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Land Degradation: A Threat to Food Security: A Global Assessment

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Abstract
Ever since mankind started agriculture, land degradation has been a single largest threat to soil productivity and has remained so till date. This has been a major global issue during the 20th century and will remain high on the international agenda in the 21st century. The study is basically the assessment of the impact of land degradation on soil loss through productivity loss and hence it effect on global food security. A major problem confronting many countries today is the inadequacy of food supply in the face of rapidly growing population. In many countries, the task of producing enough food for the teeming population has received considerable policy attention. Nevertheless, the growth rate of food production is still far below the population growth rate. This is brought about by land degradation. Experts in the field of economics, geography, soil science and agricultural development, as well as environmental management have a duty to draw the attention of policy makers to soil degradation problem and work with them to set priorities for public investment in land degradation problems. A policy framework to mitigate land degradation problems can be tackled at the national, regional and international levels, and also by the land users (the farmers) themselves and by Non-Governmental Organisations (NGOs).
Keywords: Land degradation, food security, global threat

1. Introduction

Ever since mankind started agriculture, land degradation has been the single largest threat to soil productivity and has remained so till date (Sullivan, 2004). This has been a major global issue during the 20th century and will remain high on the international agenda in the 21st century. This is so because removal of the topsoil by any means has many disastrous effects on the productive capacity of the soil as well as on ecological wellbeing. Doran and Parkin (1994), captioned the impact of land degradation in their popular maxim that, "the thin layer of soil covering the earth's surface represents the difference between survival and extinction for most terrestrial life".

The importance of land degradation among global issues is enhanced because of its impact on world food security and quality of the environment. Many countries have adopted policies in various phases for the development of agriculture with the expectation that development of agriculture would lead to overall development of their nation and help in the eradication of poverty. It has been latter realized that the increasing efforts to raise agricultural growth has resulted in forms of land and water degradation. Large scale ecological losses were reported in crop land, grass land and forest land, such as soil erosion, soil alkalinity and salinity, micronutrient deficiency, water logging and fast depletion and contamination of ground water (Miranowski, 1984).

It is true that the underlying causes of degradation have been very often the basic socio-economic structure and institutional structures of various countries. Among them are land shortage, inappropriate land tenure arrangements, poverty, and population growth. However, the diverse factors that contribute to the problem make it necessary that a comprehensive approach is taken by the authorities responsible for policy in different areas such as food security, forests, soil conservation, and water resources (Mythili 1993). Loss in the value of soil due to land degradation such as erosion or change in soil quality must be valued in order to understand the environmental cost of agriculture. In the literature, soil loss has been valued using productivity approach, preventive cost approach, and replacement cost approach. The productivity approach basically attempts to value through impacts assessment, that is, estimate soil loss through productivity loss. Preventive measures are factors such as conservation and defensive expenditure. The replacement cost is cost of restoration of soil to its original state (Mythili,1993). The study is basically the assessment of the impact of land degradation on soil loss through productivity loss and hence it effect on global food security. This study is organized as follows: Following this introduction is the analysis of the conceptual and theoretical framework. Section three presents the global impact of land degradation. Section four deals with the effect of land degradation on productivity. Section five assesses the impact of land degradation in Sub-Saharan Africa. Section six presents the measures and policies to control land degradation and they final section draws conclusions and makes recommendations for further study.

2. Conceptual and Theoretical Framework

2.1 Land Degradation

Land degradation has negative connotations that imply the loss of something of value within the environmental economic system (Gretton and Salma, 1997). The lost value may be related to the productivity of the land for agriculture, the environment as a host to naturally occurring species of Flora and Fauna or to the environment as a place for other human activities such as mining, secondary industries, human habitation and waste assimilation.

Land degradation as defined by Abdi, Glover and Luukkanen (2013), is the result of complex inter-relationships between biophysical and socio-economic issues which affect many people and their land, especially in the tropics and developing countries. According to the authors, the term land degradation involves both soil and vegetation degradation. Soil degradation refers to negative changes in the physical, chemical and biological properties of the soil, whereas vegetation degradation is the reduction in the number of species and the vegetational composition. Hence, land degradation is usually described in terms of the loss in natural resources (soil, water, fauna and flora) or in the biophysical process by which it functions.

