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Climate Change and Food Security in Small Island Developing States (SIDS)

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Abstract: Climate change is one of the major factors that affect food security around the world. Though currently many small island developing states are not very much food insecure, they are highly vulnerable to the impacts of climate change. Thus, this paper looks into the relation between impacts of climate change on food security in the most vulnerable countries in the face of climate change. As climate change affects food production and availability in small islands in many ways, and being poor and isolated, these countries face difficulties to import food. The situation differs from region to region due to their diverse socio-economic development and different levels of vulnerability to climate change. Therefore for the purpose assessing the regional difference, cases of Caribbean SIDS and Pacific SIDS have been taken up and compared.

Keywords: Food Security, Climate Change, Small Island Developing States, Pacific SIDS, Caribbean SIDS.

INTRODUCTION

In a wider aspect FAO defines the term food security as it "... exists when all people, at all times, have physical and economic access to sufficient, safe, and nutritious food to meet their dietary needs and food

preferences for an active and healthy life” (FAO 1996). For poor and developing states food security is a major challenge to cope with its issues. Current changing climatic pattern is one of the major causes that affect food production and availability in various ways and thus affect food security. The devastating impacts of climate change (i.e. sea level rise, increased frequency and intensity of tropical cyclones, salt water intrusion, degradation of arable lands, etc.) for small island states is well discussed and analyzed in many previous studies but the ramification of climate change on food security in small island states have not been much dealt with in academic research. Developing and poor countries like small islands have worst situations of food security in the facet of climate change i.e. its impacts on food production and their specific vulnerability to it.

Food security problems in the small island states are not so severe as in Africa and many parts of South Asia. The main reason of this is that in general terms the poverty level is not so acute and thus there are few instances of death due to hunger in SIDS; but they are very vulnerable to the impacts of climate change which is hampering their food production and availability, and likely to do so in future too. Therefore, the objective of this paper is to analyze the impact of climate change on the status of food security in small island states by assessing their uniqueness. The regions selected for the study are Pacific region and Caribbean region. These regions are socio-economically diverse and being located on tropical zone both are highly sensitive to the impacts of climate change. In order to access the dynamics of relationship between impacts of climate change and food security in both regions comparative analyses has been made.

THE UNIQUENESS OF SIDS

Generally, island states are often restrained by their natural circumstances, most importantly due to the fact that they are surrounded by water. This obvious geographical hindrance has evident consequences. Therefore, Small island developing states are in a different position. Not only do they share common problems with developing countries but they also have some specific characteristics and problems. As it is described in the Preamble of the *Programme of*

Action for the Sustainable Development of Small Island States: “Although they are afflicted by economic difficulties and confronted by development imperatives similar to those of developing countries generally, small island developing States also have their peculiar vulnerabilities and characteristics, so that the difficulties they face in the pursuit of sustainable development are particularly severe and complex” (UN 1994, 7). A network of working for SIDS, SIDSnet is based on the realization that small islands share the following four critical challenges: (i) Small size, (ii) Isolation, (iii) Climate change and sea-level rise, and (iv) Natural and environmental disasters. K.L. Sharma (2006, 3) mentions three major problems that affect their food security: smallness, remoteness and vulnerability. Though Sharma talks about SIDS in South Pacific region in particular, his description befits SIDS in general.

1. **Smallness.** Smallness is meant in terms of population, land area and GNP. The size of the island physically limits agricultural production, and lead to low diversity of crops and food products. This significantly increases dependence on imported foods. Besides agriculture, small size limits their urban settlement, commercial forestry and farming, mining, tourism and other infrastructural activities, and thus creates extreme competition among such various land use options (UN-OHRLLS 2011, 23).
2. **Remoteness.** By remoteness Sharma means difficulty with transport, communication and supplies. As mentioned above, communication is less of a hardship since wireless networks and satellite communication (one could also mention the underwater cable system that now entangle all the oceans and reach most of the remote islands¹). Yet, the means of personal transport and food supply has not changed and are still costly. Importing food also takes time, especially by sea transport, and it is always reliant on the suppliers and their actual ability to ship the products. Sharma refers to uncertainties in supplies due to infrequent transport, “especially to the outer islands” (as most island countries consist of several isles) (Sharma, 2006).

