Sustainable Development in the Context of Biodiversity and Food Security

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Introduction

Economic Development of a country heavily depends on wise use of its natural resource base, especially to bring people out of poverty. In the recent past, Sri Lanka started following the same path to build the country's economy, however, with parallel attempts for conservation and sustainable use of the natural resources, following a systems approach (Marambe and Silva, 2012). Economic development and growth should be used to enhance the ability of societies to conserve nature (IUCN, 1980). As an emerging economy, Sri Lanka faces a number of environmental problems such as severe land degradation, pollution of soil, water and air, poor management of water resources, loss of biological diversity, coastal erosion, improper waste disposal in urban areas, and traffic congestion in the main cities in its developmental process. The systems approach takes into account the impacts on the natural resources by its influences on favorable movements such as conservation of flora and fauna, energy and non-renewable resources, and improving quality and diversity of landscape in the development process (Marambe and Silva, 2012). Nevertheless, sustainability under changing and variable climate, has become an issue close to the heart of many people in the developing world than any other socio-economic issue with problems faced in food security. Under these circumstances the basic principle should be that the components of development should interact and maintain a balance within functional boundaries. Thus, sustainable development process in emerging economies such as Sri Lanka should consider the important ecological, social and economic ramification.

Sustainable Development in Sri Lanka

The sustainable development challenge remains urgent and acute (OECD, 2001) where abject poverty and food insecurity still ravages the lives of a sizeable population in developing countries including Sri Lanka. The approach and the strategy chosen by each country to respond to such challenges will differ from each other, with appropriate structural changes relating to economy, ecology, society and politics. For example, agriculture is sustainable when current and future food demands of a country can be met without unnecessary compromise on economic, ecological, and social/political needs.

Viewed through a sustainability lens, a sound, well-aligned organizational strategy for the 21st century, interdependent, global economy must be green and socially responsible if it is to succeed in the moderate to long term. Sustainability is in its simplest terms about how to do well now without destroying the ability to do well in the future. It's also about taking a well-rounded approach to making personal, governmental, and business decisions that put environmental awareness and social responsibility on a par with sound economics. This is also referred to as the triple bottom line. The three interrelated domains that together comprise sustainability are economic/financial, social/governance, and environmental stewardship (Figure 1). Within each of these domains, there are a number of areas in which the policies and practices of a country, region or an institution, across its entire value chain can have both short-term and longer-term impacts for the society. Sustainability could only be achieved through optimizing all three domains.

