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**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 enterpreneural 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**

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| **CONTENTS** |  |
| A. INTRODUCTION  TO FISHERIES   1. Fisheries and   national  development  (a) Meaning of  fisheries  (b) Types of  fisheries  (c) Importance of  fisheries to  national  development  2. Fishery  organisms and  their habitats  (a) Identification  and description  of common  fishery  organisms  (b) Fishery  habitats   1. 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  B. FISHING  ACTIVITIES   1. Fish landing   sites and facilities   1. Types of fish   landing sites   1. Facilities and   activities at fish landing sites  (c) Sanitation  practices at fish  landing sites  2. Fishing gear and craft.   1. Classification and   description of fishing gear  (b) Construction  and maintenance  of fishing gear   1. Description and   maintenance of fishing craft  (d) Fishing methods  (e) Harmful fishing  practices  C. FISH BIOLOGY  1. Identification and  classification of  fishery organisms  (a) Identification of  common fishery  organisms by  species  (b) Classification of  common fishery  organisms  2. Structure and  function of  fishery organisms  (a) Fish body  measurements  (b) External structures  and features of  fishery organisms  (c) Internal organs of  bony fishes and  their functions  3. Life processes in  fishes  (a) Locomotion  (b) Feeding and digestion  (c) Blood circulation  (d) Gaseous exchange  (e) Excretion  (f) Reproduction  (g) Growth  4. Fish ecology   1. Environmental   conditions in fish  habitats  (b) Ecological  processes within  fish habitats  (c) Pollution in  water bodies  5. Fish genetics and  evolution  (a) Principles of  Genetics  (b) Inheritance of genetic  characteristics  D. AQUACULTURE  1.0 Introduction to aquaculture   1. Meaning and importance of   aquaculture  (b) Types of aquaculture  (c) The state of aquaculture  2. Aquarium activities  (a) Construction of  an aquarium   1. Management of an   aquarium  3. Fish farming  (a) Introduction to  fish farming   1. Construction of   fish culture facilities  (c) Management of  fish ponds  (i) Stocking of ponds  (ii) Pond maintenance  (iii) Water quality  control and monitoring  (iv) Fish feeds and feeding  (v) Harvesting of fish ponds  (d) Fish diseases  (i) Types and causes  (ii) Symptoms  (iii) Prevention,  control and treatment  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   1. Importance of fish   processing and  preservation  (c) General principles of  fish processing  and preservation  (d) Methods of fish processing  (e) Methods of fish  preservation  (f) Packaging of fish  (g) Fish products and  by-products  (h) Fish spoilage  (i) Signs of fish  spoilage  (ii) Causes of fish spoilage  (iii) Effects of fish spoilage  F. FISHERIES  MANAGEMENT  AND BUSINESS OF  FISHERIES  1. Fisheries  management  (a) Meaning of  fisheries management  (b) Objectives and  strategies offisheries  management   1. Traditional fish stock   management practices   1. Data collection   and analysis for fisheries  management   1. Fishery policies   and regulations   1. Government   policies and regulations on  fisheries   1. International law and   conventions  3. Business of fisheries:  Budget  preparation and financial  projections for a fishery  business  4. Fish marketing  (a) The state of fishmarketing  (b) Major fisheries companies   1. Supply and value chains in   the fishery industry  (d) Food fish quality  and safety standards  G. PRACTICES IN  FISHING COMMUNITIES  AND FISHERIES  INSTITUTIONS  1. Fishing communities and  cultural practices   1. Important fishing   communities  (b) Cultural festivals and  taboos related to  fishing   1. Fisheries   institutional framework and  job opportunities  (a) Fisheries training and  research institutions  (b) Job opportunities in  the fishery sub-sector  (c) Business  opportunities in  fisheries  (d) Procedure for  establishing  enterprises in  fisheries  (e) Extension services  in the fisheries  sub sector  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 stuctures:  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 | Explanation of the term fisheries  Knowledge of the following is required:  Culture fisheries (aquaculture)  Capture fisheries (fishing)  - subsistence fisheries  - artisanal fisheries  - commercial fisheries  - industrial fisheries  Role of fisheries in the national economy e.g. food, employment, income generation, social and cultural life.  Assessment should cover the features of:  Fin fishes (e.g. herring, tuna, tilapia, *Clarias, Heterobranchus*)  Crustaceans (shrimp/prawns/lobster, crabs)  Molluscs (clam, scallops, oyster, cuttle fish/squid)  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 *Eichorniacrassipes* (water hyacinth), *Cyperus papyrus* (Papyrus reed), *Salviniamolesta*(kariba weed), *Limnocharisflava*(Limnocharis), *Pistiastratiotes* (water lettuce), *Azollafiliculoides* (water fern), *Enteromorphaflexura*(filamentous algae) *Ceratophyllum* sp. (Hornwort).  Characteristics should include the morphology of the species, mode of propagation, growth and development.  Analysis of the effects of aquatic invasive alien species on fishery habitats, fishery organisms and fishers.  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  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.  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.  