

FISHERIES (ALTERNATIVE A)*
(For candidates in Ghana only)

1. PREAMBLE

Fisheries is important to the economic development of West Africa and this syllabus has been structured to guide the assessment of learners' knowledge and entrepreneurial skills in fisheries and related vocations. It is also to guide the assessment in practically oriented knowledge and skills in fisheries.

2. AIMS AND OBJECTIVES

The syllabus will seek to assess candidates on

- (1) the importance of fisheries in the socio-economic development of West Africa.
- (2) the dangers of over fishing practices.
- (3) the regulations governing fishing practices in the country.
- (4) the differences between freshwater, brackish water and marine habitats and resources.
- (5) skills in fish farming.
- (6) basic entrepreneurship skills in fisheries related vocations and business.
- (7) the effects of water pollution on fishery resources.
- (8) fish preservation and processing techniques.
- (9) basic biology of fishes.
- (10) basic fish health management.

3. REQUIREMENTS

- (1) Schools offering fisheries must have at least an aquarium and a fish pond/concrete tank.
- (2) The study of fisheries should be supplemented by visits to well established fish farms, fisheries research institutions, fishing companies and other institutions related to fisheries.
 - (3) Candidates should keep practical notebooks which should contain records of activities based on laboratory and individual observations carried out in aquaria and fish farms, field trips and also records of specimens collected.
 - (4) Schools should prepare an album of fishery organisms, fishing gear and craft and different fish rearing facilities and equipment for teaching purposes.

4. EXAMINATION SCHEME

There will be three papers, Papers 1, 2 and 3 all of which must be taken. Papers 1 and 2 will be a composite paper to be taken at one sitting.

PAPER 1: Will consist of fifty multiple choice objective questions, all of which must be answered within 1 hour for 50 marks.

PAPER 2: Will consist of six essay-type questions. Candidates will be required to answer four questions within 2 hours for 20 marks each.

PAPER 3: Will be a practical paper for school candidates or alternative to practical work test for

private candidates. It will consist of three questions all of which must be answered within 2 hours for 60 marks.

DETAILS SYLLABUS

CONTENTS	
<p>A. INTRODUCTION TO FISHERIES</p> <ul style="list-style-type: none">● Fisheries and national development <p>(a) Meaning of fisheries</p> <p>(b) Types of fisheries</p> <p>(c) Importance of fisheries to national development</p> <p>2. Fishery organisms and their habitats</p> <p>(a) Identification and description of common fishery organisms</p> <p>(b) Fishery habitats</p>	

- Identification and

description of the characteristics of invasive alien species in fishery habitats

(d) Effects of invasive alien species in fisheries

(e) Prevention and control of invasive alien species in fishery habitats

3. Grouping of fishery organisms

ACTIVITIES

<ul style="list-style-type: none">● Fish landing sites and facilities	Explanation of the term fisheries
<ul style="list-style-type: none">● Types of fish landing sites	Knowledge of the following is required: Culture fisheries (aquaculture) Capture fisheries (fishing) <ul style="list-style-type: none">- subsistence fisheries- artisanal fisheries- commercial fisheries- industrial fisheries
<ul style="list-style-type: none">● Facilities and activities at fish landing sites	Role of fisheries in the national economy e.g. food, employment, income generation, social and cultural life.
(c) Sanitation practices at fish landing sites	Assessment should cover the features of: Fin fishes (e.g. herring, tuna, tilapia, <i>Clarias</i> , <i>Heterobranchus</i>) Crustaceans (shrimp/prawns/lobster, crabs) Molluscs (clam, scallops, oyster, cuttle fish/squid)
2. Fishing gear and craft. <ul style="list-style-type: none">● Classification and description of fishing gear	Knowledge of the characteristics of habitats: freshwater (river, lake), brackish water (estuary, lagoon) and marine (pelagic, demersal) should be covered. Knowledge should cover species such as <i>Eichorniacrassipes</i> (water hyacinth), <i>Cyperus papyrus</i> (Papyrus reed), <i>Salviniamolesta</i> (kariba weed), <i>Limnocharisflava</i> (Limnocharis), <i>Pistiastratiotes</i> (water lettuce), <i>Azollafiliculoides</i> (water fern), <i>Enteromorphaflexura</i> (filamentous algae) <i>Ceratophyllum</i> sp. (Hornwort).
	Characteristics should include the morphology of the species, mode of

propagation, growth and development.

