungry farmer in Kwara State consuming plates of tuwo shinkafa. The first plate provides high utility (say 50 utils). The second plate adds less additional satisfaction (30 utils); total utility is now 80. The third plate adds only 10 utils; $TU = 90$. The fourth plate adds 0 utils (satiation); $TU = 90$. A fifth plate would make the farmer uncomfortably full; $MU = -5$ utils; $TU = 85$. This pattern of initially positive but declining marginal utility, eventually reaching zero and turning negative, is universal in consumption behaviour and underlies the law of diminishing marginal utility.

Fill in the blank: Marginal utility (MU) is the additional utility from consuming one more unit of a good; when MU equals _____, total utility is at its maximum (the satiation point); beyond this, additional consumption reduces total utility (MU becomes negative).

3.1.3 The law of diminishing marginal utility

The law of diminishing marginal utility states that, as a consumer increases consumption of a good during a given period (holding all other goods constant), the marginal utility derived from each successive unit decreases. The first unit consumed provides the highest satisfaction; subsequent units provide progressively less additional satisfaction. This law reflects the observable reality of human psychology: the first cup of water satisfies acute thirst; the second is welcome but less so; the tenth is barely noticed. The law has two important implications: (1) the demand curve slopes downward (the consumer will only consume more of a good if its price falls sufficiently to compensate for its declining marginal utility); (2) the optimal consumption decision involves equating the ratios of marginal utility to price across all goods (the equimarginal principle, covered in Part 3.2).



Assumptions of the law: (1) the consumer is rational; (2) tastes and preferences are constant over the consumption period; (3) the units of consumption are standard (equal sized); (4) consumption is continuous (no long break between units that would restore appetite). Exceptions and qualifications: the law may not hold for the first few units of some goods (e.g. a collector's utility from paintings may increase as the collection grows up to a point); and for addictive goods (tobacco, alcohol), marginal utility may temporarily rise before falling. In Nigerian agriculture, the law explains why farmers diversify food sources: as they consume more of any single food, its marginal utility falls and the relative utility of alternative foods rises, making dietary diversification rational.

Fill in the blank: The law of _____ marginal utility states that as consumption of a good increases in a given period (*ceteris paribus*), each additional unit yields less additional satisfaction; this law underlies the downward slope of the demand curve and the rationality of diversifying food consumption.

Pilot questions 3.1

1. Define utility and distinguish between the four types of utility, giving one Nigerian agricultural example of each.
2. Distinguish between total utility and marginal utility and state the relationship between them.
3. A consumer drinks cups of zobo drink and obtains the following total utilities: 1st cup = 20; 2nd = 35; 3rd = 45; 4th = 50; 5th = 50; 6th = 45 utils. Calculate the marginal utility for each cup and identify the satiation point.
4. State the law of diminishing marginal utility and explain two assumptions on which it rests.
5. Explain two implications of the law of diminishing marginal utility for consumer behaviour in Nigerian food markets.

3.2 Consumer Equilibrium: Cardinal Utility Approach

3.2.1 Cardinal measurement of utility



The cardinal utility approach assumes that the utility a consumer derives from a good can be measured in numerical units called utils, and that these measurements are meaningful in an absolute sense (i.e. 30 utils is exactly twice as much satisfaction as 15 utils). This approach, associated with the early economists Jeremy Bentham and Alfred Marshall, allows direct comparison of utility across goods and consumers. The cardinal approach uses the concept of monetary measure of utility: the consumer is assumed to know how many naira he or she would be willing to pay for each additional unit of a good, and this willingness to pay reflects marginal utility.

In practice, the cardinal measurement of utility is problematic: satisfaction is subjective and cannot be objectively measured or compared across individuals. Nevertheless, the cardinal approach yields important insights through its implications for consumer equilibrium (the conditions under which a consumer maximises utility given a budget constraint). The ordinal approach (Part 3.3) avoids the need for cardinal measurement by requiring only that consumers can rank bundles of goods in order of preference. Despite its theoretical limitations, the cardinal approach is pedagogically useful because it produces clear, intuitive results about optimal consumer behaviour.

Fill in the blank: The _____ utility approach assumes that satisfaction can be measured in numerical units called utils, allowing the consumer to determine the exact amount of satisfaction derived from each unit of a good; this contrasts with the ordinal approach, which only requires preference ranking.

3.2.2 Consumer equilibrium with one good

With a single good, a consumer maximises utility by consuming up to the point at which the marginal utility of the last unit consumed equals the price of the good (expressed in utils per naira). More precisely, the consumer should continue consuming a good as long as the marginal utility exceeds the price, and should stop when $MU = P$ (where both are expressed in the same units). If MU exceeds P for a particular unit, the consumer gains more satisfaction than it costs; consuming that unit increases net utility. If MU falls below P , the consumer would be paying more than the unit is worth in satisfaction; that unit should not be purchased.



Example: a consumer buys bags of sorghum at N8,000 per bag and has the following MU schedule: 1st bag MU = 16,000; 2nd bag MU = 12,000; 3rd bag MU = 8,000; 4th bag MU = 4,000 utils. (Expressing price in utils: assume 1 util = N1,000, so price = 8 utils.) The consumer should buy the 1st bag (MU 16 exceeds price 8), the 2nd bag (MU 12 exceeds price 8), and the 3rd bag (MU 8 equals price 8). The 4th bag should not be purchased (MU 4 is less than price 8). Consumer equilibrium is at 3 bags; purchasing fewer would leave utility gains unrealised; purchasing more would reduce utility. This single-good equilibrium condition ($MU = P$) extends naturally to the multi-good case.

Fill in the blank: In the single-good cardinal utility model, the consumer is in equilibrium when the marginal utility of the last unit purchased _____ the price of the good; purchasing more units beyond this point would cost more in price than they yield in satisfaction.

3.2.3 Consumer Equilibrium with Two Goods: The Equimarginal Principle

3.2.3 Consumer Equilibrium with Two Goods: The Equimarginal Principle

Consumer equilibrium is the point at which a consumer obtains the maximum possible satisfaction from a fixed income and has no reason to change the combination of goods purchased. For two or more goods, equilibrium is achieved through the **equimarginal principle**, which states that the marginal utility per naira spent must be equal across all goods:

$$MU_a/P_a = MU_b/P_b$$

If $MU_a/P_a > MU_b/P_b$, the consumer should transfer spending from good B to good A. As more of A is consumed, its marginal utility falls, while consuming less of B raises its marginal utility. This adjustment continues until the marginal utility per naira is equal, subject to the budget constraint.

For example, a student has **₦1,500** to spend on chin-chin at **₦500 per pack** and groundnut at **₦300 per pack**. Their successive MU/P ratios are **0.04, 0.03, and 0.02** for both goods. The consumer first selects units with the highest MU per naira. Because the goods are purchased in



whole packs, the budget may not be fully spent. The combinations of **two packs of chin-chin and one pack of groundnut**, costing ₦1,300, and **one pack of chin-chin and three packs of groundnut**, costing ₦1,400, each provide **47 utils**. Therefore, either combination represents consumer equilibrium under the given budget and indivisibility of the goods.

Fill in the blank: The _____ principle states that a consumer maximises utility when the marginal utility per naira spent is equal across all goods ($MU_a/P_a = MU_b/P_b$); if one ratio exceeds the other, the consumer should shift spending toward the good with the higher MU per naira.

Pilot questions 3.2

1. Explain the cardinal utility approach and state one advantage and one limitation of this approach.
2. State the consumer equilibrium condition for a single good using the cardinal approach and explain why consuming beyond this point reduces utility.
3. State the equimarginal principle and explain how a consumer adjusts spending when MU_A / P_A is greater than MU_B / P_B .
4. A farmer spends all income on yam and beans. Currently MU of yam = 40 and price of yam = ₦1,000; MU of beans = 20 and price of beans = ₦400. Is the farmer in equilibrium? If not, how should spending be adjusted?
5. Explain how the equimarginal principle is related to the law of diminishing marginal utility.

3.3 Indifference Curve Analysis

3.3.1 Indifference curves: definition and properties

An indifference curve is a graphical representation of all combinations of two goods that yield the same level of total utility to a consumer; the consumer is indifferent among all points on the same indifference curve. The ordinal utility approach avoids the need to measure utility in utils; it requires only that the consumer can rank bundles of goods in order of preference (bundle A is preferred to bundle B, B is preferred to C, etc.). An indifference map is the set of all indifference curves for a consumer; higher indifference curves represent higher levels of utility (a bundle on a higher curve is preferred to any bundle on a lower curve).



Properties of indifference curves: (1) Downward-sloping: to remain at the same utility level, if the consumer consumes more of one good, they must consume less of the other; the two goods substitute for each other along the curve. (2) Convex to the origin: the slope of an indifference curve (the marginal rate of substitution, MRS) diminishes as the consumer moves along the curve; this reflects the law of diminishing MRS: as the consumer has more of good A and less of good B, each additional unit of A becomes worth less in terms of B that the consumer would be willing to give up. (3) Cannot intersect: two indifference curves cannot cross; if they did, a bundle at the intersection would simultaneously give two different utility levels, which is a logical contradiction. (4) Higher curves preferred: a bundle on a higher indifference curve gives more utility than a bundle on a lower curve (more of both goods is preferred to less, assuming non-satiation).

Fill in the blank: The marginal rate of substitution (MRS) is the rate at which a consumer is willing to _____ one good for another while remaining at the same utility level; it diminishes as the consumer moves down and to the right along an indifference curve, making the curve convex to the origin.

3.3.2 The Budget Line

The budget line is a straight line showing all combinations of two goods that a consumer can purchase by spending the entire available income at given prices. It is also called the budget constraint or price line. If income is M , and the prices of goods A and B are P_a and P_β , the budget equation is:

$$P_a Q_a + P_\beta Q_\beta = M$$

Rearranging:

$$Q_\beta = M/P_\beta - (P_a/P_\beta)Q_a$$

The vertical intercept, M/P_β , shows the maximum quantity of good B that can be purchased if all income is spent on B, while the horizontal intercept, M/P_a , shows the maximum quantity of A.



The slope is $-P_a/P_\beta$, representing the quantity of B that must be sacrificed to obtain one additional unit of A.

A change in income shifts the budget line parallel to its original position. An increase in income shifts it outward, while a decrease shifts it inward. A change in the price of one good rotates the line because only one intercept changes. For example, if a household has ₦20,000, rice costs ₦5,000 per kg, and beans cost ₦4,000 per kg, it can buy a maximum of 4 kg of rice or 5 kg of beans. The slope of the budget line is:

$$-P_r/P_\beta = -5,000/4,000 = -1.25$$

This means that obtaining one additional kilogram of rice requires giving up 1.25 kg of beans.

Fill in the blank: The slope of the budget line equals $-P_A / \underline{\hspace{2cm}}$, which represents the opportunity cost of one unit of good A in terms of the quantity of good B that must be foregone; a fall in the price of A rotates the budget line outward around the y-intercept.

3.3.3 Consumer Equilibrium: Ordinal Utility Approach

Consumer equilibrium under the ordinal utility approach is the point at which a consumer attains the highest possible level of satisfaction from a given income and market prices.

Graphically, it occurs where the highest attainable indifference curve is tangent to the budget line. At this point:

$$MRS_{a\beta} = P_a/P_\beta$$

The **marginal rate of substitution (MRS)** is the rate at which the consumer is willing to give up good B to obtain an additional unit of good A, while P_a/P_β is the rate at which the market permits that exchange. Equilibrium is achieved when the consumer's subjective trade-off equals the market price ratio, provided the indifference curve is convex to the origin and the chosen bundle lies on the budget line.



If $MRS_{a\beta} > P_a/P_\beta$, the consumer values good A more highly than the market price ratio suggests and should buy more A and less B. If $MRS_{a\beta} < P_a/P_\beta$, the consumer should buy more B and less A. This adjustment continues until the two ratios are equal. For example, a Nigerian household allocating income between rice and garri will adjust its purchases until its willingness to substitute garri for rice equals the ratio of their prices. If rice becomes relatively more expensive, the budget line rotates inward on the rice axis, and the new equilibrium will generally involve less rice and more garri because of the substitution effect.

Fill in the blank: In the indifference curve approach, consumer equilibrium occurs where the highest attainable indifference curve is _____ to the budget line. At this point, $MRS = P_a/P_\beta$, meaning the consumer's subjective rate of substitution equals the market price ratio.

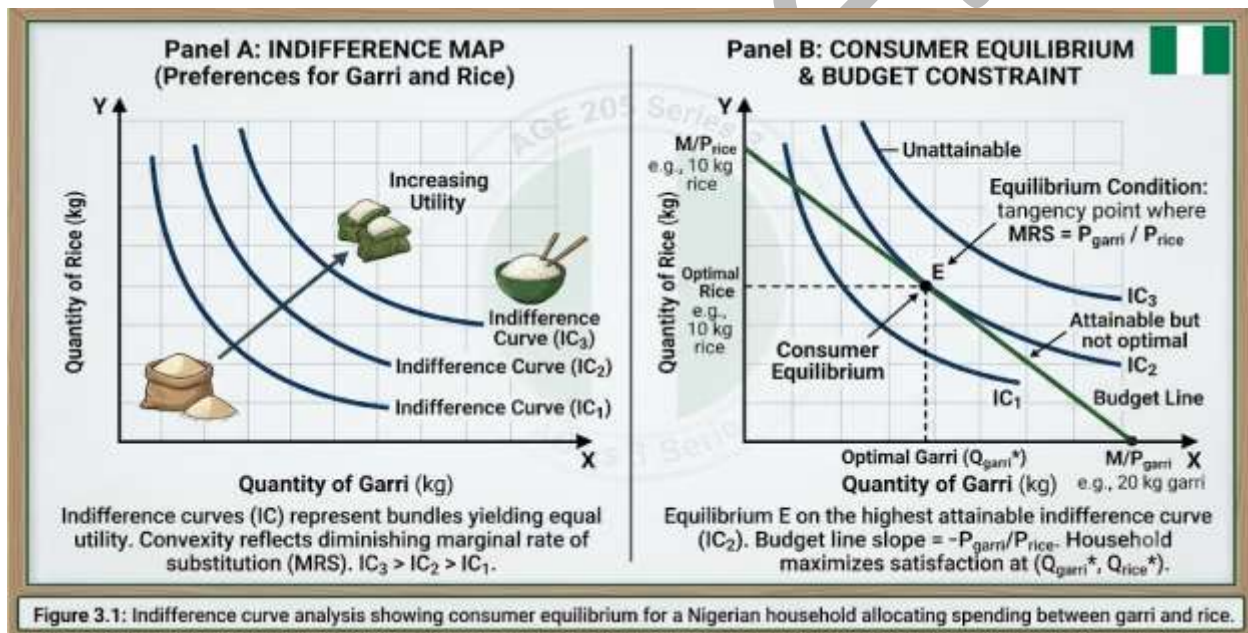


Figure 3.1: Indifference curve analysis showing consumer equilibrium for a Nigerian household allocating spending between garri and rice

Pilot questions 3.3

11. Define an indifference curve and state four properties of indifference curves.
12. Explain why indifference curves are convex to the origin using the concept of diminishing marginal rate of substitution.



13. A consumer has a budget of N12,000. Rice costs N3,000/kg and beans costs N2,000/kg. Write the budget equation and find the intercepts of the budget line.
14. Explain what happens to the budget line when (a) consumer income doubles and (b) the price of rice falls by 50 percent.
15. State the consumer equilibrium condition in the ordinal utility framework and explain the adjustment process when $MRS > P_A / P_B$.

3.4 Factors Influencing Consumer Behaviour

3.4.1 Income and Substitution Effects Revisited

The substitution effect is the change in the quantity demanded of a good caused solely by a change in its relative price, while the consumer's real utility is held constant. When the price of rice falls relative to garri, rice becomes cheaper, so the consumer substitutes rice for garri. Therefore, the substitution effect always moves in the opposite direction to price: a price fall increases quantity demanded, while a price rise reduces it.

The income effect is the change in consumption caused by the change in the consumer's real purchasing power resulting from a price change, while relative prices are held constant. When the price of rice falls, the consumer's real income rises because the same money income can buy more goods. For a normal good, the income and substitution effects reinforce each other, so quantity demanded rises when price falls. For an inferior good, the income effect works against the substitution effect because higher real income reduces demand for the good. If this opposing income effect is strong enough to outweigh the substitution effect, the good becomes a **Giffen good**, causing quantity demanded to rise as price rises, although such cases are very rare.

Fill in the blank: For a normal good, when price falls, the substitution effect and income effect _____ each other, both leading to greater consumption; this reinforcement explains the downward slope of the demand curve for most Nigerian food commodities.



3.4.2 Consumer Behaviour in Nigerian Food Markets

Consumer behaviour in Nigerian food markets refers to the factors that influence how households choose, purchase, and consume food. Income and poverty strongly affect these decisions because low-income households devote a large share of their earnings to basic staples such as garri, maize, yam, sorghum, and millet. As income rises, households usually diversify toward meat, fish, poultry, eggs, legumes, and processed foods. This reflects **Engel's law**, which states that the proportion of income spent on food tends to fall as income increases. Urbanisation also influences demand, as urban consumers generally purchase more convenience foods, packaged products, restaurant meals, and branded goods than rural consumers.