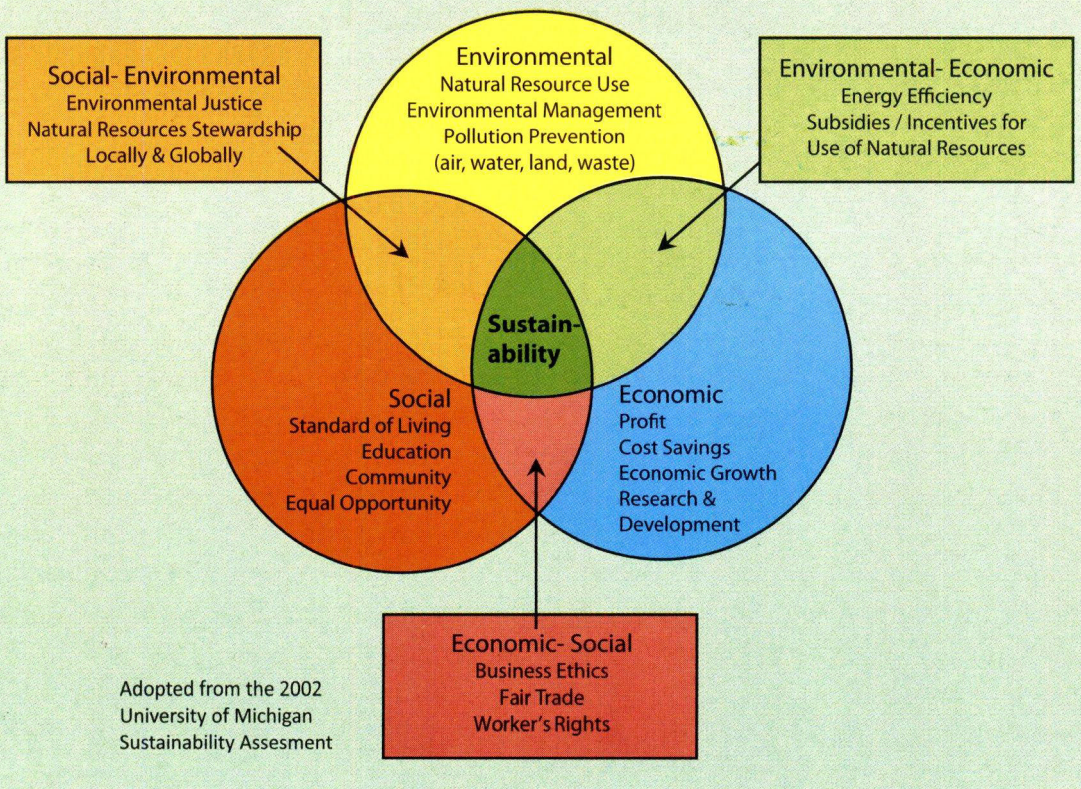


Figure 1. The three pillars of sustainability



The Sri Lanka Strategy for Sustainable Development (SLSSD) seeks to achieve this vision through eradication of poverty, ensuring competitiveness of the economy, improving social development, ensuring good governance, and a clean and healthy environment (MENR, 2007). Further the national development policy of Sri Lanka named as "Mahinda Chintana – The Emerging Wonder of Asia" identifies the development objective under the theme "environment" as "to promote sustainable development in close liaison with the land, fauna and flora and to bestow our natural heritage to our future generation" *(Mahinda Chintana,* 2010) highlighting the highest priority given by the government in terms of sustainable development.



Sri Lanka has made commitments to environmental protection and sustainable development by adopting the main instruments agreed at the UN Conference on Environment and Development (UNCED) held in 1992 in Brazil, and the World Summit on Sustainable Development (WSSD) held in 2002 in South Africa, and by ratifying the Millennium Declaration. Moreover, Sri Lanka is a party to several multilateral environmental agreements including many which predate UNCED. Among these are: International Plant Protection Convention (IPPC), Convention on Wetlands of International Importance (Ramsar Convention), Convention on International Trade in Endangered Species (CITES), Vienna Convention for the protection of the ozone layer, and the Montreal Protocol. Sri Lanka ratified the UN Conventions on Biological Diversity, Climate Change, and the Convention to Combat Desertification in 1993, 1994, and 1998, respectively. Sri Lanka is also a party to the Kyoto Protocol under the Framework Convention on Climate Change, and the Biosafety Protocol under the Biodiversity Convention. Since UNCED in 1992, the government has taken several initiatives towards sustainable development, particularly the need for environmental conservation. Institutional arrangements for coordination of actions under

the Multilateral Environmental Agreements (MEAs) were set up, and many activities and programmes were launched in this regard.

Sri Lanka has also recognized that achieving sustainability rests to a large extent on national coordinated efforts. It is towards this end that Sri Lanka has developed the "*Haritha Lanka* (Green Lanka) National Action Plan". The action plan, which is implemented under the chairmanship of His Excellency the President of Sri Lanka, has identified ten broad missions/thrust areas covered to be covered, namely (a) clean air - everywhere, (b) saving the fauna and flora and ecosystems, (c) meeting the challenges of climate change, (d) wise use of coastal belt and the sea around, (e) responsible use of land resources, (f) doing away with dumps, (g) water for all and always, (h) green cities for health and prosperity, (i) greening the industries, and (j) knowledge for right choice (NCSD, 2009).

