Climate change: challenges for Samoa

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Introduction

Global climate change is a sensitive subject that affects all key aspects of human existence - the socio-economic, political and the biophysical environments - that dictates the quality of life on the earth. In effect, environmentalists in the last few decades have been sounding warnings on the uncontrolled emissions of pollutants into the atmosphere, enhanced green house effect, and depletion of the ozone layer which are seriously threatening the life support system which God generously bestowed on earth. Simultaneously, pristine rainforests have been cleared at a tremendous rate in the pursuit of agricultural and timber products and fuel wood.

Global climate change poses not only a distant future threat, but there is compelling evidence that a shift in the global weather patterns and changes in climate are already underway. A huge volume of data from all over the world clearly signals that change is occurring. From droughts to melting glaciers and ice caps, from dramatic flips in ocean currents to regional increases in extreme and violent storms, the indications are that climate change is happening now.

So this global climate change should be regarded as one of the greatest threats to the world. Governments and scientists alike have agreed that the problem is real, and serious. Last year at the climate summit in Kyoto, industrialised countries agreed, at least on paper, to reduce the amount of carbon dioxide and other greenhouse gases they emit into the atmosphere. But crucial details, upon which the success or failure of the agreement rests, are still under negotiation, and in the meantime little real action is being taken to address the problem. It is therefore absolutely necessary to educate all people on earth about the imminent danger posed by global warming, sea level rise, increased frequency and magnitudes of cyclones, depletion of fresh water resources, etc. If the glaciers of the polar regions melt as a result of increased global temperatures, several cities will be adversely impacted by enhanced flood. Preventive measures must therefore be taken to avert these possible disasters.

In the local scenario, we have been exposed to the various impacts of climate change - from violent cyclones to severe droughts – we are very vulnerable irrespective of the minute volume of GHG (Greenhouse Gases) that Samoa emits into the atmosphere. We need to convince the bigger GHG emitters - the developed nations - to stop this madness. Before doing this, however; we must ensure that we are reducing our per capita GHG emissions, and simultaneously establish sustainable land-use practices and logging code practices. There are no miracle solutions, but total commitment of the government and the private sector plus coherent working with the global community should bear favourable results.

The climate of Samoa

Samoa is an oceanic volcanic archipelago formed in a westerly direction by the bending and rupture of the Pacific plate in association with the subduction at the Tonga volcanic arc.

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Samoa lies in the southwest Pacific between latitudes 13º 15' S and 14º 05' S, and longitudes 171° 23' W and 172º 48' W. It is comprised of two relatively large islands and seven smaller islands, two of which are inhabited. Its total land area is approximately 2,820 km^2, with the two main islands of Upolu and Savaii accounting for 1,115 km^2 and 1,700 km^2 respectively. The climate is generally hot and humid with a wet season from November to April and a drier season, particularly pronounced in the north western coastal areas, from May to October. The climate of Samoa is characteristic of small tropical islands that are geographically isolated from big land masses. The main features of the Samoan climate are as follows:

- high rainfall;
- high relative humidity;
- generally uniform temperature all year round;
- winds dominated by the south-easterly trades winds;
- the occurrence of tropical cyclones during the southern hemisphere summer;
- long dry periods in the north-western coastal areas.

Rainfall

The average annual rainfall in Samoa is relatively high with a distinctive variation in the spatial distribution. The leeward sides of the main islands - north and north western sides - receive an average of about 2200 mm of rainfall per year. On the other hand, the windward sides - south and south eastern - receives an average rainfall of about 5000 mm annually. Higher rainfall averages of up to 6000 mm per annum occur at the highlands of the main islands, Upolu and Savaii[1].

The distribution of rainfall in Samoa is largely influenced by the island topography and the persistence of the trade-winds[2]. The mountain ranges of the main islands cause rain-shadowing on the north and north western coastal areas during the April-October period. It is during this period that the rain-shadow areas receive very little rainfall because the prevailing winds at that time are south-east trade-winds. These areas receive only about 30% or less of the total yearly rainfall in this period. The wind direction becomes more variable during the summer months largely because the South Pacific Convergence Zone (SPCZ) during this period is located close to Samoa. Hence, the rainfall is evenly distributed in this time. In the windward side on the other hand, the distribution of rainfall is more even throughout the year. These areas receive about the same amount of rainfall during the winter and summer months. So the dry and wet seasons are only pronounced in the rain-shadow areas - the north and north-western sides of the main islands.

