

FISHERIES

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. Papers 1 and 2 will be combined in a 3- hour composite paper.

PAPER 1: will consist of 50 multiple choice questions, all of which should be answered within 1 hour for 50 marks.

PAPER 2: will consist of six essay type questions of which candidates will be required to answer any four in 2 hours. Each question will carry 20 marks. The section carries a total of 80 marks.

PAPER 3: will be a practical paper (for school candidates) or a test of practical paper (for private candidates). The paper will consist of three questions all of which should be answered within two hours for 60 marks.

DETAILS SYLLABUS

CONTENTS	
<p>A. INTRODUCTION TO FISHERIES</p> <p>1. Fisheries and national development</p> <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>	<p>Explanation of the term fisheries</p> <p>Knowledge of the following is required: Culture fisheries (aquaculture) Capture fisheries (fishing)</p> <ul style="list-style-type: none"> - subsistence fisheries - artisanal fisheries - commercial fisheries - industrial fisheries <p>Role of fisheries in the national economy e.g. food, employment, income generation, social and cultural life.</p> <p>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)</p> <p>Knowledge of the characteristics of habitats: freshwater (river, lake), brackish water (estuary, lagoon) and marine (pelagic, demersal) should be covered.</p>

<p>(a) Identification and description of the characteristics of invasive alien species in fishery habitats</p>	<p>Knowledge should cover species such as <i>Eichornia crassipes</i> (water hyacinth), <i>Cyperus papyrus</i> (Papyrus reed), <i>Salvinia molesta</i> (kariba weed), <i>Limnocharis flava</i> (Limnocharis), <i>Pistia stratiotes</i> (water lettuce), <i>Azolla filiculoides</i> (water fern), <i>Enteromorpha flexura</i> (filamentous algae) <i>Ceratophyllum</i> sp. (Hornwort).</p> <p>Characteristics should include the morphology of the species, mode of propagation, growth and development.</p>
<p>(d) Effects of invasive alien species in fisheries</p>	<p>Analysis of the effects of aquatic invasive alien species on fishery habitats, fishery organisms and fishers.</p>
<p>(e) Prevention and control of invasive alien species in fishery habitats</p>	<p>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</p>
<p>3. Grouping of fishery organisms</p>	<p>Assessment should cover the grouping of the following fishery organisms under freshwater, brackish water and marine habitats: <i>Tilapia</i>, <i>Clarias/Heterobranchus</i>, <i>Chrysichthys</i>, <i>Heterotis</i>, <i>Lates</i>, <i>Bagrus</i>, <i>Alestes</i>, <i>Synodontis</i>, Prawns, Crabs, Grey mullet, Shrimps, <i>Sardinella</i>, Sea bream, Cassava fish, Tuna, Mackerel, Anchovy, Shark, Cuttle fish/squid, Clam, Ray, Sea urchin.</p>
<p>B. FISHING ACTIVITIES</p> <p>1. Fish landing sites and facilities</p> <p>(a) Types of fish landing sites</p>	<p>Assessment should cover the identification and location of the following landing sites in your country: beaches, harbours, lagoons, river banks, lake shores.</p>

<p>(b) Facilities and activities at fish landing sites</p>	<p>Knowledge in the use of the following facilities is required: winch, cold store, ice plant, fuel station, slipway, dry dock, jetty and breakwater.</p> <p>Description of activities at fish landing sites:</p> <ul style="list-style-type: none"> - 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
<p>(c) Sanitation practices at fish landing sites</p>	<p>Assessment should cover knowledge and skills of proper disposal of wastes generated at fish landing sites including oil spills and vessel parts.</p>
<p>2. Fishing gear and craft.</p>	
<p>(a) Classification and description of fishing gear</p>	<p>Active fishing gear:</p> <ul style="list-style-type: none"> - cast net - seine net - trawl - dredges - scoop net <p>Passive fishing gear: e.g.</p> <ul style="list-style-type: none"> - hooking devices - stationary nets - tangle nets - traps <p>Merits and demerits of using the various gear are also required.</p>
<p>(b) Construction and maintenance of fishing gear</p>	<p>Assessment should include knowledge of materials for construction and repair of fishing gear. Basic ways of maintaining fishing gear is also required.</p>
<p>(b) Description and maintenance of fishing craft</p>	<p>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.</p>
<p>(d) Fishing methods</p>	<p>Description of active and passive fishing methods used in inland, coastal and deep sea fishing is required.</p>

