**Module one questions**

1. Explain why there is so much opposition to large dams

Brutal attempt to control nature with raw force displays lack of respect for free flowing rivers causing fragmented ecosystems and subversion of River’s physical, chemical and biological balance. Changes in air moisture, air temperature and air movement due to the presence of large water body mass, introduces a new microclimate which can easily threaten the very existence of original ecosystems. Reproduction of migratory aquatic life like fishes for instance is curtailed during excavation works which destroys fishes’ egg beds (Esguícero & Arcifa, 2010).

The disregard for lives of local citizens displaced by the reservoir is insensitive to human dignity. Whereas there might be some developmental importance with the construction of dams, some people find it uncomfortable to easily give up their agricultural lands, houses and the environment they’re used to. An example is when L. Ghana was created in 1969. As much as alternative was provided for about 80,000 people, they later came back as 100, 000 people and haphazardly occupied the shores of the lake because of their attachment to their initial homes. Such experiences can be treacherous to the Biosystems and the constructed reservoir (Tahmiscioğlu, Anul, Ekmekçi, & Durmuş, 2007). Similarly, people will resist any proposed idea that threaten to submerge their historical or culturally sacred sites under a mass of water. Indigenous people from North America and most African countries for example have very strong linkage to their worship and ancestral burial grounds.

There is also the risk of site injuries and health hazards of dam workers during construction or even fatalities of people downstream as a result of miscalculated engineering works. In a study by Colvin *et. al.,* (1998), 92% and 5.4% of 258 workers developed noise induced hearing loss and pneumoconiosis complications during construction of Lesotho Highlands Dam and Tunnel Construction. International Commission of Large Dams (ICOLD) Bulletin No. 73 of 1989 cited by Asikoglu & Kale, (2017) however, indicated that fatal risks are higher during dam construction than the risk of the dam failing.

1. Briefly but in details explain benefits of large dams

**Water supply and irrigation:** According to international commission on large dams, about 277 million hectares of land constituting 18% of world’s arable land is under irrigation contributing 40% of total crop output and employs approximately 30% of rural populations. It is further estimated that by the year 2025, 80% of addition food would originate from irrigated lands.

**Flood control:** Dams and reservoirs can be effectively used to regulate river levels and flooding downstream of the dam by temporarily storing the flood volume and releasing it later. Crops, properties and economic losses often experienced in flood prone areas are therefore averted.

**Hydro power:** Falling water power can be used to drive turbines that generate electricity. Currently, hydroelectric power plants in the world according to ICOLD have a combined capacity of 675,000 megawatts, energy equivalent to 3.6 billion barrels of oil. The hydro plants produces over 2.3 trillion kilowatt-hours of electricity each year and supplies 24% percent of the world’s electricity (Bonsor, 1998). Some of the globally notable examples of hydro power generating dams include Three Gorges in China, Itaipu in Brazil & Paraguay, Grand Coulee in USA, Guri in Venezuela among others.

**Inland Navigation:** Dams convert flowing shallow water to still, deep water, which can allow ships and badges to more easily move up and down the river systems. This mode of transportation is more advantageous to road or rail because of its more load capacity, larger dimensions and low fuel costs.

**Recreation:** This is a secondary benefit associated with dam creation. Activities such as boating, skiing, picnicking, recreational fishing, canoeing, tourism and camping emerge, boosting the economy of that region due to presence of large water body .

**Fishing:** This is also a secondary purpose. Some reservoirs are used for fisheries or aquaculture. According to Kenya Marine and Fisheries research institute, riverine, dams and small lakes fisheries contribute about 2% of Kenya’s fish landings.

1. Other than the ways discussed above, briefly discuss any technologies through which people access water in cities and rural areas

**Water tankers supplies:**

These are trucks fitted with cisterns that can hold varying volumes of water depending on truck size. They are commonly spotted in suburban, rural areas and even major cities experiencing frequent and prolonged water shortages or not served by a piped supply. The trucks transport and distribute water from source points such as rivers, canals, reservoirs, or groundwater sources to the point of use at a fee. The transported water may then be pumped into an underground storage or dispensed directly into household or other containers.

A 2017 global water leaders’ group report records that approximately 100 million people around the globe depend on tankers to supply them water for domestic use. Water tank business in Chennai in India for instance was propelled by wells drying up and lack of reliable piped water supply (Srinivasan *et.al.*, 2010)

**Pipelines**

Water may be conveyed settlements through pipelines either by gravity or by pumping. Whereas gravity flow is the cheapest option, it can only be installed when the source is at a higher point than the supply destination. Pumping on the other hand is significantly more expensive to construct, operate and maintain.

1. Is there a significant difference between water quality in shallow wells and boreholes? Justify your answer with a detailed explanation.

Indeed there’s significant difference in quality between shallow wells and boreholes water. Boreholes which is a deep underground source is of better quality in terms of bacteria and suspended solids due to minimal contamination possibilities compared to wells. This fact is supported by Oko *et.al.,* (2014), Bennett, *et.al.,* (2010), Escamilla *et al.,* (2011) and Wu *et al.,* (2011) in studies undertaken in Nigeria, Cambodia and Bangladesh.