Temperature

Samoa is usually hot all year round because it is close to the equator and its land mass is too small to cause any significant seasonal temperature variation[3]. Likewise, the diurnal temperature variation is relatively small. Observations at the Meteorological Service at the Apia Observatory have shown that the highest mean temperature of 27.1ºC occurs between December and March. The lowest mean temperature of 26.0ºC, on the other hand: occurs between July and September. Camber[4] has shown that the daily temperatures ascend to the highest value of 29.9ºC between 11.00 and 15.00 hours while the lowest mean temperature of 24.4ºC occurs at about 05.00, at dawn.

There is a general decline in temperature values from the coast to inland highlands in both Savaii and Upolu. The highest temperature officially recorded in Samoa was 35.3ºC at the Asau Station 3 metres above mean sea level (amsl), at the north-western tip of Savaii, while the Afiamalu Station, 750 metres amsl recorded the lowest temperature of 11.1ºC.

Surface winds

The most striking feature of Samoa's surface winds is the dominance of the south-easterlies. These winds are directly associated to the meridional migration of the SPCZ[5]. The SPCZ is generally located further north of the Samoan Group in winter but moves southward to Samoa's latitudes during summer. As a result the south-easterlies prevail in winter months while the wind direction becomes more variable during summer. The close proximity of the SPCZ to Samoa during summer results in the winds being generally stronger than in winter. It is also during this time of the year that Samoa generally experiences heavy rainfall, especially for the north and north-western areas.

Besides, violent tropical cyclones have always devastated the Samoan Islands during this period. Within this decade, four tropical cyclones, Ofa in 1990, Val in 1991, Lyn in 1993, and Tui in 1998 hit Samoa. Tropical cyclones, Ofa and Val 1991 are classified as hurricanes and they to both inflicted tremendous damage to the biophysical environment creating severe problems for the economy of the country. Tropical cyclones Lyn and Tui were of lesser magnitudes thus did little damage. Four other tropical cyclones - Ron in 1996 Kelly in June 1997 (linked to 1997/1998 El Niño), Martin in November 1997 and Kora in December 1998 – developed within the Samoan latitudes but did no local damage since they moved away as they intensified.

Global climate change

Despite ongoing debate about global warming, it is evident that the majority of the scientists are in favour of the opinion that this phenomenon is no longer speculation[6]. The threat is real and has far-reaching consequences and implications. While it is a frightening topic among some people, a very large number of people in many countries of the world are still unaware of the threats its poses[7]. This is actually a very serious situation because a recent UN survey has indicated a global population increase with the associated need to raise the standard of living has enhanced the pressure on the natural resources of food, water, shelter and energy. Consequently, the supplies of these resources are seriously affected and will be further exacerbated should then be a marginal change in climate[8].

With particular reference to energy supply, a small shift in climate towards aridity may substantially reduce the amount of energy production and supply especially in the developing countries where there is much reliance on hydro electric power generated from dams constructed on rivers[9].

A recent report from the University of California at Santa Barbara has indicated that the new climate models used in the US predict wetter and warmer winters and dry, hotter summers in some parts of the country such as California[10]. The report has also claimed that there will be too much water at the wrong time and too little when needed. Under such circumstances, winter precipitation will be more in the form of rain than snow, which means that there will be less water stored in snowpack and more running off immediately, exacerbating winter flooding and landslide problems. If this happens, pressure on coastal areas will increase, while the changing water cycle could lead to water shortages in the late spring and summer. On the other hand, crops that are heavily dependent on irrigation will be among the hardest hit during the enhanced summer drought condition, and forest fires could become harder to control.

Unnatural long drought conditions in Africa are also claimed to be associated with global climate change. This has exacerbated efforts to improve agricultural productivity in many African countries, and has resulted in food shortages and eventually poor living standards. These conditions are also linked to enhanced desertification in desert areas of Africa. On the other hand, rainfall in the Monsoon Region has been exceedingly heavy that the losses in human lives, economy and the environment in this decade are considered to be the worst ever recorded.

In the marine scenario, ocean temperature increase is believed to underlie massive coral bleaching in many coral reefs of the world[11]. Mass coral bleaching is considered by most reef scientists to be a serious challenge to the health of the world's coral reefs. Hoegh-Guldberg[12] indicated that the worst coral bleaching ever was recorded in 1998. Every reef system in the world's tropical oceans was affected by this event and in some places, such as the Indian Ocean, entire reef systems died.

