Institute For Christian Teaching
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WATER SUPPLY, ENVIRONMENTAL HYGIENE AND HEALTH

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INTRODUCTION

Water is a resource that is essential for life; without water there is no life. God made the firmament or heaven from the midst of waters (Genesis 1:6-8). He also made the earth by gathering together into one place the waters under the heavens. "The gathering together of the waters He called seas." And God saw that it was good (Genesis 1:10). On the fifth day, God created all water creatures (Genesis 1:20-23). In Genesis 1:26, God gave man permission to have dominion over all He created. Unfortunately, humanity fell into sin through disobedience in the garden of Eden, and the state of perfection was lost. Adam's transgression of eating of the tree of the knowledge of good and evil, opened the flood gates of woe upon our world. Today, inadequate water supply in terms of quantity and quality is a global problem. The World Health Organization's figures for 1988 showed that among the urban population of the developing countries, only about 65% have house water connection and an additional 20% have access to public taps; about half of these supplies are intermittent[1]. Of the rural population, only about 60% have access to safe water, and few of these have house connections. Overall, 32% of the people in developing countries lack adequate water supply. The statistics based on the estimates of the International Water Supply and Sanitation Decade indicate that over 1.2 billion people still suffer from poor water supply[2].

In Nigeria, it is estimated that only 48% of the inhabitants of the urban and semi-urban areas, and 39% of rural areas have access to potable water supply[3]. Without abundant water in or near the home, hygiene becomes difficult or impossible, and this eventually may lead to infection or ill-health. Good quality water is an indispensable substance for a healthy body.

Purpose of Study

The purpose of this essay is to examine the biblical basis in support of adequate use of water as a special resource from God, and the importance of hygiene and sanitation in the transmission of water and hygiene - related diseases. The essay will serve as an example to health science teachers on how to approach their subjects from the Christian world view, and thus integrate faith and learning. Such integration will ensure that students, under their influence will be able to freely internalize biblical values and a view of knowledge, life and destiny that is Christ centered, service oriented, and eternity directed.

Water, Indispensable to Life

Water is the most universal solvent on earth; every function of life is carried out in a water medium. The ability of water to dissolve mineral salts insures that vegetation and microorganisms will have a source of assimilable nutrients, without which complex life on earth would be impossible. Respiration, digestion, glandular secretion, temperature regulation,

sufficient blood volume to maintain circulation, excretion of wastes, and virtually every body activity depends on an adequate supply of water.

Water acts as a lubricant, helps protect tissues from external injury, and gives flexibility to muscles, tendons, cartilage and bones. The body of an average sized man contains about 40 litres of water, which is 50% to 70% of the body weight depending on the amount of fat it contains. The grey matter of the brain is 85% water.

Water is one of God's great gifts. According to White[4], "in health and in sickness, pure water is one of heaven's choicest blessings. Its proper use promotes health. It is the beverage which God provided to quench the thirst of animals and man. Drunk freely, it helps to supply the necessities of the system and assists nature to resist disease. The external application of water is one of the easiest and most satisfactory ways of regulating the circulation of the blood. A cold or cool bath is an excellent tonic. Warm baths open the pores and thus aid in the elimination of impurities. Both warm and neutral baths soothe the nerves and equalize the circulation."

Paul appeals to us in 1Corinthians 10:31 to drink "to the glory of God" and this injunction reinforces the first angel's message of Revelation 14:7, "Fear God and give glory to him." Ideally, the body maintains a balance between the amount of water lost each day and the amount taken in for replacement. Dehydration results in fatigue, which leads to exhaustion, fever, decreased alertness, mental depression, irritability, coma and death in extreme cases. The body requires 6 – 8 glasses of water per day.