1. Explain the frequency of testing wells and what is your opinion if you found bacteria in your well?

Centers for disease control and prevention recommends testing of wells once each year. Coliform bacteria, nitrates, total dissolved solids, and pH levels are contaminates to look out for in your test, or any other suspected contaminants like volatile organic compounds.

Prior measures like extending well shaft above ground surface to prevent surface water from running down into the well must first be undertaken to avoid contamination of well water. If contamination has however already occurred, there are a number of affordable options that can be undertaken to disinfect the water. They include nonstop chlorination, UV treatment of drawn water, boiling and pasteurization. Whereas each of these methods has their pros and cons, they’re all intended at making water safe for drinking. It is however imperative that water wells be sealed and protected from the sources of bacterial contamination for absolute disinfection to take place using any of the above methods.

1. Discuss any diseases related to mismanagement of water and how the same affects the economy of the country in question

Globally, millions of people die as a result of mismanaging water at the source, during conveyance or at the point of use. The consequence of this is contamination and breakout of waterborne diseases such as:

1. **Diarrhea:** One is said to suffer from diarrhea when loose, watery stools occurring more than three times a day is experienced with an acute condition lasting for about 2 to 3 days. The diseases is caused by a host of bacterial, viral and parasitic organisms most of which are spread by contaminated water. According to the World Health Organization WHO (2000), the disease causes death of 2.2 million people annually, majority being children under 5 years especially in developing countries.
2. **Typhoid fever:** This is a life threatening diseasecontracted byingesting *Salmonella Typhi* bacteria by means of drinking water or eating food prepared from water contaminated with sewage. The bacteria has capacity of proliferating in the bloodstream causing high fever, stomach pains, headache, extreme fatigue, joint pain and loss of appetite.
3. **Cholera:** The disease is caused by bacterium *Vibrio Cholerae* that causes infections in the intestines and is equally associated with water and street foods contaminated with fecal matter. Advanced symptoms of the disease include watery diarrhea and vomiting. Without urgent treatment, the victim will die of dehydration due to rapid loss of body fluids.
4. **Dysentery:** It’s caused by either bacteria or protozoa which inflames the intestines causing acute stomach pain and bloody diarrhea. Compromised intestinal linings can allow infection and entry of pathogens into the bloodstream.

**Economic effects of waterborne diseases**

Waterborne diseases resulting from mismanagement of water as well as poor sanitation and hygiene can undoubtedly have serious economic consequences either directly or indirectly. It ranges from missed school days, cost of treatment, opportunity cost of time in seeking treatment and draining of household income due to additional costs of say, hauling or buying clean water. To underscore how grievous this can be, Ailes *et al.*, (2013) in a study on Salmonella outbreak that occurred in Alamosa, Colorado in 1998 established that a cost of $2.6 million was incurred. This was inclusive of outbreak response costs to local, state and nongovernmental agencies and City of Alamosa healthcare facilities and schools.

1. Explain the sources of surface water and how the concerned authorities are safeguarding the same

World Health Organization describe surface water sources as those found above ground and originates mostly from rainfall and is a mixture of surface run-off and ground water. Many bulk supplies of surface water are drawn from rivers, streams, springs, lakes and surface reservoirs like dams, ponds and pans.

To safeguard surface water sources, water authorities may take control or manage the catchment from which the water runs off to ensure good quality portable water and to safe guard the run off volume. Catchment management may extend to control of abstractions from streams or the ground although there may be legal problems associated with abstraction from rivers because water may be owned by the state or riparian landowners.

1. Explain the characteristics of good rainwater harvesting system

* Roofing materials should be iron sheets, asbestos cement or tiles that are corrugated to enable water collection.
* Gutters and down pipes must correctly be attached to the storage tank
* The inlet to the storage tank should be protected with gauze screen to keep out leaves, dirt, mosquitoes and other rodents from getting access to the tank.
* When it rains for the first time after a period of drought, the water should be used to clean the tanks and if the tanks have some water, then it shouldn’t be allowed to contact the already stored water. This is because the iron sheets would have accumulated a lot of dust which would be carrying pathogens which may render the water unsafe.
* Some form of purification and disinfection is necessary, especially if the rainwater is stored for a long time.

1. What steps should the state or the water management authorities put in place to promote use of and harvesting of rainwater.

During rainy seasons, water fills up streams and rivers causing floods and even landslides. The state or water management authorities can harvest the water in dams and be used to grow grass under irrigation and water animals during dry seasons thus in the long run, raising the GDP of the country.

1. What is your take on recycling used water and the repugnancy associated with it?

Whereas the global demand for fresh water is ever increasing due to growing populations and industrial demands, the commodity is a limited resource and must be used economically. Furthermore, discharging industrial effluents into the water sources additionally compromises availability, causing more unnecessary scarcity.

It is for this reason that water recycling is a necessary intervening concept of conserving this resource in addition to preventing contamination of other clean sources through containment of discharged effluents. Most people may however find drinking recycled water distasteful, but recycled water can be beneficial in other purposes such as farming, irrigation of lawns, industrial use, bathroom uses and replenishing ground water (ground water recharge). This idea is not only a conservation approach, but also financially saving. It’s important to note that treatment of wastewater can be customized to meet quality standards of desired or planned reuse. An understanding of quality requirements for various water uses therefore, is the first step towards making intentional and planned waste water reuse, and it’s an idea that should be encouraged and supported at all times.

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