As long as the temperatures of the tropical seas increase, coral bleaching will always be a menace to the coral reefs because corals are highly sensitive to temperature changes. Corals can only live in water with temperatures between 18 and 30ºC. Most coral bleaching events were caused by a 1ºC temperature increase above the summer temperature. According to Hoegh-Guldberg[13] tropical sea temperatures have increased by 1ºC over the past 100 years and are currently increasing at the rate of 1 - 2ºC per century. Mass death of corals frequently and increasingly follows bleaching events. In addition to killing corals, increased temperature has recently been found to affect coral populations by reducing their reproductive capacity and their ability to grow.

A US Environment Protection Agency study[14] has identified that the earth's climate is predicted to change because human activities are altering the chemical composition of the atmosphere through the buildup of greenhouse gases, primarily carbon dioxide, methane, and nitrous oxide. The heat-trapping property of these gases is undisputed[15]. The EPA study also showed that global mean surface temperatures have increased 0.4 - 1 .0ºC since the late 19th century, Another interesting revelation from the EPA study is that the ten warmest years in this century all occurred in the last fifteen years. Of these, 1998 was the warmest year on record. The snow cover in the Northern Hemisphere and floating ice in the Arctic Ocean have decreased. Globally, sea level has risen 4-10 inches over the past century. Worldwide precipitation over land has increased by about one percent. Increasing levels of greenhouse gases from the burning of fossil and biomass are pushing up average global temperatures. This is recognised by the majority of scientists, the United Nations and governments around the world[16].

In regard to storm development, researchers have linked decreased Atlantic tropical storm activity to El Niño and increased activity to La Niña conditions[17]. The report has identified that the 1998 hurricane season had a total of fourteen named Atlantic storms, twice the number experienced in 1997 with El Niño conditions and considerably more than the average of nine to ten storms per season. Hurricane Mitch, the strongest October hurricane ever recorded, was marked by its duration, strength and persistent, destructive rains over Central America. Several intense storms occurred in the western Pacific Ocean, including Thelma, a category 5 storm that was the most powerful recorded off the north-west coast of Australia, and Dani that caused severe damage in Vanuatu.

Climate change and Samoa's response

Samoa's first National Communication to the United Nations Framework Convention on Climate Change (UNFCCC) has indicated that Samoa is one of the most vulnerable countries to the impacts of climate change[18]. This claim may be substantiated by the incidences in Samoa of both the worst drought ever recorded in 1998, and the strongest tropical cyclones in the beginning of this decade. The devastating aftermath of these climate change-related impacts serves to alert us that rational measures and actions need to be put in place promptly to ensure that:

- everyone is well aware about the destructive consequences of climate change;
- climate change poses danger to human life;
- climate change poses very strong health risk;
- climate change threatens the wellbeing of the biophysical environment that Samoans existence depends on;
- to raise awareness about ways to adapt to climate change;
- to inform the public about what and how mitigative measures can be implemented to alleviate these impacts.

One of the milestones in Samoa's response to climate change is the signing and ratifying of the UNFCCC. This Convention provides financial and technical assistance to enable member countries to identify vulnerabilities, and simultaneously design appropriate adaptive and mitigative measures against climate change impacts.

The high demand for food due to population expansion coupled with some inevitable changes in food production systems pose a threat to food security in the country. This is very likely to be more pronounced during extreme events generated by climate change. In addition, pest and disease outbreaks that appear to be associated with climate change pose another formidable threat to food production in Samoa. Further, the continuing degradation of the biophysical environment such as the fast pace of forest clearance - also related to climate change - imposes another major constraint to the food security in the country

Urban migration of rural dwellers has resulted in over-crowding the Apia urban area, making it the most populous area in Samoa with a population density of 565 persons per square kilometre. This situation has induced stresses in many components of the biophysical environment in the town area. For example, urban water supply despite recent upgrading is considered to be inconsistent and unhealthy if consumed without prior boiling. Besides, the increasing pressure on land resources in these areas, both from agriculture and settlement has forced agriculture into unsuitable lands, for instance steep hill sides and water catchment areas. During heavy rains the fertile topsoils from these cleared lands are easily eroded away. Usually, the eroded soil ended up in water resources and in the lagoons - exacerbating water turbidity problems, and enhancing siltation and sedimentation in the lagoons. Also, a large percentage of these development activities include the use of fertilizers and agricultural chemicals, and therefore presents a potential threat to both water resources and to other useful ecosystems[19].