Food choices are also shaped by culture, religion, season, safety concerns, and social influence. Religious and ethnic traditions affect the acceptance of particular foods and the demand for foods used during festivals, ceremonies, and hospitality. During the lean season, poorer households may reduce food quantity and quality or depend more on less-preferred staples and wild foods. Growing concern about adulteration, pesticide residues, and poor handling is increasing demand for trusted brands and certified products, especially in urban areas. Social status and demonstration effects may also encourage the consumption of imported or highly branded foods, showing that Nigerian food demand is influenced by more than income and price alone.

Fill in the blank: Engel's law states that as consumer income rises, the _____ of income spent on food falls; in Nigeria, rising urban incomes shift food consumption away from basic staples toward protein-rich foods, processed products, and convenience foods.

3.4.3 Behavioural economics and deviations from rationality

Standard consumer theory assumes fully rational agents with consistent preferences, complete information, and the ability to calculate optimal choices. Behavioural economics, developed by psychologists and economists including Daniel Kahneman and Richard Thaler (Nobel Prize



2017), documents systematic ways in which actual human decision-making deviates from this standard model. Key behavioural biases relevant to Nigerian food consumers: (1) Present bias: consumers place disproportionately high weight on immediate consumption relative to the future; a farmer may sell grain immediately after harvest (when prices are low) rather than store it for 3 to 6 months to sell at higher prices, because the immediate cash meets urgent needs (debt repayment, school fees). (2) Loss aversion: people feel the pain of a loss more intensely than the pleasure of an equivalent gain (Kahneman and Tversky); a farmer may be reluctant to adopt a new variety even if its expected yield is higher, because the risk of a lower yield looms larger psychologically than the potential gain.

(3) Anchoring: consumers judge the fairness or reasonableness of a price by comparing it to a reference price; in Nigerian markets, traders often start negotiations with a high asking price to anchor the buyer's perception (a known marketing practice in Lagos and Ibadan open markets). (4) Status quo bias: individuals tend to stick with current choices (habit persistence); once a Nigerian household is accustomed to eating a particular type of rice (local parboiled vs imported long-grain), switching requires significant price or quality incentives. (5) Social norms and herd behaviour: food choices are influenced by what peers and neighbours consume; the rapid spread of wheat bread consumption in Nigerian cities was partly driven by social norms and demonstration effects rather than price or nutrition. Behavioural insights are increasingly being applied to design food and nutrition policies in Nigeria (e.g. using default options, reminders, and simplified information to improve dietary choices among school children and rural women).

Fill in the blank: _____ bias describes the tendency of consumers to overweight immediate benefits relative to future consequences; in Nigerian farming, it leads farmers to sell grain immediately after harvest at low prices rather than store for months to sell at the higher lean-season price.

<u>Feature</u>	<u>Cardinal Utility Approach</u>	<u>Ordinal Utility Approach</u>
Measurement of Utility	Utility measured in numerical units called <i>utils</i>	Utility measured by ranking preferences; no numerical values



Key Assumption	Satisfaction can be quantified and compared directly	Consumers can rank bundles of goods by preference, not measure exact satisfaction
Equilibrium Condition	Consumer equilibrium when $MU = \text{Price (single good) or } MU/P \text{ equal across goods (equimarginal principle)}$	Consumer equilibrium at tangency point where $MRS = \text{Price ratio } (P_A / P_B)$
Main Tool	Marginal utility schedules and equations	Indifference curves and budget lines
Limitation	Utility is subjective and cannot truly be measured in numbers	Requires graphical analysis and assumes consistent preferences
Nigerian Food Example	A farmer consuming plates of <i>tuwo shinkafa</i> until $MU = \text{price}$	A household choosing between <i>garri</i> and <i>rice</i> at equilibrium where indifference curve is tangent to budget line

Box 3.1: Comparison of cardinal and ordinal utility approaches to consumer equilibrium

Pilot questions 3.4

1. Distinguish between the substitution effect and the income effect of a price change, and explain what happens to both effects when the price of a normal food good falls.
2. Explain Engel's law and describe how rising incomes are changing food consumption patterns in Nigerian cities.
3. State three cultural or religious factors that influence food consumer behaviour in Nigeria and give one example of each.
4. Define present bias and give one example of how it affects the economic decisions of Nigerian smallholder farmers.
5. Explain what loss aversion means in behavioural economics and describe how it might discourage technology adoption among Nigerian farmers.

Series Summary

This Series explained **utility as the satisfaction a consumer obtains from consuming goods and services**. Total utility is the total satisfaction from all units consumed, while marginal utility is the additional satisfaction from one extra unit. When marginal utility is positive, total utility



risers; when it is zero, total utility is at its maximum; and when it is negative, total utility falls. The law of diminishing marginal utility states that each additional unit gives less extra satisfaction. Under the cardinal approach, consumer equilibrium occurs where $MU = P$ for one good and, for several goods, where $MU_a/P_a = MU_b/P_b$. Under the ordinal approach, consumers rank bundles using indifference curves, which slope downward, are convex to the origin, do not intersect, and show diminishing marginal rates of substitution. The budget line is represented by $P_aQ_a + P_bQ_b = M$, with slope $-P_a/P_b$.

Consumer equilibrium under the ordinal approach occurs where the highest attainable indifference curve is tangent to the budget line, so $MRS = P_a/P_b$. A price change produces a substitution effect and an income effect. For normal goods, both effects reinforce each other, causing quantity demanded to rise when price falls. Consumer behaviour in Nigerian food markets is shaped by income, poverty, urbanisation, religion, culture, seasonality, food safety concerns, and social-status effects. Behavioural factors also influence decisions, including present bias, loss aversion, anchoring, status quo bias, and herd behaviour. These concepts help explain household food choices, spending patterns, and responses to changes in prices and income.

Glossary of Terms

- **Budget line:** a straight line showing all combinations of two goods that a consumer can purchase by spending exactly all of a given income at prevailing prices; slope = $-P_A/P_B$; shifts outward when income rises or inward when income falls.
- **Cardinal utility:** a measurement approach that assigns numerical values (utils) to the satisfaction derived from consuming goods; assumes utility is measurable in absolute units; contrasted with ordinal utility.
- **Consumer equilibrium:** the combination of goods that maximises a consumer's utility subject to the budget constraint; in the cardinal approach: MU/P equal for all goods; in the ordinal approach: highest attainable indifference curve tangent to the budget line ($MRS = P_A/P_B$).



- **Diminishing marginal rate of substitution:** the tendency of the MRS to fall as the consumer moves along an indifference curve consuming more of one good and less of the other; makes indifference curves convex to the origin.
- **Engel's law:** the empirical regularity that as consumer income rises, the proportion of income spent on food falls; food expenditure grows in absolute terms but represents a declining budget share.
- **Equimarginal principle:** the rule for consumer equilibrium with multiple goods: utility is maximised when the marginal utility per naira spent is equal across all goods ($MU_A/P_A = MU_B/P_B$).
- **Income effect:** the change in quantity demanded of a good resulting from the change in real purchasing power caused by a price change; positive for normal goods (real income and quantity move together); negative for inferior goods.
- **Indifference curve:** a graphical representation of all combinations of two goods that yield the same total utility to a consumer; the consumer is indifferent among all bundles on the curve.
- **Indifference map:** the complete set of indifference curves for a consumer; each curve represents a different utility level; higher curves represent greater utility.
- **Law of diminishing marginal utility:** as a consumer increases consumption of a good during a given period (*ceteris paribus*), the marginal utility of each additional unit decreases.
- **Loss aversion:** a behavioural bias in which individuals feel the psychological pain of a loss more intensely than the pleasure of an equivalent gain; identified by Kahneman and Tversky; relevant to risk-taking and technology adoption decisions.
- **Marginal rate of substitution (MRS):** the rate at which a consumer is willing to give up one good to obtain one more unit of another good while remaining on the same indifference curve; equals the absolute slope of the indifference curve at any point.
- **Marginal utility (MU):** the additional utility (satisfaction) obtained from consuming one more unit of a good, holding consumption of all other goods constant; $MU = \text{change in TU} / \text{change in quantity}$.
- **Ordinal utility:** a measurement approach requiring only that consumers can rank bundles of goods in order of preference; does not require numerical measurement of utility; basis of indifference curve analysis.



- **Present bias:** the tendency of consumers to overvalue immediate consumption relative to future consumption; in Nigerian farming, it explains why farmers may sell grain at low harvest prices rather than store for higher lean-season prices.
- **Substitution effect:** the change in quantity demanded of a good resulting purely from a change in its relative price, holding real utility constant; always negative for a price increase (less consumed) and positive for a price decrease.
- **Total utility (TU):** the total satisfaction a consumer obtains from consuming a given quantity of a good; equals the sum of the marginal utilities of each unit consumed up to that quantity.
- **Utility:** the satisfaction or pleasure a consumer derives from consuming a good or service; a subjective concept measured cardinally (in utils) or ordinally (by ranking preferences).



Concept Check Questions [Series 3]

Objective Questions

1. Marginal utility is the additional satisfaction from consuming one more unit of a good; when MU equals _____, total utility is at its maximum. (Linked to SLO 3.1)
2. The law of _____ marginal utility states that each successive unit of a good consumed in a given period yields less additional satisfaction than the previous unit. (Linked to SLO 3.1)
3. The equimarginal principle states that utility is maximised when MU_A / P_A equals $MU_B /$ _____ for all goods in the consumer's basket. (Linked to SLO 3.2)
4. An indifference curve cannot _____ because two curves crossing would imply that the same bundle gives two different utility levels simultaneously. (Linked to SLO 3.3)
5. Consumer equilibrium in the indifference curve framework occurs where MRS equals _____, meaning the subjective trade-off between goods equals the market trade-off. (Linked to SLO 3.3)

Short-Answer Questions

1. Define total utility and marginal utility and state the relationship between them when MU is positive, zero, and negative. (Linked to SLO 3.1)
2. State the equimarginal principle and explain what a consumer should do if MU_A/P_A is greater than MU_B/P_B . (Linked to SLO 3.2)
3. State four properties of indifference curves and explain the economic reasoning behind each. (Linked to SLO 3.3)
4. Distinguish between the substitution effect and the income effect of a price change and explain why both reinforce each other for normal goods. (Linked to SLO 3.4)
5. State Engel's law and explain how it applies to changing food consumption patterns in Nigerian cities. (Linked to SLO 3.4)

Long-Answer Questions

1. Explain the concept of utility, the law of diminishing marginal utility, and consumer equilibrium using the cardinal utility approach for one and two goods. Use Nigerian food examples throughout. (Linked to SLOs 3.1, 3.2)
2. Explain indifference curves and the budget line, derive the consumer equilibrium condition in the ordinal utility framework, and discuss the factors (including behavioural biases) that influence consumer behaviour in Nigerian food markets. (Linked to SLOs 3.3, 3.4)



Answers to Concept Check Questions [Series 3]

Objective Questions

1. Zero.
2. Diminishing.
3. P_B .
4. Intersect.
5. P_A / P_B .

Short-Answer Questions

1. Total utility (TU) is the cumulative satisfaction from consuming a given quantity. Marginal utility (MU) is the additional satisfaction from one more unit. When MU is positive, TU is rising. When MU is zero, TU is at its maximum (satiation point). When MU is negative, TU is falling.
2. Equimarginal principle: maximise utility by equating MU per naira spent across all goods ($MU_A/P_A = MU_B/P_B$). If MU_A/P_A exceeds MU_B/P_B , the consumer gets more satisfaction per naira from A; shift spending from B to A until the ratios equalise.
3. Downward-sloping: consuming more of one good requires less of the other to maintain same utility. Convex to origin: diminishing MRS; each extra unit of A substitutes for progressively less B. Cannot intersect: two crossing curves would imply the same bundle gives two utility levels (logical contradiction). Higher curve preferred: more of both goods yields greater utility (non-satiation assumption).
4. Substitution effect: change in consumption due to relative price change with real utility held constant; when price of a good falls, it becomes cheaper relative to substitutes, so consumers substitute toward it. Income effect: change due to change in real purchasing power; price fall raises real income; for normal goods more is purchased. For normal goods both effects reinforce (price fall leads to more consumption through both channels), confirming the downward-sloping demand curve.
5. Engel's law: as income rises, the proportion of income spent on food falls. In Nigerian cities, rising incomes shift consumption away from basic staples (garri, sorghum) toward protein-rich foods (poultry, fish, eggs), processed foods (noodles, bread, canned goods), and convenience items; food remains important but represents a declining share of urban household budgets.



Long-Answer Questions

1. Utility: subjective satisfaction from consuming a good; types: form (processed garri from cassava), place (maize transported to Lagos), time (stored yam available in lean season), possession (owning a tractor). TU: cumulative satisfaction; MU: additional satisfaction from one more unit. Law of diminishing MU: each successive unit consumed gives less additional satisfaction (first bowl of eba is most satisfying; subsequent bowls add less). MU schedule example: 1st unit MU = 50; 2nd = 35; 3rd = 20; 4th = 5; 5th = 0 (satiation); 6th = -10 (disutility). Single-good equilibrium: buy units while MU exceeds P; stop at MU = P. Example: sorghum at N8,000/bag (= 8 utils, 1 util = N1,000): buy while MU (in utils) exceeds 8; equilibrium at MU = 8 (3rd bag). Two-good equilibrium (equimarginal): $MU_A/P_A = MU_B/P_B$; if one ratio exceeds the other, shift spending toward the higher-ratio good; law of diminishing MU ensures ratios converge as consumption adjusts.
2. Indifference curves: all combinations of two goods giving equal utility; properties: downward-sloping (trade-off between goods); convex to origin (diminishing MRS: as more garri consumed, each extra unit substitutes for less rice); cannot intersect (logical contradiction); higher curves preferred. $MRS = \text{absolute slope of IC} = -\Delta Q_{\text{rice}}/\Delta Q_{\text{garri}} = MU_{\text{garri}}/MU_{\text{rice}}$. Budget line: $P_A \times Q_A + P_B \times Q_B = M$; slope = $-P_A/P_B$; x-intercept M/P_A ; y-intercept M/P_B ; income rise shifts it outward parallel; own price fall rotates it outward on that axis. Consumer equilibrium: highest IC tangent to budget line; $MRS = P_A/P_B$ (subjective trade-off = market trade-off). If MRS exceeds P_A/P_B : value A more than market price; buy more A, less B until MRS falls to equal ratio. Nigerian consumer behaviour: income and poverty (poor spend 60 to 70% on food; Engel's law: proportion falls with income; shift to proteins and processed foods with urbanisation); cultural and religious factors (Muslim food taboos; festival foods; kola nut hospitality); seasonal lean season (reduced quality and variety); food safety awareness (shift toward certified products in cities). Behavioural biases: present bias (sell grain at harvest at low prices; short-term cash needs dominate); loss aversion (reluctance to adopt new variety; fear of downside outweighs expected gain); anchoring (high initial prices in Lagos markets); status quo bias (habit persistence in food choices); herd behaviour (spread of wheat bread in cities through social demonstration).

Answers to Pilot Questions [Series 3]



Part 3.1

1. Utility: subjective satisfaction from consuming a good. Form utility: garri processed from cassava is more useful to consumers than raw cassava tubers. Place utility: maize transported from Kaduna to Mile 12 market Lagos has higher utility to Lagos consumers. Time utility: stored yam available in the lean season commands higher utility than the same yam at harvest. Possession utility: a farmer owning an irrigation pump derives satisfaction from ownership even when the pump is not in use.
2. Total utility (TU) is the cumulative satisfaction from all units consumed to date. Marginal utility (MU) is the additional satisfaction from consuming one more unit. When MU is positive, TU is increasing. When MU is zero, TU is at its maximum. When MU is negative, TU is declining.
3. MU: 1st cup = 20; 2nd = 15; 3rd = 10; 4th = 5; 5th = 0; 6th = -5. Satiation point: 5th cup, where MU = 0 and TU is at its maximum of 50 utils.
4. Law of diminishing marginal utility: as consumption of a good increases in a given period, the marginal utility of each additional unit decreases. Assumptions: (1) the consumer is rational and aims to maximise utility; (2) tastes and preferences remain constant throughout the consumption period.
5. The downward-sloping demand curve: a consumer only demands more of a good at a lower price because the declining MU of additional units means each extra unit is worth less; price must fall to match the lower MU. Dietary diversification: as a consumer eats more of any single food, its MU falls relative to other foods; this makes it rational to consume a variety of foods rather than maximising one item.

Part 3.2

1. Cardinal utility assumes satisfaction can be measured in numerical utils, allowing direct comparison. Advantage: produces clear, intuitive equilibrium conditions ($MU = P$; $MU_A/P_A = MU_B/P_B$). Limitation: utility is subjective and cannot realistically be measured in absolute units or compared across individuals.
2. Single-good equilibrium: consume until $MU = P$. Beyond this point, the price paid for the next unit exceeds the marginal utility it yields; purchasing that unit reduces net utility (the consumer pays more than the satisfaction received).
3. Equimarginal principle: $MU_A/P_A = MU_B/P_B$ for all goods. If MU_A/P_A exceeds MU_B/P_B : each naira spent on A yields more satisfaction than on B; the consumer



should buy more A and less B. As more A is consumed, MU_A falls (diminishing MU); as less B is consumed, MU_B rises; adjustment continues until the two ratios are equal.