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  Assessment should cover knowledge and skills of proper disposal of wastes generated at fish landing sites including oil spills and vessel parts.  Active fishing gear:  - cast net  - seine net  - trawl  - dredges  - scoop net  Passive fishing gear: e.g.  - hooking devices  - stationary nets  - tangle nets  - traps  Merits and demerits of using the various gear are also required.  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.  Description of active and passive fishing methods used in inland, coastal and deep sea fishing is required.  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.  Common and scientific names are required.  Common fishery organisms should be classified under phylum and class for Mollusca, Arthropoda and Echinodermata. Phylum Chordata should be classified to the subclass level.  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.  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.  An understanding of the mechanism of gaseous exchange is required.  Knowledge of osmo-regulation and the excretory process and products is required.  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.  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.  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.  Assessment should cover the culture of organisms including fish, clams, shrimps and sea weeds.  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.  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.  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.  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.  Skills in site clearing, marking, excavation, formation of walls, fitting drainage structures and grassing should be included.  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.  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.  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.  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.  Assessment should be limited to the following:  Gill rot - fungus  Furunculosis - bacteria  Ich - protozoa  Assessment should be based on the identification of symptoms:  Gill rot - red/whitish spots on gills  Furuncolosis - ulcers on skin  Ich - white spots on skin and fins  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.  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.  The importance of proper handling of fish to delay spoilage should be included.  Knowledge of effects such as loss of value, taste and income should be assessed.  The public health hazard of consuming spoiled fish should be covered.  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.  Objectives of fisheries management should include maximizing sustainable catches and maintaining spawning stock.  Strategies should include limiting the number of fishing units, fishing closures, regulating mesh sizes and catch quotas.  Assessment should include the use of practices such as close seasons, taboos, non-fishing days and cultural festivals to maintain fish stocks.  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.  Skills in the analysis of the data are also required.  Factors (such as climate and breeding) responsible for seasonal variations in fish catches (bumper and lean) should be covered.  Explanation of the effect of upwelling on bumper harvest of fish should be assessed.  Knowledge of government policies and regulations on fisheries e.g. subsidy on fishing inputs, role of stakeholders, fish imports should be assessed.  Knowledge of the importance of fisheries policies and regulations e.g. preventing capture of juvenile fishes, protection of the environment is also required.  Meaning and economic benefits of the Exclusive Economic Zone (EEZ) should be covered.  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.  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.  Knowledge and skills in pricing of fish products in relation to demand and supply of fish product should be covered.  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  Problems of fish marketing and their solutions should be covered.  Activities involved in fish import and export should be outlined.  Explanation of the effects of bumper harvest on import/export and prices of fish should be assessed.  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.  Assessment should cover knowledge of value chains in the fishery industry. The responsibilities of actors in the supply and value chain should be included.  Quality and safety standards of various fish products should be mentioned.  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  Knowledge of the influence of the festivals and taboos on the fishing industry should be covered, e.g. close season/fishing holiday.  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.  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.  Procedures should include the development of business plans, registration of business, management of the business, etc  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.  Assessment should cover drawing and labelling of different fishing gear.  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.  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.  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.  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.  Assessment should cover organisms such as maggots, fungi and insects in spoiled fish.  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.  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.  Identification of gill rot, furunculosis and ich by their symptoms is required. |

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