DEFINITION OF HEALTH AND ENVIRONMENTAL HYGIENE

Health

The World Health Organization[5] defines health as a state of complete physical, social, and mental well-being, and not merely the absence of disease and infirmity. The above definition should include spiritual well-being because man is a spiritual being – "God created man in His own image" (Genesis 1:27). The religion of the Bible is not detrimental to the health of the body or of the mind. "Heaven is all health and the more deeply the heavenly influences are realized, the more sure will be the recovery of the believing invalid"[6]. Satan is the originator of disease and following Satan's way and disobeying God's laws, leads to disease and death while following God's way leads to life and health. A truly healthy person from the Biblical perspective is one who is physically well, mentally alert, socially concerned and spiritually committed. This is God's ideal for us, as stated in 3 John 2, "Beloved, I pray that you may prosper in all things and be in health, just as your soul prospers." "A pure, healthy life is most favourable for the perfection of Christian character and for the development of the powers of mind and body. The harmonious, healthy action of all the powers of body and mind results in happiness; the more elevated and refined the powers, the more pure and unalloyed the happiness"[7]. Pragmatic studies have shown that an active religious/spiritual life is associated with better health and decreased morbidity[8].

Environmental Hygiene

The environment is an epidemiological term that refers to the surroundings, which may be described as physical, biological and socio-economic. Physical or inanimate environment includes geologic, geographic or climatic features; animate or biological includes trees, grasses, flowers, animals as well as pathogenic parasites; and socio-economic environment is comprised of a variety of elements, including the relationship of people to other people"[9].
Hygiene is the science of health, its preservation and the prevention of disease, the practice of measures designed to attain and preserve health.

Environmental hygiene could therefore be defined as the science of health in relation to the surrounding, the prevention of disease and the practice of measures designed to attain and preserve health. In addition to the fundamental role that hygiene plays in the prevention of diseases, it also creates order and beauty and demonstrates respect for social morality[10].

WATER AND HYGIENE RELATED DISEASES

It has been estimated that as many as 80% of all diseases in the world are associated with unsafe water or poor environmental hygiene[11]. Most infectious, diseases are caused by living organisms, such as bacteria, viruses, or parasitic worms, and a disease is transmitted by the passing of these organisms from one person's body to another or through intermediate hosts. Four distinct types of water-related diseases are recognized as follows: water-borne diseases, water-washed or water-scarce diseases, water-based diseases and water-related insect vectors.

Water-borne and water-washed diseases are mostly faecal-oral in nature; in fact, all the faecal-oral infections can be transmitted by both water-borne and water-washed routes, as shown in Table 1. A faecal-oral disease is any disease which is transmitted by the pathogen passed out in the faeces of an infected person and subsequently ingested by a new host. Table 1 lists the major water-related infections and assigns them to their category in addition to linking them to the type of organism which causes them. The second category of infections in Table 1 are exclusively water-washed; that is, the skin and eye infections plus diseases which are associated with lice. Each water-related infection can then be assigned to one of the following four categories: faecal-oral, water-washed, water-based and insect-vectored.

Faecal-oral transmission can follow a number of routes as shown in the 'F-diagram' of Wagner and Lanoix[12] {Figure 1}. Water and sanitation affect transmission in a variety of ways. Sanitation, defined as 'the safe management of human excreta' naturally has its greatest impact on excreta-related diseases. The World Bank reports that 30% of the total disease burden in developing countries results from contamination at the household level and that 75% of life years lost within this 30% are due to lack of good water supply and sanitation and the prevalence of risky hygiene behaviour[13].

The finding of the World Bank[13] on the linkage between lack of good water supply and sanitation, and risky hygiene behaviour had been expressed earlier by God during the Old Testament times. In the teaching that God gave to Israel, the preservation of health received careful attention. The people who had come from slavery with the unclean and unhealthful habits which it engenders, were subjected to the strictest training in the wilderness before entering Canaan. Health principles were taught and sanitary laws enforced (Leviticus 12 – 14). Not only in their religious service, but in all the affairs of daily life was observed the distinction

between clean and unclean (Leviticus 11 – 15). All who came in contact with contagious or contaminating disease were isolated from the encampment, and they were not permitted to return without thorough cleansing of both the person and clothing (Leviticus 13 & 14). The necessity of personal cleanliness was taught in the most impressive manner. Before gathering at Mount Sinai to listen to the proclamation of the law by the voice of God, the people were required to