(b) Construction and maintenance of fishing gear

Analysis of the effects of aquatic invasive alien species on fishery habitats, fishery organisms and fishers.

- Description and maintenance of fishing craft

Assessment to include preventive measures such as awareness creation, screening at entry points and enforcement of plant protection and regulatory laws and control measures both physical and biological

(d) Fishing methods

Assessment should cover the grouping of the following fishery organisms under freshwater, brackish water and marine habitats:

Tilapia, Clarias/Heterobranchus, Chrysichthys, Heterotis, Lates, Bagrus, Alestes, Synodontis, Prawns, Crabs, Grey mullet, Shrimps, *Sardinella*, Sea bream, Cassava fish, Tuna, Mackerel, Anchovy, Shark, Cuttle fish/squid, Clam, Ray, Sea urchin.

(e) Harmful fishing practices

C. FISH BIOLOGY

1. Identification and classification of fishery organisms

Assessment should cover the identification and location of the following landing sites in your country: beaches, harbours, lagoons, river banks, lake shores.

Knowledge in the use of the following facilities is required: winch, cold store, ice plant, fuel station, slipway, dry dock, jetty and breakwater.

(a) Identification of common fishery organisms by species

Description of activities at fish landing sites:

- unloading fish from vessels
- fuelling vessels
- loading of ice into vessels
- beaching of vessels for repairs
- repairs and maintenance of vessels/gear
- fish processing
- fish marketing

(b) Classification of common fishery organisms

2. Structure and function of fishery organisms

Assessment should cover knowledge and skills of proper disposal of wastes generated at fish landing sites including oil spills and vessel parts.

(a) Fish body measurements	Active fishing gear:
	- cast net
	- seine net
(b) External structures and features of fishery organisms	- trawl
	- dredges
	- scoop net
(c) Internal organs of bony fishes and their functions	Passive fishing gear: e.g.
	- hooking devices
	- stationary nets
	- tangle nets
	- traps
3. Life processes in fishes	Merits and demerits of using the various gear are also required.
(a) Locomotion	Assessment should include knowledge of materials for construction and repair of fishing gear. Basic ways of maintaining fishing gear is also required.
	Fishing craft should include canoes, trawlers and purse seiners. Accessories such as oars, sails, outboard and inboard engines, winches, sonar and radar should also be covered.
(b) Feeding and digestion	Description of active and passive fishing methods used in inland, coastal and deep sea fishing is required.
(c) Blood circulation	Assessment should cover the description of harmful fishing practices and an analysis of their effects. Ways of preventing harmful fishing practices and minimizing their effects are also required.
(d) Gaseous exchange	
(e) Excretion	
(f) Reproduction	Common and scientific names are required.
(g) Growth	Common fishery organisms should be classified under phylum and class for Mollusca, Arthropoda and Echinodermata. Phylum Chordata should be classified to the subclass level.

4. Fish ecology

- Environmental

conditions in fish habitats

Ability to measure total, standard and fork lengths, and weights should be assessed.

Assessment should cover a mollusc (cuttle fish), crustaceans (shrimp/prawn, crab), cartilaginous fish (shark, ray) and bony fishes (tilapia, *Clarias*).

Assessment should cover organs such as gills, alimentary canal, heart and blood vessels, kidneys and gonads.

(b) Ecological processes within fish habitats

Assessment should cover role of muscles and fins in movement and the maintenance of balance (pitching, rolling, yawing).

Assessment should include knowledge of ingestion, digestion, absorption and egestion in fishes.