Up until mid-1993 (the incidence of the taro leaf blight), agriculture and commercial logging were the most dominant land uses which converted indigenous rainforest into arable land at an extremely rapid pace. Today agro-deforestation is quite insignificant which implies that forest clearance, which is mostly in higher inland areas, is almost completely timber-oriented[20]. The lack of a proper mechanism to provide sound management and conservation practices in these operations enhances severe soil erosion and flooding during rainy seasons[21].

Although little is known about the link between health and climate change in Samoa, studies in other countries have shown positive correlations between climate change and vector-borne and water-borne diseases. Outbreak of dengue fever which appears to be associated with heavy rainfalls, especially in high population-density areas infested with inadequate sewage and drainage systems, is a usual health risk in tropical climate. In addition, gastroenteritis and diarrhoea (identified with poor water quality and flooding) are also related to climate change. Besides, tropical cyclones Ofa and Val both caused the loss of lives, further validating Samoa's vulnerability to climate change health risks.

Most of the economic activities, infrastructure and human settlement are located in the coastal areas. This area also hosted nearly all traditional villages m Samoa in the past. The fast growth in population, and in development activities coupled with the soaring demand for land and other resources increase pressure on the coastal zone environment. Poorly-planned tourism activities are also contributing to the deteriorating condition of the coastal environment. Other human activities such as sand mining, and land reclamation, are also inducing stresses on the coastal environments and the marine resources[22].

The impacts of tropical cyclones Ofa and Val have caused some coastal areas to suffer more from storm surge attacks, inundation of low-lying areas and serious damage to the infrastructure. Several coral reefs are still recovering from the damage caused by these cyclones. Further, the severe aftermath of these tropical cyclones is the sole cause for the displacement of several households from traditional residences including two whole villages - Falealupo and Papa in northwest Savai'i[23]. Perhaps this has prompted the government to build a high seawall around Apia seafront to provide protection for public and private infrastructure. Most coastal villages, however, lack robust seawalls, hence are still vulnerable to sea level rise and storm surges. Observations have shown that coastlines are continually eroding and inundated due to the absence of any form of protection.

At the global level, Samoa is classified under the bio-geographical province number 9 - a region hosting similar combinations of plants and animals to those found in Samoa. Among the 226 islands of the South Pacific Region, the Samoa islands rank fairly high in terms of their conservation value. Human activities unfortunately are increasingly stretching the existing ecosystems to their limits, especially when the bio-diversity still provides for a large percentage of the economy today[24]. In addition, several species are already endangered partly due to the incidence of extreme climate change extreme events. Tropical cyclones Ofa and Val destroyed a large portion of the merchantable forests in Samoa. It is estimated that only 14% of the remaining forests are classified as merchantable while the rest are only essential to protect water catchments and to conserve the bio-diversity[25].

From the economic perspective, the devastation caused by tropical cyclones Ofa and Val dominated the poor growth over the following two years. Fairbairn and Vaai[26] have indicated a drop in the GDP from WS$180,000,000 in 1989 to about WS$172,000,000 in the 1992/1993 period, a fall of 4.5%, or just over a 1 .0% per annum. Commercial agriculture (including fisheries and forestry) was identified to have been among the most severely affected during the 1990-1992 period which included the cyclone phase.

There is compelling evidence of a change in the trend regarding climate change extreme events, not only in the Pacific Region, but throughout the whole world as well. In the local scene, the frequent tropical cyclones, and the intensified ENSO-related droughts are clear

examples and Samoa is vulnerable to them all. Observations have shown that the ENS0 weather pattern has become more frequent since 1977, bringing an increase in rainfall in the northeast Pacific and rainfall decrease in the southwest where Samoa is located. The last ENS0 event in 1998, the worst ever recorded, has generated significant and diverse climate variations in Samoa. It is associated with increases in temperature and long dry periods.