However, a number of theories have been put forward as the fundamental cause of land degradation. McConnell (1983), asserts that soil erosion is a result of rational farm decision making. A rational producer, maximizing the discounted net revenue from land over time would not respond to soil loss until the present value of marginal private returns obtained from additional soil loss goes below the implicit marginal private cost of soil loss. The net value from land consists of two components which are the present value of the revenue stream and the present value of the terminal value off the land. According to Miranowski (1984), soil erosion, not only affects future productivity but also the terminal value. The presence of large external cost (off-site costs) is neglected in the private decision. The rationale for policy intervention arise in two contexts, (a) where off-site costs are significant, (b) where the on-site land degradation effect is not transparent to the owner. Various types of market failures in the land market have also been noted. Notable among them are common resource problem, tenurial arrangements and absence of risk market (Mythili, 1993).

However, land degradation has received widespread debate at the global level as evidenced in the literature: UNEP, 1992, Johnson and Lewis, 1995; Oldeman et al; 1992, Middleton and Thomas, 1997; Maingnet, 1994; Lal et al, 1997. At least two distinct schools have emerged regarding the prediction, severity, and impact of land degradation. One school believes that it is a serious global threat posing a major challenge to humans in terms of its adverse impact on biomas productivity and environmental quality (Dregne and Chou, 1994). Ecologists, soil scientists, and agronomists primarily support this argument (Eswaran, Lal and Reich, 2001). The second school, comprising primarily economists, believes that if land degradation is a severe issue, why market forces have not taken care of it. Supporters argue that land managers (farmers) have vested interest in their land and will not let it degrade to the point that it is detrimental to their profits (Crosson, 1997).

Moreover, according to Eswaran, Lal and Reich (2001), there are numerous terms and definitions that are a source of confusion, misunderstanding and misinterpretation. A wide range of terms is used in the literature, often with distinct disciplinary – oriented meaning, and leading to misinterpretation among disciplines. Some common terms used are soil degradation, land degradation and desertification. The authors further maintained that the term degradation or desertification refers to irreversible decline in the biological potential of the land. The biological potential in turn depends on numerous interacting factors and it is difficult to define.

Therefore, for the purpose of this study, the definition given by Gretton and Salma (1997) is preferred. The authors defined land degradation as the decline in the biological productivity or usefulness of land resources in their predominant intended use. It encompasses the reduction in the productivity of land resulting from soil loss, breakdown in soil structure, salinization, waterlogging, nutrient loss, and pollution from toxic substances.

2.2 Food Security

A major problem confronting many countries today is the inadequacy of food supply in the face of rapidly growing population. In many countries, the task of producing enough food for the teeming population has received considerable policy attention. Nevertheless, the growth rate of food production is still far below the population growth rate. This is brought about by land degradation.

Definitions of food security abound, but essentially, food security is access by all people at all times to the food required for a healthy life (Frankenberger, 1990; Von Braun ,1991). However, increasing food prices arising from declining farm productivity have reduced the economic access of the poor to the minimum quantity of food required. Consequently, 550 million people in the world were food insecure in 1989 (World Food Commission, WFC, 1990). This number increased to 800 million in 1994 (IFPRI, 1995), thereby making a 45 % increase in less than a decade. Worse still, it was realized that food insecurity, like malnutrition breeds at the highest rate in South Asia and the sub-Saharan Africa (SSA), thus indicating that hunger might remain a major challenge confronting the world by 2020 (Oyekale, 2001). As possibilities for expansion of agricultural land are limited, this would imply taking in use marginal lands (Biswas, 1994). Therefore, an increase in food production is necessary per hectare of arable land. Currently, there is increased attention for environmental degradation

impact on food productivity and it has been an important issue during the 1996 FAO World Food Summit.

