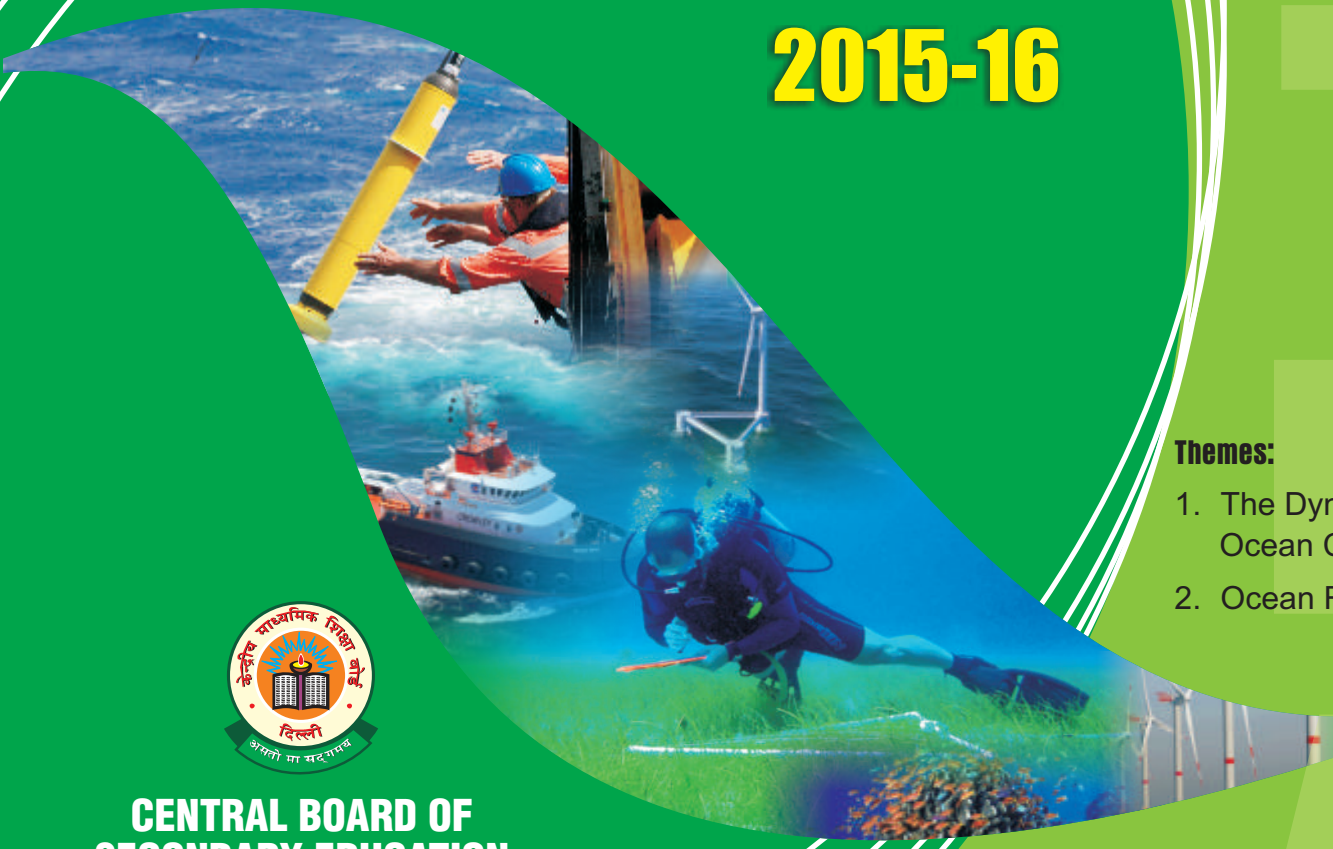
Geography

Class-XI

OPEN TEXT-BASED ASSESSMENT

2015-16



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Themes: **Page**

CENTRAL BOARD OF SECONDARY EDUCATION

Shiksha Kendra, 2, Community Centre,
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OPEN TEXT BASED ASSESSMENT

GEOGRAPHY CLASS-XI

Theme–1: The Dynamic Ocean Current

Abstract

Ocean currents contribute to the transportation of heat from the tropics to the poles, partially equalizing earth surface temperatures. Ocean circulation patterns influence climate and living conditions for plants and animals, on land and in the marine ecosystem. They also affect the routes taken by ships as they carry goods and people across the sea. Ocean currents in their own inevitable way play an important role in our life impacting our economic and socio cultural activities.

Introduction

There are many similarities between the ocean and the atmosphere. Due to differential heating of air and water, their movement is influenced. Like the ocean has currents, atmosphere has winds. These ocean currents like the wind are a means to redistribute solar energy from one place to another. The oceans also have surface currents and deep water current just as the atmosphere has surface winds and upper atmospheric circulations. Also like the winds, many of these currents have established "permanent" patterns, which can last for tens of thousands of years. Our climate is very much dependent on ocean currents, since they redistribute massive amounts of heat energy from one part of the earth to another. A disruption of ocean currents would lead to dramatic changes in the climate and vice versa.

The ocean currents have a significant impact on the movement of energy and moisture between the oceans and the atmosphere as they circulate water worldwide, as an end result, they are important to the world's weather. The Gulf Stream for example is a warm current that originates in the Gulf of Mexico and moves north toward Europe. Since it is full of warm water, the sea surface temperatures are higher, which keeps places along the coast of Europe warmer than other areas at similar latitudes.

The cold Humboldt or Peruvian Current is another example of a current that affects weather. This current is normally present off the coast of Chile and Peru, it creates extremely productive waters and keeps the coast cool and northern Chile arid. However, Chile's climate is altered when it gets disrupted it is believed that El Niño plays a role in its disturbance.