¹ See, <http://www.cablemap.info>, for a complete map of undersea communications infrastructure.

3. **Vulnerability.** SIDS are exceedingly vulnerable to natural disasters. These islands are located in the tropics where tropical cyclones occur every year, causing destructive winds and floods in their path. These weather systems are devastating to any land they hit but small islands are especially vulnerable because of their size and narrow resource and technological advancement to cope with. Other island countries are also subject to disasters but small island countries can suffer much greater losses proportionally. A recent instance of this was Tropical Cyclone Evan in December 2012 which caused a major disaster for Samoa equivalent to 29.3 per cent of the country's GDP in 2011, the full recovery and reconstruction from which is estimated is to require 2-3 years (UNESCO 2013:4).

RAMIFICATION OF CLIMATE CHANGE ON FOOD SECURITY

As mentioned earlier the term food security is concerned with “the ability of all people at all times to have both physical and economic access to a sufficient amount of safe and nutritious food which meets their dietary needs and food preference for an active and healthy life” (Sharma 2006, 1; Schmidhuber and Tubiello 2008). Thus, it can be said that food security of any region depends on three major factors: (i) food availability; (ii) access to the food; and (iii) food utilization. These components depend on food system more than food production and food security diminishes when food systems are under stress.

The food availability relies on local food productions and food import, and more importantly in what way people are able to produce or import their own food. This presumes markets for local products and labors, including labor costs comparable to food prices. Utilization of food products is associated with human health. Improper food utilization results in ‘secondary malnutrition’. For instance common diseases such as malaria and gastro-intestinal disorders hinder the body's capability to extract effectively the essential proteins, calories and other micronutrients from food for healthy life (Barnett, 2007).

Climate change, as any long term change in the statistics of climate, has the probability to cause harm to our natural and social surroundings. The main causes of this anthropogenic climate change are emission of greenhouse gasses, over-utilization of the natural resources, disruption

to bio-geochemical cycles, loss of bio-diversity, and other aspects of the Earth system functioning. These have the potential to increase in tropical storms, hurricanes and flooding (especially in tropical zone in which small island states are located). All have implication for primary activities like agriculture, fisheries, rural livelihoods and food security and are driven by food system activities (GECAFS 2012). Recent climate change patterns have significant threats for long-term traditional livelihoods and food security in small island states where adaptation cost of climate change impacts is relatively very high to their national incomes. Adequate and appropriate plans and policies are required to implement in order to make population furnished with the needed tools and skills so that they can be able to adapt properly to climate change and reduce social, cultural and economic loss induced by climate change.

As listed under the United Nations system, there are 52 SIDS, which falls under three geographic regions. Out of these 3 regions 2 regions have been taken for this study: Pacific region and Caribbean region. All SIDS have some specific characteristics such as some are newly decolonized, different levels of their vulnerability while some comes under Least Developing Countries (LDCs), other regional groups and group of commonwealth countries. SIDS can be considered unique in several ways but their most apparent attribute that renders them more disadvantaged than other countries is, as mentioned previously, their size and geographical isolation. This particular attribute alone is answerable for a relatively lower threshold of susceptibility to risks and threats, a problem that all small states have in common (Commonwealth Advisory Group 1997, 14-15).

Climate change induces changes in temperature, precipitation patterns, wind directions, impacts crop types that can be grown, production, and agricultural yields. For instance, extreme rainfall patterns (more or less) may cause a significant decreased production, mainly due to flood situations, water-logging, heat stress, magnified flood over river catchment areas and coastal areas and soil erosions. These changes could also further threaten productions though the introduction and foundation of new pests and disease carrying vectors, especially insects. The diseases can be carried between humans and

animals threatening significantly human health and livestock population. Additionally, increased humidity levels cause plants' fungal diseases and are capable of wiping off crops, e.g. in 1990s the incident occurred with taro leaf blight in Samoa. Apart from production and health issues these pest and disease occurrence status can also impacts SIDS as they may lose existing markets and ability to access international food markets (Wayne, 2014).