2.3 Land Degradation and Food Security Linkage

The two most important driving forces of land degradation in many countries of the world are limited land resources and population increase which has given rise to food insecurity. The resultant effect is small farms, low production per person and increasing landlessness. Land shortage and productivity decrease, taken together, lead to non-sustainable land management practices, the direct causes of degradation. Poor farmers are led to clear forest, cultivate steep slopes without conservation, overgraze rangelands and make unbalanced fertilizer applications (Mythili, 1993).

Land degradation then leads to reduced productivity. This has the effect of increasing land shortage still further, and thus leads to more and more food insecurity. Most of the countries are experiencing rapid population growth. Hence, they have to cultivate increasing areas of available land, ranging from arable land to all other types of soil. In so doing, natural vegetation is destroyed and replaced by cultivated fields. Thus, with constant farming, a once fertile land loses its fertility. As a consequence, there is loss in productivity which has resulted in food insecurity in many parts of the world.

3. The Global Impact of Land Degradation

Table I shows the global supply and use of land. The land surface of the earth totals 13.0 billion hectares, of which 1.5 billion are unused wasteland and 2.8 billion are unused but largely inaccessible (Oldeman, 1994). Of the 8.7 billion hectares used, most is suitable only for forest, woodland, grassland, or permanent vegetation, only 3.2 billion hectares are potentially arable. About half of this potentially arable land is currently cropped and 41 % is considered moderately to highly productive (IFPRI, 1999).

Table I: Global Supply and Use of Land

Type of Land	Area (billion hectares)
Total ice-free land area in the world	13.4
Total land area without water bodies	13.0
Land used	8.7
Potentially arable land	3.2
Moderately to highly productive	1.3
Low productive land	1.9
Current use of potentially arable land	3.2
Crop land	1.5
Permanent Pasture, forest and woodland	1.7

Source: Buringh and Dudal (1987); Data for total land area without water bodies and land used are from Oldeman (1994).

There is historical evidence of large-scale soil degradation in many parts of the world in the past 5000 years (Hillel 1991; Hyams 1952). UNEP (1997) calculated that 2 billion hectares of land that was once biologically productive has been irreversibly degraded in the past 1,000 years. Rozanov, Targulian, Orlov's (1990) analysis of global changes in the humusphere found that there has been a loss of humus at a rate of 25.3 million tons per year on average ever since agriculture began 10,000 years ago. This loss accelerated to 300 million tons per year in the past 300 years and 760 million tons per year in the past 50 years. Nearly 16 percent of the original stock of organic soil carbon may have been lost. Within the past 300 years, 100 million hectares of irrigated land alone apparently have been destroyed and another 110 million hectares have come to suffer, from diminished productivity due to secondary salinization. The amount of land thus affected is nearly equivalent to the 220 million hectares of global irrigated area in 1984. Rozanov, Targulian and Orlov (1990) concluded that more productive land may have been irreversibly lost in the past 10,000 years than is currently under agricultural production.

3.1 Extent and Rate of Land Degradation

The geographical distribution and total areas affected by land degradation was only roughly known, even though land degradation is generally recognized as a serious and wide-spread problem. Dregne (1986) stated that sweeping statements on the fact that soil erosion is undermining the future prosperity of mankind do not help planners who need to know where the problem is serious and where it is not.

The need to obtain a better overview of the geographical distribution of land degradation came to fruition when regional experts carried out the Global Assessment of Soil Degradation (GLASOD) and this was the first worldwide comparative analysis to focus specifically on soil degradation (Oldeman 1994). GLASOD was designed to provide continental estimates of the extent and severity of degradation from World War II to 1990. The study concluded that 1.97 billion hectares, that is, 23 % of globally used land had been degraded.

Oldeman further established that thirty-eight percent of all agricultural land had become degraded,

along with 21 % of permanent pasture and 18 % of forests and woodland (see Table 2). Nine percent of all cropland, pasture and woodland were lightly degraded in 1990. Ten percent was moderately degraded implying a large decline in productivity, and 4% was strongly degraded, implying a virtual loss in productive potential. Land degradation caused by water erosion was higher than wind erosion (see Table 3 and Table 4).