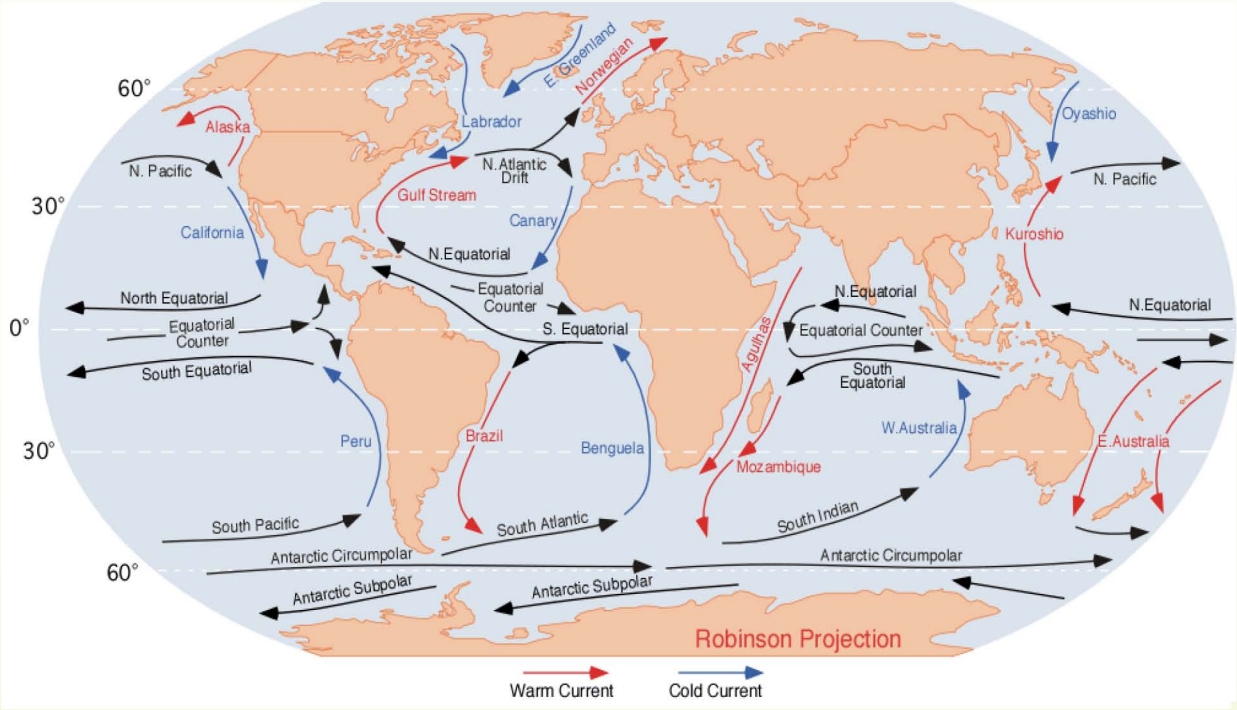

Figure-1: Ocean Currents

The volume of water carried by ocean currents is measured in units called Sverdrup, where 1 Sverdrup is a flow rate of 1 million cubic meters of water per second. To give an example of how large this circulation is, the total flow of fresh water from all the rivers in the world is about 1 Sverdrup. Whereas the flow of just one single ocean current - the Gulf Stream - varies from 30 Sverdrup to 150 Sverdrup, depending upon its location. This is why an oceanic current which is just a few degrees warmer or colder than the surrounding water can carry enormous amounts of heat energy from one location to another.

Impact of ocean currents on our lives:

1. The currents have an effect on nutrient levels in the ocean, which can affect the variety and concentration of flora and fauna of sea.
2. Some of the world's best fishing areas are located in places where a surface current moves away from a shore, because wherever surface currents flow away from the coast in the interior part of the sea, deep sea water upwells which is rich in nutrients.
3. Ocean currents are also responsible for the accumulation of nutrients in rich patches, which are major fishing grounds.
4. Many species of marine life take advantage of ocean currents for their seasonal migrations. The migrations of many organisms in the sea follow various currents in the oceans. Traveling along the path of a current is energy efficient and fast. They also affect the fisheries

development and thus, fishing industry. Obviously, fishing along the migration path of a commercial species can be a good idea, if implemented at the right time.

5. Also traveling along a current saves fuel, while traveling against it costs more fuel. In the old days of sail ships, this impact could be even more significant - the gulf stream in Atlantic. Ocean was a great support for Spanish ships moving back from Caribbean Islands to Spain. The Agulhas Current in the southwest Indian Ocean was a major obstacle to Portuguese sailors trying to reach India.
6. The sailing of ships is also affected by Icebergs movement caused by currents - Labrador Current, which flows south out of the Arctic Ocean along the coasts of Newfoundland and Nova Scotia, is famous for moving icebergs into shipping lanes in the North Atlantic ocean.
7. Debris floating in the ocean also tends to converge in certain zones because of these currents. The North Atlantic Garbage Patch and the Great Pacific Garbage Patch are places where a lot of trash dumped into the oceans has aggregated.

Typically, ocean currents are divided into two types based on depth: surface currents (which usually extend not more than about 400 meters below the surface), and deep water currents (also known as the thermohaline circulation) which prevail in greater depth of the ocean.

Causes for the formation of Ocean Current

Currents normally move in a definite direction and assist considerably in the circulation of the Earth's moisture, they affect the weather, marine life and water pollution. It changes the pressure conditions over water bodies, finally, wind blows from higher pressure to low atmospheric pressure area which directly affect the ocean's surface water and current start moving.

Solar Activity

The Sun's energy drives the circulation of water in the oceans, indirectly through winds. The direct effect of solar energy is highest at the equator, decreasing towards the poles producing uneven heating of water in the ocean. It changes the pressure conditions over water bodies. Finally, wind blows from high pressure to low atmospheric pressure areas which directly affect the ocean's surface water and currents start moving.

Winds

The oceans are largely flat expanses, unobstructed by topography, winds can blow for long distances, for prolonged periods of time. It takes winds blowing over a longer time period to produce a sustained movement of water in the wind's direction. When steady wind blowing in a certain direction at 20 miles per hour for about 10 hours are going to generate a surface water current at about 0.4 miles per hour. There are many long-duration wind patterns (such as the trade winds or the westerly winds) which blow for sustained periods of weeks or months in the same direction over vast expanse of ocean.

Coriolis Force and Ocean Gyres

Due to the Coriolis force, currents tend to flow in curves rather than in straight lines. Such circular flows are called oceanic gyres. When the space for movement by the ocean current is restricted by land bounding the ocean, these curves can close in on themselves, and cause a circular flow of water around a centre. Gyres are usually bounded by the shallow waters of continental shelves. There are five major gyres in the world's oceans, which are limited by the continents around them. These gyres are responsible for much of the world's surface currents. Their locations are highly influenced by the temperature of the water and the ocean-land boundary. In fact, all ocean gyres have clockwise circulation in the northern hemisphere and anticlockwise circulation in the southern hemisphere. However, there are smaller currents that are produced as the result of local heating or cooling, or because of the presence of land forms such as undersea ridges, hills, mountain ranges, the presence of island chains, etc.