Water is vital to all sectors of the national economic development, particularly for human consumption and for agriculture. It is also the basic resource for hydropower generation, thus its availability in adequate quantity all the time is of the utmost necessity. Within this decade, only a few rivers in Samoa have run all year round despite high annual rainfall and this has severe social, economic and environmental implications for the country[27]. For instance, the frequent occurrences of these negative climate change impacts on water availability represents a serious threat to the already vulnerable hydropower development in Samoa,

The availability of water in Samoa is heavily dependent on heavy rainfall, land-use practices and user demand. An increase in rainfall intensity, which some models have projected, will increase runoff, enhance soil erosion on cleared land, and accelerate sedimentation in the existing water supplies[28]. Not only will such an event reduce the potential of catchments to retain water, but exacerbate water quality as well. Tropical cyclones and storm surges also affect water supplies by damaging water supply infrastructure. Sea level rise, in addition, enhances the intrusion of salt water into fresher lenses thus reducing the quality of potable water. Underground water and coastal springs as a result will be always vulnerable if the sea level continues to rise.

Long droughts, on the other hand, especially those that are linked to the ENSO phenomenon, have serious direct impact on water supplies. It is during these dry conditions that the forest areas are very vulnerable to wildfire. The 1998 forest fire during the prolonged drought destroyed up to 15,400 acres of land, containing village agriculture, rainforests and plantation forests.

Samoa had already taken some steps to address the climate change issue. The first National GHG inventory was completed in early 1999. The inventory revealed a very insignificant GHG emissions for Samoa, nevertheless, it also identified priority issues that need timely addressing. Undertaking this task should encompass a clear understanding that the actions involved in each issue are fundamental components of an integrated national effort to adapt to, and to mitigate negative impacts of climate. change[29]. The inventory also indicated that with the enhanced greenhouse effect as a major contributing factor to climate change, the pathetic situation regarding data quality, quantity and management is a matter of great concern. This is especially so when there is sufficient evidence to link climate change extreme events, such as severe hurricanes, to an increase in both frequency and magnitude of precarious threats to human life and to the biophysical environment.

Samoa’s commitment to combat the climate change issue is also reflected by the development of environmental policies in key components of the environment. Draft policies in four of these areas: Population; Water; Waste Management; and Land-use.

They have already been developed and are now awaiting Cabinet approval. The biodiversity and the climate change issues are currently addressed by Cabinet appointed committees coordinated by the DEC.

The Government is becoming aware of the need to ensure that its assets, both infrastructure and natural, are safely protected from the impacts of climate change. The Apia seawall, which provides protection for the best part of the Government assets, is an obvious indication of this growing awareness. More seawalls have been recently constructed adjacent public roads close to the sea in Savaii by the Public Works Department (PWD). Close to 100% of all seaside public roads in Savaii are already protected by seawalls (Faalogo Iosefa pers. comm. Sept. 8, 1999). Faalogo also said that there are plans to undertake similar programs in Upolu, with assistance from the World Bank.

Community-based work for the same purpose at the village level are also undertaken. Some villages have solicited help from the Government and/or other donor agencies to assist in their seawall projects. In some cases, villages, on their accord, have initiated their own seawalls to provide some protection during cyclone seasons. Most of these community-based projects, however, lack the necessary structural engineering that provides lasting endurance. The Government of Samoa has also stressed the need to improve the processes involved with the construction of buildings to ensure maximum human safety during tropical cyclones and other severe impacts of climate change.

Since Samoa is a party to the Montreal Protocol which deals with the protection of the ozone layer, recommendations have already been suggested to develop appropriate regulations, under the Customs Department (CD), to control the importation of ozone depleting substances (ODS) and associated appliances. Further suggestions to design a piece of legislation empowering the CD to censure imported second-hand motor vehicles; i.e., old vehicles and outdated models should not be allowed into the country because they are big GHG emitters. In addition, stronger regulations under either the DLSE or the Ministry of Agriculture, Forests, Fisheries and Meteorology (MAFFM) were part of a recommendation made by the Biodiversity Statement Committee to promote proper land-use practices and to establish a sustainable code of logging practice to ensure Samoa's land resources are safely protected.

A vision into the future prompted the Government of Samoa to take the initiative in providing a mechanism to control unsustainable land-use practices in watersheds. The rising frequency of harsh climate patterns - particularly heavy rains and anomalously long drought periods - necessitates the Watershed Management Program at the Vaisigano area. The project discourages poor development activities and provides alternative land-use that are more suitable such as agro-forestry.

The Government, in collaboration with the FAO, recently introduced the Food security Project. The project is geared towards assuring the availability of sufficient local food items all the time. Included in the project is the need to identify fast crops that could be harvested within a period of at most seven months so that the maximum damage imposed by tropical cyclones and other climatic elements are minimised. Drought resistant crops and animals are also part of the project.