4. $MU_{yam}/P_{yam} = 40/1,000 = 0.04$; $MU_{beans}/P_{beans} = 20/400 = 0.05$. Since 0.04 is less than 0.05, the farmer gets more utility per naira from beans; not in equilibrium. Adjustment: shift spending from yam to beans. As more beans are consumed, MU_{beans} falls; as less yam is consumed, MU_{yam} rises; equilibrium is restored when the ratios equalise.
5. The equimarginal principle requires the consumer to keep adjusting spending until MU per naira is equalised across all goods. This adjustment is possible because of diminishing marginal utility: as more of a good is consumed, its MU falls; as less is consumed, its MU rises. Without diminishing MU, the ratios could never converge and equilibrium could not be reached.

Part 3.3

1. An indifference curve shows all combinations of two goods that give a consumer equal total utility. Four properties: downward-sloping (more of one good requires less of the other to maintain equal utility). Convex to origin (diminishing MRS; substitution becomes less willing as one good is consumed in excess). Cannot intersect (a crossing point would imply the same bundle gives two utility levels simultaneously). Higher curve preferred (more of both goods yields greater utility under non-satiation).
2. Indifference curves are convex because of diminishing MRS: as the consumer moves down the curve consuming more garri and less rice, garri becomes relatively abundant while rice becomes relatively scarce; each additional unit of garri substitutes for progressively less rice, making the curve flatten. This declining willingness to substitute makes the curve bow inward toward the origin.
3. Budget equation: $3,000 \times Q_{rice} + 2,000 \times Q_{beans} = 12,000$. X-intercept (all beans): $Q_{beans} = 12,000/2,000 = 6$ kg beans, $Q_{rice} = 0$. Y-intercept (all rice): $Q_{rice} = 12,000/3,000 = 4$ kg rice, $Q_{beans} = 0$.
(a) Income doubles to N24,000: both intercepts double (rice intercept = 8 kg; beans intercept = 12 kg); the budget line shifts outward parallel to the original. (b) Price of rice falls by 50 percent to N1,500: rice intercept rises to $12,000/1,500 = 8$ kg; beans intercept unchanged at 6 kg; budget line rotates outward around the beans intercept.
4. Equilibrium condition: highest attainable IC tangent to budget line; $MRS = P_A/P_B$. If MRS exceeds P_A/P_B : consumer values A more than the market requires; buy more A



and less B. As more A is consumed, MRS falls; as less B is consumed, MRS rises; adjustment continues until $MRS = P_A/P_B$.

Part 3.4

1. Substitution effect: change in consumption due solely to relative price change (real utility held constant); when a good's price falls, it is cheaper relative to substitutes; consumers substitute toward it. Income effect: change due to change in real purchasing power; price fall raises real income. For a normal good, price fall: SE increases consumption (substitution toward cheaper good); IE increases consumption (higher real income raises demand for normal goods); both reinforce each other; demand curve unambiguously downward-sloping.
2. Engel's law: as income rises, the proportion (share) of income spent on food declines, even though absolute food spending increases. In Nigerian cities, rising incomes shift consumption from garri and maize meal toward rice, wheat bread, noodles, poultry, and dairy; food remains important but represents a smaller share of urban household budgets as incomes grow.
3. Religious food taboos: northern Nigerian Muslims avoid pork; demand for pork is zero in Muslim-majority areas regardless of price. Festival foods: Yoruba communities buy large quantities of yam for the New Yam festival; demand spikes seasonally. Social hospitality: kola nuts are offered to guests in Igbo and Yoruba homes; their demand is maintained even at higher prices because of cultural obligation.
4. Present bias is the tendency to overweight immediate rewards relative to future ones. Nigerian farmer example: at harvest, the farmer needs cash urgently for school fees and debt repayment; even knowing that grain prices will be 30 to 50 percent higher in 6 months, the immediate cash need is so pressing that the farmer sells all grain now, forgoing the higher future price.
5. Loss aversion means the psychological pain from a loss is greater than the pleasure from an equivalent gain. For Nigerian farmers, adopting a new crop variety involves risk: if the new variety fails, the farmer experiences a loss (lower yield, income, food security). Even if the expected yield gain is positive, the psychological weight of the potential downside may exceed the appeal of the expected gain, causing the farmer to reject the technology and stick with the familiar variety.





References and Attributions [Series 3]

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Figures, Plates, Tables, and Boxes

- Figure 3.1: Indifference curve analysis showing consumer equilibrium for a Nigerian household allocating spending between garri and rice. Attribution: AI generated. Suggested OER search string: “indifference curve budget line consumer equilibrium tangency diagram garri rice Nigeria OER”.
- Box 3.1: Comparison of cardinal and ordinal utility approaches to consumer equilibrium. Attribution: AI generated. Suggested OER search string: “cardinal ordinal utility consumer equilibrium comparison table indifference curve budget line OER”.



Series 4: Production, Costs and Returns

- **Part 4.1: Theory of Production**

- Sub Part 4.1.1: Concepts of production and production functions
- Sub Part 4.1.2: Total, average, and marginal product
- Sub Part 4.1.3: The law of diminishing returns

- **Part 4.2: Returns to Scale and Optimal Input Use**

- Sub Part 4.2.1: Returns to scale: increasing, constant, and decreasing
- Sub Part 4.2.2: Isoquants and isocost lines
- Sub Part 4.2.3: Least-cost input combination

- **Part 4.3: Theory of Costs**

- Sub Part 4.3.1: Fixed, variable, and total costs
- Sub Part 4.3.2: Average and marginal costs
- Sub Part 4.3.3: Short-run and long-run cost curves

- **Part 4.4: Revenue, Profit, and Optimum Output**

- Sub Part 4.4.1: Total, average, and marginal revenue
- Sub Part 4.4.2: Profit maximisation: $MR = MC$ condition
- Sub Part 4.4.3: Returns to farm investments in Nigeria



Introduction

Production economics is the core of agricultural economics at the farm level. Every farming decision, from how many bags of fertiliser to apply to a maize plot, to which enterprise combination to grow on a mixed farm, to when to hire additional labour, is fundamentally a production economics question. Understanding how inputs are transformed into outputs, how costs change with output, and how profit is maximised allows agricultural economists to guide farmers, agribusiness managers, and policymakers toward more efficient and profitable resource use.

This Series develops the theory of production (production functions, the law of diminishing returns, returns to scale), the theory of costs (fixed, variable, average, and marginal costs; short-run and long-run cost curves), and the theory of the firm's output decision (revenue, profit maximisation at $MR = MC$, and returns to investment). All concepts are applied to Nigerian farming systems using maize, cassava, poultry, and other relevant examples.

Series Learning Outcomes

Upon completing this Series, you should be able to:

- **SLO 4.1** define production and production functions, and distinguish between total product, average product, and marginal product (Linked to Part 4.1),
- **SLO 4.2** state and explain the law of diminishing returns and apply it to Nigerian agricultural examples (Linked to Part 4.1),
- **SLO 4.3** distinguish between increasing, constant, and decreasing returns to scale, describe isoquants and isocost lines, and derive the least-cost input combination (Linked to Part 4.2),
- **SLO 4.4** define and distinguish between fixed, variable, total, average, and marginal costs, and describe short-run and long-run cost curves (Linked to Part 4.3), and
- **SLO 4.5** define total, average, and marginal revenue, apply the $MR = MC$ profit-maximisation condition, and evaluate returns to farm investments in Nigeria (Linked to Part 4.4).



4.1 Theory of Production

4.1.1 Concepts of production and production functions

Production is the process of combining inputs (factors of production) to create outputs (goods and services). In agriculture, the inputs are land (farmland area, soil quality, water), labour (family and hired farm workers), capital (tools, machinery, irrigation equipment, buildings), and intermediate inputs (seeds, fertiliser, pesticides, animal feed). The output is the physical quantity of crop or livestock product harvested. Production differs from mere transformation: it creates form, place, or time utility that increases the value of the output relative to the inputs.

A production function specifies the maximum output that can be produced from any given combination of inputs, given the state of technology. It can be written as: $Q = f(L, K, N, \dots)$ where Q is output, L is labour, K is capital, and N is land. The production function captures the technical relationship between inputs and output and represents the state of technical knowledge available to the producer. In the short run, at least one input is fixed (typically land or capital equipment); in the long run, all inputs are variable and the producer can adjust the entire scale of operation. The Cobb-Douglas production function ($Q = A \times L^a \times K^b$, where A is a technology constant and a and b are output elasticities with respect to labour and capital) is widely used in empirical agricultural production studies in Nigeria.

Fill in the blank: A production _____ specifies the maximum output obtainable from any given combination of inputs at a given level of technology; it can be expressed as $Q = f(L, K, N)$ where L is labour, K is capital, and N is land.

4.1.2 Total, Average, and Marginal Product

Total product (TP) is the total output produced from a given quantity of a variable input while other inputs remain fixed. Average product (AP) is output per unit of the variable input, while marginal product (MP) is the additional output obtained from one more unit of that input. For labour:

$$AP_L = TP/L$$



$$MP_1 = \Delta TP / \Delta L$$

As labour increases while land and capital remain fixed, TP first rises rapidly, then rises at a decreasing rate, reaches its maximum when **MP = 0**, and eventually falls when **MP becomes negative**. When **MP > AP**, AP rises; when **MP = AP**, AP reaches its maximum; and when **MP < AP**, AP falls.

Production is divided into three stages. **Stage I** ends where AP is at its maximum and **MP = AP**; stopping before this point is inefficient because the fixed inputs are not yet fully utilised. **Stage II** extends from maximum AP to maximum TP, where MP remains positive but declines to zero; this is the rational stage of production. **Stage III** begins when MP becomes negative, meaning that additional labour reduces total output. For example, if successive labour levels produce 500, 1,100, 1,600, 1,900, 2,000, and 1,800 kg of maize, TP reaches its maximum at five workers, while the sixth worker has a negative marginal product of **-200 kg**.

Fill in the blank: When marginal product (MP) exceeds average product (AP), AP is _____; when MP equals AP, AP is at its maximum; when MP falls below AP, AP is declining; rational production occurs in Stage II where MP is positive but less than AP.

4.1.3 The law of diminishing returns

The law of diminishing (marginal) returns states that as successive units of a variable input are added to a fixed quantity of other inputs, the marginal product of the variable input will eventually decline. This law applies in the short run when at least one input is fixed. It does not say that MP immediately falls; it may initially rise (Stage I), but eventually, as the fixed input becomes a binding constraint, each additional unit of the variable input has less of the fixed input to work with and its MP falls. The law is a short-run phenomenon; in the long run, all inputs can be varied and diminishing returns do not necessarily apply.

Agricultural applications in Nigeria: (1) Fertiliser application: as more fertiliser is applied to a fixed area of farmland, the yield response per additional kg of fertiliser eventually falls (the



Nigerian research recommendation system specifies an economic optimum fertiliser rate beyond which additional fertiliser adds more cost than value). (2) Labour on a fixed farm: as more labourers are added to a fixed size farm, each additional worker has less land to work with; their MP falls. (3) Water application in irrigation: as more water is applied to a fixed plot, each additional litre adds less to yield and eventually causes waterlogging, reducing yield. The law of diminishing returns is the empirical basis for the downward-sloping demand for inputs: farmers will only hire more labour or buy more fertiliser if their price falls to match the declining MRP.

Fill in the blank: The law of _____ returns states that as more units of a variable input are added to a fixed quantity of other inputs, the marginal product of the variable input eventually declines; this law applies in the short run and underlies the economic optimum fertiliser rate for Nigerian crops.

Pilot questions 4.1

1. Define a production function and state two inputs and one output in a typical Nigerian smallholder maize production system.
2. A farmer adds workers to a 1 ha cassava farm and obtains the following TP: 1 worker = 800 kg; 2 = 1,500 kg; 3 = 2,100 kg; 4 = 2,500 kg; 5 = 2,700 kg; 6 = 2,700 kg; 7 = 2,500 kg. Calculate AP and MP for each labour level.
3. Identify the three stages of production from the data in question 2 and state which stage is rational.
4. State the law of diminishing returns and give two examples from Nigerian agriculture.
5. Explain why a Nigerian maize farmer should stop applying fertiliser before reaching the point of maximum total product.

4.2 Returns to Scale and Optimal Input Use

4.2.1 Returns to Scale: Increasing, Constant, and Decreasing

Returns to scale describe how output changes when all production inputs are increased in the same proportion. It is a long-run concept because labour, land, capital, and other inputs are



all variable. **Increasing returns to scale (IRS)** occur when output rises by a greater proportion than inputs, often because of specialisation, division of labour, and better use of large equipment. **Constant returns to scale (CRS)** occur when output rises in the same proportion as inputs, while **decreasing returns to scale (DRS)** occur when output rises by a smaller proportion because of management, coordination, or resource problems.

For the Cobb–Douglas production function:

$$Q = A L^a K^b$$

returns to scale are determined by the sum of the input elasticities. If $a + b > 1$, there are increasing returns to scale; if $a + b = 1$, there are constant returns to scale; and if $a + b < 1$, there are decreasing returns to scale. In Nigerian agriculture, small farms may experience IRS or CRS as they expand and use resources more efficiently, while very large farms may face DRS because of increasing supervision and coordination difficulties.

Fill in the blank: If all inputs are doubled and output more than doubles, the farm exhibits _____ returns to scale; if output exactly doubles, the farm has constant returns to scale; if output less than doubles, it has decreasing returns to scale.

4.2.2 Isoquants and isocost lines

An isoquant (iso = equal; quant = quantity) is a curve showing all combinations of two inputs (e.g. labour L and capital K) that produce the same level of output. It is the production-theory equivalent of the indifference curve in consumer theory. Properties of isoquants: (1) Downward-sloping: to produce the same output with less labour, more capital is needed (inputs are substitutable). (2) Convex to the origin: reflects the diminishing marginal rate of technical substitution (MRTS); as more labour is used relative to capital, each additional unit of labour becomes a poorer substitute for capital, so increasingly more labour is needed to compensate for the loss of one unit of capital. (3) Cannot intersect: two isoquants crossing would imply the same input combination gives two different output levels. (4) Higher isoquants represent more output.



The marginal rate of technical substitution (MRTS) is the rate at which one input can be substituted for another while keeping output constant: $MRTS_{LK} = -\text{change in } K / \text{change in } L$ (along an isoquant) $= MP_L / MP_K$. The MRTS diminishes as labour is substituted for capital (isoquant is convex). An isocost line shows all combinations of two inputs that cost the same total amount given input prices. If the firm has a total cost budget C and faces wage rate w (price of labour) and rental rate r (price of capital): $wL + rK = C$. Rearranging: $K = C/r - (w/r)L$. The isocost line has y-intercept C/r , x-intercept C/w , and slope $-w/r$. A higher budget shifts the isocost line outward (parallel); a change in input prices rotates it.

Fill in the blank: The marginal rate of technical substitution (MRTS) equals $MP_L / \rule{1cm}{0.4pt}$, representing the rate at which labour can be substituted for capital while holding output constant; it diminishes along the isoquant because of the law of diminishing marginal returns to each input.

4.2.3 Least-cost input combination

The least-cost input combination (or cost-minimising input combination) is the combination of inputs that produces a given level of output at the minimum total cost. Graphically, it is the point at which the isoquant is tangent to the lowest attainable isocost line. At this tangency point, the slope of the isoquant (MRTS) equals the slope of the isocost line (w/r): $MRTS_{LK} = w/r$. Equivalently: $MP_L / MP_K = w/r$, which rearranges to $MP_L/w = MP_K/r$. This states that the marginal product per naira spent must be equal across all inputs; this is the production analogue of the equimarginal principle in consumer theory.

Example: a Nigerian poultry farmer produces 1,000 broilers using two inputs: labour ($w = \text{N}2,000/\text{day}$) and feed ($r = \text{N}5,000/\text{bag}$). At the optimal combination, $MP_{\text{labour}} / 2,000 = MP_{\text{feed}} / 5,000$, or $MP_{\text{labour}} / MP_{\text{feed}} = 2,000/5,000 = 0.4$. If the current ratio of MPs is 0.6 (labour more productive per naira spent), the farmer should use more labour and less feed; as more labour is used, MP_{labour} falls (diminishing returns); adjustment continues until the ratio equals 0.4. The least-cost principle guides Nigerian farmers to substitute cheaper inputs for expensive ones up to the point where the ratio of MPs equals the ratio of prices, ensuring they get maximum output from every naira spent on inputs.



Fill in the blank: The least-cost condition for two inputs is $MP_L / w = MP_K / \underline{\hspace{2cm}}$, meaning the marginal product per naira spent must be equal across all inputs; this is the production analogue of the equimarginal principle in consumer theory.

Pilot questions 4.2

1. Define returns to scale and distinguish between increasing, constant, and decreasing returns to scale with one Nigerian agricultural example of each.
2. Define an isoquant and state four properties it shares with an indifference curve.
3. A farmer has a budget of N60,000. Labour costs N3,000/day and fertiliser costs N6,000/bag. Write the isocost equation and find the intercepts.
4. State the least-cost input combination condition and explain what a farmer should do if MP_L/w exceeds MP_K/r .
5. Explain why the MRTS diminishes along an isoquant and what this implies about the shape of the isoquant.