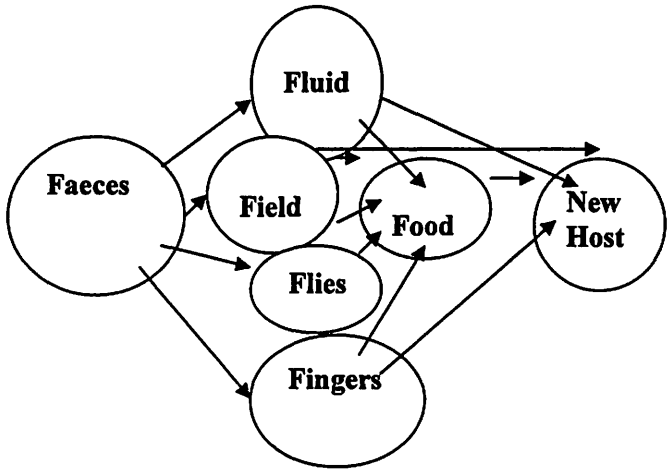
Table 1: Environmental Classification of Water-related Infections

Category		Infection	Pathogenic agent
1	Faecal-oral	Diarrhoeas, dysenteries	
	(water-borne or water-washed)	Amoebic dysentery	P
		Balantidiasis	P
		Campylobacter entritis	B
		Cholera	B
		Cryptosporidiosis	P
		E. coli diarrhoea	B
		Giardiasis	P
		Rotavirus diarrhoea	V
		Salmonellosis	B
		Shigellosis (bacillary dysentery)	B
		Yersiniosis	B
		Enteric fevers	
		Typhoid	B
		Paratyphoid	B
		Poliomyelitis	V
		Hepatitis A	V
		Leptospirosis	S
2	Water-washed:		
	(a) skin and eye infections	Infectious skin disease	M
		Infectious eye diseases	M
	(b) other		
		Louse-borne typhus	R
		Louse-borne relapsing fever	S
3	Water-based:	Schistosomiasis	H
	(a)penetrating skin	Guinea worm	H
	(b) ingested	Clonorchiasis	H
		Diphyllobothriasis	H
		Fasciolopsiasis	H
		Paragonimiasis	H
		Others	H
4	Water-related insect vector		
	(a) biting near water	Sleeping sickness	P
	(b) breeding in water	Filariasis	H
		Malaria	P
		River blindness	H
		Mosquito-borne viruses	
		Yellow fever	V
		Dengue	V
		Others	V

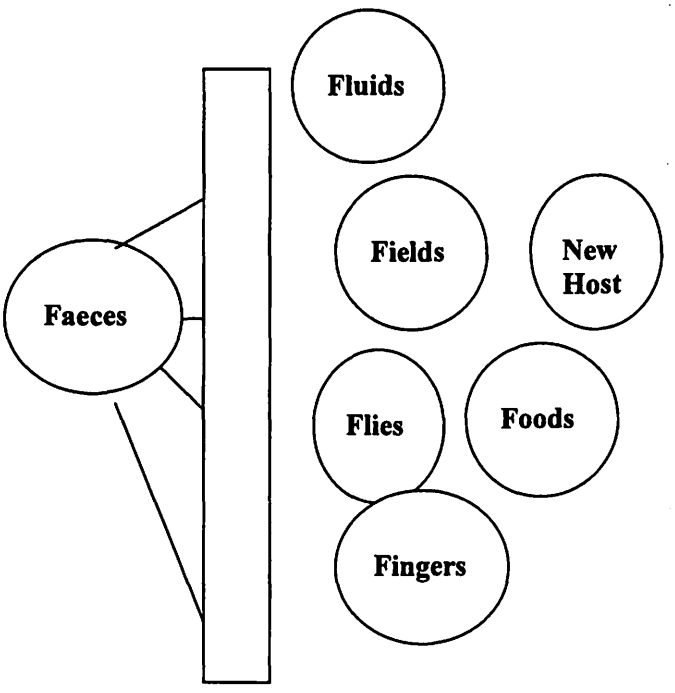
B= Bacterium	M = Miscellaneous
R= Rickettsia	H = Helminth
S= Spirochaete	V = Virus
P= Protozoon	

Source: Caincross and Feachem, 1999[14]

FIGURE 1: DISEASE TRANSMISSION ROUTES



This is the famous F-diagram which shows the different routes that diseases take from faeces, through the environment, to a new person. If we can prevent faeces from getting into the environment, then we do not have to worry so much about boiling drinking water, storing food correctly or keeping away flies.