Biodiversity and Sustainable Development

Sri Lanka, being an island nation covering an area of 65,610 km^2, is blessed with a wealth of floral and faunal diversity, and together with Western Ghats of India, has thus being recognized as one of the 34 biodiversity hotspots at the global scale (Mittermeier et al. 2005). Sri Lanka has the highest species diversity per unit land area of all Asian countries in terms of flowering plants and all vertebrate groups, excluding birds (http://www.sacep.org/html/mem_srilanka.htm). In the terrestrial ecosystems of Sri Lanka, the wet zone forests in the southwest are especially important as they sustain 75 % of the endemic species of flora and fauna (http://www.uicn.org/about/union/ secretariat/offices/asia/asia_where_work/srilanka/programmes/forest/). Based on the diversity of plants distributed in the wild, 15 floristic regions have been designated in the country (Ashton and Gunatillake, 1987). Approximately 25% of the 3,771 species of flowering plants, 18 % of 91 species of mammals, 7 % of the 227 bird species, 83 % of the 246 species of land snails, 85 % of the 106 species of amphibians, 60 % of the 171 species of reptiles and 100 % of the 59 species of fresh water crabs found in the country are endemic. In the national assessment conducted by the IUCN and MENR (2007), of a total of 1,104 flowering plant species assessed (out of which 553 are endemic), 675 species are threatened (out of which 411 are endemic). Among the fauna, of 674 vertebrate species (out of which 290 are endemic), 21 amphibians (all of which are endemic) are considered, extinct while 222 species are considered threatened (out of which 137 endemic species). In the invertebrate groups, of 246 species (out of which 204 are endemic), 33 species are threatened (out of which 32 are endemic). The country is also rich in marine biodiversity (http://www.natcog.org/marinebdsl.htm) among which the coral reefs are the most diverse. The actual richness of life in Sri Lanka's seas has not been adequately assessed. The marine fauna recorded in Sri Lanka include 213 species of echinoderms, 228 species of marine molluscs, 61 species of sharks, 31 species of rays, 18 species of marine reptiles (including 5 turtles, 12 sea snakes and 1 salt water crocodile), 28 species of marine mammals (including 27 whales/ dolphins and 1 dugong), more than 183 species of corals and 49 species of sea birds (Bambaradeniya, 2006). Sri Lanka is ranked 6th among those countries with over 70 % of the amphibian species are either threatened or extinct, primarily as a result of habitat loss (IUCN, 2009). About 80 % of all Sri Lankan freshwater crabs are threatened (critically endangered, endangered or vulnerable), with an alarming 50 % of all species critically endangered and possibly on the brink of extinction (IUCN 2009). One in every two species of mammals and one in every three species of reptiles and freshwater fish and one in every 5 species of birds in the island are currently facing the risk of becoming extinct (IUCN and MENR, 2007). The biodiversity that underpins agricultural systems spans a continuum from simple use of wild species by human beings to the creation and intensive management of genetically modified organisms (GMOs). Within this spectrum agro-biodiversity represents the group of organisms, which has been domesticated, maintained and adapted in a process of co-evolution with human management systems. Thus, landraces and wild species of animals and plants as well as live organisms contained

in soils and water are the essential source of genetic variability for responding to biotic and abiotic stresses through genetic adaptation.

Sri Lanka also possesses a globally significant agro-biodiversity in the agricultural ecosystems. The agro-biodiversity is central to the livelihood strategies of small-scale farmers, rural communities and indigenous people of the country. The diversity in agro-ecosystems which includes about 237 fruit species, 82 vegetable species, 16 cereal and legume species, 20 species of spices, 1550 medicinal plant species, 211 species of ornamental plants, 20 species of edible freshwater fish and over 133 species of bees (Pushpakumara and Silva, 2008).