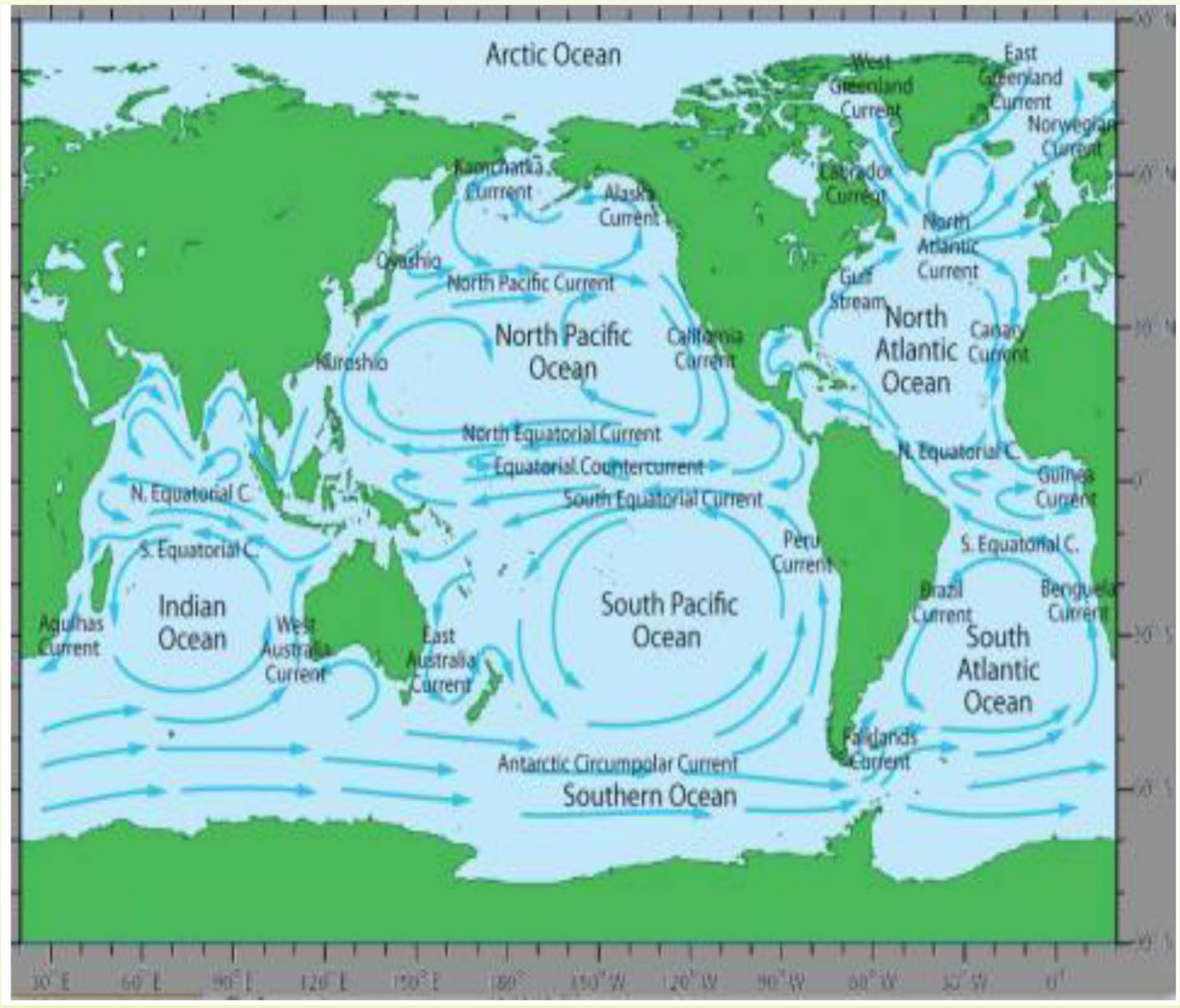

Figure-2: Ocean Gyres

Gravity

The equatorial bulge of the oceans caused by the expansion of water under equatorial heat creates a slope, and water tends to run downhill under the force of gravity. This is one of the major reasons for surface water flow from the equator or areas of lower latitudes towards poles, areas of higher latitude.

What do disaster managers and food industry have in common?

They both use the El Niño/Southern Oscillation (ENSO) data. ENSO refers to the cyclical changes in sea surface temperatures, surface air pressure, and atmospheric and rainfall patterns, that occur across the Equatorial Pacific Ocean.

These global maps centered on the Pacific Ocean show patterns of sea surface temperature during El Niño and La Niña episodes. The colours along the equator show areas that are warmer or cooler than the long-term average.

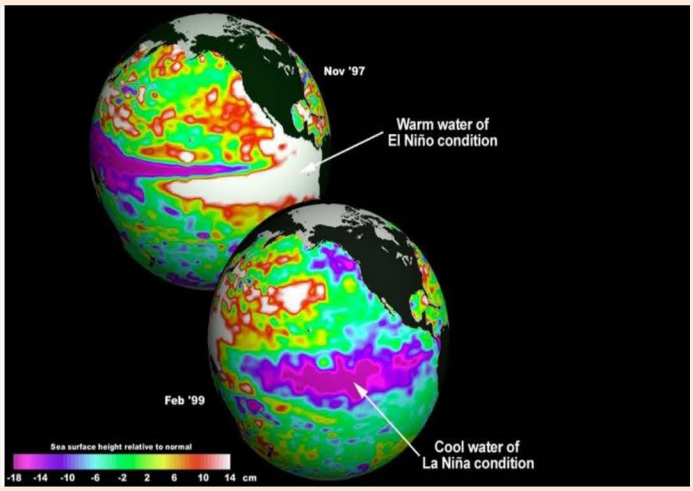

Figure-3: El Nino and La Nina

Effect of the El Nino and La Nina

Weather patterns in many parts of the world are influenced by El Niño and La Niña. Humans and ecosystems can be positively and negatively affected. Natural climate patterns result from interactions between the ocean and the atmosphere. They affect weather around the world and may cause cultivation of food crops and food prices to jump or fall, cause human deaths and billions of rupees in property damage.

On the Pacific coast of South America in the 1800's, local fishermen noticed a warm ocean current. Every year this warm water would appear around Christmas-time. Referring to the birth of Christ, they named this current El Niño, which means "the boy" in Spanish. El Niño is today known to be much more than just a local current off the coast of Peru.

An El Niño condition is said to occur when surface water in the Pacific, near the equator, becomes warmer and the winds are blowing weaker than normal from the East. The opposite condition, when the water is colder than average and winds are blowing stronger from the East, is called La

Niña. El Niño and La Niña events usually occur every 3 to 5 years. These interactions of the ocean and atmosphere produce important consequences for people and ecosystems in many parts of the globe. Food production is impacted by El Nino Southern Oscillation phenomenon (ENSO). Changes in temperatures and currents in the oceans that happen during El Niño impact marine life. This can impact people who make their livelihood from fishing and consumers who depend on certain fish for food. Agriculture is heavily dependent on climate as ENSO's effect on rainfall and temperature influences agriculture.

How El Nino impacts monsoon rainfall in India:

According to Skymet, a private weather forecaster, El Nino and Indian monsoon are inversely related. The most prominent droughts in India - six of them - since 1871 have been El Nino droughts, including the recent ones in 2002 and 2009, it said. However, one thing is clear that El Nino years do affect monsoon rainfall in India. During this time, the rainfall is generally below normal, which has its bearing on crop production. El Nino directly impacts India's agrarian economy as it tends to lower the production of rainy season Kharif crops such as rice, sugarcane, cotton and oilseeds. The ultimate impact is seen in the form of high inflation and low gross domestic product growth as agriculture contributes around 14 per cent to the Indian economy.

The table shows the impact of El Nino and La Nina over a decade

Year	Occurrence	Impact	Monsoon*
2004	El Nino	Drought	88%
2005	Neutral	Normal	101%
2006	Neutral	Normal	103%
2007	La Nina	Excess	110%
2008	La Nina	Above Normal	105%
2009	El Nino	Severe Drought	79%
2010	La Nina	Normal	100%
2011	La Nina	Normal	104%

2012	Mild El Nino	Below Normal	92%
2013	Neutral	Above Normal	106%

**Monsoon as percentage of 50–year average*

Source: Skymet

El Nino may impact India's 2014-15 GDP, inflation: report

Press Trust of India | Updated On: April 27, 2014 14:01 (IST)

New Delhi: An El Nino-induced below normal monsoon this year could have a bearing on India's economic growth and inflation in fiscal year 2014-15, according to reports. An HSBC report said inflation may remain sticky in the current financial year as a possible El Nino effect on the monsoon is likely to push up food prices and geopolitical uncertainties are likely to pump up commodity rates across the world.

El Nino refers to the warmer-than-average sea surface temperature in the central and eastern tropical Pacific Ocean. This condition occurs every 4-12 years and had last impacted India's monsoon in 2009, leading to the worst drought in almost four decades. El Nino-induced drought result in a spike in inflation levels to around 8-10 per cent, a Bank of America-Merrill Lynch report said. If rains are normal, Consumer Price Index (CPI)-based inflation should come off to 7-7.5 per cent by March 2015 and if the El Nino impacts the kharif harvest, rising food prices would push up CPI inflation to 8-10 per cent.