Assessment should cover composition, circulation and functions of blood.

(c) Pollution in water bodies

An understanding of the mechanism of gaseous exchange is required.

Knowledge of osmo-regulation and the excretory process and products is required.

5. Fish genetics and evolution

(a) Principles of Genetics

Knowledge and understanding of the stages in the reproductive process: gamete formation, spawning, fertilization and parental care are required. Identification of male and female tilapia should be assessed. Examination of eggs of gravid/berried fish is required.

Knowledge and understanding of the life cycle in fishes and the factors affecting growth (e.g. temperature, dissolved oxygen, nutrients, food availability, competition) are required.

(b) Inheritance of genetic characteristics

Knowledge and understanding of the environmental conditions and their effects on fish populations (temperature, dissolved oxygen, salinity, pH, turbidity, light, nutrients, upwelling phenomenon) are required. Measurement of environmental conditions using water test kits on water from pond, river/stream, lagoon, lake and sea is required.

D. AQUACULTURE

1.0 Introduction to aquaculture

- Meaning and importance of

aquaculture

(b) Types of aquaculture

(c) The state of aquaculture

Knowledge of the following processes is required:

- feeding behaviour
- predation, competition
- food chain, food web
- food pyramid
- fish mortality
- adaptation of fishes to their environment

The causes (poisons, sewage, debris, household refuse etc), effects, prevention and control of pollution are required.

Effects of pollution on fish populations should be covered.

Assessment should cover knowledge and understanding of chromosomes, genes, genetic crossings, genotype and phenotype as applied to fish.

Application of the principles of genetics to fish breeding, e.g.

development of super male tilapia and Genetically Improved Farmed Tilapia (GIFT) should be assessed.

Explanation of the concept of inheritance of external characters in fishes e.g. skin colour is required.

2. Aquarium activities

(a) Construction of an aquarium

Assessment should cover the culture of organisms including fish, clams, shrimps and sea weeds.

- Management of an aquarium

Assessment should be limited to the state of aquaculture in your country: Numbers and sizes of farms, types of cultured species, practices, infrastructure/facilities, levels of production, prospects and challenges.

Factors/problems affecting aquaculture should include:

few specialists in the field, high cost of pond construction, high cost of feed, difficulty in obtaining fingerlings, difficulty in accessing credit and difficulty in land acquisition.

Solutions to problems facing aquaculture in the country should be covered.

3. Fish farming

(a) Introduction to

(a) introduction to fish farming

Assessment should cover knowledge and skills involved in the identification of materials required, design and construction of an aquarium.

Assessment should cover knowledge and skills involved in the identification of suitable species, capture, transport and stocking of aquarium fish.

Keeping records of daily management activities and costs is also required.

- Construction of fish culture facilities

Assessment should include the importance of fish farming, levels of fish farming (extensive, semi-intensive, intensive) and types of fish farming (monoculture, polyculture, integrated culture)

Knowledge of the facilities for growing fish (earthen ponds, cages, concrete tanks, raceways, fish pens) is required.

(c) Management of fish ponds

Knowledge and skills in the selection of suitable sites for construction of ponds, cages and pens is required.

Criteria for the selection of sites for the construction of ponds, cages and pens should include topography, soil type, water quality and quantity and security.

(i) Stocking of ponds

Skills in site clearing, marking, excavation, formation of walls, fitting drainage structures and grassing should be included.

(ii) Pond maintenance

Knowledge and skills required should include species selection, fingerling packaging and transport and stocking.

Criteria for selection of fish species should include feeding habits, availability of fingerlings, growth rate and adaptability.

(iii) Water quality control and monitoring

Knowledge of maintenance activities on fish ponds to be assessed should include:

- the control of water level
- repairing leakages
- predator and weed control
- fertilizer application

Knowledge and skills in monitoring of water quality should cover:

- pH
- dissolved oxygen

- turbidity
- ammonia content
- temperature

Knowledge of measures to improve water quality such as stirring, lime application and fertilizer application is required.