Significant numbers of islands' population live in coastal and low-lying areas. Therefore, they are highly vulnerable to sea level rise and salt water intrusion as it leads to the loss of productive land by increased coastal erosion and contamination of salt water into ground water sources. Thus, given the limited available agriculture land, these small states hold a unique vulnerable position to sea-level rise. Increased salt water intrusion further limits the crops' varieties that can be grown in such harsh environment and thus exacerbates the existent threats to food security. These factors altogether are likely to increase SIDS dependence on processed and imported foods and significantly affect their health. With the change in rainfall pattern and salt water intrusion, water resource management has also become more difficult and costly in small island countries. In addition changing climate also contributes to the degradation of genetic diversity of the region and negatively affects interaction of agro-biodiversity within food and agriculture ecosystems. Disturbances in ecosystem services such as disruption, pollination and the natural biological control of plant and animal pests also possess threats for food production (IPCC, 2014). This has certain consequences as SIDS' limited food productions lead them to depend on cheap imported foods. Imported food to SIDS is shipped in by food companies that operate according to business priorities. The markets of the SIDS are very captive markets; small size and limited accessibility of these countries also renders them more exposed to commercial fluctuations, due to their economic vulnerability. Food companies decide on the selection and variety of food they import; thus consumption has no choice but to adapt to the supply. This direct dependence also contributes to perpetuate the changed food styles that can be observed in most of the island populations, but it is most visible in the Pacific region. Curtis (2004) points out that as a result of Pacific islanders abandoning their

subsistence lifestyle, traditional foods have been replaced with food purchased from Western nations. Thus, in lieu of fresh fish, meat, and local fruits and vegetables, their diet became dominated by rice, sugar, flour, tinned meats, tinned fruits and vegetables, soft drinks and beer (Curtis 2004, 38). As a matter of fact, it is not uncommon that surplus food is sold for purchasing tinned food items (Sharma 2006, 14).

At the root of this situation is the people's actual dependency on imported food. N.J. Pollock describes this phenomenon in the context of the Pacific island states and calls it "dietary colonialism" (Pollock 1992, 180). Referring to Terry McGee's (1975) research on food dependency in the Pacific, Pollock identifies four, rather historical, factors to which this dependency is attributable to:

1. The development of cash cropping of cotton, coconuts, coffee, and sugar. Introducing western-style marketing of crops rendered the traditional local food production neglected, resulting in increased need of the population for food produced elsewhere.
2. The arrival of large numbers of expatriates, Expatriates, such as missionaries, government officials and plantation managers maintained the European and American dietary habits that they were accustomed to, generating a demand for imported foodstuff.
3. Laborers on the plantations were fed imported food (most of all rice), which naturally altered their dietary habits, further reducing need for indigenous foods.
4. Instead of developing internal marketing systems for local foodstuff, the colonizers concentrated solely on maximizing export efficiency.

Thus, as T.G. McGee (1975, 6-7, as quoted by Pollock 1992, 182) suggests, "It has been easier to avoid the problems of developing these marketing systems by allowing increased use of imported foodstuffs. As mentioned, Pollock's description refers to the Pacific islands, but it well demonstrates underlying causes of the emergence of basic food dependency in formerly island colonies. In addition, the quality of the imported food is often rather low, which results in nutritional issues such as high prevalence of obesity and other NCDs related to

unbalanced dietary habits. In half of the countries defined as SIDS, more than 30 per cent of the adult population is obese² (WHO, 2008).