Lal (1994), using GLASOD data derived that of all degraded soils, 58% were in drylands and 42% in humid areas. For the tropics alone, 915 million hectares had been degraded by water erosion, 474 million by wind erosion, 239 million by chemical degradation and 50 million by physical degradation. Lal's estimate further showed that nearly 20% of 1.1 billions hectares of global dryland soils have been degraded. This is well below estimates from Dregne and Chou's (1992) comprehensive review of literature on dryland degradation including degradation of soil as well as vegetation and nonagricultural soil functions. They found that more than 70 percent of drylands in Africa, Asia, and South America were degraded, that is, 30 percent of irrigated drylands, 47 % of rainfed drylands and 73% of rangelands.

In the GLASOD study, lightly degraded soil is defined as having somewhat reduced agricultural suitability, but is suitable in local farming systems. Original biotic functions are still largely intact, and restoration to full productivity is possible through modifications in farm management. Moderately degraded soil is soil that offers greatly reduced productivity, but is still suitable for use in local farming systems. Major improvements are needed that are typically beyond the means of local farmers. The original biotic functions are partially destroyed. In strongly degraded soil, productivity is virtually lost and not suitable for use in local farming systems. The original biotic functions are largely destroyed. Major investments or engineering works would be needed to restore the land to full productivity. Extremely degraded soil is defined as a human-induced wasteland, unreclaimable, beyond restoration, and with biotic functions that are fully destroyed.

Table 2 : Global estimates of soil degradation, by region and land use agricultural land permanent pasture forests and woodland all used land

Region													Seriously Degraded	Percent
	Total	Degraded	Percent	Total	Degraded	Percent	Total	Degraded	Percent	Total	Degraded	Percent		
	(Million hectares)			(Million hectares)			(Million hectares)			(Million hectares)			(million hectare)	
Africa	187	121	65	793	243	31	683	130	19	1,663	494	30	321	19
Asia	536	206	38	978	197	20	1,273	344	27	2,787	747	27	453	16
South America	142	64	45	478	68	14	896	112	13	1,516	244	16	139	9
Central America	38	28	74	94	10	11	66	25	38	198	63	32	61	31
North America	236	63	26	274	29	11	621	4	1	1,131	96	9	79	7
Europe	287	72	25	156	54	35	353	92	26	796	218	27	158	20
Oceania	49	8	16	439	84	19	156	12	8	644	104	17	6	1
World	1,475	562	289	3,212	685	141	4,048	719	132	8,735	1,966	158	1,217	103

Source: For all totals, FAO (1990), and for others, Oldeman, Hakkeling and Sombroek (1991)

Table 3: Global extent of chemical and physical soil degradation by region chemically degraded area physically degraded area

Region	Loss of nutrients	Salinization	Pollution	Acidification	Compaction sealing and crusting	Water logging	Loss of organic matter	Total degraded land	Total degraded land as percentage of total land used
					(million hectares)				
Africa	45	15	+	1	18	1	-	81	4.8
Asia	15	53	2	4	10	+	2	86	3.0
South America	68	2	-	-	4	4	-	78	5.1
Central America	4	2	+	-	+	5	-	12	6.0
North America	-	+	+	+	1	-	-	1	+
Europe	3	4	19	+	33	1	2	62	7.7
Australia	+	1	-	-	2	-	-	3	
World	135	77	21	5	68	11	4	323	26.6

Source: Oldeman, Hakkeling, and Sombroek (1991).

Note: Degradation figures include data for slightly, moderately, strongly and extremely degraded lands. Plus sign means negligible, minus sign means none reported.