<p>(e) Harmful fishing practices</p> <p>C. FISH BIOLOGY</p> <p>1. Identification and classification of fishery organisms</p> <p>(a) Identification of common fishery organisms by species</p> <p>(b) Classification of common fishery organisms</p> <p>2. Structure and function of fishery organisms</p> <p>(a) Fish body measurements</p> <p>(b) External structures and features of fishery organisms</p> <p>(c) Internal organs of bony fishes and their functions</p> <p>3. Life processes in fishes</p> <p>(a) Locomotion</p>	<p>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.</p> <p>Common and scientific names are required.</p> <p>Common fishery organisms should be classified under phylum and class for Mollusca, Arthropoda and Echinodermata. Phylum Chordata should be classified to the subclass level.</p> <p>Ability to measure total, standard and fork lengths, and weights should be assessed.</p> <p>Assessment should cover a mollusc (cuttle fish), crustaceans (shrimp/prawn, crab), cartilaginous fish (shark, ray) and bony fishes (tilapia, <i>Clarias</i>).</p> <p>Assessment should cover organs such as gills, alimentary canal, heart and blood vessels, kidneys and gonads.</p> <p>Assessment should cover role of muscles and fins in movement and the maintenance of balance (pitching, rolling, yawing).</p>
---	--

(b) Feeding and digestion	Assessment should include knowledge of ingestion, digestion, absorption and egestion in fishes.
(c) Blood circulation	Assessment should cover composition, circulation and functions of blood.
(d) Gaseous exchange	An understanding of the mechanism of gaseous exchange is required.
(e) Excretion	Knowledge of osmo-regulation and the excretory process and products is required.
(f) Reproduction	<p>Knowledge and understanding of the stages in the reproductive process: gamete formation, spawning, fertilization and parental care are required.</p> <p>Identification of male and female tilapia should be assessed.</p> <p>Examination of eggs of gravid/berried fish is required.</p>
(g) Growth	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.
4. Fish ecology	
(a) Environmental conditions in fish habitats	<p>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.</p> <p>Measurement of environmental conditions using water test kits on water from pond, river/stream, lagoon, lake and sea is required.</p>
(b) Ecological processes within fish habitats	<p>Knowledge of the following processes is required:</p> <ul style="list-style-type: none"> - feeding behaviour - predation, competition - food chain, food web - food pyramid - fish mortality - adaptation of fishes to their environment

<p>(c) Pollution in water bodies</p> <p>5. Fish genetics and evolution</p> <p>(a) Principles of Genetics</p> <p>(b) Inheritance of genetic characteristics</p>	<p>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.</p> <p>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.</p> <p>Explanation of the concept of inheritance of external characters in fishes e.g. skin colour is required.</p>
<p>D. AQUACULTURE</p> <p>1.0 Introduction to aquaculture</p> <p>(a) Meaning and importance of aquaculture</p> <p>(b) Types of aquaculture</p> <p>(c) The state of aquaculture</p>	<p>Assessment should cover the culture of organisms including fish, clams, shrimps and sea weeds.</p> <p>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.</p> <p>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.</p>

<p>2. Aquarium activities</p> <p>(a) Construction of an aquarium</p> <p>(b) Management of an aquarium</p> <p>3. Fish farming</p> <p>(a) Introduction to fish farming</p> <p>(c) Construction of fish culture facilities</p> <p>(c) Management of fish ponds</p> <p>(i) Stocking of ponds</p>	<p>Assessment should cover knowledge and skills involved in the identification of materials required, design and construction of an aquarium.</p> <p>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.</p> <p>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)</p> <p>Knowledge of the facilities for growing fish (earthen ponds, cages, concrete tanks, raceways, fish pens) is required.</p> <p>Knowledge and skills in the selection of suitable sites for construction of ponds, cages and pens is required.</p> <p>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.</p> <p>Skills in site clearing, marking, excavation, formation of walls, fitting drainage structures and grassing should be included.</p> <p>Knowledge and skills required should include species selection, fingerling packaging and transport and stocking.</p> <p>Criteria for selection of fish species should include feeding habits, availability of fingerlings, growth rate and adaptability.</p>
---	--