While reserving that this problem is not exclusive to SIDS, E.U. Reed (2012) implies that there are two main reasons behind excessive food-import dependency. On the one hand, it is climate change that makes it very hard and complicated for island states to be self-sufficient in their food production, particularly with regards to soil erosion, soil-salinization and coral bleaching. On the other hand, however, Reeds suggests that there is no longer even a need to retain self-sufficiency, as the historically always present hunger has been reduced by globalization. Thus, in actuality one could say that food importation may play an important role in a strategy for climate change adaptation (Reed 2012).

According to FAO, most small island states are categorized as Low-Income Food Deficit Countries³ (LIFDCs) or as Net Food-Importing Developing Countries⁴ (NFIDCs). According to the WTO, SIDS depends upon trade and food imports to satisfy their food needs. Classification of small island states under NFIDCs or LIFDCs indicates SIDS vulnerability and dependence on import for their food demand. The most interesting point is their dependence on food import to satisfy their needs comprising both dependency on imported food as a percentage of total food consumption and the raising ratio of the food import bills as a ratio of aggregate export earnings (FAO 2005, 18-19).

Table-1 below reveals that many islands rely on imported cereals, approximately more than 95 per cent in order to satisfy their domestic food needs. In these imported cereals primarily rice, wheat and coarse grains and dairy products are included. This means a large proportion of their daily calorie intake comes from imported foodstuffs.

² According to WHO report (2008) World's most obese country is Nauru, a small island country located in Pacific Ocean. 72 per cent of its total population is obese.

³ A LIFDC generally meets three criteria - low per capita income, negative net food (calories) trade and wishes to be listed as a LIFDC.

⁴ A NFIDC can be a developing country recognized by ECOSOC as a LDC or it can be a developing country that has been a net importer of basic foodstuffs in any three years of the most recent five-year period and wishes to be listed as an NFIDC.

Table 1: Cereal Self-Sufficiency Ratios for SIDS

SIDS Countries	Production/Consumption Ratio of Cereal (%)
Barbados, Vanuatu , Antigua and Barbuda, Bahamas, Grenada, Dominica, Jamaica, Saint Lucia, Mauritius, Maldives, Trinidad and Tobago	< 5
Solomon Islands, Fiji, Saint Vincent and the Grenadines, Malta	< 10
Sao Tome and Principe	< 15
Cuba, Comoros, Cape Verde, Dominican Republic, Cyprus	< 30
Haiti	< 45
Guinea-Bissau	> 50
Belize	> 70
Guyana, Suriname	> 100
SIDS (total)	29.8

Source: FAOSTAT 2011; SIDSnet.org

FOOD SECURITY IN SIDS

Employing the definition of food security that was described above, the facets need to be examined in the context of SIDS. Can real food security ever be achieved in SIDS? Availability of food on small islands is naturally limited, since small land area means less room for agriculture and therefore smaller arable land area. While population in almost all SIDS⁵ has been growing for decades, and according to the UN's population prospects they will continue to grow (UN-DESA 2011), areas classified by the FAO as *arable land* in many cases declined. In fact, arable land has been decreasing in all small island states (e.g. case of Barbados, Seychelles, and Samoa) (FAO 2009).

The consequences of decreasing arable land area are clear – food imports will have to substitute for the missing food products which increase dependency on external factors, resulting in increased food insecurity. However, it is important to note that in many cases, cheap food import is in fact the reason behind declining agricultural

⁵ The population between 2006 and 2011 declined only in the following four SIDS: Cook Islands, Dominica, Nauru, and Niue (UN-DESA 2011).

production. A retrenched agricultural sector renders the country even more dependent and therefore vulnerable to fluctuations in prices and other outside factors.

Nevertheless, imported food in some cases of SIDS may also already be more expensive than locally produced food due to the costs of transport. Consequently, the second facet of food security is in jeopardy because the access of the poorer population to foodstuff becomes even more limited. Successfully offsetting fluctuations in production and prices of food is at the very heart of ensuring food security, and it is best achievable by supporting domestic agricultural production, particularly in small scale and on household levels. Increasing resilience can also be an effective strategy against fluctuations in supplies, which contributes to ensuring stability.