That is why our first priorities should be:

- Safe disposal of human excreta
- Effective hand-washing at critical times
- Protection of drinking water from contamination

Source: "Hygienic, Happy and Healthy" (1998)[15]
(Adapted from Wagner and Lanoix (1958)

wash both their persons and their clothing, as stated in Exodus 19: 10 & 11, "And the Lord said to Moses, "Go to the people and consecrate them today and tomorrow. Have them wash their clothes and be ready by the third day, because on that day the Lord will come down on Mount Sinai in the sight of all the people." The directive was enforced on pain of death. No impurity was to be tolerated in the presence of God.

Furthermore, during the sojourn in the wilderness, the Israelites were almost continually in the open air, where impurities would have less harmful effect than upon the dwellers in close houses. But the strictest regard to cleanliness was required both within and without their tents. No refuse was allowed to remain within or about the encampment, for the Lord said, "The Lord thy God walketh in the midst of thy camp to deliver thee, and to give up thine enemies before thee; therefore shall thy camp be holy." (Deuteronomy 23:14). If as a people, the Isrealites had lived according to God's plan, they would have been preserved from the diseases that afflicted other nations (Exodus 15: 26). According to White[16], "disease never comes without a cause. The way is first prepared and disease invited by disregarding the laws of health". "Sickness is caused by a violation of the laws of health"[17]. "There is a divinely appointed connection between sin and disease – sin and disease bear to each other the relationship of cause and effect"[18]. However, in Christ teaching, a disease can occur without sin. In John 9: 1 & 2, the disciples asked Jesus whether the occurrence of congenital blindness was due to sin, "As He went along, He saw a man blind from birth. His disciples asked Him, "Rabbi, who sinned, this man or his parents, that he was born blind?". Jesus answered the question in John 9: 3, "Neither this man nor his parents sinned," "but this happened so that the work of God might be displayed in his life." There are similar cases in the world today, when infected HIV/AIDS patients give birth to children with congenital HIV or any other diseases. This shows that human beings may not have all answers to the cause of diseases, although it is well known that pathogens are responsible for most animal diseases including man. Health situations that are not clear to and understood by man are very plain in the sight of God, for "He is our God and Creator".

Water-borne diseases

In water borne diseases, the pathogen enters the body through contaminated drinking water, or through food which has been contaminated via water; the contamination is from human or animal origin. Potentially water-borne diseases include cholera, typhoid, diarrhoeas, hepatitis and dysenteries. All water-borne diseases can also be transmitted by any route which permits faecal material to pass into the mouth, that is, faecal-oral route. Thus, cholera may be spread by various faecal-oral routes such as via contaminated food. Faecal-oral diseases are always dependent on the level of sanitation and waste disposal.

Water-washed diseases

A water-washed disease can be defined as one whose transmission will be reduced following an increase in the volume of water used for hygienic purposes, irrespective of the quality of that water. That is, water-washed diseases are due to lack of water. When people use very little water, either because there is little available or because it is too far away to be brought home in sufficient quantities, it is extremely difficult to maintain a reasonable personal as well as household and environmental hygiene. The importance of water quality may remain marginal if the general household hygiene is very poor. Water washed diseases include most of the faecal-

oral diseases listed as water-borne because many of them may also be transmitted by food, hand-to-mouth contact, and other means which may be affected by washing. Other water-washed diseases include various skin and eye infections which are heavily influenced by availability of water for washing.

Water-based or Water-contact diseases

A water-based disease is one whose pathogen spends a part of its life-cycle in a water snail or other aquatic animal. Water-based diseases are due to infection by parasitic worms (helminths) which depend on aquatic intermediate hosts to complete their life cycles. The most important water-based disease is schistosomiasis in which water, contaminated by excreta, contain aquatic snails (*Biomphalaria*; *Bulinus*) in which the schistosome worms develop until they are shed into the water as infective cercariae and re-infect man through his skin. Another water-based disease is guinea worm (*Dracunculus medinensis*), found in most of West Africa, the only parasitic infection which is exclusively transmitted in drinking water. The other diseases in this category are acquired by eating insufficiently cooked fish, crabs, crayfish or aquatic vegetation; they are clearly unrelated to water but they may be affected by excreta disposal. Many skin, eye, ear, nose and throat diseases may be acquired through water contact.