The Warm Kuroshio Current

The Kuroshio Current (also known as the Black Tide or the Japanese Current) is the north-flowing portion of the North Pacific Ocean gyre. It is the Pacific Ocean's counterpart of the Atlantic's Gulf Stream. The Kuroshio Current brings warm tropical water from the equatorial regions towards the polar regions. Thus, like the Gulf Stream, it moderates the climate of Japan, the Aleutians and coasted Alaska and British Columbia. The Kuroshio Current carries copepods, squid, and other marine life northwards. It's warm waters sustain coral reefs off the east coast of Japan, some of most northerly coral reefs in the world. The Kuroshio Current is considered to have its beginning off the east coast of Taiwan, where the North Equatorial Current changes from flowing west to flowing more toward the north. At its southern beginning, the Kuroshio Current has a temperature of up to 25°C. By the time it turns east off the Aleutian Islands, the water temperature has dropped to as low as 2°C. The overall transfer of heat from the tropical regions to northern polar regions is massive.

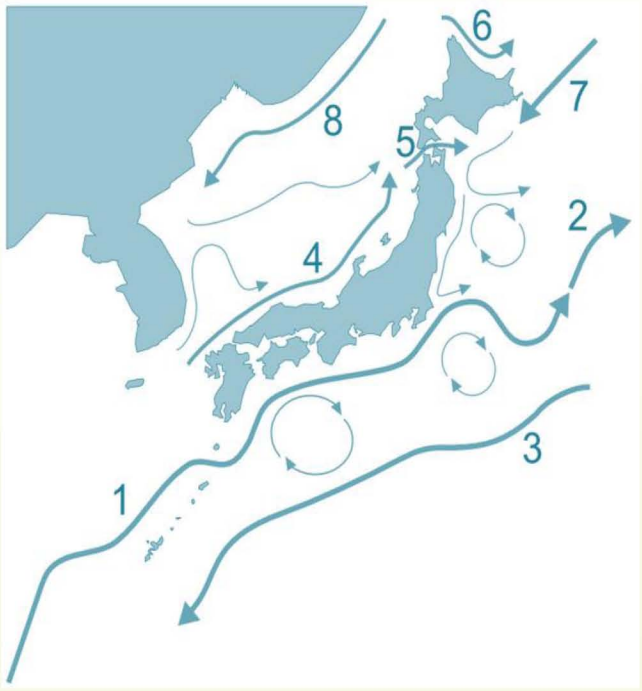

Figure-4:The ocean currents surrounding the Japanese archipelago: 1. Kuroshio 2. Kuroshio extension 3. Kuroshio countercurrent 4. Tsushima Current 5. Tsugaru Current 6. Sōya Current 7. Oyashio 8. Liman Current

Kuroshio Power Plant:

Taiwan imports 99.2% of its energy, with only a small portion of indigenous energy, such as hydro, wind, and solar because as a country it lacks energy reserves. These situations in terms of energy security are very severe. To resolve these severe situations, harnessing the power of the Kuroshio in eastern Taiwan offers a great opportunity. This ocean current is strong and stable as it passes through eastern Taiwan. By precisely locating high-quality sites and with careful planning, one can possibly generate exploitable power more than 30 GW(gigawatt). With 30 GW of clean energy, Taiwan could effectively enhance energy security, reduce green house gas emission, and lower energy-purchasing cost.

Source: Energy Research Centre and Institute of Applied Mechanics, National Taiwan University, Taipei Taiwan.

The Cold Oyashio current:

It is a cold subarctic ocean current flows south and circulates counter clockwise in the western North Pacific Ocean. The waters of the Oyashio Current originate in the Arctic Ocean and flow southward via the Bering Sea, passing through the Bering Strait and transporting cold water from the Arctic Sea into the Pacific Ocean. It collides with the Kuroshio Current off the eastern shore

of Japan to form the North Pacific Current (or Drift). The upwelling, nutrient-rich water of the Oyashio from the north is a boon that provides for and nurtures marine organisms.

The current has an important impact on the climate of the Russian Far East, mainly between Lake Baikal in Eastern Siberia to the Kamchatka. The waters of the Oyashio Current are possibly the richest fishery in the world owing to the exceedingly high-nutrient content of the cold water. However, the Oyashio Current also causes Vladivostok to be the most equatorward port to seasonally freeze and necessitates icebreaking ships to remain open in winter.

The Warm Gulf Stream in the Atlantic Ocean

The Gulf Stream is a very warm, deep, current that carries water from the tropics to the poles. It makes up a portion of the North Atlantic Subtropical Gyre. It is a strong, fast moving, warm ocean current that originates in the Gulf of Mexico and flows into the Atlantic Ocean. The behavior of the Gulf Stream is determined by the presence of a coastline - in this case the eastern United States and Canada. The Gulf Stream was first discovered in 1513 by the Spanish explorer Juan Ponce de Leon and was then used extensively by Spanish sailors as they travelled from the Caribbean to Spain across the Atlantic ocean.

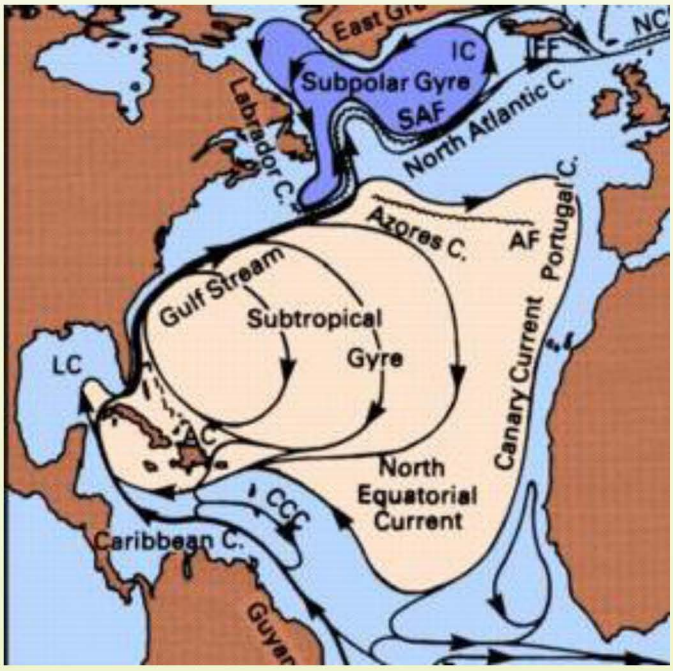

Figure-5: Gulf Stream Current in the Atlantic

Impact of the Gulf Stream

The Gulf Stream is one of the most significant currents dictating the climate of the region where it flows. It gathers all of its water from the warm tropical waters of the Caribbean and the Gulf of

Mexico. As such, it keeps sea surface temperatures warm, causing the areas around it to be warm and more hospitable. Climate of Florida and much of the Southeastern United States for instance remains mild all the year round.

The greatest impact of the Gulf Stream is on the climate of Europe. Since it flows into the North Atlantic Ocean, it too is warm (though at this latitude the sea surface temperatures are cooled considerably) it helps keep places like Ireland and England much warmer than they would otherwise be at such a high latitude. The Gulf Stream is also responsible for keeping northern Norway's coast free of ice and snow.