The agro-biodiversity in any form can only be effectively maintained and adapted with the human management systems that created it, including indigenous knowledge systems and technologies, specific forms of social organization, customary or formal law and other cultural practices (Marambe et al, 2012). The small tank (reservoir) cascade system (Madduma Bandara 1994) and Kandyan Homegarden System (Pushpakumara et al., 2010) are proven examples that have historically contributed to village food and nutritional security, livelihoods and environmental protection, biodiversity conservation as well as community cohesion and well being. Both systems have most likely been developed as an adaptation to patterns of rainfall and geology of the area. On the basis of their form and appearance, the cascading systems in Sri Lanka are particularly important because they operate as an ideal rainwater harvesting technology, a soil moisture and groundwater maintaining technology, a soil erosion and siltation control technology, a technology that ensured the maintenance of ecological balance, a technology that promoted the need for community leadership, a system that nurtured the development of drought insurance through animal husbandry and fragmented land ownership, and that provided opportunities for inland fishing and human and animal nutrition. Thus, the surface storage systems of VTs provided the lifeblood for human settlement and existence in these areas (Panabokke et al. 2002; Marambe et al, 2012). The primary service provided by the tanks was the storage of rainfall to enable year-long rice cultivation. In addition to providing irrigation water, the tanks made the micro-climate pleasant and cool, rich biodiversity and agro-biodiversity, and paved the way for a unique decentralized social system in Sri Lanka where farmers had the highest social rank (Marambe et al. 2012). Kandyan homegarden system, in contrast, has evolved in high rainfall areas and slopy lands with minimum natural forest cover and higher rate of soil erosion, where, farmers have led the protection of soil with agro-biodiversity and enhancing multi-layer tree cover of the area (Pushpakumara et al., 2010).

The conservation of biodiversity is of special significance to Sri Lanka in the context of its predominantly agriculture-based economy and the high dependence on many plant species for food, medicines and domestic products. The rich and diverse ecosystems of the country harbour many wild relatives of cultivated species, and the genepools represented by these wild plants, and cultivated species, are a national and global resource of significant importance and potential. Considering "Respect for Nature" as one of the fundamental values for humanity, the United Nations Millennium Declaration of 2000 urges that "Prudence must be shown in the management of all living species and natural resources, in accordance with the precepts of sustainable development. Only in this way can the immeasurable riches provided to us by nature be preserved and passed on to our descendants. The current unsustainable patterns of production and consumption must be changed in the interest of our future welfare and that of our descendants." (United Nations, 2000). The Declaration calls for a new ethic of conservation and environmental stewardship. Respect for biological diversity implies respect for human diversity (UNESCO and UNEP 2003), and cultural diversity is the key to a mutually enriching future for humankind. Sustainable development requires that the moral vision of human beings be harnessed in as much harmony with local cultural aspirations as possible. Cultural diversity guarantees sustainability as it binds universal developmental goals to plausible and specific moral

visions. Biological diversity provides an enabling environment for it (Appadurai, 2003). The combine conservation of existing biodiversity and agro-biodiversity with the introduction of new diversity in an integral component of sustainable development. In turn, Biodiversity can be managed in a sustainable way to support sustainable development, only if the management plans take proper account of the socio-economic context. This may include a requirement to develop employment based on the sustainable exploitation of biodiversity, and ensuring that biodiversity conservation is carried out in a socially acceptable and cost-effective manner that benefits the local population.

Food Security and Sustainable Development

Food security is one the key issues that is extremely important and linked to sustainable development, and food security itself is a multifaceted sustainability issue. Food security is built on four main pillars namely, food availability, access, utilization and stability. At the global scale, countries have experienced food price spikes in 2007/2008 and 2010/2011 reversing the recent progress in reducing hunger. It has been estimated that 70 % increase in food production will be needed to feed 9 billion people by 2050 (FAO, 2010), in a world of increased resource scarcity (land, water). In addition, the climate change induced variations in temperature, precipitation and the increased likelihood of extreme weather events, will alter crop and animal productivity, and ultimately global trade flows.