Water-related insect vector diseases

Malaria, yellow fever, dengue and onchocerciasis (river blindness) are transmitted by insects which breed in water while West African sleeping sickness is transmitted by the riverine tse-tsefly (*Glossina* sp) which bites near water.

PREVENTION AND CONTROL OF WATER-AND HYGIENE-RELATED DISEASES.

The Bible states in 1Corinthians 6:19, 20, "What? Know ye not that your body is the temple of the Holy Ghost which is in you, which ye have of God, and ye are not your own? For ye are bought with a price; therefore glorify God in your body, and in your spirit, which are God's." God requires us to keep our bodies in the best possible condition physically and spiritually. The sacred temple of the body must be kept pure and uncontaminated, that God's Holy Spirit may dwell therein. We need to guard faithfully the Lord's property, for any abuse of our powers shortens the time that our lives could be used for the glory of God.
According to White[19], "a great amount of suffering might be saved if all would labor to prevent disease, by strictly obeying the laws of health. Strict habits of cleanliness should be observed." In addition, White[20] reported that, "when Lord Palmerston, premier of England, was petitioned by the Scottish clergy to appoint a day of fasting and prayer to avert cholera, he replied, "clean and disinfect your streets and houses, promote cleanliness and health among the poor, and see that they are plentifully supplied with good food and raiment, and employ right sanitary measures generally, and you will have no occasion to fast and pray. Nor will the Lord hear your prayers while these, his preventives, remain unheeded."

The preventive strategies for water-related infections are summarized in Tables 2 and 3. Improvement of water supply, sanitation, sewerage and waste disposal are among the most efficient means of controlling environmental health hazards together with measures in

Table 2: PREVENTIVE STRATEGIES FOR WATER-RELATED INFECTIONS

Transmission route	Preventive strategies
Water-borne	Improve quality of drinking water Prevent casual use of unprotected sources
Water-washed (or water-scarce)	Increase water quantity used Improve accessibility and reliability of domestic water supply Improve hygiene
Water-based	Reduced need for contact with infected water1 Control snail populations1 Reduced contamination of surface waters2
Water-related Insect vector	Improve surface water management Destroy breeding sites of insects Reduced need to visit breeding sites Use mosquito netting

1Applies to schistosomiasis only

2The preventive strategies appropriate to the water-based worms depend on the precise life-cycle of each and this is the only general prescription that can be given.

Source: Caincross and Feachem, 1999

Table 3: Environmental Classification of excreta-related infections

Category		Infection	Pathogenic agent	Dominant transmission	Major control measures (engineering measure in italics)
1	Facial-oral (non-bacterial) Non-latent, Low infectious dose	Poliomyelitis Hepatitis A Rotavirus diarrhea Amoebic dysentery Giardiasis Balantidiasis Enterobiasis Hymenolepiasis	V V V P P P H H	Person to person contact Domestic contamination	Domestic water supply Improved housing Provision of toilets Health education
2	Faecal-oral (bacterial) Non-latent, Medium or high infectious dose, moderate persistent and able to multiply	Diarrheas and dysenteries *Camylobacter* enteritis Cholera *E.coli* diarrhea Salmonellosis Shigellosis Yersiniosis Enteric fevers Typhoid Paratyphoid	 B B B B B B B	Person to person contact Ground contamination Water contamination Crop contamination	Domestic water supply Improved housing Provision of toilets Excreta treatment prior to re-use or discharge Health Education
3	Soil transmitted helminthes Latent and persistent with no intermediate host	Ascariasis (roundworm) Trichuriasis (whimpworm) Hookworm Strongyloidiasis	H H H H	Yard contamination Domestic contamination Crop contamination	Provision of toilets with clean floors Excreta treatment prior to land application
4	Beef and pork Tapeworm Latent and persitent with cow or pig intermediate host	Taeniasis	H	Yard contamination Field contamination Fodder contamination	Cooking and meat inspection
5	Water-based helminths Latent and persistent with aquatic intermediate host(s)	Schistosomiasis Clonorchiasis Diphyllobothriasis Fasciolopsiasis Paragonimasis	H H H H H	Water contamination	Provision of toilets Excreta treatment prior to discharge Control of animal harbouring infection Cooking
6	Excreta-related insect vectors	Filariasis (transmitted by Culex pipiens mosquitoes) Infections in Categories I-V, Especially I and II, which may be transmitted by flies and cockroaches	H M	Insects breed in various faecally contaminated sites	Identification and elimination of potential breeding sites Use of mosquito netting