Table 4: Global extent of soil degradation due to erosion by region area eroded by water erosion: area eroded by wind erosion:

Region	Light	Moderate	Strong and extreme	Total	Light	Moderate	Strong and Extreme	Total	Total area eroded	Total area seriously eroded	Total area seriously eroded as a percent of total land used
					(million hectares)						
Africa	58	67	102	227	88	89	9	186	413	267	16
Asia	124	242	73	441	132	75	15	222	663	405	15
South America	46	65	12	123	26	16	-	42	165	93	6
Central America	1	22	23	46	246	4	1	5	51	50	25
North America	14	46	-	60	3	31	1	35	95	78	7
Europe	21	81	12	114	3	38	1	42	156	132	17
Oceania	79	3	222	83	16	-	27	16	99	3	3
World	343	526	444	1,094	253	253	54	548	1,642	1,028	89

Source: Oldeman, Hakkeling, and Sombroek (1991).

4. The effect of Land Degradation on Productivity

The assessment of the effect of land degradation on productivity is a challenging task (Lal, 1998). The difficulties in obtaining global estimates of the impact of land degradation on productivity in turn created problems and raised skepticism. In Pimentel, Alien and Beer's (1993) estimate which were based on available secondary data showed that global production is 15 – 30 % lower as a result of all the various effects of soil erosion. Buringh and Dudal's (1987) estimates are even higher. Using an International Institute for Advanced Systems Analysis (IIASA) model that assumes no soil conservation, they predicted that just between 1984 and 2000, 22 % of the more productive crops, pasture, and forest land including 14% of the most productive soils would be degraded. Erosion induced soil nutrient depletion would result in a 29% decline in rain-fed crop production and a 19% loss in total potential production (see Table 4).

Other estimates are based on empirical evidence. Dregne and Chou (1992) estimate showed that more than a third of irrigated land in Asia and more than half of rain-fed land in Africa and Asia had experienced a 10% loss in productive potential, while 8% of irrigated and 10 % of rain-fed land in Asia has experienced at least a 25% loss in potential productivity. They estimated that over half the range lands has experienced more than 50% loss in potential productivity. Using GLASOD data, Crosson (1997) estimated an aggregate global loss of 11.9-13.4 % of agricultural supply, assuming a 15%, 35% and 75% yield decline respectively for light, moderate, and strongly degraded cropland soils, and a 5%, 18% and 50% decline for pasture soils.

Oldeman (1998) used Crosson's coefficients to calculate that global crop land production was 12.7 percent lower and pasture production 3.8% lower than they would have been without degradation, for a total agricultural loss of 4.8% (see Table 5). What is deduced from all the estimates is a loss in agricultural production which has threatened food security in all part of the world. Oyekale (2001) asserted that food insecurity, like malnutrition breeds at the highest rate in South Asia and the Sub-Saharan Africa (SSA), thus indicating hunger might remain a major challenge confronting developing countries by 2020. Accordingly, Lal (1998) maintained that in spite of the unfavourable farm policy and other institutional constraints that are partly responsible for the food insecurity, the potentials of the natural resources most especially the soils to sustain yield increases, given the present farming systems, have been seriously questioned. The Word Commission on Environment and Development (WCED 1987) and IFPRI (1995) had therefore, addressed the world on the need to promote sustainable use of natural resources to enhance sustainable development.

5. The Impact of Land Degradation in Sub-Saharan Africa (SSA)

Soil degradation seems to be the greatest factor limiting soil productivity and impeding agricultural enterprise in the entire humid tropical region. This is evident in many regions of Africa (Dregne, 1990), mainly in the humid and sub-humid zones of Sub-Saharan Africa (SSA) where population pressure and deforestation exacerbate the situation and the rains come as torrential downpours. As the region's population continues to grow rapidly (3% per annum), outpacing the growth rate in other regions of the world, the carrying capacity of its agricultural land is becoming lower, bringing closer the land frontier (Diagana, 2003).

Agricultural productivity and food security in SSA are being seriously threatened by the steady decline in soil fertility. Declining soil fertility jeopardizes the sustainability of farming systems in SSA especially in arid and semi-arid areas that are ecologically fragile. In spite of the fact that the problem of land degradation is particularly severe in SSA, only little reliable data were available by the end of the 20th Century both on its extent (FAO, 1995; Warren, Batterbury and Osbahr, 2001) and on the cause effect relationship between soil

erosion and soil productivity. Thereafter, no significant research progress has been made to beef up the extent of soil degradation in the region.