(ii) Pond maintenance	<p>Knowledge of maintenance activities on fish ponds to be assessed should include:</p> <ul style="list-style-type: none"> - the control of water level - repairing leakages - predator and weed control - fertilizer application
(iii) Water quality control and monitoring	<p>Knowledge and skills in monitoring of water quality should cover:</p> <ul style="list-style-type: none"> - pH - dissolved oxygen - turbidity - ammonia content - temperature <p>Knowledge of measures to improve water quality such as stirring, lime application and fertilizer application is required.</p>
(iv) Fish feeds and feeding	<p>Knowledge about types of fish feeds and their nutrient content e.g. formulated feeds, agricultural by-products, pelletized and floating feeds is required.</p> <p>Skills in the formulation of nutritionally balanced fish feed/diets, procedures for feeding fish, feeding times and quantities should be covered.</p>
(v) Harvesting of fish ponds	<p>Types of harvesting (partial and total) using various fishing gear and methods should be assessed.</p> <p>Draining and refilling of fish ponds as measures of pond preparation after harvest should be covered.</p>
(d) Fish diseases	
(i) Types and causes	<p>Assessment should be limited to the following:</p> <p>Gill rot - fungus</p> <p>Furunculosis - bacteria</p> <p>Ich - protozoa</p>

	mechanical equipment is required.
(e) Methods of fish preservation	<p>Assessment should cover knowledge in the following:</p> <p>Traditional methods (e.g. smoking, cooking, salting, drying and frying.)</p> <p>Modern methods (e.g. freezing, canning, irradiation and use of chemicals – pickling.)</p> <p>Identification and description of common fish preservation equipment such as Chorkor smoker is required.</p>
(f) Packaging of fish	<p>Identification of materials for packaging fresh and preserved fish for local and export markets e.g. cartons, crates and baskets is required.</p> <p>Demonstration of methods of packaging fresh fish and fish preserved by smoking,</p>
(g) Fish products and by-products	<p>Major fish products to be identified: fish fillets, chunks and flakes, canned, smoked, dried, salted, pickled, marinated fish.</p> <p>Fish by-products to be identified should include fish oils, fish entrails (guts and gills) and fish bones.</p> <p>Uses of fish by-products should be covered.</p>
(h) Fish spoilage	
(i) Signs of fish spoilage	<p>Signs of fish spoilage to be detected should include sunken eyes, mucus on the skin and darkening colour of gills.</p>
(ii) Causes of fish spoilage	<p>Knowledge of the causes of fish spoilage should be limited to microbial, enzymatic and fat oxidation.</p> <p>The importance of proper handling of fish to delay spoilage should be included.</p>
(iii) Effects of fish spoilage	<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>
F. FISHERIES MANAGEMENT AND BUSINESS OF FISHERIES	
1. Fisheries management	
(a) Meaning of fisheries management	<p>Assessment should cover knowledge of measures taken to maintain fish stock levels for</p>

	<p>sustainable exploitation. The concept of Maximum Sustainable Yield (MSY) should be covered.</p> <p>Objectives of fisheries management should include maximizing sustainable catches and maintaining spawning stock.</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>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>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>Explanation of the effect of upwelling on bumper harvest of fish should be assessed.</p>
(b) Objectives and strategies of fisheries management	
(c) Traditional fish stock management practices	
(d) Data collection and analysis for fisheries management	
2. Fishery policies and regulations	
(a) Government policies and regulations on fisheries	<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>Knowledge of the importance of fisheries policies and regulations e.g. preventing capture of juvenile fishes, protection of the environment is also required.</p>
(b) International law and conventions	<p>Meaning and economic benefits of the Exclusive Economic Zone (EEZ) should be covered.</p> <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).</p>