A bigger risk of food importation lies in its effect on the utilization aspect of food security. The diet of the necessitous families can become unbalanced due to the lower quality of cheap products, resulting in less healthy and poorly utilized foodstuffs. This increases the risk and indeed the prevalence of malnourishment, thus increased food insecurity. The different food habits have also been influenced by the dietary colonialism that was described by Pollock (1992).

It is possible for SIDS to achieve real food security but with decreasing arable lands and growing populations it is significantly and growingly more of a challenge than in other developing states. The dominance of food importation seems a major obstacle in this challenge; thus it is of great importance to minimize dependence by strengthening their local agricultural production. As it has been previously discussed SIDS are in a very particular situation concerning their physical existence. Climatic change is a worldwide phenomenon described by scientific observations and proven by theoretical models small tropical islands are expressly exposed to its impacts. According to Wisner et al. (2004: 267) “small island states are particularly vulnerable to tropical cyclones and more generally, to climate change,” It also seems evident that food security, or more broadly the agriculture, is probably the most vulnerable sector. In the 2011 *Disaster Risk Reduction for Food and Nutrition Security Framework Programme*,

FAO lists the primary threats to food and nutrition security, among which climate change is explicitly mentioned⁶ (FAO 2011, 19).

Precipitation is one of the natural criteria to the agriculture as rainfall is entirely their only source of water as opposed to real irrigation systems. Therefore the predictions of more rainfall in the wet season and less rainfall in the already dry months depict a very direct and alarming impact (Barnett 2011). This aspect is also mentioned in the *Fourth Assessment Report* of the Intergovernmental Panel on Climate Change (IPCC), namely that the impacts of climate change will not only include extended periods of droughts, but also an increased precipitation that leads to loss of soil fertility and degradation, “both of which will negatively impact on agriculture and food security” (Mimura et al. 2007).

As Barnett points out there are also many evidences that tropical cyclones may become more intense in the future, which means they may last longer, manifest higher wind speeds and unleash more rainfall. Thus, it is the intensity and frequency of tropical weather hazards that will increase rather than changes in mean conditions (Barnett 2011; IPCC 2007, 31). Nevertheless, their impact on agriculture, though indirect, is clear. In areas prone to floods more intense rainfall itself can be a cause of a destructive disaster.

Food availability exists when the system of food production functions flawlessly. Consequently, food security ensues in part from food production; hence the importance of ensuring the successfulness of agriculture and the relevance of examining climate change impacts on agriculture. It is also important to note that though the concepts of food security and food production are not interchangeable, any impact climatic change may have on agricultural production does affect food security at large in SIDS.

CASE OF PACIFIC AND CARIBBEAN REGIONS

SIDS in the Pacific region are mainly low-lying small atoll countries, which cause their extreme vulnerability to the impacts of climate

⁶ It is so mainly because of its adverse impacts on the frequency and intensity of weather-related hazards.

change. These SIDSs are characterized by small size including land areas, populations and economies. In the Pacific region small population is frequently spread and fragmented over many small islands that create extremely isolation within and between countries in the region and problems in communication (Overton 2006; FAO 2009). Various historical and current data sets on the implications of extreme events reveals that the cost of natural disasters in the Pacific region was more than US \$1 billion in the 1990s and even more will be observed during 21st century (Bettencourt and Warick 2000). The impact of climate change in the Pacific region have already been observed and being dealt adequately to by various organizations such as the Secretariat of the Pacific Community (SPC), the Food and Agriculture Organization (FAO), the Pacific Regional Environment Program (SPREP). National and regional governments recognize that actions to deal climate change and its associated impacts require development partnership and support from rest of the world (SPREP 2005; APN 2010). SIDS in this region is highly dependent on agriculture for their food needs. Table-2, gives an overview of Pacific SIDS and significance of agriculture for them and Table-3, identifies specific impacts of climate change in the region and their impacts on agriculture and thus food security.