4.3 Theory of Costs

4.3.1 Fixed, variable, and total costs

Costs of production are the monetary payments made for inputs used in production, including both explicit costs (actual cash payments: purchased inputs, hired labour, fuel, rent) and implicit costs (opportunity costs of owned inputs: the value of the farmer's own labour and land in their best alternative use). The distinction between fixed and variable costs applies in the short run. Fixed costs (FC) are costs that do not change with the level of output in the short run; they must be paid even if output is zero. Examples in Nigerian farming: annual land rent on a leased farm; depreciation on a tractor or irrigation pump; annual insurance premium; a fixed management fee. Variable costs (VC) are costs that change directly with the level of output. Examples: cost of seed (more area = more seed); hired labour for weeding and harvesting; fuel for tractors and water pumps; fertiliser and pesticides.

Total cost (TC) is the sum of fixed and variable costs: $TC = FC + VC$. As output increases, TC rises because VC rises; FC remains constant. The total cost function in the short run is typically



S-shaped (cubic): TC rises slowly at first (when variable inputs are used efficiently), then more steeply (as diminishing returns set in and more variable inputs are needed per unit of additional output). Total variable cost (TVC) has the same S-shape as TC (they differ only by the constant FC). Example: a Nigerian tomato farmer with fixed costs of N50,000 (land rent) and variable costs rising with each tonne of tomatoes produced: 0 tonnes TVC = 0; 1 tonne TVC = N30,000; 2 tonnes TVC = N55,000; 3 tonnes TVC = N75,000; 4 tonnes TVC = N100,000; 5 tonnes TVC = N135,000. TC at each output level = FC (N50,000) + TVC.

Fill in the blank: Total cost equals fixed cost plus _____ cost; fixed costs do not change with output (e.g. land rent) while variable costs increase with output (e.g. fertiliser and hired labour); at zero output, total cost equals fixed cost.

4.3.2 Average and marginal costs

Average fixed cost (AFC) = FC / Q . AFC falls continuously as output rises because the fixed cost is spread over more and more units; the AFC curve is a rectangular hyperbola falling toward the x-axis. Average variable cost (AVC) = VC / Q . AVC is U-shaped: initially falls as variable inputs are used more efficiently at low output, reaches a minimum at the output level corresponding to maximum AP of the variable input, then rises as diminishing returns increase the variable cost per unit of output. Average total cost (ATC) = $TC / Q = AFC + AVC$. ATC is also U-shaped; it lies above AVC by the amount AFC; the gap between ATC and AVC narrows as output rises (because AFC falls).

Marginal cost (MC) = $\text{change in TC} / \text{change in } Q = \text{change in TVC} / \text{change in } Q$ (since FC does not change with output, MC depends only on VC). MC is U-shaped: initially falls (Stage I of production; increasing MP of variable input means each additional unit of output requires less variable input), reaches a minimum at the output level where MP is maximum, then rises as diminishing returns set in (Stage II and III; each additional unit of output requires more variable input). Key relationship: MC intersects both AVC and ATC at their minimum points (from below); when MC is below AVC, AVC is falling; when MC equals AVC, AVC is at its minimum; when MC exceeds AVC, AVC is rising. This is the same mathematical relationship as between MP and AP.



Fill in the blank: Marginal cost is U-shaped because it initially falls (as the marginal _____ of the variable input rises) and then rises (as diminishing returns reduce the efficiency of additional variable inputs); MC intersects AVC and ATC at their respective minimum points.

4.3.3 Short-run and long-run cost curves

The short-run cost curves (AFC, AVC, ATC, MC) described above apply when at least one input (typically capital) is fixed. In the long run, all inputs are variable; the producer can choose among different plant sizes or production scales. The long-run average cost (LRAC) curve is the envelope of all possible short-run ATC curves, each associated with a different fixed capital level. The LRAC shows the minimum average cost achievable for each output level when all inputs are optimally adjusted. The LRAC curve is typically U-shaped: it falls over the range of output where increasing returns to scale exist (economies of scale), reaches a minimum at the minimum efficient scale (MES), and rises where decreasing returns to scale (diseconomies of scale) dominate.

Economies of scale are the reductions in average cost that arise as output increases in the long run: specialisation of labour, use of more efficient large-scale machinery, bulk purchasing discounts, and spreading of overhead costs over more units. Diseconomies of scale are increases in average cost at very large scales: management coordination difficulties, communication breakdowns, bureaucratic inefficiency. In Nigerian agriculture, small subsistence farms (below 5 ha) often face diseconomies related to inability to afford machinery and modern inputs (not true diseconomies of scale, but a reflection of factor market imperfections). Large commercial poultry, fish, and dairy farms exhibit significant economies of scale in feed purchasing, veterinary services, and processing. The minimum efficient scale differs considerably across agricultural enterprises.

Fill in the blank: The long-run average cost (LRAC) curve is the _____ of all short-run average total cost curves; it traces the minimum average cost achievable at each output level when all inputs are optimally adjusted to that output level.



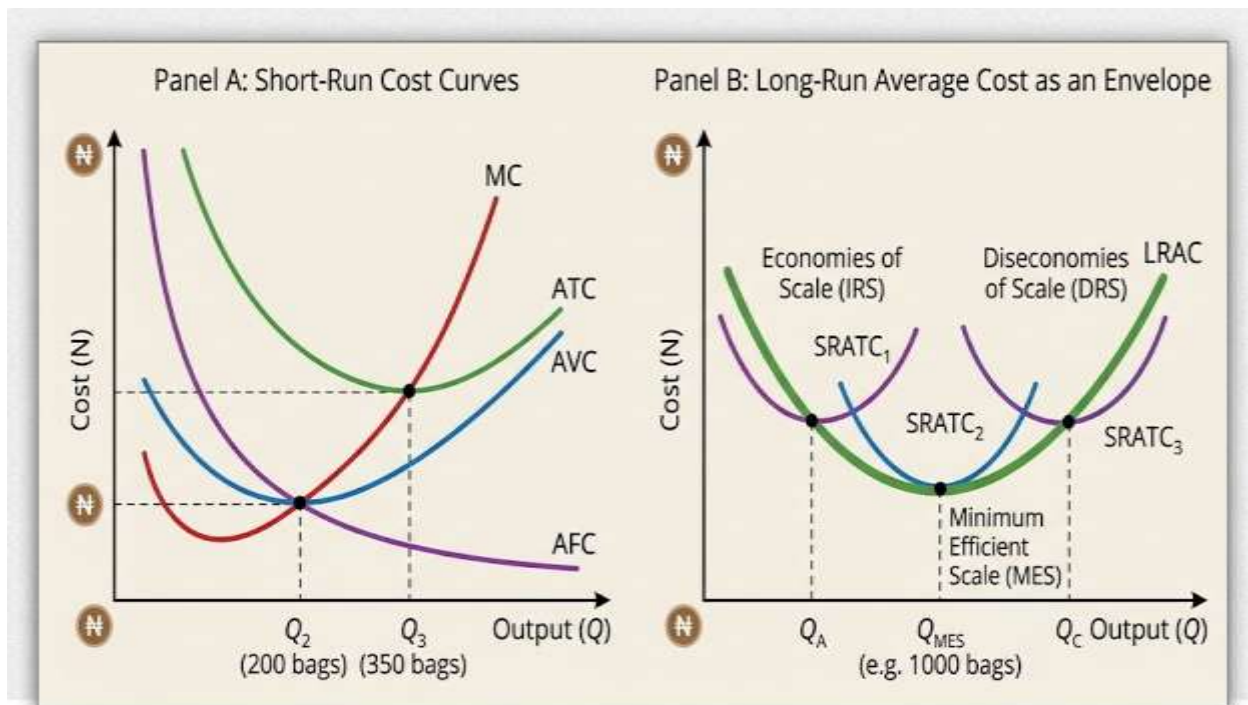


Figure 4.1: Short-run cost curves showing relationships between AFC, AVC, ATC, and MC (left) and the U-shaped long-run average cost envelope curve (right).

Figure 4.1: Short-run cost curves (left) and the long-run average cost curve as an envelope of short-run ATC curves (right)

Pilot questions 4.3

1. Distinguish between fixed costs and variable costs in Nigerian smallholder farming, giving two examples of each.
2. A farmer has fixed costs of N80,000 and the following variable costs: $Q=1$: N20,000; $Q=2$: N35,000; $Q=3$: N55,000; $Q=4$: N80,000; $Q=5$: N115,000. Calculate TC, ATC, AVC, AFC, and MC for each output level.
3. Explain the U-shape of the AVC curve using the concept of the marginal product of the variable input.
4. Explain the relationship between MC and ATC and state at what point MC intersects the ATC curve.
5. Distinguish between short-run and long-run cost analysis and explain what the LRAC curve represents.



4.4 Revenue, Profit, and Optimum Output

4.4.1 Total, average, and marginal revenue

Revenue is the income received by a firm from selling its output. Total revenue (TR) is price multiplied by quantity sold: $TR = P \times Q$. Under perfect competition (where the individual firm is a price taker and faces a horizontal demand curve), price is constant regardless of quantity sold; TR rises linearly with output. Under imperfect competition (where the firm faces a downward-sloping demand curve), price must fall as more is sold; TR first rises, reaches a maximum, then falls. Average revenue (AR) is revenue per unit sold: $AR = TR / Q = (P \times Q) / Q = P$. Under perfect competition, AR equals price and is constant (horizontal line). Under imperfect competition, AR equals price and falls as quantity rises (AR curve coincides with the demand curve).

Marginal revenue (MR) is the additional revenue from selling one more unit: $MR = \text{change in TR} / \text{change in Q}$. Under perfect competition: $MR = AR = P$ (the firm sells each additional unit at the same fixed market price; no discount needed). Under imperfect competition: MR falls faster than AR and is below AR for all output levels beyond the first unit (because selling one more unit requires lowering the price on all units previously sold as well as the additional unit). The TR, AR, and MR concepts are directly applicable to Nigerian agricultural producers: a smallholder selling maize in a competitive village market faces a roughly horizontal demand curve (price taker); MR approximately equals the market price. A large rice processor with market power faces a downward-sloping demand; MR is below AR.

Fill in the blank: Under perfect competition, average revenue (AR) equals _____ and is constant (the firm is a price taker); under imperfect competition, AR falls as output rises and marginal revenue (MR) falls even faster than AR.

4.4.2 Profit maximisation: $MR = MC$ condition

Profit (π) is total revenue minus total cost: $\pi = TR - TC$. A firm maximises profit at the output level where the difference between TR and TC is greatest. This occurs at the output where $MR = MC$. The logic: if MR exceeds MC, selling one more unit adds more to revenue than to cost; profit increases; the firm should expand output. If MC exceeds MR, producing the last unit adds



more to cost than to revenue; profit decreases; the firm should reduce output. Only when $MR = MC$ is there no incentive to change output; this is the profit-maximising (or loss-minimising) output level. A second condition for profit maximisation (rather than minimisation) is that MC must be rising at the $MR = MC$ point.

Under perfect competition, $MR = P$ (price is constant); so the profit-maximisation condition simplifies to $P = MC$. This means competitive firms expand output until the marginal cost of the last unit equals its market price; this is also the condition for productive efficiency. Example: a Nigerian poultry farmer selling broilers at N4,500 per bird should produce up to the output level where MC of the last bird equals N4,500. If MC at 1,000 birds is N3,000 (MR exceeds MC; expand), and at 1,500 birds is N4,500 ($MR = MC$; optimal), and at 2,000 birds is N6,000 (MC exceeds MR; contract), the profit-maximising output is 1,500 birds. Profit = $TR - TC = (4,500 \times 1,500) - TC$ at 1,500 birds. The firm should shut down in the short run if TR falls below TVC (price below AVC); it should shut down in the long run if TR falls below TC (price below ATC).

Fill in the blank: The profit-maximising output is where marginal _____ equals marginal cost ($MR = MC$); under perfect competition this simplifies to $P = MC$, meaning the firm produces until the market price equals the cost of producing the last unit.

4.4.3 Returns to farm investments in Nigeria

Agricultural investment analysis evaluates whether a farm investment is economically worthwhile. Key measures of investment returns: (1) Gross margin (GM): gross revenue minus variable costs; $GM = TR - TVC$. It measures the contribution of an enterprise to covering fixed costs and generating profit; widely used in farm enterprise budgeting in Nigeria. (2) Net farm income (NFI): gross revenue minus all costs (fixed and variable), including implicit costs of family labour and owned land. (3) Return on investment (ROI): $(\text{Net profit} / \text{Total investment cost}) \times 100$ percent; measures profitability as a percentage of capital invested. (4) Benefit-cost ratio (BCR): total discounted benefits / total discounted costs; BCR exceeds 1 indicates a worthwhile investment; widely used in project appraisal for irrigation, mechanisation, and storage investments in Nigeria.



(5) Net present value (NPV): the sum of discounted net benefits over the project life, using an appropriate discount rate (typically the opportunity cost of capital or the bank lending rate; approximately 20 to 25 percent per annum in Nigeria): $NPV = \sum [(Benefits_t - Costs_t) / (1 + r)^t]$ for $t = 0$ to n . A positive NPV indicates the investment is worthwhile. (6) Internal rate of return (IRR): the discount rate that makes $NPV = 0$; an investment is worthwhile if IRR exceeds the cost of capital. Empirical estimates for Nigerian agricultural investments: fertiliser use on maize typically yields BCR of 2 to 4 (investment in fertiliser returns 2 to 4 naira per naira invested); improved cassava variety adoption yields BCR of 3 to 5; small-scale irrigation investments for dry-season vegetable farming yield IRR of 30 to 60 percent in northern Nigeria, well above the cost of capital.

Fill in the blank: Gross margin equals total revenue minus _____ costs; it is the most widely used financial indicator in Nigerian farm enterprise budgeting because it measures the contribution of each crop or livestock enterprise to covering fixed costs and generating profit.

<u>Measure</u>	<u>Formula & Interpretation</u>
Gross Margin (GM)	Formula: $GM = \text{Total Revenue} - \text{Variable Costs}$. Interpretation: Indicates profitability of farm enterprises before accounting for fixed costs; useful for enterprise comparison.
Net Farm Income (NFI)	Formula: $NFI = \text{Gross Margin} - \text{Fixed Costs}$. Interpretation: Measures overall profitability after deducting all costs; reflects farmer's return to management, labour, and capital.
Return on Investment (ROI)	Formula: $ROI = (\text{Net Profit} \div \text{Total Investment}) \times 100$. Interpretation: Shows efficiency of farm investment; higher ROI means better use of capital.
Benefit-Cost Ratio (BCR)	Formula: $BCR = \text{Total Benefits} \div \text{Total Costs}$. Interpretation: If $BCR > 1$, the project is financially viable; compares benefits relative to costs.
Net Present Value (NPV)	Formula: $NPV = \sum (\text{Cash Inflows} - \text{Cash Outflows}) \div (1 + r)^t$. Interpretation: Present value of future net cash flows; positive NPV indicates profitable investment.
Internal Rate of Return (IRR)	Formula: IRR is the discount rate that makes $NPV = 0$. Interpretation: Measures profitability as a percentage; higher IRR than cost of capital means investment is worthwhile.



Box 4.1: Financial performance measures for farm investment analysis in Nigeria

Pilot questions 4.4

1. Define total revenue, average revenue, and marginal revenue. Under perfect competition, what is the relationship between MR, AR, and price?
2. State the profit-maximisation condition ($MR = MC$) and explain the economic logic underlying it.
3. A competitive maize farmer sells maize at N120,000 per tonne. His MC schedule is: Q=1: N60,000; Q=2: N80,000; Q=3: N100,000; Q=4: N120,000; Q=5: N150,000. What is the profit-maximising output?
4. Define gross margin and explain why it is more commonly used than net profit in Nigerian farm budgeting.
5. Define the benefit-cost ratio (BCR) and NPV and explain when each indicates that a farm investment is worthwhile.

Series Summary

This Series examined production as the process of combining inputs such as land, labour, capital, and materials to produce output. A production function, $Q = f(L, K, N)$, shows the maximum output obtainable from given inputs and technology. Total product is total output, average product is output per unit of input, and marginal product is the additional output from one more unit. Production passes through three stages, with Stage II being the rational stage where marginal product is positive but declining. The law of diminishing returns applies in the short run when one input varies while others remain fixed. Returns to scale apply in the long run when all inputs change together: increasing, constant, or decreasing. For $Q = AL^aK^b$, returns are increasing if $a + b > 1$, constant if $a + b = 1$, and decreasing if $a + b < 1$.

The Series also covered isoquants, isocost lines, costs, revenue, profit, and investment appraisal. An isoquant shows input combinations producing the same output, while an isocost line is $wL + rK = C$. Least-cost production occurs where $MRTS = w/r$ or $MP_L/w = MP_K/r$. Total cost equals fixed cost plus variable cost, while average and marginal cost curves help explain production



decisions. Revenue concepts include $TR = P \times Q$, $AR = P$, and $MR = \Delta TR / \Delta Q$. Profit is $\pi = TR - TC$ and is maximised where $MR = MC$; under perfect competition, $P = MR = MC$ at equilibrium. Investment decisions may be assessed using gross margin, net farm income, benefit–cost ratio, net present value, and internal rate of return.