The Cold Labrador Current in the North Atlantic Ocean

The current flows from the Arctic Ocean south along the coast of Labrador and passes around Newfoundland, continuing south along the east coast of Nova Scotia. This cold water current keeps the east coast of Canada (in the north) cold and sparsely inhabited. In fact, the tree line on the east coast of Canada stops at about 53° to 56° N latitude (there are no trees north after that). Whereas some places in central Siberia, the tree line extends as far north as 72°N, a difference of about 15° of latitude.

An interesting thing happens when the cold Labrador Current meets the warm Gulf Stream off the coast of Newfoundland and the Maritime Province. This meeting of a cold and warm current produces heavy fogs in the Grand Banks, as well as very rich fishing grounds. These shallow waters are rich in many commercial species, like the swordfish and halibut.

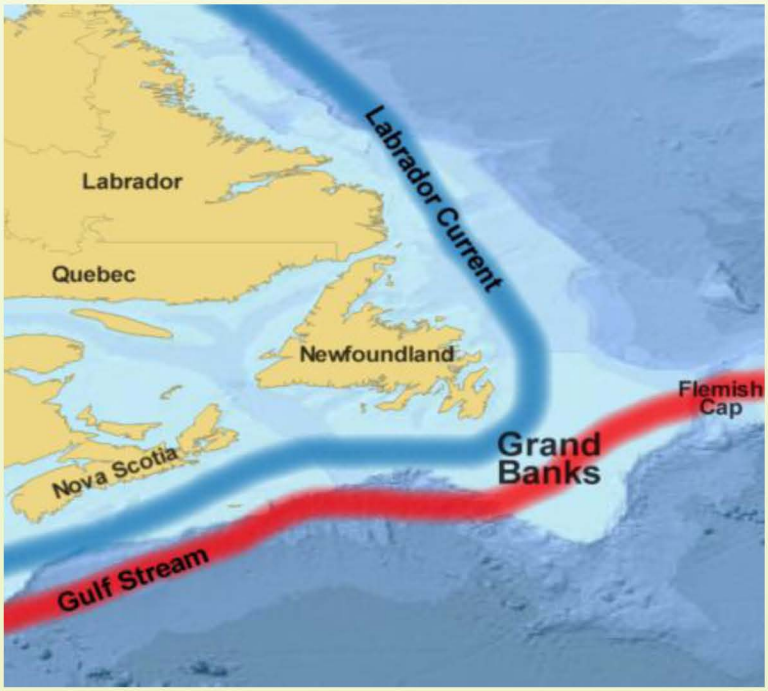

Figure-6: Meeting of the warm Gulf Stream and the Cold labrador Current in the Grand bank

The Labrador current sometimes, consists of icebergs, which can cause a shipping hazard in far southerly waters where icebergs are normally not expected.

Iceberg in the Narrows off St. John's harbour. Iceberg-viewing has become a popular tourist attraction, but icebergs can also present a real danger to shipping and vessel movement.

Figure-7: Iceberg at Baffin bay

The cold Labrador current has been known to transport icebergs as far south as Bermuda and as far east as the Azores. The International Ice Patrol was set up to track icebergs, including those found in areas of the ocean where they are rarely located.

Two coastal areas at about the same latitude but on opposite sides of the North Atlantic Ocean!

It is a known fact that due to the oblique rays of the sun places nearer the poles are colder in comparison to places near the equator. However there are two places approximately on the same latitude Place **A** Scoresby Sund, is on the eastern coast of Greenland's, while Place **B** Tromsø, on the north western coast of Norway but their climates are very different.

Figure-8: Scoresby Sund at Latitude 70.5^0

Figure-9: Tromso at latitude 69.5^{0}Norway

Figure-10: Location of Scores Sund and Tromso

The Peru Current and Its Impact

The Peru Current also called Humboldt Current flows along the southeast Pacific Ocean. As it is a cold current, except at times of the phenomenon known as El Niño, the Peru Current brings fog to the nearby coast and results in the coast being one of the most intensely arid regions in the world.

The flow of the cold current caused by the combined effects of the drag of surface winds of the Southeast Trades and the Earth's rotation results in the upwelling of deep water which brings plentiful nutrients close to the surface. The advantageous effects of sunlight, helps in the rich growth of plankton thereby making the waters off Peru, Chile, and Ecuador one of the world's greatest fishing grounds for anchovies and the larger fish (*e.g.,* tuna) that feed upon them. Guano droppings deposited by the flocks of birds that feed on the anchovies is used as fertilizer as it is highly effective fertilizer due to its exceptionally high content of nitrogen, phosphate, and potassium, three nutrients essential for plant growth. Today, guano is increasingly sought after by organic farmers.

Peru: Where have all the anchovies gone?

April 14th 2013

LIMA, Peru – Growing to about 5 inches on average, the Peruvian anchovy might seem an unlikely candidate for the title of the world's mightiest fish. Thriving in the Humboldt Current, the plankton-rich upwelling of Antarctic waters off South America's Pacific coast, this diminutive, bright-silver forager gathers in vast shoals that have become the fishing industry's easiest pickings. According to the United Nations' Food and Agriculture Organization, the Peruvian anchovy is "the most heavily exploited fish in world history,". Most of that haul is caught in Peru, making the country the world's top exporter of fish meal the lucrative industry churns out feed to fatten up livestock from the US Midwest to China. Because Anchovies are a part of the food chain, their decline is fast affecting many other, larger species in the teeming water off Peru coast.

http://www.globalpost.com/dispatch/news/regions/americas/peru/130412/overfishing-eruvian-anchovy-marine-conservation

The Great Swirling Pacific Garbage Patch

Geography in the News.

Sources: "The Great Pacific Garbage Patch," Aug. 20, 2008

Ocean pollution is growing at an astonishing rate. On June 1, 2008, two scientists and a photographer/blogger sailed from Long Beach, California, and headed westward across the Pacific Ocean to Hawaii. The two men and a woman were not traveling on any luxury cruise liner. They were sailing on the JUNK, a boat created from 15,000 plastic bottles and the fuselage of a Cessna 310 airplane. The group successfully raised awareness about plastics that are fouling the world's oceans.

Figure-11: The unaltered stomach contents of a dead albatross chick include plastic marine debris fed to the chick by its parents.

As the JUNK sailed across the ocean, it ventured into the "Great Pacific Garbage Patch," . The problem in the "Great Pacific Garbage Patch" is that historically the rubbish that made it out to sea would biodegrade. However, modern-day plastics are so durable that the gyres contain some 50-year old plastics – the plastics do not break down for years.