	<p>The importance of international conventions should also be included.</p>
<p>3. Business of fisheries: Budget preparation and financial projections for a fishery business</p>	<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>4. Fish marketing</p>	<p>Knowledge and skills in pricing of fish products in relation to demand and supply of fish product should be covered.</p>
<p>(a) The state of fish marketing</p>	<p>Assessment should cover knowledge in quality control, packaging, storage and transportation of fish.</p> <p>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> <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>(b) Major fisheries companies</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>
<p>(c) Supply and value chains in the fishery industry</p>	<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>(d) Food fish quality and safety standards</p>	<p>Quality and safety standards of various fish products should be mentioned.</p>

<p>G. PRACTICES IN FISHING COMMUNITIES AND FISHERIES INSTITUTIONS</p> <p>1. Fishing communities and cultural practices</p> <p>(a) Important fishing communities</p> <p>(b) Cultural festivals and taboos related to fishing</p> <p>3. Fisheries institutional framework and job opportunities</p> <p>(a) Fisheries training and research institutions</p> <p>(b) Job opportunities in the fishery sub-sector</p> <p>(c) Business opportunities in fisheries</p>	<p>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.</p> <p>List of festivals should include: Bakatue of Edina Fetu of Oguaa Dzawuwu of Agave</p> <p>Knowledge of the influence of the festivals and taboos on the fishing industry should be covered, e.g. close season/fishing holiday.</p> <p>Identification, objectives and activities of the institutions e.g. Water Research Institute and University of Ghana are required.</p> <p>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.</p> <p>Factors required for establishing enterprises in fisheries</p> <ul style="list-style-type: none"> - Identification of business opportunities - Identification of fishery product or service needed in a locality - availability of market for the product or service
---	---

	<p>- demand for the product or service Resources should include land, capital, materials, structures, services, labour, technical know-how.</p>
(d) Procedure for establishing enterprises in fisheries	Procedures should include the development of business plans, registration of business, management of the business, etc
(e) Extension services in the fisheries sub sector	Knowledge and understanding of the role of extension services in the fisheries sub-sector should be assessed, e.g. technical assistance to fish farmers and education of fisher folks on fisheries regulations.
1. Fishing gear: Identification, uses and maintenance	Assessment should cover drawing and labelling of different fishing gear.
2. Fish Identification: Identification and classification of common freshwater, brackish water and marine fishes	Assessment should cover the following fishery organisms: <i>Tilapia</i> , <i>Clarias/Heterobranchus</i> , <i>Chrysichthys</i> , <i>Heterotis</i> , <i>Lates</i> , <i>Bagrus</i> , <i>Alestes</i> , <i>Synodontis</i> , <i>Sardinella</i> , prawns/shrimps, crabs, grey mullet, sea bream, cassava fish, tuna, mackerel, anchovy, ray, shark cuttlefish/ squid and sea urchins.
3. Identification and description of characteristics of invasive alien species in fishery habitats	Assessment should cover the following alien species. <i>Eichornia crassipes</i> (water hyacinth) <i>Cyperus papyrus</i> (Papyrus reed), <i>Salvinia molesta</i> (kariba weed) <i>Pistia stratiotes</i> (water lettuce) <i>Ceratophyllum sp</i> (Hornwort)
4. Fish structure and function	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.
(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	Measurement of the environmental conditions: temperature, dissolved oxygen, pH, and salinity is required.
6. Ecological processes within the aquatic environment	Construction of food chain, food web and food pyramid should be covered.
7. Characteristic features of fresh and spoiled fish	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.
8. Identification of micro-organisms and macro-organisms in spoiled fish	Assessment should cover organisms such as maggots, fungi and insects in spoiled fish.
9. Fish processing and preservation	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.
10. Fish by-products	Assessment should be based on the identification and uses of fish by-products.
11. Pond construction	Identification of suitable soils, material and equipment for pond construction.
12. Feed formulation and feeding	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.
13. Pond fertilization	Assessment should cover identification of types, uses and methods of application of fertilizers in fish ponds.

14. Fish diseases	Identification of gill rot, furunculosis and ich by their symptoms is required.
-------------------	---