Glossary of Terms

- **Average cost (ATC):** total cost divided by output ($ATC = TC/Q$); U-shaped in the short run; minimum point intersected by MC from below.
- **Average product (AP):** output per unit of variable input ($AP = TP/L$); maximised in Stage I of production; declines through Stage II.
- **Benefit-cost ratio (BCR):** total discounted benefits divided by total discounted costs; BCR greater than 1 indicates a worthwhile investment; widely used in Nigerian agricultural project appraisal.
- **Cobb-Douglas production function:** a production function of the form $Q = A \times L^a \times K^b$; exhibits IRS if $a+b$ exceeds 1, CRS if $a+b = 1$, and DRS if $a+b$ is less than 1; widely used in empirical agricultural studies.
- **Diseconomies of scale:** increases in long-run average cost as output expands beyond the minimum efficient scale; caused by management coordination difficulties and communication breakdowns at very large scales.
- **Economies of scale:** reductions in long-run average cost as output increases; caused by specialisation, indivisible inputs, and spreading of overhead costs; relevant to commercial poultry and dairy farming in Nigeria.
- **Fixed costs (FC):** costs that do not change with the level of output in the short run; must be paid even if output is zero; examples include land rent and machinery depreciation.
- **Gross margin (GM):** total revenue minus total variable costs ($GM = TR - TVC$); the most common financial indicator in Nigerian farm enterprise budgeting; measures contribution to covering fixed costs and profit.
- **Isocost line:** a straight line showing all combinations of two inputs that cost the same total amount given input prices; slope = $-w/r$; shifts outward if budget increases; rotates if input price changes.



- **Isoquant:** a curve showing all combinations of two inputs that produce the same level of output; downward-sloping and convex to the origin; higher isoquants represent greater output.
- **Law of diminishing returns:** as successive units of a variable input are added to fixed inputs, the marginal product of the variable input eventually declines; applies in the short run only.
- **Least-cost input combination:** the combination of inputs that produces a given output at minimum total cost; where the isoquant is tangent to the isocost line; condition: $MP_L/w = MP_K/r$.
- **Long-run average cost (LRAC):** the minimum average cost achievable at each output level when all inputs are optimally adjusted; the envelope of all short-run ATC curves; U-shaped due to economies and diseconomies of scale.
- **Marginal cost (MC):** the additional cost of producing one more unit of output; $MC = \Delta TC / \Delta Q$; U-shaped; intersects AVC and ATC at their minimum points.
- **Marginal product (MP):** the additional output from employing one more unit of a variable input, holding all other inputs fixed; eventually falls due to the law of diminishing returns.
- **Marginal rate of technical substitution (MRTS):** the rate at which one input can be substituted for another while maintaining constant output; $MRTS = MP_L / MP_K$; diminishes along an isoquant making it convex to the origin.
- **Marginal revenue (MR):** the additional revenue from selling one more unit of output; $MR = \Delta TR / \Delta Q$; under perfect competition $MR = P$; under imperfect competition MR falls faster than AR.
- **Net present value (NPV):** the sum of discounted net benefits over a project's life; positive NPV indicates the investment is worthwhile; discount rate reflects the opportunity cost of capital.
- **Production function:** a technical relationship specifying the maximum output obtainable from any given combination of inputs at a given level of technology; $Q = f(L, K, N)$.
- **Profit maximisation:** the output level where $MR = MC$; under perfect competition $P = MC$; a second-order condition requires MC to be rising at this point.
- **Returns to scale:** the relationship between a proportionate increase in all inputs and the resulting change in output; increasing (IRS), constant (CRS), or decreasing (DRS) returns to scale.
- **Variable costs (VC):** costs that change directly with the level of output; examples include seed, fertiliser, pesticides, and hired labour in Nigerian farming.





Concept Check Questions [Series 4]

Objective Questions

1. A production function specifies the maximum _____ obtainable from any given combination of inputs at a given level of technology. (Linked to SLO 4.1)
2. Rational production occurs in Stage _____ of production, where marginal product is positive but less than average product. (Linked to SLO 4.1)
3. If the Cobb-Douglas exponents sum to more than 1 ($a + b$ greater than 1), the production process exhibits _____ returns to scale. (Linked to SLO 4.3)
4. The least-cost input condition requires MP_L / w to equal MP_K / r , so that the marginal product per naira is equal across all inputs. (Linked to SLO 4.3)
5. Profit is maximised at the output where marginal revenue equals marginal _____; under perfect competition this simplifies to price equals marginal cost. (Linked to SLO 4.5)

Short-Answer Questions

1. Define total product, average product, and marginal product and explain the relationship between AP and MP. (Linked to SLO 4.1)
2. State the law of diminishing returns and give two examples from Nigerian crop or livestock production. (Linked to SLO 4.2)
3. Distinguish between fixed costs and variable costs and give two Nigerian farm examples of each. (Linked to SLO 4.4)
4. Explain the relationship between marginal cost and average total cost and state where MC intersects ATC. (Linked to SLO 4.4)
5. Define gross margin and the benefit-cost ratio and explain when each indicates a worthwhile agricultural enterprise or investment. (Linked to SLO 4.5)

Long-Answer Questions

1. Explain the theory of production, including the production function, TP, AP, and MP, the three stages of production, the law of diminishing returns, and returns to scale. Apply these concepts to Nigerian agricultural examples. (Linked to SLOs 4.1, 4.2, 4.3)
2. Explain the theory of costs (FC, VC, TC, AFC, AVC, ATC, MC, LRAC) and the theory of revenue and profit (TR, AR, MR; $MR = MC$ profit maximisation). Describe how gross margin, BCR, and NPV are used to evaluate farm investments in Nigeria. (Linked to SLOs 4.4, 4.5)



Answers to Concept Check Questions [Series 4]

Objective Questions

1. Output.
2. II.
3. Increasing.
4. r.
5. Cost.

Short-Answer Questions

1. Total product (TP): total output from a given quantity of variable input. Average product (AP): TP divided by input quantity (output per unit of input). Marginal product (MP): additional output from one more unit of input. Relationship: when MP exceeds AP, AP is rising; when MP equals AP, AP is at its maximum; when MP is below AP, AP is falling.
2. Law of diminishing returns: as successive units of a variable input are added to fixed inputs, MP eventually falls. Example 1: applying more fertiliser to a fixed area of maize; each additional kg of fertiliser adds less to yield as the land becomes fully supplied with nutrients. Example 2: adding more labourers to a fixed poultry pen; each additional worker has less space and equipment to work with; their marginal output eventually falls.
3. Fixed costs: do not change with output in the short run; examples: annual land rent on a leased farm; depreciation on a tractor. Variable costs: change directly with output; examples: cost of seeds (more area means more seeds); cost of hired labour for harvesting.
4. MC intersects ATC at the minimum point of ATC. When MC is below ATC, each additional unit costs less than the average; pulling the average down. When MC equals ATC, ATC is at its minimum. When MC exceeds ATC, additional units cost more than the average; pulling the average up.
5. Gross margin = $TR - TVC$; indicates the contribution of an enterprise to fixed costs and profit; a positive gross margin means the enterprise covers its variable costs; used in enterprise budgeting. $BCR = PV \text{ of benefits} / PV \text{ of costs}$; BCR exceeds 1 means benefits outweigh costs; indicates a worthwhile investment.

Long-Answer Questions

1. Production: combining inputs to create output. Production function: $Q = f(L, K, N)$; specifies max output at given technology; short run (at least one fixed input); long run (all variable). TP: total



output at given input level. $AP = TP/L$ (output per worker). $MP = \Delta TP / \Delta L$ (additional output from one more worker). Stage I: MP positive and rising; AP rising; irrational to stop (more workers improve average). Stage II: MP positive but below AP; both falling; rational zone. Stage III: MP negative; TP falls; irrational. Law of diminishing returns: in short run with fixed land, adding more labour eventually reduces MP; fertiliser example (each additional kg adds less yield as soil becomes saturated); labour example (more workers on fixed land have less land to work). Returns to scale (long run; all inputs vary): IRS (doubling inputs more than doubles output; specialisation, indivisible machinery); CRS (doubling inputs doubles output; replication); DRS (doubling inputs less than doubles output; management difficulties). Cobb-Douglas $Q = AL^a K^b$: IRS if $a+b$ exceeds 1; CRS if $a+b = 1$; DRS if $a+b$ is less than 1. Nigerian smallholder studies typically find $a+b$ close to 1 (CRS). Isoquants: same output, different input combinations; downward-sloping, convex (diminishing MRTS), non-intersecting, higher = more output. Isocost: $wL + rK = C$; slope = $-w/r$. Least cost: $MRTS = w/r$; $MP_L/w = MP_K/r$; equimarginal in production.

- Costs: FC (land rent, depreciation; constant regardless of output); VC (seeds, fertiliser, labour; rises with output); $TC = FC + VC$. $AFC = FC/Q$: falls continuously (fixed cost spread over more units). $AVC = VC/Q$: U-shaped (falls as variable inputs used efficiently; rises as diminishing returns set in). $ATC = TC/Q = AFC + AVC$: U-shaped; above AVC by AFC; gap narrows as output rises. $MC = \Delta TC / \Delta Q$: U-shaped; falls when MP rising; rises when MP falling; intersects AVC at AVC minimum; intersects ATC at ATC minimum. LRAC: envelope of all short-run ATCs; U-shaped; economies of scale (falling LRAC; specialisation, bulk discounts); minimum efficient scale; diseconomies (rising LRAC; management complexity). Nigerian examples: large poultry farms achieve economies in feed purchasing; subsistence farms face high unit costs due to inability to use machinery efficiently. Revenue: $TR = P \times Q$; $AR = P$ (perfect competition; price taker; horizontal demand); $MR = P$ under perfect competition; MR less than AR under imperfect competition (downward-sloping demand). Profit $\pi = TR - TC$; maximised at $MR = MC$ ($P = MC$ under competition); logic: MR exceeds MC means expand; MC exceeds MR means contract; optimum at equality. Nigerian example: broiler farmer at N4,500 per bird; produce until $MC = N4,500$. Shut down if P falls below AVC (short run) or ATC (long run). Investment: gross margin ($TR - TVC$; enterprise budgeting); net farm income ($TR - TC$ including implicit costs); BCR ($PV \text{ benefits} / PV \text{ costs}$; greater than 1 = worthwhile; fertiliser BCR 2 to 4 in Nigeria); NPV (sum of discounted net benefits; positive = worthwhile); IRR (discount rate at $NPV = 0$; greater than cost of capital = worthwhile; irrigation IRR 30 to 60 percent).



Answers to Pilot Questions [Series 4]

Part 4.1

1. A production function specifies the maximum output obtainable from any given combination of inputs at a given level of technology: $Q = f(L, K, N)$. Two inputs: labour (family and hired farm workers) and fertiliser (purchased intermediate input). One output: maize grain in kg per season.
2. $AP = TP/L$; $MP = \text{change in TP/change in } L$. $L=1$: $TP=800$, $AP=800$, $MP=800$. $L=2$: $TP=1500$, $AP=750$, $MP=700$. $L=3$: $TP=2100$, $AP=700$, $MP=600$. $L=4$: $TP=2500$, $AP=625$, $MP=400$. $L=5$: $TP=2700$, $AP=540$, $MP=200$. $L=6$: $TP=2700$, $AP=450$, $MP=0$. $L=7$: $TP=2500$, $AP=357$, $MP=-200$.
3. Stage I: $L = 1$ only ($MP = AP = 800$; MP not yet below AP). Stage II: $L = 2$ to 6 (MP positive but below AP and falling; TP still rising). Stage III: $L = 7$ (MP negative; TP falling). Rational stage: Stage II (MP positive and output still increasing; maximising efficient use of fixed land).
4. Law of diminishing returns: as successive units of a variable input are added to a fixed quantity of other inputs, the marginal product eventually declines. Nigerian examples: (1) fertiliser on maize (each additional bag applied to fixed land adds less yield beyond a point); (2) irrigation water on vegetables (each additional litre adds less yield and eventually causes waterlogging).
5. The farmer should stop before maximum TP because marginal analysis requires comparing the cost of the last unit of fertiliser with its revenue contribution (MRP). As more fertiliser is applied, MRP falls; once MRP falls below the fertiliser price, additional fertiliser adds more cost than revenue, reducing profit even though TP may still be rising slightly.

Part 4.2

1. Returns to scale: what happens to output when all inputs increase proportionately. IRS: doubling all inputs more than doubles output; example: a large commercial poultry farm that can use an automated feeding system unavailable at small scale achieves more than proportionate output increase. CRS: doubling inputs doubles output; example: smallholder maize farmer replicating the same production process on another identical plot. DRS: doubling inputs less than doubles output; example: a very large cassava processing factory where management coordination problems reduce efficiency at scale.
2. An isoquant shows all combinations of two inputs producing the same level of output. Properties: downward-sloping (substituting one input for another to maintain output). Convex to origin (diminishing MRTS). Cannot intersect (same input combination cannot give two different output levels). Higher isoquant represents greater output.



3. Isocost equation: $3,000L + 6,000K = 60,000$. Rearranging: $K = 10 - 0.5L$. Labour intercept ($K=0$): $L = 60,000/3,000 = 20$ days. Fertiliser intercept ($L=0$): $K = 60,000/6,000 = 10$ bags.
4. Least-cost condition: $MP_L/w = MP_K/r$; or $MRTS = w/r$. If MP_L/w exceeds MP_K/r : each naira spent on labour yields more output than each naira on capital; shift spending from capital to labour. As more labour is used, MP_L falls (diminishing returns); as less capital is used, MP_K rises; adjustment continues until the ratios equalise.
5. MRTS diminishes because of the law of diminishing marginal returns: as more labour is substituted for capital while holding output constant, labour becomes progressively less productive relative to capital; more and more units of labour are needed to compensate for the loss of each unit of capital. This makes the isoquant progressively flatter (less steep) as we move to the right, creating its convex shape.

Part 4.3

1. Fixed costs: do not change with output; examples: annual land lease payment on a rented farm plot; depreciation on a tractor or water pump. Variable costs: increase with output; examples: cost of improved seed (planted area rises with output); cost of hired labour for weeding and harvesting.
2. $FC = 80,000$ throughout. TVC and TC ($FC + TVC$): $Q=1$: $TVC=20,000$, $TC=100,000$. $Q=2$: $TVC=35,000$, $TC=115,000$. $Q=3$: $TVC=55,000$, $TC=135,000$. $Q=4$: $TVC=80,000$, $TC=160,000$. $Q=5$: $TVC=115,000$, $TC=195,000$. $AFC = FC/Q$: 80,000; 40,000; 26,667; 20,000; 16,000. $AVC = TVC/Q$: 20,000; 17,500; 18,333; 20,000; 23,000. $ATC = TC/Q$: 100,000; 57,500; 45,000; 40,000; 39,000. $MC = \Delta TVC / \Delta Q$: $Q=1$: 20,000; $Q=2$: 15,000; $Q=3$: 20,000; $Q=4$: 25,000; $Q=5$: 35,000.
3. AVC is U-shaped because of the law of diminishing returns. Initially, as output rises, the marginal product of the variable input (labour) is rising (Stage I); each additional unit of labour produces more output, so the variable cost per unit of output falls (AVC falls). Eventually, diminishing returns reduce MP ; more labour is needed per unit of additional output; AVC rises.
4. MC intersects ATC at the minimum point of ATC . When MC is below ATC , producing additional units costs less than the current average; ATC is pulled down. When MC equals ATC , ATC is at its minimum and neither rises nor falls. When MC exceeds ATC , additional units cost more than average; ATC rises.
5. Short-run cost analysis holds at least one input (capital) fixed; all cost curves (FC , VC , TC , AFC , AVC , ATC , MC) are short-run concepts. Long-run cost analysis allows all inputs to vary; the producer can choose the optimal plant size for each output level. The $LRAC$ curve shows the



minimum average cost achievable at each output when all inputs are optimally adjusted; it is the envelope of all possible short-run ATC curves.

Part 4.4

1. $TR = P \times Q$ (total sales revenue). $AR = TR/Q = P$ (revenue per unit; equals price). $MR = \Delta TR / \Delta Q$ (additional revenue from one more unit). Under perfect competition: $MR = AR = P$ because the firm sells each additional unit at the same fixed market price; the demand curve is horizontal and price is constant regardless of quantity sold.
2. Profit-maximisation condition: $MR = MC$. Logic: if MR exceeds MC , the last unit adds more to revenue than to cost; net profit increases; the firm should produce more. If MC exceeds MR , the last unit adds more to cost than to revenue; profit falls; the firm should produce less. Only at $MR = MC$ is there no incentive to change output; this is the optimum.
3. At $P = MR = \text{N}120,000$ (price taker): MC at $Q=1$ is $\text{N}60,000$ (MR exceeds MC ; expand). MC at $Q=2$ is $\text{N}80,000$ (MR exceeds MC ; expand). MC at $Q=3$ is $\text{N}100,000$ (MR exceeds MC ; expand). MC at $Q=4$ is $\text{N}120,000$ ($MR = MC$; stop). MC at $Q=5$ is $\text{N}150,000$ (MC exceeds MR ; contract). Profit-maximising output = 4 tonnes.
4. Gross margin = $TR - TVC$. It is more commonly used than net profit in Nigerian farm budgeting because: (1) fixed costs are difficult to allocate to individual enterprises on a mixed farm; (2) gross margin allows comparison of enterprise profitability without the complication of arbitrary fixed cost allocation; an enterprise with a positive gross margin contributes to fixed costs and profit even if the farm as a whole is not yet profitable.
5. $BCR = \text{total discounted benefits} / \text{total discounted costs}$; BCR exceeds 1 means benefits outweigh costs in present value terms; the investment is worthwhile. $NPV = \sum (B_t - C_t) / (1+r)^t$ over the project life; NPV positive means the project generates more value in present terms than it costs; the investment is worthwhile. Both require discounting future cash flows at an appropriate rate (opportunity cost of capital; approximately 20 to 25 percent per annum in Nigeria).