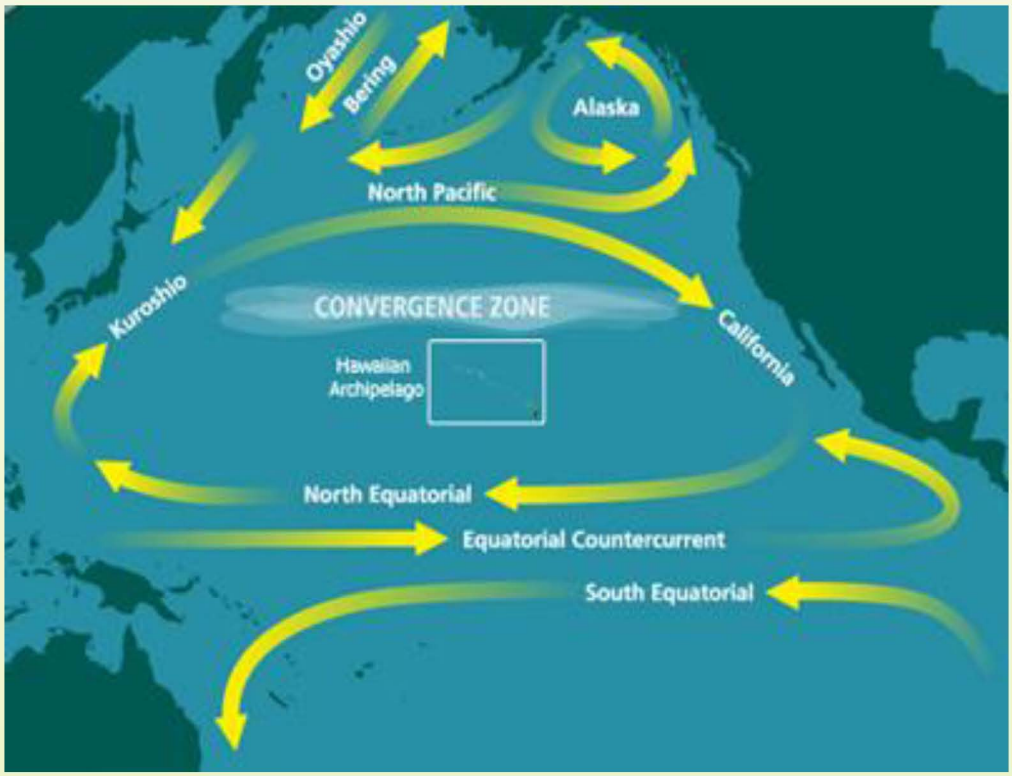

Figure-12:.The Patch is created in the gyre of the North Pacific Zone.

The animals mistake the plastics for food and die trying to digest them. All manners of plastics are found inside the carcasses of dead and dying marine birds. The rubbish is resulted into multiple problems and firstly, fish population is dwindling as they try to eat contaminated marine food or plastic particles. Secondary, livelihood of fishermen is going to be vanished poses a risk to humans. Tiny plastic pellets, or nurdles, the raw materials comprising plastics, are lost or spilled each year. Many of these make their way into the oceans. These pollutants behave as chemical sponges, attracting synthetic chemicals like hydrocarbons and the pesticide DDT. As fish ingest the tiny polluted particles, they become contaminated. When humans eat the fish, they also ingest the chemicals.

With 40 percent of the world's oceans as subtropical gyres, plastics may already cover almost a quarter of the oceans' surface area. This is a huge environmental issue with major geographic implications and no permanent solutions in sight.

This is the high time we need to address the issue in a planned manner by spreading awareness among masses through various means like printed and audio-visual media.

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SAMPLE QUESTIONS

Q 1. As a news paper reporter at the port of Bergen, on the west coast of Norway write an article on the impact and importance of the North Atlantic Drift on the local population. (5 Marks)

Q2. Imagine yourself to be a community leader along the seacoast. Draw up an action plan for the community to stop the pollution of the oceans. (5 Marks)

MARKING SCHEME

A1. Source and direction of flow of the North Atlantic Drift

Characteristic features of the current

The climatic impact: Moderating influence of the North Atlantic Drift

Economic impact: Ice free port of call

Fishing

Tourism throughout the year

A 2. Influence change in your community by discussing the points given below or any other relevant point.

Make safe and sustainable seafood choices

Avoid plastic products

Don't purchase items that exploit marine life

Support organizations working to protect oceans

Travel the ocean responsibly

Educate yourself and the community about oceans and marine life

OPEN TEXT BASED ASSESSMENT

GEOGRAPHY CLASS-XI

Theme–2: Ocean Resources

Abstract

Oceans which cover almost two-thirds of the earth's surface contain large number of resources, many of which are being used by humankind from early stages of evolution. Apart from these there are many ocean resources which are still unknown and untapped. The processes of development combined with advanced technology have propelled the exploration of the oceans in search of resources. The oceans provide us with large number of resources – from food to sustain our hunger, to different sources of energy to run our machines, from minerals to various biomedical organisms etc. Solutions to our various needs are being met by the resources from oceans and many believe that as resources on land are diminishing with time, humankind would become more dependent on ocean resources. However, these ocean resources are being heavily exploit has endangered the marine ecosystem. Therefore, for proper conservation of marine eco system and a better future, a call must be taken and addressed towards balanced use of air ocean resources.

Introduction

Our earth is a unique planet which is full of resources that support life. Earth is called the 'blue planet' because of the abundant supply of water – majority of which is found in the vast-oceans. If one looks at photographs of the earth taken from space, it looks like a 'blue marble'. The reason behind this is that oceans cover 71 percent of the earth's surface. The remaining of the earth's surface is covered by land masses. Oceans contain 97 percent of the earth's water. They merge naturally and have been divided into five major oceans - the Pacific, the Atlantic, the Indian, the Southern ocean and the Arctic. Both the land masses and the oceans are sources of vast natural resources. The resources available on the land have been comparatively more utilised than the ocean resources. Although people have been using the various ocean resources – food, energy, minerals, biomedical organisms etc., there are many that still remain untapped and moreover unknown. The oceans have also been used for transportation, recreation, waste disposal and many other activities by people for ages. Among the vast ocean resources, those which are used abundantly are explained in the following sections.

Figure 1: "The Blue Marble" is a famous photograph of the Earth taken on December 7, 1972, by the crew of the Apollo 17 spacecraft

Oil and Natural Gas

Two most sought after ocean resources are oil and natural gas embedded in the depth of ocean floors. Drilling oil from off-shore oil wells is complex and expensive compared to on–shore oil fields, but with rise in demand for oil and improved technology, off-shore oil exploration has increased. There are around 900 large-scale oil and gas platforms in the world. Around one third of the world's oil is pumped from deposits under the ocean floor .In United States, the first coastal oil rigs were constructed in the late 19thcentury. These offshore oil rigs stood in only a few metres of water. With time the offshore oil wells are being built in deeper waters. The water depth record for oil production is currently held by an international oil company which produces oil from a well, located in the Tobago field. It extracts oil from a depth of 2,934 metres below the surface of the Gulf of Mexico. Off-shore oil wells are massive platforms built near the oil deposits which house workers and necessary equipments required to pump out oil and natural gas from the sea floor. They are like artificial islands, built to withstand harsh weather conditions developing in the oceans like tides, storms etc. The most productive areas are the North Sea, the Gulf of Mexico, the Atlantic Ocean off Brazil and West Africa, the Arabian Gulf and the seas off South East Asia. Countries are trying to explore new oil reserves in the ocean floors and they are also drilling in deeper and deeper water. Many new oil reserves are being explored, for example in the South China Sea.

Figure 2: Offshore oil field

India has its own share of offshore oil fields. For example, the Bombay High or the Mumbai High and the Panna-Mukta oilfield on the Arabian Sea off the Mumbai coast.