Table-2: Case of Pacific SIDS

	Country	Area (km²)	Population (1000)	Agriculture Contribution to GDP (%)
1	American Samoa	197	55	-
2	Cook Islands	237	12	15.1
3	Fiji	18270	945	9
4	French Polynesia	4167	267	3.1
5	Guam	541	159	-
6	Kiribati	811	113	24
7	Marshall Islands	181	65	22
8	Federated States of Micronesia	702	107	47
9	Nauru	21	14	6.1
10	Niue	260	1	-
11	New Caledonia	18576	252	5

12	Palau	458	21	20
13	Papua New Guinea	462840	6057	29.6
14	Samoa	2944	220	18
15	Solomon Islands	28450	596	40
16	Timor Leste	14874	1066	32.1
17	Tonga	748	121	20.4
18	Tuvalu	26	12	24
19	Vanuatu	12200	219	20.6

Source: CIA Country Profile; FAO, 2012

Table-3: Climate Change, Agriculture and Food Security in Pacific Region

Source: FAO 2011

Predicted Trends Climate Change in Pacific Region	Agriculture in Pacific Region	Impact of Climate Change on Agriculture and Food Security	Climate Hazards will affect Agriculture Through
<ul style="list-style-type: none"> • Increase in sea-level by around 0.39 metres, • Increase in surface air-temperature by 2.3°C, • Rise and fall in precipitation with predicted impacts of 8.36 per cent to 20.2 per cent respectively, • ENSO conditions predicted to be occur more often, • increased episodes of flooding • tropical cyclones becoming more frequent and intense, • salinization of freshwater lenses, 	<ul style="list-style-type: none"> • Major food source • Raw materials supply for manufacturing • Source of income • Contribution to GDP • Foreign Exchange • Employment 	<ul style="list-style-type: none"> • Agriculture productions are likely to be adversely affected by increase in temperature, changing precipitation pattern, and more frequently occurring intense extreme events. • All these likely to affect directly crop production and growth. By hampering supply of water for irrigation and quality of soil and prevalence of pests and diseases. • In the context of livestock, impacts of climate change also will alter the quality and quantity of feed supply and water. 	<ul style="list-style-type: none"> • Changes in soil moistures and temperature will affect crop production and quality. • heat stress on plants, • top soil erosion causes loss in soil fertility to a great extent • alteration in available water for irrigation purposes • changes in water levels • salinization of fresh-water aquifers, • Loss fertile land of land through rise in sea-level.

Unlike the Pacific region, SIDS in the Caribbean region are of Volcanic and tectonic origin (except few) having relatively high lands and more developed economies. There are more than twenty five SIDS and more than 40 million population lies in the Caribbean region (AOSIS 2011). SIDS in this region experience unique challenges in the facet of climate change and in the effort to broaden their economies and markets for assuring their food security, self-reliance and boost sustainable livelihood in the region (SIDSnet: Caribbean region). Similar as Pacific region increase in temperature, sea-level rise and increased hurricane intensity threaten lives, property food security and livelihoods throughout the Caribbean region. Increased frequency and intensity of extreme events, natural hazards, variability in rainfall, floods and droughts along with fragile coastal systems and eco-systems and livelihoods dependent on primary activities all make the region more vulnerable to the impacts of climate change. R. Selvaraju highlights this vulnerability as a threat to sustainable development efforts, (Selvaraju 2013). Table-4, gives an overview of Caribbean SIDS and significance of agriculture for them and Table-5 identifies specific impacts of climate change in the region and their impacts on agriculture and thus food security.