References and Attributions [Series 4]

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Figures, Plates, Tables, and Boxes

- Figure 4.1: Short-run cost curves and the long-run average cost curve as an envelope of short-run ATC curves. Attribution: AI generated. Suggested OER search string: “short run cost curves AFC AVC ATC MC long run average cost LRAC envelope diagram OER”.
- Box 4.1: Financial performance measures for farm investment analysis in Nigeria. Attribution: AI generated. Suggested OER search string: “farm investment analysis gross margin benefit cost ratio NPV IRR Nigeria agricultural economics table OER”.



Series 5: Market Structures and Pricing Policies

- **Part 5.1: Perfect Competition**

- Sub Part 5.1.1: Characteristics of perfect competition
- Sub Part 5.1.2: Short-run equilibrium of the competitive firm
- Sub Part 5.1.3: Long-run equilibrium under perfect competition

- **Part 5.2: Monopoly**

- Sub Part 5.2.1: Definition and sources of monopoly power
- Sub Part 5.2.2: Output and pricing under monopoly
- Sub Part 5.2.3: Welfare effects of monopoly and price discrimination

- **Part 5.3: Monopolistic Competition and Oligopoly**

- Sub Part 5.3.1: Monopolistic competition: definition and characteristics
- Sub Part 5.3.2: Short-run and long-run equilibrium under monopolistic competition
- Sub Part 5.3.3: Oligopoly: definition, characteristics, and models

- **Part 5.4: Agricultural Market Structures and Pricing Policies in Nigeria**

- Sub Part 5.4.1: Market structure in Nigerian agricultural commodity markets
- Sub Part 5.4.2: Pricing policies in Nigerian agriculture
- Sub Part 5.4.3: Market failures and government interventions in Nigerian agriculture



Introduction

The structure of a market, defined by the number of buyers and sellers, the nature of the product, the freedom of entry and exit, and the degree of information available to participants, fundamentally determines how prices are set and how efficiently resources are allocated. Four major market structures are recognised in economic theory: perfect competition (many sellers, identical products, free entry and exit), monopoly (single seller, no substitutes, blocked entry), monopolistic competition (many sellers, differentiated products, free entry), and oligopoly (few sellers, high interdependence, barriers to entry). Real-world agricultural markets span this entire spectrum.

This Series analyses the output and pricing decisions of firms under each market structure, evaluates the welfare implications of each structure, and applies these frameworks to Nigerian agricultural markets. It concludes by examining the major pricing policy instruments used by the Nigerian government in agriculture, including price supports, subsidies, marketing boards, and the regulation of food markets.

Series Learning Outcomes

Upon completing this Series, you should be able to:

- **SLO 5.1** describe the characteristics of perfect competition and determine the short-run and long-run equilibrium of a competitive firm (Linked to Part 5.1),
- **SLO 5.2** explain the sources and characteristics of monopoly power, determine the monopolist's profit-maximising output and price, and explain the welfare effects of monopoly and price discrimination (Linked to Part 5.2),
- **SLO 5.3** describe and distinguish between monopolistic competition and oligopoly, and explain the short-run and long-run equilibrium under monopolistic competition (Linked to Part 5.3), and
- **SLO 5.4** identify and classify the market structures prevalent in Nigerian agricultural commodity markets, describe the major pricing policy instruments used in Nigerian



agriculture, and explain market failures and the rationale for government intervention (Linked to Part 5.4).

5.1 Perfect Competition

5.1.1 Characteristics of perfect competition

Perfect competition is a market structure characterised by five conditions: (1) Many buyers and sellers: no individual buyer or seller is large enough to influence the market price; each is a price taker. (2) Homogeneous (identical) product: all sellers supply an identical good with no quality or brand differences; buyers have no reason to prefer one seller over another. (3) Free entry and exit: there are no barriers preventing new firms from entering the market or existing firms from leaving; entry and exit respond freely to profit signals. (4) Perfect information: all buyers and sellers have complete and costless knowledge of all prices and product qualities. (5) Perfect factor mobility: resources (land, labour, capital) can move freely between industries without cost or delay.

These conditions imply that the competitive firm faces a horizontal (perfectly elastic) demand curve at the prevailing market price: it can sell any quantity at the market price but nothing above it. Therefore $MR = AR = P$ for the competitive firm. In practice, no market fully satisfies all five conditions, but some agricultural commodity markets approximate perfect competition. The market for uniform bulk commodities in large central wholesale markets (maize at Dawanau market Kano; tomatoes at Mile 12 market Lagos; sorghum at Kasuwan Dawa Jos) has many sellers, relatively homogeneous products (within grade), relatively free entry, and broadly available price information, making these closer to perfect competition than most other markets.

Fill in the blank: In perfect competition, each firm is a price _____ because no individual firm is large enough to influence the market price; the firm faces a perfectly elastic (horizontal) demand curve at the prevailing market price.



5.1.2 Short-run equilibrium of the competitive firm

In the short run, a competitive firm maximises profit by choosing output where $MR = MC$ (equivalently $P = MC$ since $MR = P$). The firm can be in one of three positions: (1) Economic profit (supernormal profit): if price exceeds ATC at the profit-maximising output (P exceeds ATC), TR exceeds TC ; the firm earns positive economic profit. (2) Normal profit (zero economic profit): if price equals ATC at the profit-maximising output ($P = ATC$), $TR = TC$; the firm earns exactly enough to cover all costs including the opportunity cost of capital and entrepreneurship; the firm is earning the minimum return needed to keep it in the industry. (3) Economic loss: if price is below ATC at profit-maximising output (P is less than ATC), TR is less than TC ; the firm makes a loss. However, the firm continues to produce in the short run as long as P exceeds AVC , because producing covers variable costs and contributes to fixed costs; shutdown occurs only if P falls below AVC (the shutdown point).

Shutdown condition: if P falls below AVC , the firm cannot cover its variable costs from revenue; it minimises losses by shutting down and paying only fixed costs (loss = FC) rather than producing (loss = FC + deficit on VC). If P equals AVC , the firm is indifferent between producing and shutting down (both result in loss = FC). The short-run supply curve of the competitive firm is the MC curve above the AVC minimum; below the AVC minimum, the firm shuts down and supplies zero. The market supply curve is the horizontal summation of all individual firm supply curves. Example: a tomato farmer in Kano with AVC minimum of N80,000/tonne and ATC minimum of N120,000/tonne: at market price N100,000 (above AVC but below ATC), the farmer produces and incurs a loss but stays in business; at N70,000, the farmer shuts down.

Fill in the blank: A competitive firm should shut down in the short run if price falls below _____ variable cost; at that point, producing would result in a larger loss than paying only the fixed costs with zero output.

5.1.3 Long-run equilibrium under perfect competition



In the long run, free entry and exit drive all firms to earn exactly zero economic profit (normal profit). If existing firms earn economic profit, new firms enter the industry; industry supply increases; market price falls; profits are eroded until $P = ATC$ for all firms. If existing firms incur losses, some exit the industry; industry supply decreases; market price rises; losses are eliminated until $P = ATC$. The long-run equilibrium of the competitive firm occurs where $P = MC = ATC$ (minimum ATC), which is also where the long-run average cost curve is at its minimum. At this point: (1) Allocative efficiency: $P = MC$ (price equals marginal cost; the good is produced up to the point where consumers' marginal benefit equals the marginal cost of production). (2) Productive efficiency: $P = \text{minimum ATC}$ (firms produce at the lowest possible average cost; no resources are wasted).

Long-run equilibrium implications for Nigerian agriculture: in competitive commodity markets (maize, sorghum, cassava), if farm-gate prices rise above average total costs (including opportunity cost of labour and land), more land is brought into production, more farmers enter, and supply increases until profits are eroded. This self-correcting mechanism helps explain why food prices tend to return to long-run average cost levels after supply shocks, provided markets are competitive and entry is free. However, land tenure constraints, credit barriers, and input market failures in Nigeria impede the free entry and exit assumed by the model, causing deviations from the perfectly competitive long-run outcome.

Fill in the blank: In long-run competitive equilibrium, price equals minimum average total cost (ATC), achieving both allocative efficiency ($P = \text{_____} = \text{social marginal benefit}$) and productive efficiency (production at lowest possible unit cost).

Pilot questions 5.1

11. State the five characteristics of perfect competition and explain why each is necessary for price-taking behaviour.
12. Explain the three short-run positions a competitive firm may be in and state the shutdown condition.
13. A competitive maize farmer has AVC minimum of N90,000/t and ATC minimum of N130,000/t. If the market price is N110,000/t, should the farmer produce or shut down? Explain.



14. Describe the long-run adjustment process in a competitive industry when firms are earning economic profits.
15. State the two efficiency conditions achieved in long-run competitive equilibrium and explain why each is desirable.

5.2 Monopoly

5.2.1 Definition and sources of monopoly power

A monopoly is a market structure in which there is a single seller of a product for which there are no close substitutes, and entry by new firms is completely or effectively blocked. The monopolist is a price maker: it faces the entire downward-sloping market demand curve and can set either price or quantity (but not both simultaneously; the demand curve constrains the relationship between them). Sources of monopoly power: (1) Legal barriers: exclusive licences, patents, or copyrights granted by government prevent competition (e.g. the exclusive licence granted to a single firm to import rice at a zero tariff; patents on new seed varieties). (2) Control over key inputs: a single firm controls an essential resource required for production (e.g. a single firm owning all cassava processing facilities in a region has monopsony power over farmers who must sell to it). (3) Economies of scale (natural monopoly): long-run average costs fall over the entire relevant range of output; a single large firm can produce more cheaply than multiple smaller competitors (e.g. the national electricity grid; rural water supply infrastructure). (4) Government ownership: state enterprises with exclusive mandates (e.g. a national marketing board with sole authority to purchase and export a commodity).

In Nigerian agricultural history, the commodity marketing boards (Cocoa Board; Groundnut Board; Cotton Board; Palm Produce Board) established in the colonial period and retained post-independence were effective state monopolies on the purchasing and export of major export crops. They bought produce from farmers at a fixed price (below world price) and sold at world price, retaining the difference as revenue for the government; farmers received a lower price than the competitive market would have provided. The boards were gradually dismantled between



1986 and 1995 under Structural Adjustment Programme (SAP) liberalisation; Nigerian agricultural export markets became more competitive but also more volatile.

Fill in the blank: A _____ monopoly arises when long-run average costs fall over the entire relevant range of output, making it more efficient for one firm to supply the entire market than for multiple competing firms; the national electricity grid and rural water supply infrastructure are examples.

5.2.2 Output and pricing under monopoly

The monopolist faces a downward-sloping demand curve; to sell more, it must lower price on all units (not just the additional unit). Therefore, MR falls faster than AR (price) and lies below the AR curve. The monopolist maximises profit at the output where $MR = MC$. At that output, price is read off the demand curve ($P = AR$ at that quantity) and is above MR and MC. Compared to the competitive outcome ($P = MC$): monopoly output is lower ($MR = MC$ is reached at a smaller quantity because MR is below P); monopoly price is higher (P exceeds MC). The monopoly markup (the difference between P and MC) is the source of the monopoly's supernormal profit, which it can maintain in the long run because entry is blocked.

Example: a sole rice processor in a region faces the following demand: Q=1000t at P=N200,000/t; Q=2000t at P=N180,000/t; Q=3000t at P=N160,000/t; Q=4000t at P=N140,000/t; Q=5000t at P=N120,000/t. TR: 200M; 360M; 480M; 560M; 600M. MR: 200,000; 160,000; 120,000; 80,000; 40,000 (MR = change in TR / 1000t). MC is constant at N100,000/t. Profit max: $MR = MC$ at approximately Q=3000t (MR between 120,000 and 80,000 straddles 100,000); at Q=3000, set P=N160,000. Monopoly profit = $(P - ATC) \times Q$. Compare: under competition, $P = MC = N100,000$ and $Q = 5,000t$; under monopoly $P = N160,000$ and $Q = 3,000t$; consumers pay more and get less.

Fill in the blank: Under monopoly, the profit-maximising output is where $MR = MC$, but price is set above MR by reading the _____ curve at that output level; consequently monopoly price exceeds marginal cost, which is not the case under perfect competition.



5.2.3 Welfare effects of monopoly and price discrimination

Welfare analysis compares monopoly with perfect competition. Consumer surplus (CS) is the difference between what consumers are willing to pay and what they actually pay; producer surplus (PS) is the difference between what producers receive and their minimum supply price. Under perfect competition ($P = MC$), the sum of CS and PS (total surplus; TS) is maximised. Under monopoly (P exceeds MC), the monopolist's higher price transfers some CS to PS (a redistribution from consumers to the monopolist), and a portion of TS is lost entirely (deadweight loss; DWL). The DWL represents the surplus that would have existed if the output between the monopoly quantity and the competitive quantity had been produced; it represents the inefficiency of monopoly. DWL is the primary economic cost of monopoly and the justification for anti-monopoly policy (competition policy; antitrust law).

Price discrimination occurs when a monopolist charges different prices to different buyers for the same good, based on their willingness to pay. First-degree (perfect) price discrimination: the monopolist charges each consumer their maximum willingness to pay; all CS is extracted as PS; no DWL (output = competitive level). Second-degree price discrimination: different prices for different quantities (quantity discounts; bulk price breaks; e.g. fertiliser sold at a lower price per bag in bulk). Third-degree price discrimination: different prices in different market segments (e.g. a rice trader charging urban consumers a higher price than rural consumers because urban consumers have higher incomes and less access to substitutes; differential pricing between export and domestic markets). Price discrimination requires: ability to segment markets; prevention of resale between segments (arbitrage); different price elasticities in different segments (higher price charged in the segment with lower elasticity).

Fill in the blank: Deadweight loss under monopoly represents the value of _____ that would have been produced if the market were competitive but is not produced under monopoly because the monopolist restricts output below the competitive level; it is the primary economic cost of monopoly power.

Pilot questions 5.2



11. Define monopoly and state four sources of monopoly power with one Nigerian agricultural example of each.
12. Explain why MR lies below the demand curve (AR) for a monopolist and why this leads to a lower output and higher price than under perfect competition.
13. Describe the welfare effects of monopoly, explaining consumer surplus, producer surplus, and deadweight loss.
14. Define price discrimination and state the three conditions necessary for a firm to practise it successfully.
15. Explain the role played by Nigerian commodity marketing boards as agricultural monopolies and state what happened to them under the Structural Adjustment Programme.

5.3 Monopolistic Competition and Oligopoly

5.3.1 Monopolistic competition: definition and characteristics

Monopolistic competition (developed by Edward Chamberlin and Joan Robinson in the 1930s) is a market structure combining features of both perfect competition and monopoly: (1) Many sellers: a large number of firms compete in the same broad market; no single firm is dominant. (2) Product differentiation: each firm sells a product slightly different from those of its competitors in terms of quality, brand, packaging, location, or service; each firm therefore faces a downward-sloping (rather than horizontal) demand curve, giving it some price-setting power over its differentiated product. (3) Free entry and exit: there are no significant barriers; in the long run, new firms can enter and existing firms can exit freely. (4) Non-price competition: firms compete through advertising, branding, quality improvements, and customer service as well as price.

Monopolistic competition is the most common market structure for processed and differentiated agricultural and food products in Nigeria: processed cassava products (different brands of packaged garri; fufu of varying quality); packaged rice (local parboiled rice vs FMARD-branded rice vs premium imported varieties); branded palm oil; flavoured groundnut snacks; packaged



suya seasoning; branded tomato paste. Each firm has some loyal customers who prefer its particular brand or quality, giving it a small degree of monopoly power over its product, but the many competing alternatives constrain that power significantly. Unlike monopoly, supernormal profits are eroded in the long run by the entry of new firms with similar but differentiated products.

Fill in the blank: Monopolistic competition combines many sellers (as in perfect competition) with _____ products; each firm faces a downward-sloping demand curve because consumers perceive its product as somewhat different from those of competitors, giving it a limited degree of pricing power.

5.3.2 Short-run and long-run equilibrium under monopolistic competition

Short-run equilibrium under monopolistic competition: the firm maximises profit at $MR = MC$, just as under monopoly. Because it faces a downward-sloping demand curve, MR lies below AR (price). In the short run, the firm may earn economic profit (P exceeds ATC), zero economic profit ($P = ATC$), or loss (P is less than ATC). The short-run analysis is identical in structure to monopoly: the firm sets output at $MR = MC$ and price above MC on the demand curve. The key difference from monopoly is that barriers to entry are absent.