(iv) Fish feeds and feeding

Knowledge about types of fish feeds and their nutrient content e.g. formulated feeds, agricultural by-products, pelletized and floating feeds is required.

Skills in the formulation of nutritionally balanced fish feed/diets, procedures for feeding fish, feeding times and quantities should be covered.

(v) Harvesting of fish ponds

Types of harvesting (partial and total) using various fishing gear and methods should be assessed.

Draining and refilling of fish ponds as measures of pond preparation after harvest should be covered.

(d) Fish diseases

(i) Types and causes

Assessment should be limited to the following:

- Gill rot - fungus
- Furunculosis - bacteria
- Ich - protozoa

(ii) Symptoms

Assessment should be based on the identification of symptoms:

- Gill rot - red/whitish spots on gills
- Furunculosis - ulcers on skin
- Ich - white spots on skin and fins

(iii) Prevention,
control and
treatment

Knowledge of the following methods is required:
chemotherapy, sterilization, minimal handling of fish, suitable diet and disinfection.

Assessment should also include knowledge of aquatic conditions which favour fish diseases.

E. FISH UTILIZATION

1. Nutritive value of fish:

Nutritive composition of fin fish, crustaceans and molluscs

2. Fish processing and preservation

(a) Meaning of fish processing and preservation

- Importance of fish

processing and preservation

(c) General principles of fish processing and preservation

(d) Methods of fish processing

(e) Methods of fish preservation

Knowledge of the nutrients in fishery organisms - proteins, lipids, mineral salts, water and vitamins - and experiments to test for protein and lipids in fish are required.

Meaning of fish processing: Explanation should include activities carried out to prepare fish for consumption and marketing.

Meaning of fish preservation: Explanation should include activities carried out to extend the shelf life of fish.

Distinction between fish processing and fish preservation is also required

Reasons for fish processing and preservation should include prevention of spoilage, increase of shelf life, improvement of taste and adding value.

Knowledge of the principles should include the removal of microbes and water, slowing down enzymatic action, denaturing of enzymes, slowing down bacterial activity and preventing fat oxidation.

Assessment should be based on knowledge and skills in washing, scaling, gutting and filleting of fish.

Identification of common fish processing equipment such as knives, scissors and mechanical equipment is required.

Assessment should cover knowledge in the following:

Traditional methods (e.g. smoking, cooking, salting, drying and frying.)

Modern methods (e.g. freezing, canning, irradiation and use of chemicals – pickling.)

Identification and description of common fish preservation equipment such as Chorkor smoker is required.

Identification of materials for packaging fresh and preserved fish for local and export markets e.g. cartons, crates and baskets is required.

Demonstration of methods of packaging fresh fish and fish preserved by smoking,

Major fish products to be identified: fish fillets, chunks and flakes, canned, smoked, dried, salted, pickled, marinated fish.

Fish by-products to be identified should include fish oils, fish entrails (guts and gills) and fish bones.

Uses of fish by-products should be covered.

Signs of fish spoilage to be detected should include sunken eyes, mucus on the skin and darkening colour of gills.

Knowledge of the causes of fish spoilage should be limited to microbial, enzymatic and fat oxidation.