Table-4: Case of Caribbean Region

	Country	Area (km ²)	Population (1000)	Agriculture contribution to GDP
1	Antigua and Barbuda	443	85	12
2	Anguilla	91	13.6	4
3	Aruba	179	101	-
4	Bahamas	13940	309	5
	Barbados	439	277	3.1
5	Belize	22966	308	10
6	British Virgin Islands	153	28	1.5
7	Commonwealth of Northern Marianas	463	77	-
8	Cuba	110860	11452	4.3
9	Dominica	754	73	15.7
10	Dominican Republic	48730	9650	11.5
11	Grenada	344	91	11
14	Guyana	214970	772	20.3
15	Haiti	27750	91	25.7

16	Jamaica	10991	2826	6.6
18	Montserrat	102	5	-
19	Netherlands Antilles	800	175	1
20	Puerto Rico	9104	3667	0.6
21	Saint Kitts and Nevis	261	40	3.6
22	Saint Lucia	616	160	7
23	Saint Vincent and	389	105	8.4
24	Suriname	163271	481	10.4
25	Trinidad and Tobago	5128	1230	0.3
26	U.S. Virgin Islands	346	106	-

Source: CIA country profile; FAO, 2012

Table-5: Climate Change, Agriculture and Food Security in Caribbean Region.

Predicted trends climate change in Caribbean region	Agriculture in Caribbean region	Impact of climate change on agriculture and food security	Climate hazards will affect agriculture through
<ul style="list-style-type: none"> • sea-level rise by about 1-3 metres, • surface air-temperature to increase by 1.52° to 2.64°C, • rainfall could either rise or fall with predicted impacts of 7.76% to 12.59%, • increased episodes of ENSO • tropical cyclones becoming more intense, • saline intrusion into freshwater lenses, • increased flooding 	<ul style="list-style-type: none"> • Major food source • Raw materials supply for manufacturing • Source of income • Contribution to GDP • Foreign Exchange • Employment 	<ul style="list-style-type: none"> • Increased biomass potential and increased potential efficiency of physiological water use in crops and weeds • Modified hydrological balance in the soils due to C/N ratio modification • Changed weed ecology with potential for increased weed competition with crops • Agro-ecosystems modifications • Crop yield decrease; less than robustness in livestock development • Nitrogen cycle alteration with huge elevations resulting from livestock farming 	<ul style="list-style-type: none"> • Crop failure and increase mortality rate in livestock • Yield decrease in both crop and livestock • Competition for water • Destruction of livestock dwellings predispose animals to harsh conditions • Greater incidences of forest fires due to drought conditions • Damage to grain formulation, increase in some pests, droopiness in animals

Source: IPCC, (2007); Adaptation from Iglesias and others (2009)

COMPARATIVE ANALYSIS

From the above description (Table-3 and Table-5) it has been clear that both regions have almost similar tropical locations but they experience different intensity of climate change (i.e. increase in average sea level rise and temperature). Yet they face similar environmental challenges. Their diverse geographical (i.e. SIDS in Caribbean are relatively close to each other and to other developed countries, while SIDS in Pacific are isolated within countries and far from developed countries) and socio-economic characteristics make them differently vulnerable to the impacts. In the SIDS in the Pacific region agriculture has significant contribution to their national GDP in comparison to Caribbean region, thus depending more upon agriculture. Pacific region SIDS are more vulnerable to the impacts of climate change for their agriculture output. The major cause for this is comparative advancement and geographical closeness of Caribbean region to developed countries of North America and Europe, which are their main tourist origin markets; thus making it capable to cope with the adverse impacts of climate change and less dependent on agriculture for their food security (Parry and McElroy 2009). McElroy and Parry also found that Caribbean islands are on an average significantly more affluent than their Pacific counterparts and that much of the difference seemed to be due to a greater level of tourism and marketing development than in the former.

Both of the regions are not self-sufficient and self-resilient in their domestic food productions; therefore, they have to rely on imported food to satisfy their food demand.