The governments are currently facing one of the toughest challenges in finding mechanisms to feed more billions of people in the future within the perspective of climate change, energy shortages, economic crises and growing competition for the use of renewable and non-renewable resources. The *Mahinda Chintana* (2010), which is the Government national policy document, states that "Ensuring food and nutrition security has emerged as one of the priority requirements in improving the living standards of the population". This government's policy framework aims to achieve multiple goals in agriculture sector such as achieving food security, ensuring higher and sustainable income to farmers, fair and remunerative price for agriculture products, expanding the area under cultivation, using high yield seeds, reducing post harvest losses and introducing efficient farm management. Financing the agriculture sector adequately has been vital in achieving these set goals. The National Agriculture Policy of 2007 aims at increasing domestic agricultural production to ensure food and nutrition security of the nation, promoting agricultural productivity and ensure sustainable growth, maximizing benefits and minimize adverse effects of globalization on domestic and export agriculture, adopting productive farming systems and improved agro-technologies with a view to reduce the unit cost of production and increase profits, applying environmental friendly techniques in agriculture, promoting agro-based industries and increase employment opportunities thereof, and, enhancing the income and the living standard of farming community. The National Livestock Development Policy of 2007 considers developing the livestock sector is a necessary condition for ensuring the food security in the country. This is true not only for increased availability of livestock produce, but also to improve soil fertility for greater crop productivity. The policy also recognizes that livestock farming should be made more attractive to the younger generations to get the potential of the livestock sector in poverty alleviation, livelihood improvement and in increased food security. The National Fisheries and Aquatic Resources Development Policy of 2006 aims at improving the nutritional status and food security of the people by increasing the national fish production. The Food and Nutrition Policy for 2004-2010 was released by the Government of Sri Lanka, which emphasized focusing on the poor and integrating nutrition with other sectoral activities, including health, agriculture, education, economic reform, and rural development.

In parallel to the national policies and development programmes, there are several food security-related programmes in Sri Lanka targeted at special groups and the poor. The government's total investment

on Agriculture was Rs. 30,547 million in 2010, of which 75.5 % was on fertilizer subsidies (Anon 2010) to achieve higher crop productivity thus, ensuring food security. The *"Api Wawamu Rata Nagamu"* programme has continued providing Rs. 456 million mainly to promote domestic production through development of 375,000 home gardens and enhancing other sub programmes including re-cultivation of abandoned paddy lands, production and use of organic fertilizer and increasing community based seed production. Meanwhile, the production and use of the organic fertilizer programme has been assisted by providing Rs. 137 million to increase sustainable crop production, improve long term soil fertility and reduction of foreign exchange spending on chemical fertilizer. The government has invested Rs. 1,021 million for research and development in 2010 considering the emerging needs of introducing modern technology and enhancing value addition in agriculture sector. The need to address under-nutrition has been recognized by the Sri Lankan Government, whereby in 1978 a Food and Nutrition Policy Planning Division was established at the central level, followed later by a Nutrition Coordination Unit.

The National Program for Food Security (NPFS, 2009) stated that about a third of the Sri Lankan population is food insecure and vulnerable to economic, natural or any other adverse events impacting on food security. There are three main food security-related programmes in Sri Lanka targeted at special groups and the poor, namely the *Samurdhi, Thriposha* and the Mid-day meal programme in schools. The *Samurdhi* programme is the largest welfare programme with the twin objectives of ensuring food security and reducing poverty, launched in 1995, and intended to cover a target of 20 % of the population which is below the poverty line. The programme actually covers half the total number of households in the country. The *Thriposha* Programme focuses on the specific group of mothers in low income groups with children below the age of one year, and distribute supplement food cereals, pulses and micro-nutrient among the target group. The school Mid-day meal programme targets children with the objective of improving school attendance and children's nutrition, which have at least 30 % malnourished children. The *Divi Neguma* programme implemented in 2011 by the Ministry of Economic Development of Sri Lanka with the assistance of line Ministries focuses on the development of 1.5 million homegardens as economic units ensuring higher agricultural productivity and ensuring household food security.

In the context of food security, two key questions are addressed, namely (a) whether agriculture will be able to meet future global food demands without adversely affecting the resource base, and (b) the optimum approach to enable agriculture to both provide sufficient food and also act as an engine of pro-poor growth despite resource constraints. The governments in the Asia and Pacific region, including Sri Lanka, has come under enormous pressure due to rising food prices and diminishing global stocks, and are striving hard to provide food required for the most vulnerable and poor in their respective countries. Among the many problems faced by the world economy in the past, it is proven that nothing can be more pressing than the food crisis (including food price crisis experienced in the recent past) (Marambe and Silva, 2012). A large number of people lives in south Asia experienced the disastrous conditions due to steep food prices as food and energy together account for more than 75 % of total spending of the poor in the region (Marambe, 2008).