The New Zealand Government under its bilateral assistance, is funding the Community Forestry Project that is now a part of the responsibilities of the Forestry Division of the MAFFM. The focus is now upon developing community capacity in managing their own forests and forest products. The project also considers impacts from climate change so proper forest development and management are also highlighted. The need for accurate and up-to-

date agricultural data has prompted the Government to undertake an Agricultural Census which started in October, 1999.

A World Bank funded project, known as the "Infrastructure Asset Management Project" is about to begin in Samoa. The project will highlight the need to provide better management mechanisms for the Government's infrastructure assets, including the collection and analysis of data from Geographic Information System, topography maps, coastal profiles, integrated coastal zone management, and infrastructure engineering.

Environmental Science - a priority area in the school curriculum that is still in the preparation phase - includes climate change and its associated impacts. There are also courses and programs already approved by senate, but awaiting council sanction, at the NUS, which addresses the issue of climate change. The major goal of both programs, when launched, is to raise public awareness and to enhance public appreciation of Samoa's vulnerabilities to climate change, which may convince the public about the need to adapt accordingly and to start implementing proper mitigation measures. The outcomes of the GHG inventory and the V&A Statement have identified a need to educate all Samoans about the need to adapt to current climate change. A large percentage of the problem will be resolved if the communities recognise the need to act according to changes in climate patterns and trends.

Conclusions and recommendations

Climate affects our daily lives in many ways. Physical and biological processes are climate dependent. When faced with extreme droughts, floods or violent storms, we realize just how sensitive our biophysical and socio-economic systems are to our climate. We expect long-term shifts in average climate conditions and/or a change in the frequency of extreme climate events as a result of climate change. Both will have significant direct and indirect impacts on our lands, our oceans and our resources. In some areas of the country, current changes in climate are impacting upon natural resources, water resources and the associated socio-economic systems. For example, in north western Savaii in 1998, anomalously long drought conditions created serious stresses on forests making them very vulnerable to bush-fires.

The anomalous climate patterns that Samoa has been experiencing in the last few decades are strongly believed to be linked to the global climate change that is affecting other parts of the world. Although there is still some scepticism, the majority of the scientists support the opinion that human activities plays a major role in this global change. The burning of fossil fuel and biomass coupled with the emissions from other anthropogenic development are increasing the concentration of greenhouse gases in the atmosphere. Consequently, the global atmospheric temperature has risen and eventually the sea surface temperatures followed suit. Both these features play roles in the changes in the global climate.

If no prompt action is made to reduce the emissions of GHG into the atmosphere, we would expect more anomalous weather patterns and the impacts of climate change are likely to be more devastating to both human beings and the biophysical environment. On global standard, Samoa's GHG contribution is very small, however, that is no excuse to be complacent. Samoa is very vulnerable to climate change, hence it should be a role model in the fight against climate change by setting up appropriate mechanisms that guarantee a reduction of local GHG emissions.

Such mechanisms need to include the promotion of public awareness through formal and informal education. Every Samoan must have a good understanding of the severity of

extreme climate events. Equally important is the need to raise understanding about the possible links between the human activities, like uncontrolled burning of fossil fuel and unsustainable deforestation, and global warming. Mechanisms designed to combat climate change are more likely to be accepted if the people understand them and how people can benefit from keeping them.

The Samoan Government should be leading the way to a fundamentally new energy direction based on clean renewable energy, like wind, solar, biomass and wave power. The technology is already available for all these overseas but the capital cost is still too high. Only when Samoa is fully committed to this cause and working collaboratively with the other small island states through the AOSIS, that it can justify its plea to developed countries to reduce GHG emissions.

Samoa needs to design with a full understanding of the general climate pattern so that when planning for an urban settlement for example: -

- the full potential for using solar energy is realised;
- air drainage patterns carry pollutants away from residential areas;
- urban-dwellers enjoy improved levels of climatic comfort and
- the site of a new settlement is chosen to lessen danger from natural hazards.

The same is also applicable to the other sectors of the economy so that the full benefit of climate elements are fully utilised. This undertaking, however, requires encouraging capacity building particularly with regards to data and information that are sorely lacking. This should include upgrading the Apia Observatory and other key agencies in terms of physical facilities and human resources. Finally, Samoa needs to sound the message that the longer action is delayed, the more drastic it will need to be in order to avoid dangerous impacts of global climate change from the enhanced greenhouse effect or global warming. Samoa must do the right thing; never become complacent and simultaneously, it needs to have more faith in God and act according to his will.

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