Similar to oil, the consumption of natural gas is also increasing. At present, 28 per cent of global gas production takes place offshore. Important regions where offshore deposits of natural gas are found are the North Sea, the Gulf of Mexico, Australasia, Africa and the Commonwealth of Independent States (CIS) states. The highest off shore deposit of natural gas is in the Middle East, which harbours considerably more gas in the ocean floor than in its land-based reserves. The South Pars/North Dome field located on the Iranian border with Qatar in the Persian Gulf is considered the world's largest reserve of natural gas by the International Energy Agency (IEA), with an estimated 38 trillion cubic metres. North Sea is the most important gas-producing area. New extraction points are to be found off India and Bangladesh, Indonesia and Malaysia. Similar to oil exploration, countries are conducting drilling operations to find natural gas into greater water depths. The Cheyenne gas field in the Gulf of Mexico currently holds the record for producing natural gas from a depth of 2,700 metres. More and more offshore gas fields are being discovered. For example, between 2007 and 2012, major gas fields were discovered off the coast of Mozambique and Tanzania and in the Mediterranean region, close to Israel and Cyprus. Significant deposits have been discovered in the Santos Basin off the coast of Brazil. It holds several major oil and gas fields with as much as one billion tonnes of oil and a billion cubic metres of natural gas.

The insatiable hunger for energy in the form of oil and natural gas coupled with many shore and shallow water deposits getting exhausted, companies are increasingly foraying into deeper waters. Three separate categories have been defined on the basis of depths at which oil is produced -

- shallow water production :at depths of less than 400 metres;
- deep-water production :at depths up to around 1500metres, and
- ultra-deepwater production : at depths greater than1500 metres.

Technology has been a boon for the oil and natural gas sector. Equipped with latest high-resolution geophysical exploration technology, scientists can detect oil and gas deposits in the seabed and other geological strata to a depth of around 12,000 metres. Latest reports suggest that between 2007 and 2012 around 481 larger fields were found in deep and ultra-deep waters which account for more than 50 per cent of the newly discovered larger offshore fields. With onshore reserves nearing exhaustion, these deep and ultra-deep water fields are of utmost importance to meet the growing demands. However, the challenges for these deep and ultra-deep water oil fields are not only technological but also financial as the cost of drilling is directly proportional to depth of drilling, i.e., deeper the water, higher is the cost of drilling.

Figure 3: Floating Wind Turbine, approximately 5 km offshore of Póvoa de Varzim, Portugal

Renewable Energy Resources

Apart from these non-renewable energy resources, oceans provide massive renewable energy in the form of wind, waves, currents that have remained mostly untapped. The key renewable marine energies are wind energy, wave energy, tidal energy, ocean current energy, energy derived from temperature differences at various ocean depths (ocean thermal energy conversion – OTEC), energy derived from the different salt content of freshwater and saltwater (osmotic power) etc. However, technologies to tap and use these energies are in the nascent stages. Among these, wind energy is the most developed and widely used form of energy. Most of the offshore wind energy projects are found in the United Kingdom, Denmark, the Netherlands and Sweden. With dwindling reserve of fossil fuels and rise in demand for energy, countries are looking to use these renewable energies to meet their future energy needs. Moreover, renewable resources are better for the environment too as they are less polluting compared to non-renewable resources.

Food –Fish and Shell Fish

Similar to the lands, the oceans too have been a source of food in the form of fish and shellfish. The oceans are home to innumerable kinds of fish which are an important source of food for humans. Fishing is associated with humankind since the early stages of evolution. It is also an important contributor to the world economy. Livelihood of a large population around the world is dependent on this resource of the ocean and for some countries, fisheries have been the mainstay of their economy. Fishing has been the most important livelihood for the coastal population around the world. For statistical purposes required for any major industry, fishing areas (inland and marine) have been established internationally. There are 27 major fishing areas(inland and marine) out of which 19 are major marine fishing areas covering the waters of the Atlantic, Indian, Pacific and Southern Oceans, with their adjacent seas. An increase in the demand for sea food has expanded the fishing industry and created many supporting industries, thus generating more jobs and revenue for the respective countries. China is the top fish producing country followed by India which lies at a distant second place. Other major fish producing countries are Indonesia, US, Peru, Russia, Japan, Vietnam etc.

Table 1: Major Marine Fishing Areas

Major Marine Fishing Areas		
S. No.	**Fishing Area Code**	**Fishing Area**
1.	18	Arctic Sea
2.	21	Northwest Atlantic
3.	27	Northeast Atlantic
4.	31	Western Central Atlantic
5.	34	Eastern Central Atlantic
6.	37	Mediterranean and Black Sea
7.	41	Southwest Atlantic
8.	47	Southeast Atlantic
9.	48	Atlantic, Antarctic
10.	51	Western Indian Ocean
11.	57	Eastern Indian Ocean
12.	58	Indian Ocean, Antarctic and Southern

13.	61	Northwest Pacific
14.	67	Northeast Pacific
15.	71	Western Central Pacific
16.	77	Eastern Central Pacific
17.	81	Southwest Pacific
18.	87	Southeast Pacific
19.	88	Pacific, Antarctic

Source: CWP Handbook of Fishery Statistical Standards, FAO

Fishery is a very important economic activity in India. India has a long coastline of around 8,118km. Government data suggest that there are around 3,432 fishing villages in India (Table 2). Although producing way below its potential, there has been a significant growth in fish production in India. According to Food and Agriculture Organization of the United Nations (FOA) data, the fish production in India has increased from 0.75 million tonnes in 1950-51 to 9.6 million tonnes during 2012–13. The statistics from the Department of Animal Husbandry, Dairying and Fisheries, under the Ministry of Agriculture, Government of India, provided in Table 3 below shows the growth in total fish production in the last decade. The data shows the share of inland fish production and marine fish production in India's total fish production.

Table 2: Fishery Resources (Marine), India

Fishery Resources (Marine), India		
S. No.		
1.	Length of coast line (Km)	8,118
2.	Exclusive Economic Zone (EEZ) million Sq Km	2.02
3.	Continental Shelf ('000 sq km)	530
4.	Number of Fish Landing Centres	1,537
5.	No of Fishing villages	3,432
6.	No of fishermen families	8,74,749
7.	Fisher-folk population	40,56,213

Source: Department of Animal Husbandry, Dairying and Fisheries (DADF)

Table 3: Fish Production (2004-05 to 2013-14), India

Fish Production (2004-05 to 2013-14), India						
Year	Inland Fish Production		Marine Fish Production		Total Fish Production	
	Inland (lakh tonnes)	Growth rate (%)	Marine (lakh tonnes)	Growth rate (%)	Total production (lakh tonnes)	Growth rate (%)
2004-05	35.26	1.96	27.79	-5.53	63.05	-1.48
2005-06	37.56	6.52	28.16	1.33	65.72	4.23
2006-07	38.45	2.37	30.24	7.39	68.69	4.52
2007-08	42.07	9.41	29.20	-3.44	71.27	3.76
2008-09	46.38	10.24	29.78	1.99	76.16	6.87
2009-10	48.94	5.52	31.04	4.23	79.98	5.02
2010-11	49.81	1.78	32.50	4.70	82.31	2.91
2011-12	52.94	6.28	33.72	3.75	86.66	5.28
2012-13	57.19	8.03	33.20	-1.51	90.40	4.32
2013-14 (provisional)	61.36	7.28	34.43	3.68	95.79	5.96

Source: Department of Animal Husbandry, Dairying and Fisheries (DADF)

The growing demand for sea food has led to the development of aquaculture, which refers to the cultivation of aquatic organisms in controlled aquatic environments for any commercial, recreational or public purpose. Aquaculture is of two types – marine and freshwater. Growth of aquaculture has played a significant part in the increase of total fish production. However, on the flipside as aquaculture relies on intensive monoculture systems it has posed some ecological challenges too – habitat degradation, introduction of non-native species, spread of new diseases etc. Therefore, as aquaculture grows further, strategies to counter the challenges is required for sustainable development. The rapid growth in demand for sea food has led to problems associated with over-fishing. Exploitation in the form of excessive fishing and other abuses has resulted in decline of many highly prized marine fisheries around the world.