Long-run equilibrium under monopolistic competition: if firms earn economic profits in the short run, new firms enter the market with similar but differentiated products; the demand curve facing each existing firm shifts left (fewer customers) and becomes more elastic (more close substitutes available). Entry continues until all economic profit is eliminated: the demand curve just touches (is tangent to) the ATC curve at the profit-maximising output. At long-run equilibrium: $P = ATC$ (zero economic profit; as in perfect competition), but P exceeds MC (as in monopoly; the firm sets $MR = MC$ and price above MC). This means the firm does not achieve allocative efficiency (P exceeds MC) or productive efficiency (it operates to the left of minimum ATC , with excess capacity). The excess capacity theorem: in monopolistic competition, each firm produces less than the output at minimum ATC , so the industry as a whole uses more resources than necessary



to produce a given output. The trade-off is that consumers enjoy product variety and differentiation that would not exist under perfect competition.

Fill in the blank: In long-run monopolistic competition equilibrium, price equals _____ (zero economic profit; new entry erodes profits) but price exceeds marginal cost (allocative inefficiency); firms operate with excess capacity to the left of minimum ATC.

5.3.3 Oligopoly: definition, characteristics, and models

Oligopoly is a market structure in which a small number of large firms dominate the market. Key characteristics: (1) Few sellers: typically 2 to 10 firms supply the bulk of the market; each firm has significant market share. (2) Interdependence: each firm's pricing and output decisions affect and are affected by its rivals; firms must consider how competitors will react to their actions. (3) Barriers to entry: high capital requirements, economies of scale, brand loyalty, or legal barriers prevent new firms from entering. (4) Differentiated or homogeneous products: some oligopolies sell homogeneous products (cement, petrol, beer in Nigeria); others sell differentiated products (telecommunications; commercial banking).

Models of oligopoly behaviour: (1) Kinked demand curve model (Sweezy, 1939): explains price rigidity in oligopoly; each firm assumes competitors will match price cuts (to avoid losing customers) but not price increases (to gain customers); the demand curve has a kink at the current price; MR is discontinuous at the kink; MC can shift within the gap without changing the profit-maximising price and output; explains why oligopoly prices tend to be stable. (2)

Collusion and cartels: oligopolists may collude to act as a joint monopoly (cartel); OPEC (Organisation of Petroleum Exporting Countries; includes Nigeria) is the most prominent real-world cartel; cartels restrict output to raise price above competitive level; they are unstable because each member has an incentive to cheat by producing more. (3) Game theory (Nash equilibrium): models the strategic interaction between oligopolists; each firm chooses its best strategy given what it believes competitors will do; the Nash equilibrium is where no firm has an incentive to change its strategy unilaterally. (4) Price leadership: one firm (the price leader) sets price; others follow; common in Nigerian cement and flour milling industries.



Fill in the blank: The kinked demand curve model of oligopoly explains price _____ by assuming that competitors will match price cuts but not price increases; this creates a kink in the demand curve and a discontinuity in MR that allows MC to shift without changing the profit-maximising price.

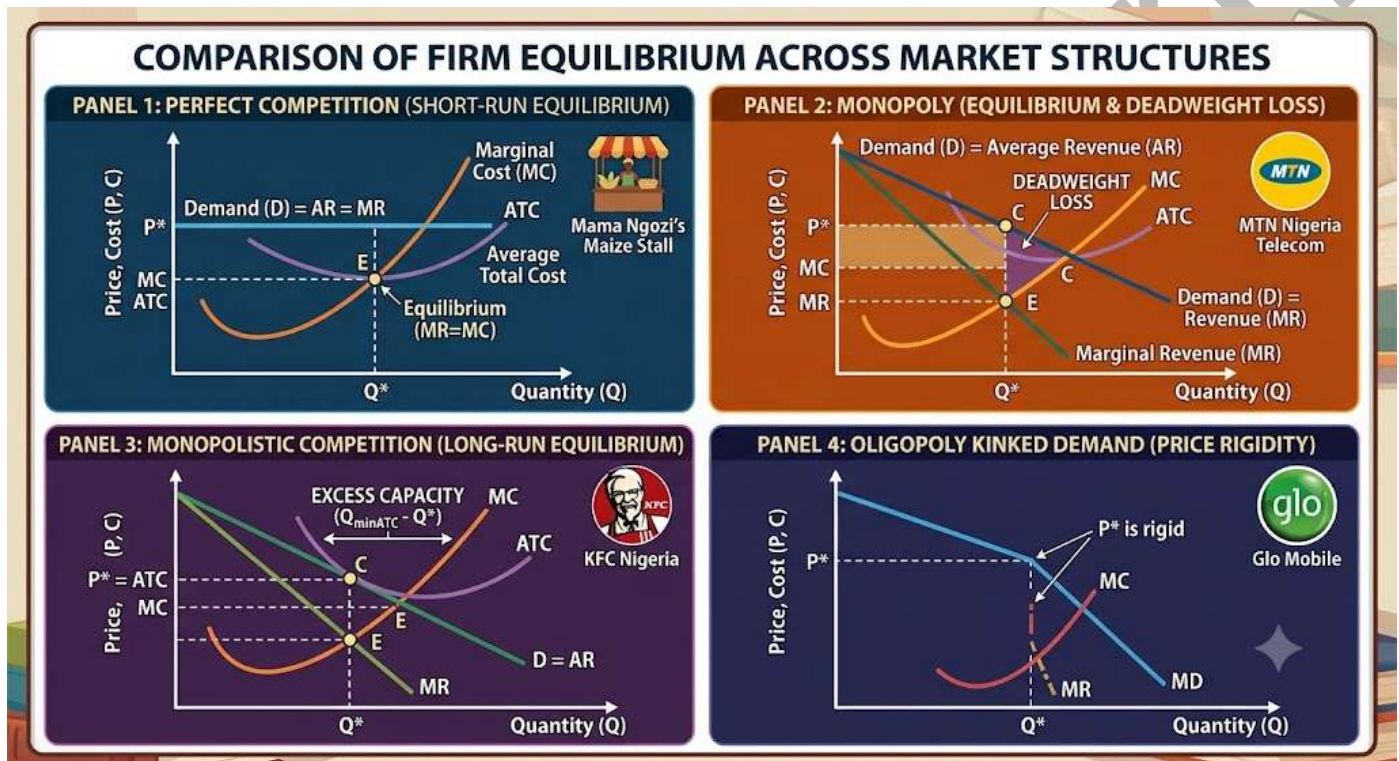


Figure 5.1: Firm equilibrium under four market structures

Pilot questions 5.3

16. State four characteristics of monopolistic competition and give two Nigerian food market examples of this structure.
17. Explain the long-run adjustment process in monopolistic competition when firms earn short-run economic profit.
18. State four characteristics of oligopoly and give two Nigerian agricultural or agro-industrial examples.
19. Explain the kinked demand curve model of oligopoly and what it predicts about price behaviour.



20. Distinguish between perfect competition and monopolistic competition in terms of product type, demand curve shape, and long-run profit.

5.4 Agricultural Market Structures and Pricing Policies in Nigeria

5.4.1 Market structure in Nigerian agricultural commodity markets

Nigerian agricultural commodity markets exhibit a wide range of structures. Producer markets (farm gate): most staple food producers (smallholder maize, cassava, yam, cowpea, sorghum farmers) sell in broadly competitive markets with many sellers and buyers; no individual farmer controls price; markets approximate perfect competition. However, local monopsony (a single buyer) is common in remote areas where a single trader or processor is the only buyer accessible to isolated farmers; the monopsonist pays below the competitive price. Input markets: seeds and fertiliser are increasingly competitive at the retail level since the deregulation of input markets under SAP (1986 to 1995), but at wholesale level, a few large importers and blenders dominate; fertiliser blending capacity is concentrated in a small number of companies, creating oligopolistic structure.

Processing and wholesale markets: key agro-processing subsectors are oligopolistic or near-monopolistic. Flour milling: dominated by four large integrated mills (Flour Mills of Nigeria Plc; Dangote Flour Mills; Honeywell Flour Mill; BUA Milling), which collectively control over 90 percent of milling capacity and operate as an oligopoly in the wheat flour market. Cement (relevant to agro-processing): Dangote Cement, BUA Cement, and Lafarge Holcim hold oligopoly positions. Poultry processing: moving from fragmented smallholder production toward integration by a few large commercial farms and processors. Rice milling: historically fragmented (many small mills) but consolidating toward larger integrated rice mills in Kebbi, Kano, and Cross River states under the Anchor Borrowers Programme and CARES programme. Retail food markets: highly competitive (many traders, little product differentiation for staple foods); major supermarket chains (Shoprite, Spar, SuperMart) are expanding in urban centres but still hold small market shares relative to open-market traders.



Fill in the blank: Nigeria's wheat flour market is dominated by a few large integrated mills (Flour Mills of Nigeria, Dangote Flour Mills, Honeywell, BUA) which collectively control over 90 percent of milling capacity, making it an _____ market structure.

5.4.2 Pricing policies in Nigerian agriculture

Agricultural pricing policy encompasses all government measures that affect the prices received by farmers (producer prices) or paid by consumers (consumer prices) for agricultural commodities and inputs. Key pricing policy instruments used in Nigeria: (1) Producer price support: the government sets a guaranteed minimum price above the market equilibrium to ensure farmers receive adequate income; historically used by commodity marketing boards for cocoa, groundnuts, cotton, and palm produce; creates a price floor and potential surplus. (2) Input subsidies: the government subsidises the purchase price of fertiliser, improved seed, and agrochemicals to reduce production costs and increase supply; the Growth Enhancement Scheme (GES; 2012 to 2015) provided electronic vouchers for subsidised inputs; the Presidential Fertiliser Initiative (PFI; 2017 to present) blends fertiliser domestically and sells at subsidised prices; the Anchor Borrowers Programme (ABP; 2015 to present) provides subsidised inputs on credit linked to a commodity buyer.

(3) Consumer price protection: import tariffs on rice, sugar, wheat, and poultry impose duties on imported commodities to protect domestic producers from lower-priced imports; Nigeria has maintained high tariffs on rice (50 to 110 percent at various times) and banned the importation of some commodities (frozen poultry; certain rice grades) to force domestic production. (4) Commodity price stabilisation: buffer stock operations (purchasing and storing commodities at harvest to release during shortage periods) stabilise seasonal price swings; the Strategic Grain Reserve (SGR; managed by the Federal Government through NEMA and FMARD) holds stocks of maize, sorghum, and rice. (5) Export policy: at various times Nigeria has imposed export bans or levies on food staples (cassava, maize, sorghum) during periods of domestic shortage to keep domestic prices low; these reduce farmer incentives and long-run supply. (6) Exchange rate policy: devaluation of the naira (as occurred sharply in 2016 and 2023) raises the naira price of



imported food and inputs, effectively protecting domestic agricultural producers but raising consumer food prices.

Fill in the blank: The Strategic Grain _____ (SGR) is a buffer stock policy instrument used by the Nigerian federal government to stabilise seasonal food price swings by purchasing commodities at harvest and releasing them onto the market during shortage periods.

5.4.3 Market Failures and Government Interventions in Nigerian Agriculture

Market failure occurs when the market or price mechanism does not allocate resources efficiently, causing socially desirable goods or services to be underprovided or harmful activities to be overproduced. In Nigerian agriculture, this may arise from public goods, externalities, and information asymmetry. Agricultural research, extension services, rural roads, and irrigation systems are often underprovided by private firms because users cannot easily be excluded from benefiting. Farming may also create negative externalities such as soil erosion, water pollution, and greenhouse-gas emissions, or positive externalities such as pollination, tree cover, and groundwater recharge. Information gaps concerning input quality, technology, prices, and markets may further prevent farmers from making efficient decisions.

Other failures include limited access to credit and the absence or weakness of important markets. Smallholders may be denied formal loans because they lack collateral and face weather, price, and repayment risks, leading to low investment in improved inputs and technology. Markets for crop insurance, warehouse receipts, land rental, and forward contracts may also be poorly developed. Government may respond through public research and extension, credit guarantees, agricultural banks, insurance schemes, market-information services, commodity exchanges, and warehouse-receipt systems. However, intervention is justified only when its benefits exceed its costs, because poorly designed subsidies, price controls, or inefficient public enterprises may create government failure and worsen market outcomes.

Fill in the blank: _____ market failure occurs when a farming activity generates costs or benefits for third parties that are not reflected in market prices; examples include agrochemical runoff polluting rivers (negative externality) and tree crops recharging groundwater (positive externality).



<u>Feature</u>	<u>Perfect Competition</u>	<u>Monopoly</u>	<u>Monopolistic Competition</u>	<u>Oligopoly</u>
Number of Sellers	Many small sellers	One dominant seller	Many sellers with product differentiation	Few large sellers dominate
Product Type	Homogeneous (identical)	Unique, no close substitutes	Differentiated but similar	Homogeneous or differentiated
Entry Barriers	None; free entry and exit	Very high; legal or natural barriers	Low; relatively easy entry	High; economies of scale, collusion
Demand Curve Faced by Firm	Perfectly elastic (horizontal)	Downward-sloping	Downward-sloping but more elastic than monopoly	Kinked or interdependent demand curve
Long-Run Profit	Zero (normal profit only)	Positive (can sustain supernormal profit)	Zero (competition erodes profit)	Positive (collusion or market power)
Price Relative to MC	$P = MC$ (efficient allocation)	$P > MC$ (allocative inefficiency)	$P > MC$ (due to differentiation)	$P > MC$ (due to market power)
Nigerian Agricultural Example	Open-air tomato markets in Kano	Nigerian Bottling Company (exclusive Coca-Cola bottling rights, though not purely agricultural, illustrates monopoly power)	Local bread bakeries in Lagos competing with differentiated brands	Fertiliser market dominated by few large firms

Box 5.1: Comparison of the four market structures with Nigerian agricultural examples

Pilot questions 5.4



11. Classify the following Nigerian agricultural markets by market structure and justify your classification: (a) smallholder yam production in Benue State; (b) wheat flour milling in Nigeria; (c) branded packaged garri in Lagos supermarkets.
12. Explain two Nigerian agricultural pricing policy instruments and state the economic objective of each.
13. Explain the economic rationale for government subsidising agricultural research and extension services in Nigeria.
14. Explain what is meant by credit market failure in Nigerian agriculture and describe one government policy response.
15. State three pricing policy instruments used in Nigeria to protect domestic rice producers and explain the economic effects of each on producers and consumers.



Series Summary

This Series examined the main market structures in agricultural markets. **Perfect competition** exists where many firms sell identical products, entry is free, and firms are price takers, so $P = AR = MR$. In the short run, firms produce where $P = MC$ and may earn profit, normal profit, or loss, but they shut down if price falls below AVC. In the long run, entry and exit lead to $P = MC = \text{minimum ATC}$. **Monopoly** exists where one seller controls the market and entry is restricted. The monopolist produces where $MR = MC$ but charges a price above marginal cost, creating lower output and possible deadweight loss. Price discrimination may be first-degree, second-degree, or third-degree.

Monopolistic competition involves many firms selling differentiated products, while **oligopoly** involves a few interdependent firms with high entry barriers. Nigerian examples include branded food products under monopolistic competition and flour, cement, and beer industries under oligopoly. Agricultural policy may involve price support, input subsidies, tariffs, strategic grain reserves, export restrictions, and exchange-rate measures. The Series also covered market failures such as public goods, externalities, information gaps, credit constraints, and missing markets. Government responses include research and extension, credit schemes, crop insurance, commodity exchanges, and warehouse-receipt systems.

Glossary of Terms

- **Allocative efficiency:** the condition in which price equals marginal cost ($P = MC$), meaning resources are allocated to their highest-valued uses; achieved under perfect competition but not under monopoly or monopolistic competition.
- **Anchor Borrowers Programme (ABP):** a Nigerian Central Bank of Nigeria programme (launched 2015) providing smallholder farmers with subsidised inputs on credit linked to a large-scale commodity processor or buyer; aimed at increasing domestic food production.



- **Cartel:** a group of firms that collude to act as a joint monopoly, restricting output to raise price above competitive levels; OPEC is the most prominent example; cartels tend to be unstable because members have incentives to cheat.
- **Deadweight loss (DWL):** the reduction in total surplus (consumer plus producer surplus) caused by a market distortion such as monopoly, price controls, or taxes; represents a net loss to society that is not transferred to any other party.
- **Excess capacity:** the gap between the output at which a firm produces in long-run monopolistic competition equilibrium and the output at minimum average total cost; reflects the productive inefficiency of monopolistic competition.
- **Kinked demand curve:** an oligopoly model in which each firm assumes rivals will match price cuts but not price increases; produces a kink in the demand curve at the current price and a discontinuity in MR; explains why oligopoly prices tend to be stable (rigid).
- **Market failure:** a situation in which the price mechanism fails to allocate resources efficiently; types relevant to Nigerian agriculture include public goods, externalities, information asymmetry, credit market failure, and missing markets.
- **Monopolistic competition:** a market structure with many sellers of differentiated products and free entry; firms face downward-sloping demand; long-run equilibrium has zero economic profit but allocative inefficiency (P exceeds MC).
- **Monopoly:** a market structure with a single seller, no close substitutes, and complete barriers to entry; the monopolist sets output at $MR = MC$ and price above MC ; earns supernormal profit in both short and long run.
- **Nash equilibrium:** an outcome in a game (or oligopoly market) in which no player has an incentive to change strategy given the strategies of all other players; a key concept in game theory applied to oligopoly behaviour.
- **Natural monopoly:** a monopoly arising because long-run average costs fall over the entire relevant range of output, making it more efficient for one firm to supply the market; examples include utility networks (electricity transmission, water supply).