<p>(f) Packaging of fish</p>	<p>The importance of proper handling of fish to delay spoilage should be included.</p> <p>Knowledge of effects such as loss of value, taste and income should be assessed.</p> <p>The public health hazard of consuming spoiled fish should be covered.</p>
<p>(g) Fish products and by-products</p>	
<p>(h) Fish spoilage</p>	<p>Assessment should cover knowledge of measures taken to maintain fish stock levels for sustainable exploitation. The concept of Maximum Sustainable Yield (MSY) should be covered.</p>
<p>(i) Signs of fish spoilage</p>	<p>Objectives of fisheries management should include maximizing sustainable catches and maintaining spawning stock.</p>
<p>(ii) Causes of fish spoilage</p>	<p>Strategies should include limiting the number of fishing units, fishing closures, regulating mesh sizes and catch quotas.</p> <p>Assessment should include the use of practices such as close seasons, taboos, non-fishing days and cultural festivals to maintain fish stocks.</p>
<p>(iii) Effects of fish spoilage</p>	<p>Knowledge of basic data required for fisheries management e.g. fish catch, fishing effort, fish length and weight, fish age and gear type should be assessed.</p>
<p>F. FISHERIES MANAGEMENT AND BUSINESS OF FISHERIES</p>	<p>Skills in the analysis of the data are also required.</p> <p>Factors (such as climate and breeding) responsible for seasonal variations in fish catches (bumper and lean) should be covered.</p>
<p>1. Fisheries management</p>	<p>Explanation of the effect of upwelling on bumper harvest of fish should be assessed.</p>
<p>(a) Meaning of fisheries management</p>	<p>Knowledge of government policies and regulations on fisheries e.g. subsidy on fishing inputs, role of stakeholders, fish imports should be assessed.</p>
<p>(b) Objectives and strategies offisheries management</p>	<p>Knowledge of the importance of fisheries policies and regulations e.g. preventing capture of juvenile fishes, protection of the environment is also required.</p> <p>Meaning and economic benefits of the Exclusive Economic Zone (EEZ) should be covered.</p>

<ul style="list-style-type: none"> • Traditional fish stock management practices 	<p>Assessment should include knowledge of endangered fishery organisms and international conventions which protect them e.g. IUCN Red List, Convention on Biodiversity (CBD), International Convention for the Conservation of Atlantic Tunas (ICCAT). The importance of international conventions should also be included.</p>
<ul style="list-style-type: none"> • Data collection and analysis for fisheries management 	<p>Knowledge and skills in the preparation of budgets using expenditure and income items from culture and capture fisheries and other fishery related businesses (sale of fishing inputs, fish marketing and fish processing) are required. Cashflow projections are also required.</p>
	<p>Knowledge and skills in pricing of fish products in relation to demand and supply of fish product should be covered.</p>
<ul style="list-style-type: none"> • Fishery policies and regulations 	<p>Assessment should cover knowledge in quality control, packaging, storage and transportation of fish. Major fish marketing centres in the country should be identified, e.g. fishing harbours – Tema, Takoradi fish landing beaches – Elmina fish landing sites – Yeji other fish markets – Mankessim</p>
<ul style="list-style-type: none"> • Government policies and regulations on fisheries 	<p>Problems of fish marketing and their solutions should be covered. Activities involved in fish import and export should be outlined.</p>
	<p>Explanation of the effects of bumper harvest on import/export and prices of fish should be assessed.</p>
	<p>Major companies involved in fisheries activities in your country should be named e.g. fishing – Kaas, Afko, Enyidado fish farming – Tropo farms, Crystal lake fish company cold storage – Felibat Ltd.</p>
<ul style="list-style-type: none"> • International law and conventions 	<p>Assessment should cover knowledge of value chains in the fishery industry. The responsibilities of actors in the supply and value chain should be included.</p> <p>Quality and safety standards of various fish products should be mentioned.</p>

3. Business of fisheries:
Budget
preparation and financial
projections for a fishery
business

Knowledge of the location of important fishing communities in your country is required e.g.
freshwater fishing communities- Yeji, Dambai, Kwamikrom and Abotoase.
marine fishing communities- Teshie, Elmina, Chorkor and Shama.

List of festivals should include:
Bakatue of Edina
Fetu of Oguaa
Dzawuwu of Agave

4. Fish marketing

Knowledge of the influence of the festivals and taboos on the fishing industry should be covered, e.g. close season/fishing holiday.

(a) The state of fishmarketing

Identification, objectives and activities of the institutions e.g. Water Research Institute and University of Ghana are required.