B= Bacterium V= Virus
H= Helminth M= Miscellaneous
P= Protozoon

Source: Caincross and Feachem, 1999

controlling use of chemicals and improvement of hygiene practices[21]. All of the transmission routes shown in the F-diagram (Figure 1) can be blocked by changes in domestic hygiene practice. Improved infrastructure, such as water and excreta disposal facilities, can also contribute to preventing transmission. However, public infrastructure can only be fully effective if employed in conjunction with safe hygiene practices in the home[22].

Figure 1 allows a distinction to be made between primary and secondary measures to prevent the spread of pathogens in the environment[23]. The four arrows originating from excreta on the left represent the primary routes by which infectious organisms get into the environment. Primary barriers are the practices that stop this happening and these include the disposal of stools in such a way that they are isolated from all future human contact (by the use of latrines, sewers, burying, etc.) and the removal of traces of faecal material from hands after contact with excreta. Secondary barriers are hygiene practices that stop faecal pathogens that have got into the environment in stools, or on hands, from multiplying and reaching new hosts. Secondary barriers thus include washing hands before preparing food or eating, and preparing, cooking, storing and re-heating food in such a way as to avoid pathogen survival and multiplication. They also include protecting water supplies from faecal contaminants and water treatments such as boiling or chlorination. Other secondary barriers include keeping play spaces free of faecal material, preventing children from eating earth, and controlling flies.

PRACTICAL APPLICATION

The knowledge of water supply, environmental hygiene and health is very relevant as part of the curriculum in Public Health Education, Microbiology, Nursing and Medicine. The theoretical and practical knowledge of water, sanitation and hygiene are of relevance in the above named disciplines. The practical aspect may be undertaken in the form of a community development project, around the institutions of higher learning and in distant communities too. Objectives of such water supply, environmental hygiene and health development project are as follows:

- To assess community needs in relation to water supply, environmental hygiene and health.
- To develop a joint plan of action with the government, non-governmental organizations (NGOs), and community members for the supply of water and promotion of environmental hygiene and health.
- To promote the adoption of safe hygienic practices within the project communities in order to limit the occurrence and effects of water and sanitation related diseases.
- To assist in empowering the communities for behavioural changes through participatory approaches.
- To establish a powerful network with international organizations working on water, the environment and health in order to provide technical assistance for the project, especially as regards training of trainers.

Procedure for the Project.

Establishment of a joint planning committee including all the stakeholders and community members is very necessary for the project. This is important in order to have active participation and a sense of ownership of the project; such multisectoral committee will enhance the

sustainability of the programme. Suggeted composition of the planning committee are as shown Figure 2.

FIGURE 2 COMPOSITION OF WATER, HYGIENE & HEALTH PLANNING COMMITTEE

NGOs	COMMUNITY	PRIVATE FIRMS
-health providers -others	-class -gender -age -location	-health providers -others

GOVERNMENT	ADVENTIST COLLEGE/ UNIVERSITY	ADVENTIST CHURCH
-Politicians -Health Ministries	-Dept of Public Health -Dept of Microbiology -Dept of Nursing -Dept of Medicine	-Dept of Health & Temperance -Dept of Women's Ministries -Dept of Youth Ministries -Dept of Men's Ministries -Adventist Health Services