Climate Change and Food Security

Climate change has contributed significantly to reduced rate of growth in development, food insecurity and poor agricultural production at a global scale. The long term increase in food prices as population and income growth surpass productivity and area growth is estimated to be further accentuated by the effect of climate change. The scientists predict short term increased food price volatility and link with energy market, and yet, the productivity is stagnating and growth in agricultural yield has almost

halved since 1990. The expected climate induced change in the year 2050 irrigated rice, which is the main food production system in Sri Lanka, is illustrated in Figure 2.

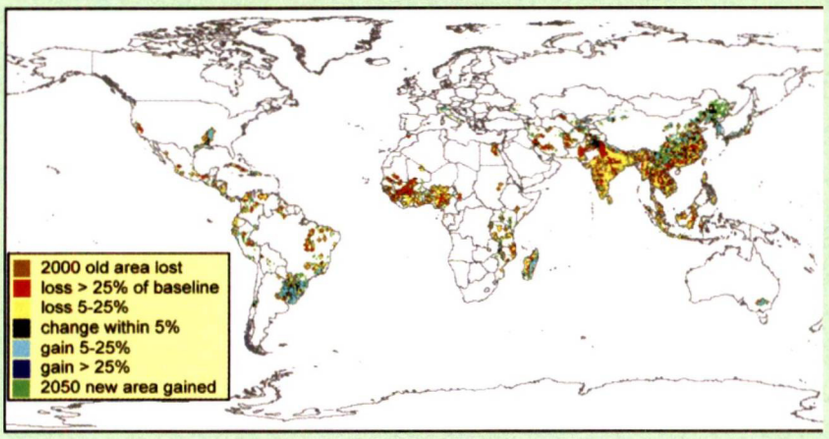


Figure 2. Climate Induced Percentage Change in Yields in 2050 – Irrigate Rice (Source: Ringler, 2009)

In 2007, drought-affected Crop and Animal Production in Australia and the shortfall in the production of staples in Ukraine and Kazakhstan heavily contributed to the global food shortages. Extreme weather conditions have affected the cereal production in China, India, Indonesia, Cambodia, Sri Lanka, etc., in the recent past. In early 2008, the world cereal stocks were adequate to meet 2 months of consumption, the worst scenario experienced since 1970 (Marambe, 2008). In addition, the fuel prices also increased dramatically in 2007-2008 (also due to the weakening US $ against Euro). The effects will be most acute in developing countries, where the increase in demand for consummative goods is expected to be the highest and growing at a rate faster than increases in production (FAO, 2006). These countries are also located in the region where climate change is projected to have its greatest impact. Cline (2007) reported that the agricultural productivity in developing countries is expected to decline by between 9 to 21 % due to global warming. In Sri Lanka, most crops, e.g., coarse grain, legumes, vegetables, and potato are likely to be adversely affected due to climate change. The highest negative impact is estimated for coarse grains and coconut production. Tea, rubber and coconut industries are the major sources of income for labour. The monsoon rainfall pattern and an increase in maximum air temperature are likely to be the two key factors that will affect coconut production in the principal growing regions (Titumir and Basak, 2010).

Food insecurity most parts of the developing world has raised the core issue of concern "sustainable development". South Asia is no exception. The Colombo Statement on Food Security made in 2008 by the state leaders of SAARC (http://www.mea.gov.lk/index.php/ component/content/article/1349-15th-saarc-summit-colombo-statement-on-food-security) and The World Summit on Food Security (FAO, 2009) resulted in a declaration highlighting the need to achieve food security at country and regional levels, promotion of new investments to increase sustainable agricultural production and productivity, support increased production and productivity of agriculture, and implementation of sustainable practices, improved resource use, protection of the environment, conservation of the natural resource base and enhanced use of ecosystem services, thus ensuring sustainable development.