With time, the policymakers have understood the need to strictly regulate fishing for protecting the natural resources and preventing species from getting extinct. There are laws which require managers of fisheries to abide by the recommendations of scientists in establishing annual catch

limits that do not allow overfishing. Regulations like fishing licenses can limit access to these fisheries. Then there are comprehensive laws like the United Nations Convention on the Law of the Sea (UNCLOS) of 1982or the Law of the Sea Treaty, according to which nations can claim territorial rights to many important offshore fisheries. The agreement addresses a myriad of issues including navigational rights of ships and aircraft, limits on the extension of national sovereignty over the oceans, environmental protection of the oceans, conservation of living resources and mining rights. Besides regulating quantity of fishing and protecting individual species from extinction, environmentalists also suggest that eco-friendly methods of fishing should be encouraged as many fishing techniques like trawling, blast fishing have detrimental effect on the aquatic ecosystem. For example, in large areas of the Gulf of Maine, on the east coast of North America formerly productive ocean floor ecological communities have been reduced to virtual deserts by repeated trawling. In blast fishing, explosives are used to kill fish, which results in killing of a large number of marine organisms in the surrounding, like coral reefs, etc. Therefore, efforts from both policymakers and other stakeholders become necessary for the proper preservation of fisheries around the world.

Water

Earth is called the blue planet and the oceans contain around 97 percent of earth's water, still scarcity for drinking water exists. The reason is that salinity of ocean or sea water makes it unsuitable for drinking. However, with advancement in technology, in several places sea water is made suitable for drinking after proper desalination. Desalination isused on many ships and submarines too which go on voyage for long periods. Several countries where drinking water is a scarce resource are turning to desalination plants where sea water is converted to potable water. The Minjur Desalination Plant in Chennai is the largest desalination plant in India. However, this process of acquiring potable water is very costly and therefore is not a very viable option for the developing countries which face comparatively higher scarcity of water.Many developed countries like US, UK, Australia etc. are meeting their demand for water in regions where water scarcity exists through desalination plants. However, the day technology would be able to desalinate at a cost viable for developing countries, the oceans would be able to quench the thirst of humankind around the world.

Medicine

From ancient times, oceans and seas are believed to have medicinal powers to heal. Oceans are home to millions of plants, animals and bacterial strains and many among them have medicinal characteristics. Marine products have for centuries been an integral part of folk medicine all around the world. For example, sea salt has traditionally been used to treat skin diseases, and algae to treat parasitic worms. Marine organisms such as bacteria, corals and sea sponges contain thousands of interesting substances that could provide us with the medications of the future. Some substances are already being used as cancer drugs and painkillers. Medical research suggests that several marine creatures like Caribbean sponge, skates, corals, mollusks etc. have been successful in

treating diseases like aids, cancer, vision loss etc. There are others which are undergoing trials and would be used once successfully tested. However, the main challenge is locating them and then using them for producing medicines on a large scale. Advancement in technology in the future will help to extract more such medicinal substances from the ocean to treat our diseases.

Figure 4:Underwater Flora and Fauna

Marine Flora and Fauna

Marine ecosystems are home to a host of different species ranging from plank tonic organisms that form the base of the marine food web to large marine mammals. Many species depend on marine ecosystems for food as well as getting shelter from predators. The marine ecosystems are bearing the brunt of exploitation of its resources and therefore conservation on priority basis is required, otherwise large scale permanent damage would take place. Effective conservation can take place with government initiatives like policy making, regulation, public awareness etc. along with public support. Altering the marine ecosystem would result in extinction of large number of marine species. Similar to protection of forest areas, marine parks which contain various species of flora and fauna also need to be conserved. Illegal extraction of corals and sands endanger the fragile marine ecosystems. The first national marine park of India is in Gujarat – the Marine National Park in the Gulf of Kutch. Another national marine park is in the Gulf of Mannar, off the coast of Tamil Nadu, in the Indian Ocean. It is one of the richest marine regions in terms of marine biodiversity. The area boosts of being home to all the mangrove species found in India. It hosts 147 species of sea weeds and 11 types of sea-grass. This provides ample grazing ground for the sea cow known as Dugong dugong. Other marine creatures found here are dolphins, sea horse, turtles etc. The marine ecosystem of Gulf of Mannar contains around 3,600 species of plants and animals. The Indian government has taken up the work of conserving this highly diverse marine ecosystem.

Consequences of Exploitation

Any resource if overused will have detrimental effects on it. Therefore, it becomes our duty for proper protection and conservation of the natural resources. Many experts believe that the ultra-deep off shore oil fields are the final bastion of oil and natural gas, thus it requires proper planning for their utilisation and strategies to shift from non-renewable to renewable sources of energy. Oceans provide us a plethora of resources, some of which are well known and over-utilised and some which are known to few and are being utilised without considering the environmental effects. It is not only the duty of governments and international bodies to limit this exploitation but requires active public participation and proper implementation of the laws and regulations for effective conservation and utilization of the marine resources.

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SAMPLE QUESTIONS

Q1. From the table given below, mention the year that recorded the lowest growth in total fish production and what is the lowest growth rate? In which year, the share of marine production

in total fish production was the highest and by how much? What are the reasons for variations in fish production? (5 Marks)

Fish Production (2005-06 to 2012-13)					
Year	Inland Fish Production		Marine Fish Production		Total Fish Production
	Inland (lakh tonnes)	Growth rate (%)	Marine (lakh tonnes)	Growth rate (%)	Total production (lakh tonnes)
2005-06	37.56	6.52	28.16	1.33	65.72
2006-07	38.45	2.37	30.24	7.39	68.69
2007-08	42.07	9.41	29.20	-3.44	71.27
2008-09	46.38	10.24	29.78	1.99	76.16
2009-10	48.94	5.52	31.04	4.23	79.98
2010-11	49.81	1.78	32.50	4.70	82.31
2011-12	52.94	6.28	33.72	3.75	86.66
2012-13	57.19	8.03	33.20	-1.51	90.40

Q2. In the figure given below identify which form of energy is being generated and what are the benefits/drawbacks in generating such type of energy? (5 Marks)

MARKING SCHEME

1. The lowest growth in total fish production was recorded in 2010-11 and the growth rate was 2.91 percent (lowest). 2006-07 recorded the highest share of marine production in total fish production i.e., 44.02 percent.

   Reasons for variation in fish production.

2. The figure is that of floating wind turbine generating wind energy in the ocean. The benefits and drawbacks of generating wind energy are given below:

   Benefits: Generating renewable energy is less polluting and less harmful to the environment. Since wind energy is a renewable form of energy therefore, there is no issue of depleting resources.

   Drawbacks: Cost of producing energy is high. The technology for generating at large scale is in development stage.

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