EXTERNAL DONORS
-ADRA
-USAID

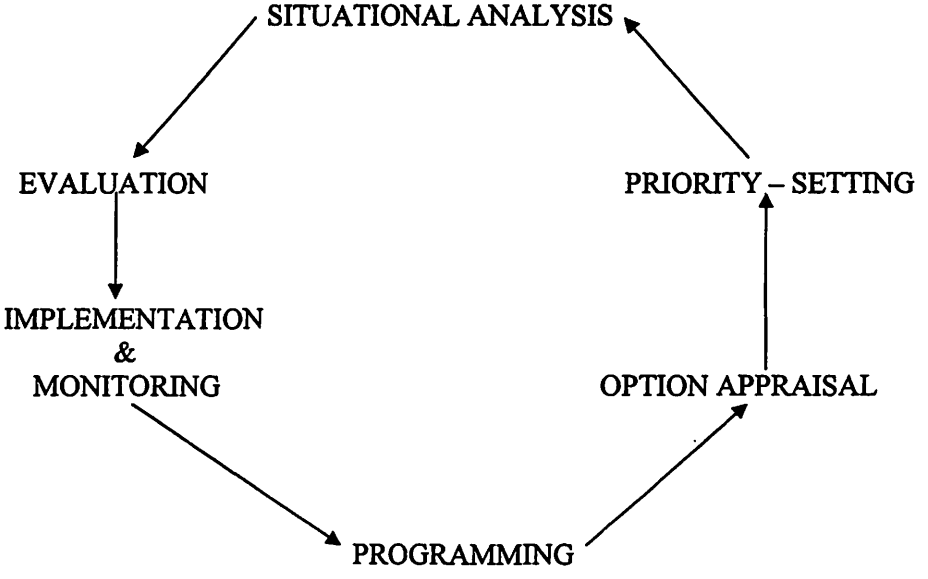
After the establishment of the planning committee, the first step is to assess the health needs of the community, that is, to carry out situational analysis. This analyzes the current situation from various perspectives including:

- Examination of the current and projected characteristics of the population including its demography.
- Assessment of the physical and socio-economic characteristics of the area and its infrastructure.
- Analysis of the policy and political environment including existing health policies.
- Analysis of the health needs of the population.
- Assessment of health facilities provided, their utilization and service gaps, together with organizational arrangements.
- Examination of the resources used in the provision of services and their current efficiency, effectiveness, equity and quality of services.

The second stage of the planning involves the determination of a hierarchy of the project goals, objectives and targets. This will be influenced by the situational analysis, especially the health needs and by the broad policy objectives of the government. The third stage involves the generation and assessment of the various options available for achieving the set objectives and

targets, as there are usually several ways of reaching a target. Each of the option chosen will be assessed in three ways: impact of the option on health needs, resource implications of the option and the feasibility of the option. The option appraisal stage will result in preferred options or a combination of approaches, which will then form part of the plan.The programming stage translates the results of the option appraisal into a series of programmes, each with a budget, over the plan period.The penultimate stage involves the implementation of the plan. This involves transforming the broad programmes into more specific timed and budgeted sets of tasks and activities, and involves the drawing up of a more operational plan or a work plan. The work plan is closely monitored during the implementation stage. The last part of this planning process is evaluation which provides the basis for the next situational analysis.

FIGURE 3 THE PLANNING SPIRAL



Source : Green (2000)[24]

CONCLUSION

"In order to live a perfect life, man must live in harmony with those natural laws which govern his being. Therefore it is of the greatest importance that he knows how to live so that his powers of body and mind be exercised to the glory of God."[25]. Simple behavioural changes have complex repercussions. However, such changes will not occur unless they are appropriate, affordable and acceptable, considering the complex web of socio-cultural, economic factors impacting at the individual and the community level, ultimately determining whether or not people are willing or able to make basic changes in their lifestyles[26]. The changes are geared towards the safe disposal of human wastes and involved breaking the transmission routes of the four main disease groups in the water, sanitation and hygiene domain. The establishment of sanitary barriers to break these transmission routes is both biblical and scientific. Hence, there is a consensus on the preventive and control measures towards water and hygiene related diseases.

Adventist institutions should endeavour to put into practice our health message, especially our knowledge of the relationship between adequate water supply, hygiene and health, through community development projects. Execution of such projects will serve to evangelize the communities and lead to soul winning. Adventist institutions should not isolate themselves from the reality of their surroundings; we are supposed to be our 'brother's keepers'. The love of Christ could be shared through execution of viable health projects. Many developing countries like Nigeria need such health projects in order to make positive impacts on the society. Babcock University is the only institution of higher learning belonging to the Seventh-day Adventist Church in Nigeria. This paper therefore serves as a challenge to all health scientists in the Babcock University, especially Department of Public Health Education. Preliminary discussion on how to set up water, environmental hygiene and health community project in Ogun State of Nigeria (immediate community of Babcock University) is, however, being done with the relevant department in Babcock University. This move came about as a result of the 28th International Faith & Learning Seminar held at the Babcock University.

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