Conclusions

The development programs of Sri Lanka face major challenges of increasing food production in a sustainable manner and improving farm family income in order to ensure household food and nutritional security, while at the same time conserving the natural resource base, biodiversity in particular. After 33 years of civil war, Sri Lanka expands economically and consumers demand more, better and healthy food, a varied and resounding impact awaits for agricultural production and consumption. The climate

changes in recent decades in the forms of natural calamities like drought, flood, fluctuation in rainfall pattern, cyclone, sea level rise also pose serious threat to food security. Decreasing arable agricultural land, together with increasing population render this challenge more difficult to tackle. In Sri Lanka, most crops, e.g., coarse grain, legumes, vegetables, and potato are likely to be adversely affected due to climate change (Titumil and Basak, 2010). Changes in the monsoon rainfall pattern and an increase in maximum air temperature are likely to be the two key factors that will affect food production principal growing regions. Farming in Sri Lanka is dominated by small holdings *i.e.* average size of holding is below one ha. Another serious disadvantage faced by the farmers in the country is the heavy dependence on rain-fed agriculture. The area under irrigation as per cent of arable land is around 39 % in Sri Lanka. Besides, the ever-increasing population, even at a rate less than 1 % as at present and that the population is expected to reach 22.16 million in 2020, is a major challenge in supplying enough food to their basic daily demand in the future, and skewing the human:land ratio. Livelihood security, eradication of poverty, reduction in hunger, and sustainable and inclusive growth of economy of the country would thus critically hinge on the future of agriculture

Strategies for sustainable development integrates environmental management, social equity, and economic development, to ensure a reasonable quality of life for people today without compromising the ability of next generations meeting their needs. People and their activities are totally dependent on biodiversity and food security under changing and variable climate, and the goods and services provided by the ecosystem, but these processes often conflicts with the conservation aspects of nature. It is important to note that unsustainable resource use and unsustainable consumption lead to ecosystem damage and unsustainable development. Strategies and plans for sustainable development thus, must take an account of biodiversity and achieving food security. The challenge of achieving the sustainable development objectives requires innovative, multifaceted, science-based, technological, economic and political approaches, and action. It is crucial that the government of Sri Lanka seriously consider the significant food demands of people, while contributing to conservation of biodiversity and climate change adaptation and mitigation, and strike a balance in the social, economic and environmental domains of sustainable development.

References:

Annonymous (2009): National Food Security Programme – Development Strategy. Ministry of Agriculture and Agrarian Service, Sri Lanka

Anonymoys (2010): Annual Report. Ministry of Finance and Planning, Sri Lanka.

Appadurai A. (2003): Diversity and sustainable development. In: Cultural Diversity and Biodiversity for Sustainable Development. United Nations Education, Scientific and Cultural Organization and United Nations Environment Programme. pp 16-19.

Ashton, P.S. and Gunatillake, C.V.S. (1987): New light on the plant geography of Ceylon - historical plant geography. Journal of Biogeography 14: 249-285.

Bambaradeniya C.N.B. (2006): The Fauna of Sri Lanka – Status of taxonomy, Research and Conservation. IUCN, Sri Lanka

Cline W.R. (2007): Global Warming and Agriculture: Impact Estimates by Country. Centre for Global Research Development and Peterson Institute for International Economics.

FAO (2006): Livestock's long shadow – environmental issues and options (Ed. by H. Steinfeld, P. Gerber, T. Wassenaar, V. Castel, M. Rosales and C. de Haan). FAO, Rome, (Available at: http://www.fao.org/docrep/010/a0701e/a0701e00.htm).

FAO (2009): Increasing Crop Production Sustainably - the perspective of biological processes. Food and Agriculture Organization of the United Nations. Rome, Italy.