Table-6: Pacific Region (Imports of Food Products Countries in 000' Tonnes)

Countries	Fruits (including juices)	Milk (including dried and milk products)	Vegetables	Cereals
Fiji	15.870	6.42	28.321	102.899
Cook island	0.237	0.059		3.910
Kiribati	2.807	0.190		0.052
Nauru	0.158	0.010	0.044	0.029
Niue	0.013	0.012	0.008	0.018
Papua new	4.615	5.873	32.556	165.684

guinea				
Samoa	1.896	2.264		1.606
Solomon island	0.808	0.227	0.503	19.168
Vanuatu	1.335	0.199	0.397	6.495
Tuvalu	0.440	0.016	0.002	0.066

Source: FAOSTAT, 2011

Table-7: Caribbean Region (Imports of Food Products Countries in 000' Tonnes)

Countries	Fruits (including juices)	Milk (including dried and milk products)	Vegetables	Cereals
Antigua and Barbuda	2.201	1.161	1.082	5.853
Barbados	7.776	3.455	1.723	48.663
Belize	1.227	0.941	1.355	20.784
Dominica	0.903	0.95	1.870	2.972
Grenada	3.125	0.703	0.851	34.085
Haiti	8.000	29.293	11.732	264.158
Jamaica	4.394	3.112	9.297	454.77
St. Vincent the grenadines	0.495	249.104		21.297
Suriname	4.624	0.944	7.306	45.371
Trinidad and Tobago	4.825	6.586	13.812	189.133

Source: based on FAOSTAT, 2011

Comparing food imports of major countries of both regions (Table 6 and Table 7) shows that according to food and agriculture organization, Caribbean region SIDS are more dependent on food import rather their own food production and in contrast at the same time, SIDS in pacific are developing or underdeveloped countries due to their recent colonial history and depends on their domestic agriculture for food needs. Besides lack of financial resources geographical scattering of SIDS in pacific region is other important reason that makes food import more expensive and difficult for poor countries. Considering their dependency on agriculture for food security Impacts of climate change and consequences of such impacts are likely to be particularly severe in the atoll islands (e.g. Tuvalu and Kiribati etc.) because in these islands agriculture is already under stress due to poor soil, limited available land, declining arable land and water scarcity. Therefore, the impacts of climate change on the food security of the region will become more severe and urgent to cope with.

Data provided by Economic Intelligence Unit (EIU) for both regions in the context of respective food security shows that SIDS in Caribbean region found more food security than the SIDS in Pacific region as a recent food security report of 109 countries consists two Caribbean countries Dominican Republic (rank 55 with the points of 54.6) and Haiti (ranked 103 with the points 30.2) by the Economist Index Unit (EIU 2014). There is no any entry of Pacific country in the respective report. The main reason behind this is that the economy of Caribbean region is relatively more developed. For instance, McElroy and Sandborn (2005) found that SIDS in the Caribbean were significantly more affluent, socially progressive and demographically mature than their sovereign counterparts, located predominantly in the Pacific.

CONCLUSION

If consideration given to geographic characteristics such as location, size, isolation and resulting narrow natural and human resource base, it would be clear that food security situation in SIDS is more problematic than in other places of the globe. The physical setting of small island states and current trends of climate change render the situation of island countries over complicated. More importantly isolation, smallness and colonial past led SIDS into major food stress regions of the world. They have to deal with land and resource scarcity in order to achieve self-sufficiency in food production and to reduce their dependency of food imports.

Climate change has significant impacts on the agriculture sector and policies and plans that govern the allocation of resources and activities in these sectors therefore have to be developed or reviewed with these impacts in mind. Mainstreaming climate change adaptation involves incorporation of measures, strategies and information that reduce vulnerability to climate change into policies, strategies, programs, development planning, institutions and decision-making processes. Due to major hurdles and challenges presented by climate change to the developmental efforts of SIDS and lacking fundamental resources and capacity to cope with challenge related to climate change and food security, small islands are unable to satisfy their need at

national level. They have to rely on food imports and high food prices, transportation costs caused difficulty for poor SIDS. The situation is not same in all SIDS throughout the world but it is similar indeed. Therefore, international cooperation is needed to promote and ensure food security (availability, access and utilization) in small island states of both regions as they do not have such resources to deal with challenges presented by climate change. In this context international cooperation, efforts of civil society, non-governmental organizations can significantly increase the capability of SIDS to cope with and better prepare for the impacts that natural hazards and climate change might pose to their future and food security.

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