Job opportunities in the fishery sub-sector should be identified, e.g. teaching/research, fish farming, fish pond engineer, fish import/export, fish processing, cold store operation and fishing gear/craft manufacturing.

(b) Major fisheries companies

Factors required for establishing enterprises in fisheries

- Identification of business opportunities
- Identification of fishery product or service needed in a locality
- availability of market for the product or service
- demand for the product or service

Resources should include land, capital, materials, structures, services, labour, technical know-how.

● Supply and value chains
in

Procedures should include the development of business plans, registration of business, management of the business, etc

the fishery industry

Knowledge and understanding of the role of extension services in the fisheries sub-sector should be assessed,

- (d) Food fish quality and safety standards

e.g. technical assistance to fish farmers and education of fisher folks on fisheries regulations.

Assessment should cover drawing and labelling of different fishing gear.

G. PRACTICES IN FISHING COMMUNITIES AND FISHERIES INSTITUTIONS

Assessment should cover the following fishery organisms: *Tilapia*, *Clarias/Heterobranchus*, *Chrysichthys*, *Heterotis*, *Lates*, *Bagrus*, *Alestes*, *Synodontis*, *Sardinella*, prawns/shrimps, crabs, grey mullet, sea bream, cassava fish, tuna, mackerel, anchovy, ray, shark cuttlefish/ squid and sea urchins.

1. Fishing communities and cultural practices

Assessment should cover the following alien species.

Eichorniacrassipes (water hyacinth)

Cyperus papyrus (Papyrus reed),

Salviniamolesta (kariba weed)

Pistiastratiotes(water lettuce)

Ceratophylumsp(Hornwort)

Drawing and labelling of external features is required. Dissection, drawing and labelling of gills, swim bladder, alimentary canal and heart should be covered. Structure should be related to function.

- Important fishing communities

(b) Cultural festivals and taboos related to fishing

Measurement of the environmental conditions: temperature, dissolved oxygen, pH, and salinity is required.

Construction of food chain, food web and food pyramid should be covered.

- Fisheries institutional framework and job opportunities

Knowledge of the following characteristics is required:

Fresh fish - firm flesh, bright eyes, bright red gills and sea-weedy smell.

Spoiled fish - sunken eyes, dark gills, mucus on skin and off odour smell.

(a) Fisheries training and research institutions

Assessment should cover organisms such as maggots, fungi and insects in spoiled fish.

(b) Job opportunities in the fishery sub-sector

(c) Business opportunities in fisheries

Identification of common forms of
(a) processed fish: e.g. gutted, filleted, skilled fish.
(b) preserved fish: e.g. frozen, salted, canned and smoked fish.
Identification and uses of common processing and preservation methods e.g. Chorkor smoker is required.

Assessment should be based on the identification and uses of fish by-products.

Identification of suitable soils, material and equipment for pond construction.

(d) Procedure for establishing enterprises in fisheries

Identification of ingredients used for fish feed formulation and identification of types of fish feed are required.
Methods of formulation of fish feed are also required.

Assessment should cover identification of types, uses and methods of application of fertilizers in fish ponds.

(e) Extension services in the fisheries sub sector

Identification of gill rot, furunculosis and ich by their symptoms is required.

1. Fishing gear:
Identification, uses and maintenance

2. Fish Identification:
Identification and classification of common freshwater, brackish water and marine fishes

3. Identification and description of characteristics of invasive alien species in fishery habitats

4. Fish structure and function

(a) External features:
body form, fins, scales,
lateral line etc.

(b) Internal structures:

gills, swim bladder
alimentary canal, heart,
blood vessels, kidney
and gonads.

5. Environmental
conditions in fish
habitats

6. Ecological processes
within the aquatic
environment

7. Characteristic features
of fresh and spoiled fish

8. Identification of micro-
organisms and
macro-organisms in
spoiled fish

9. Fish processing and
preservation

10. Fish by-products

11. Pond construction

12. Feed formulation and
feeding

13. Pond fertilization

14. Fish diseases