- **Oligopoly:** a market structure dominated by a small number of large firms with significant market share, high entry barriers, and strong mutual interdependence; examples in Nigeria include flour milling and cement production.
- **Perfect competition:** a market structure with many sellers, identical products, free entry and exit, and perfect information; each firm is a price taker ($MR = AR = P$); achieves both allocative and productive efficiency in long-run equilibrium.
- **Price discrimination:** the practice of charging different prices to different buyers for the same good, based on differences in willingness to pay; requires market segmentation, prevention of resale, and different price elasticities across segments.
- **Productive efficiency:** the condition in which firms produce at the minimum average total cost; achieved under perfect competition in the long run ($P = \text{minimum ATC}$) but not under monopolistic competition (excess capacity).
- **Strategic Grain Reserve (SGR):** a buffer stock policy instrument managed by the Nigerian federal government to stabilise seasonal food price swings by purchasing grain at harvest and releasing it during shortage periods.



Concept Check Questions [Series 5]

Objective Questions

1. Under perfect competition, each firm is a price _____ and faces a horizontal demand curve; $MR = AR = P$. (Linked to SLO 5.1)
2. A competitive firm should shut down in the short run if price falls below average _____ cost; at that point, producing would result in a larger loss than paying only fixed costs with zero output. (Linked to SLO 5.1)
3. Under monopoly, MR lies _____ the demand curve (AR) because selling one more unit requires lowering price on all units, not just the additional unit. (Linked to SLO 5.2)
4. In long-run monopolistic competition equilibrium, economic profit is _____ because free entry shifts each firm's demand curve leftward until price equals average total cost. (Linked to SLO 5.3)
5. The _____ demand curve model of oligopoly explains price rigidity by assuming that rivals will match price cuts but not price increases. (Linked to SLO 5.3)

Short-Answer Questions

1. State the five characteristics of perfect competition and explain what they imply for the demand curve facing an individual firm. (Linked to SLO 5.1)
2. Explain why monopoly leads to a lower output and higher price than perfect competition and define deadweight loss. (Linked to SLO 5.2)
3. Distinguish between short-run and long-run equilibrium under monopolistic competition and explain the excess capacity theorem. (Linked to SLO 5.3)
4. Classify the Nigerian wheat flour milling industry by market structure and justify your classification. (Linked to SLO 5.4)
5. Explain two types of market failure in Nigerian agriculture and state one government policy response to each. (Linked to SLO 5.4)

6. Long-Answer Questions

7. Describe the characteristics, short-run and long-run equilibrium, and efficiency properties of perfect competition and monopoly. Explain the welfare effects of monopoly and the concept of price discrimination. (Linked to SLOs 5.1, 5.2)



8. Describe monopolistic competition and oligopoly. Explain the market structures prevalent in Nigerian agricultural markets, the major pricing policy instruments used in Nigerian agriculture, and the market failures that justify government intervention. (Linked to SLOs 5.3, 5.4)

Answers to Concept Check Questions [Series 5]

Objective Questions

1. Taker.
2. Variable.
3. Below.
4. Zero.
5. Kinked.

Short-Answer Questions

1. Perfect competition: many buyers and sellers (no individual influences price); homogeneous product (no brand difference); free entry and exit; perfect information; perfect factor mobility. Implication: the firm can sell any quantity at the market price but nothing above it; its demand curve is perfectly elastic (horizontal); $MR = AR = P$.
2. Under monopoly: MR lies below AR (selling more requires a price cut on all units); $MR = MC$ equilibrium occurs at a lower quantity than under competition (where $P = MC$); price is set above MR on the demand curve, yielding P exceeds MC . Deadweight loss is the surplus that would exist if the monopoly output between Q_{monopoly} and $Q_{\text{competitive}}$ were produced; it is lost entirely (neither consumer nor producer receives it) and represents the net cost of monopoly to society.
3. Short-run: firm sets $MR = MC$; faces downward-sloping demand; may earn economic profit. Long-run: economic profit attracts new entrants with differentiated products; each firm's demand curve shifts left and becomes more elastic; entry continues until $P = ATC$ (zero profit). Excess capacity theorem: at long-run equilibrium, the firm produces to the



left of minimum ATC; industry output could be produced with fewer firms each at minimum cost; represents productive inefficiency.

4. Nigerian wheat flour milling is an oligopoly: a small number of large integrated mills (Flour Mills of Nigeria, Dangote Flour Mills, Honeywell, BUA) control over 90 percent of milling capacity; there are significant barriers to entry (high capital investment for mills; access to imported wheat); each firm is large enough to influence market price; firms are mutually interdependent in pricing decisions.
5. Credit market failure: smallholders are rationed out of formal credit due to lack of collateral and high monitoring costs; government response: Agricultural Credit Guarantee Scheme Fund (ACGSF; CBN guarantees loans by commercial banks to farmers). Information asymmetry: farmers lack knowledge of input quality, market prices, and new technologies; government response: government agricultural extension service (ADP network) provides technical and market information to farmers.

Long-Answer Questions

1. Perfect competition: many sellers; identical product; free entry; perfect information; price taker ($MR = AR = P$; horizontal demand). Short-run: $P = MC$; three positions: profit (P exceeds ATC), normal profit ($P = ATC$), loss (P is less than ATC; produce if P exceeds AVC; shutdown if P falls below AVC). Short-run supply = MC above AVC. Long-run: free entry and exit; profits attract entry (supply rises; P falls); losses cause exit (supply falls; P rises); equilibrium at $P = MC = \min ATC$; allocative efficiency ($P = MC$; output at socially optimal level) and productive efficiency (minimum ATC; no waste). Monopoly: single seller; no substitutes; blocked entry; faces downward-sloping demand; MR below AR. Profit max at $MR = MC$; P set above MC on demand curve; output below competitive level; P above MC. Long-run: supernormal profit maintained (no entry). Sources: legal barriers (patents, licences); control of key inputs; natural monopoly (falling LRAC); state enterprise (Nigerian commodity marketing boards were effective monopsonies on export crop purchases). Welfare effects: CS transferred to PS (redistribution to monopolist); DWL (surplus lost entirely; no output produced between Q_{monopoly} and $Q_{\text{competitive}}$). Price discrimination: first-degree (charge each consumer WTP; eliminates CS; no DWL; output = competitive); second-degree (quantity discounts; fertiliser bulk pricing); third-degree (different prices in different market



segments; urban vs rural consumers; export vs domestic; requires segmentation, no resale, different elasticities).

2. Monopolistic competition: many sellers; differentiated products; free entry; downward-sloping demand. Short-run: $MR = MC$; economic profit possible. Long-run: entry erodes profit; demand shifts left; equilibrium where demand tangent to ATC; $P = ATC$ (zero profit) but P exceeds MC (allocative inefficiency); excess capacity (produce left of min ATC). Nigerian examples: branded garri, packaged palm oil, flavoured groundnut snacks. Oligopoly: few large sellers; high entry barriers; strong interdependence; kinked demand (rivals match price cuts not increases; price rigidity); cartels (OPEC; restrict output; raise price; unstable; members cheat); Nash equilibrium (no firm can improve by changing strategy unilaterally); price leadership (one firm sets; others follow). Nigerian examples: flour milling (4 firms control 90 percent); cement (Dangote, BUA, Lafarge). Nigerian market structures: smallholder staple markets (yam, cassava, maize; many sellers, competitive); input wholesale markets (fertiliser importers and blenders; oligopolistic); processing (flour milling; oligopoly); retail (highly competitive; open markets dominant). Pricing policies: producer price support (price floor; commodity boards; surplus; discourages efficiency); input subsidies (PFI, GES, ABP; reduce production costs; increase supply; fiscal cost; risk of inefficiency); import tariffs on rice, sugar, poultry (protect domestic producers; raise consumer prices); Strategic Grain Reserve (buffer stocks; reduce seasonal price swings; requires storage capacity and funding); export bans (keep domestic prices low; reduce farmer incentives; short-run relief vs long-run disincentive); exchange rate policy (naira depreciation raises import food prices; protects domestic producers). Market failures: public goods (research, extension; under-provided by private sector; government must supply); externalities (agrochemical pollution negative; tree crop groundwater recharge positive; Pigouvian tax/subsidy corrections); information asymmetry (extension services; market information systems; NBS); credit market failure (collateral constraints; ACGSF; ABP; Bank of Agriculture); missing markets (crop insurance via NAIC; warehouse receipts via NCX).



Answers to Pilot Questions [Series 5]

Part 5.1

1. Many buyers and sellers: no single buyer or seller controls price; each is a price taker. Homogeneous product: buyers have no reason to prefer one seller over another; no brand loyalty. Free entry and exit: new firms enter when profits exist; existing firms exit when losses persist; keeps long-run profits at zero. Perfect information: all participants know all prices and qualities; no search costs or information rents. Perfect factor mobility: resources can move freely to highest-valued uses; ensures efficient allocation.
2. Profit (P exceeds ATC at $MR = MC$ output): TR exceeds TC ; firm earns supernormal profit. Normal profit ($P = ATC$): $TR = TC$; firm earns exactly its opportunity cost; zero economic profit; stays in industry. Loss (P is less than ATC): TR is less than TC ; firm loses money but continues if P exceeds AVC (covers variable costs and contributes to fixed costs). Shutdown condition: P falls below AVC ; producing makes the loss larger than paying only fixed costs.
3. $P = N110,000$ exceeds AVC minimum ($N90,000$) but is below ATC minimum ($N130,000$). The farmer should produce because price covers all variable costs and contributes to fixed costs; shutting down would mean paying fixed costs with zero revenue (a larger loss). The farmer incurs a short-run loss but stays in business; in the long run, if price stays below ATC , the farmer would exit.
4. When firms earn economic profit, new firms enter the industry because profits attract investment. Industry supply increases; market price falls. As price falls, economic profit erodes. Entry continues until $P = ATC$ (minimum ATC in the long run); at this point, economic profit is zero and no further entry occurs.
5. Allocative efficiency ($P = MC$): the good is produced up to the point where the marginal benefit to consumers (measured by price) equals the marginal cost of production; no overproduction or underproduction; resources go to their highest-valued uses. Productive efficiency ($P = \text{minimum } ATC$): firms produce at the lowest possible average cost; no resources are wasted in production; society gets the maximum output from available inputs.

Part 5.2



1. Monopoly: a single seller with no close substitutes and complete barriers to entry. Legal barriers: exclusive import licence (e.g. a sole licensed importer of a particular pesticide). Control of key inputs: a single cassava processor controlling the only dryer in a remote area has monopsony power over local farmers. Natural monopoly: national electricity grid (falling LRAC makes one firm more efficient than many). State enterprise: colonial-era marketing boards were statutory monopolies on purchasing and exporting cocoa, groundnuts, and cotton.
2. The monopolist faces a downward-sloping demand curve; to sell one more unit it must lower the price on all units already being sold, not just the additional unit. The revenue gained on the new unit is partly offset by the revenue lost on existing units; MR is therefore less than the price (AR) at every output level beyond the first unit. Consequently, when the monopolist sets $MR = MC$ to maximise profit, the equilibrium output is lower than the competitive level (where $P = MC$), and price is higher (set above MR on the demand curve).
3. Under competition ($P = MC$): CS and PS together are maximised (total surplus maximised). Under monopoly (P exceeds MC): the monopolist's higher price transfers some consumer surplus to the monopolist (PS increases by this amount; CS decreases by the same amount; redistribution). The output reduction from competitive to monopoly level causes some surplus to disappear entirely; this is the deadweight loss (DWL): the surplus that would exist if the units between monopoly and competitive output were produced; it is a net loss to society.
4. Price discrimination: charging different prices to different buyers for the same good. Three conditions: (1) market segmentation (the firm must be able to identify and separate buyers into groups with different willingness to pay); (2) prevention of resale between segments (arbitrage must be impossible or costly; otherwise, low-price buyers resell to high-price buyers); (3) different price elasticities in different segments (the firm charges higher prices where demand is less elastic).
5. Nigerian commodity marketing boards (Cocoa Board, Groundnut Board, Cotton Board, Palm Produce Board) were statutory monopsonies: they had the sole legal right to purchase major export crops from farmers and were the sole exporters. They bought at a fixed producer price below the world price and sold at world price, retaining the



marketing margin as government revenue. Under the 1986 to 1995 Structural Adjustment Programme, export crop marketing was liberalised; the boards were dissolved; private traders and exporters entered; markets became more competitive but more price-volatile.

Part 5.3

1. Monopolistic competition: (1) many sellers; (2) differentiated products; (3) free entry and exit; (4) non-price competition (advertising, branding, quality). Two Nigerian examples: branded packaged garri (many brands varying in quality and packaging; consumers loyal to some brands; new brands can enter). Flavoured suya seasoning brands (many small producers; each recipe slightly different; competition on flavour and packaging as well as price).
2. If firms earn short-run economic profit, new competitors enter the market with similar but differentiated products. Each existing firm loses some customers to new entrants; its demand curve shifts left (fewer customers at every price) and becomes more elastic (more close substitutes are available). This continues until the demand curve for each firm is tangent to its ATC curve; at that point $P = ATC$ (zero economic profit) and no further entry is profitable.
3. Oligopoly: (1) few sellers with large market shares; (2) high barriers to entry (capital, scale, brand loyalty); (3) strong mutual interdependence (each firm considers rivals' reactions); (4) products may be identical or differentiated. Two Nigerian examples: flour milling (four mills control over 90 percent of capacity; each firm watches competitors' pricing closely). Beer brewing (Nigerian Breweries Plc and Guinness Nigeria dominate; strong brand loyalty; few new entrants due to high capital requirements).
4. The kinked demand curve model assumes that if a firm raises price, rivals do not follow (customers switch away; demand is elastic above current price). If the firm cuts price, rivals match to avoid losing market share (demand is inelastic below current price). This creates a kink in the demand curve at the current price and a discontinuity in MR at that output. MC can shift within the gap without changing the profit-maximising price and output. Prediction: oligopoly prices are sticky (resistant to change) even when costs change.
5. Perfect competition: many identical sellers; identical product; horizontal demand curve (price taker); $MR = AR = P$; long-run profit = zero ($P = \min ATC$); allocative and



productive efficiency. Monopolistic competition: many sellers; differentiated products; downward-sloping demand curve (price maker with limited power); MR is below AR; long-run profit = zero ($P = ATC$) but P exceeds MC (allocative inefficiency); excess capacity (productive inefficiency).

Part 5.4

- (a) Smallholder yam production in Benue State: perfect competition; many small producers; relatively homogeneous product within grade; free entry (any farmer can grow yam); no single farmer controls price; competitive market approximation. (b) Wheat flour milling in Nigeria: oligopoly; four large integrated mills (FMN, Dangote, Honeywell, BUA) control over 90 percent of capacity; high capital barriers to entry; firms are mutually interdependent in pricing. (c) Branded packaged garri in Lagos supermarkets: monopolistic competition; many small and medium producers; products are differentiated by brand, quality, grain size, and packaging; free entry for new brands; non-price competition on quality and branding.
1. Import tariff on rice: imposes a duty (50 to 110 percent) on imported rice; makes imported rice more expensive; protects domestic rice producers from cheaper foreign competition and encourages domestic production. Presidential Fertiliser Initiative (PFI): government subsidises production and sale of blended NPK fertiliser at below-market prices; reduces farmers' input costs; increases profitability and supply of food crops.
 2. Agricultural research (new varieties, agronomic practices) and extension services (transmitting knowledge to farmers) are public goods: once produced, their benefits are non-excludable (any farmer can benefit) and non-rival (one farmer using the knowledge does not reduce its availability to others). Private firms cannot recoup the cost through sales because they cannot exclude non-paying farmers from benefiting; they therefore under-invest in research and extension. Government must provide or subsidise these services to achieve the socially optimal level of agricultural knowledge production and diffusion.
 3. Credit market failure: smallholder farmers lack land titles and moveable collateral; formal banks face high monitoring costs and high default risk (weather, price shocks) in lending to smallholders; credit is rationed below the socially optimal level; farmers



under-invest in improved inputs and technology. Government response: the Agricultural Credit Guarantee Scheme Fund (ACGSF; managed by the CBN since 1977) guarantees up to 75 percent of agricultural loans made by commercial banks to farmers; this reduces bank risk and encourages lending; the Bank of Agriculture provides direct credit at subsidised rates.

4. Import tariff on rice (50 to 110 percent): makes imported rice more expensive; protects domestic producers who receive a higher price; raises consumer prices for rice; encourages domestic production but reduces consumer welfare. Rice importation ban (at various times): complete prohibition of rice imports; maximises domestic producer price protection; severe consumer price increases; encourages smuggling through land borders. Anchor Borrowers Programme (ABP): provides credit for seeds and inputs to rice farmers linked to a processor buyer at an agreed price; supports domestic rice production by reducing input costs and guaranteeing a market; benefits producers; consumer effects depend on whether increased supply lowers prices.



References and Attributions [Series 5]

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Figures, Plates, Tables, and Boxes

- Figure 5.1: Firm equilibrium under four market structures. Attribution: AI generated. Suggested OER search string: “market structure comparison perfect competition monopoly monopolistic competition oligopoly equilibrium diagram four panels OER”.
- Box 5.1: Comparison of the four market structures with Nigerian agricultural examples. Attribution: AI generated. Suggested OER search string: “four market structures perfect competition monopoly monopolistic oligopoly comparison table Nigerian examples OER”.