FAO (2010): The State of the Food Insecurity in the World. Addressing Food Security in Protracted Crisis. Food and Agriculture Organization of the United Nations. Rome, Italy.

http://www.sacep.org/html/mem_srilanka.htm (accessed on 30th March 2012).
http://www.mea.gov.lk/index.php/component/content/article/1349-15th-saarc-summit-colombo-statement-on-food-security (accessed on 2nd May 2012).
IUCN (1980): World Conservation Strategy: Living Resource Conservation for Sustainable Development, IUCN-UNEP-WWF, Gland, Switzerland.
IUCN and MENR (2007): The 2007 red list of threatened fauna and flora of Sri Lanka. IUCN, Colombo, Sri Lanka.
Madduma Bandara, C.M. (1994): Tank cascades in Sri Lanka. In. Proceedings of IRMU Seminar Series (Ed. K.A. Haq). Irrigation Research and Management Unit of the Irrigation Department, Sri Lanka.
Mahinda Chinhtana (2010): Wonder of Asia. Department of National Planning, Ministry of Finance and Planning, Sri Lanka.
Marambe B. (2008): Outcomes of the SAARC towards solving the food crisis in the region. Economic Review (Special Edition on Food Crisis and Food Security) 34: 20-27.
Marambe B. and Silva P. (2012): Sustainable agriculture – a systems approach. In: Handbook of Sustainability Management (Eds. C.N. Madu and C-H Kuei). World Scientific Publishers ISBN 978-981-4354-81-3 (In Press).
Marambe B., Pushpakumara G, and Silva P. (2012): Biodiversity and agro-biodiversity in Sri Lanka – Village tank systems. In: The Biodiversity Observation Network in the Asia-Pacific Region – Toward further Development of Monitoring. (Eds. S-I Nakano, T. Yahara, and T. Nakashizuka). Ecological Research Monographs. Springer. ISBN 978-4-431-54031-1 (In Press).
MENR (2007): Sri Lanka Strategy for Sustainable Development. Ministry of Environment and Natural Resources, Colombo, Sri Lanka.
Mittermeier, R.A., Gill, P.R., Hoffman, M., Pilgrim, J., Brooks, T., Mittermeier, C.G., Lamoreux, G., da Fonseca, G.A.B. (2005): Hotspots revisited: Earth's biologically richest and most endangered terrestrial ecoregions. CEMEX Conservation Book Series 12, Conservation International, Arlington, USA.
OECD (2001): Strategies for Sustainable Development – Practical Guidance for Development Cooperation. Organization for Economic Cooperation and Development. France.
Panabokke, C.R. Sakthivadivel, R. and Weerasinghe, A.D. (2002): Small tanks in Sri Lanka, evolution, present status and issues, IWMI, Colombo, Sri Lanka.
Pushpakumara, D.K.N.G., Wijesekara, A. and Hunter, D.G. (2010): Kandyan homegardens: a promising land management system in Sri Lanka. In: Belair, C., Ichikawa, K., Wong, B.Y.L. and Mulongoy, K.J. (eds) Sustainable use of biological diversity in socio-ecological production landscapes. Background to the '*Satoyama* Initiative for the benefit of biodiversity and human well-being. Secretariat of the Convention on Biological Diversity (2010), Montreal. Technical Series no. 52. pp 102-108.
Pushpakumara, G. and Silva, P. (2008): Agrobiodiversity in Sri Lanka. Biodiversity Secretariat, Minitry of Environment and Natural Resources, Sri Lanka.
Ringler, C. (2009): Climate Change and Agricultural Trade: How effective is reform as an adaptation measure? Senior Research Fellow, IFPRI. Presented at ICTSD and IPC Dialogue on Climate Change and International Agricultural Trade Rules (1 October), Geneva, Switzerland.
Titumil, R.A.M. and Basak J.K. (2010): Agriculture and Food Security in South Asia. A Historical Analysis and a Long Run Perspective. The Innovators, India.
UNESCO and UNEP (2003): Cultural diversity and biodiversity for sustainable development. United Nations Education, Scientific and Cultural Organization and United Nations Environment Programme. 60 pp.
United Nations (2000): United Nations Millennium Declaration. Resolution adopted by the UN General Assembly at its 8th plenary meeting. http://www.un.org/millennium/declaration/ ares552e.htm (accessed on 4th May 2012).
World Bank (2007): Malnutrition in Sri Lanka: Scale, Scope, Causes, and Potential Response, World Bank, Washington DC.