Batjes (2001), reports that degraded soils amount to about 494 millions hectares in Africa. It is also estimated that 65% of SSA's agricultural land is degraded because of water and soil erosion, chemical and physical degradation (Oldeman, Hakkeling, Sombroek 1991; Scherr, 1999). According to the authors, forms of degradation vary with the causative factor, this is, in terms of loss of top soil, terrain deformation, mass movement or over blowing (water and wind erosion), loss of nutrient and organic matter, salinization/alkalization, acidification, pollution (chemical deterioration, compacting/crusting, water logging, subsidence of organic soils (physical deterioration). Of the total degraded area, overgrazing, agricultural mismanagement, deforestation and overexploitation of natural resources are said to account respectively for 49%, 24%, 14% and 13%.

Table 5: Average percentage cumulative loss of productivity during post - Second World War period as a result of human-induced soil degradation, worldwide and per continent

Percentage loss per degradation category (light, moderate, strong)	Cropland 15, 35, 75	Pasture Land 5, 18, 50	Crops and Pastures 5, 18, 50	(Crops and Pastures) 15, 35, 75
World	12.7	3.8	4.8	8.9
Africa	25.0	6.6	8.1	14.2
Asia	12.8	3.6	4.7	8.9
South America	13.9	2.2	4.1	6.7
Central America	36.8	3.3	8.7	14.5
North America	8.8	1.8	3.0	5.8
Europe	7.9	5.6	4.6	9.0
Oceania	3.2	1.1	1.2	3.2

Source: Oldeman (1998)

A literature review by Dregne (1990) of 33 countries found compelling evidence of serious land degradation in subregions of 13 countries: Algeria, Ethiopia, Ghana, Kenya, Lesotho, Mali, Morocco, Nigeria, Swaziland, Tanzania, Tunisia, Uganda and Zimbabwe. In another literature review, focused on drylands only, Dregne and Chou (1992) estimated that 73% of drylands were degraded and 51% severely degraded. They concluded that 18% of irrigated lands, 61% of rainfed lands, and 74% of range lands located in dry lands are degraded.

Diagana (2003) asserts that most economies in SSA are agriculturally based and about two-thirds of Africans depend on agriculture for their livelihoods. The fate of the agricultural sector, therefore, directly affects economic growth, poverty alleviation and social welfare in Africa. Therefore, the consequence of land degradation is the stagnation or decline in crop production in many African countries which has given rise to food insecurity in the region.

6. Policies to Mitigate Land Degradation

Experts in the field of economics, geography, soil science and agricultural development, as well as environmental management must draw the attention of policy makers to soil degradation concerns and work with them to set priorities for public investment in land degradation problems. This is necessary because soil is virtually a non renewable resource. The society has an obligation to protect soil, conserve it, or even enhance its quality for future generations. This section therefore, presents a framework for action to tackle the problem of land degradation at the national, regional, international levels, by the Non-governmental Organisations (NGOs) and the farmers themselves.

6.1 Action at the National Level

Agricultural policies can have a profound effect on land use. Subsides, incentives and taxes can all have a tremendous effect on what crops are grown, where and whether or not the land is well managed. Governments, attempting to achieve self sufficiency in food production, frequently promote policies which result in marginal land being misused. This in turn, leads to land degradation. On the other hand, the price of food crops is sometimes controlled and kept to such a low level that it becomes pointless for farmers to manage their crops or land well. This therefore leads to land degradation. All government policies which affect the economics of land use should be carefully reviewed and where necessary, modified so that they encourage productive and sustainable land use rather than destructive practices.

Land users are frequently ready to participate in conservation programmes but lack the essential knowledge and skills. It is therefore, necessary to provide practical training if conservation programmes are to

succeed. Successful technology diffusion depends on building links between farmers, extension agents, researchers, administrators and policy makers.

Land degradation, in its different forms, is now probably the most important environmental problems facing countries of the world. National publicity campaigns are needed if this subject is to receive the attention that it deserves. Programmes should include national publicity campaigns that sensitize the public in general, and the rural population in particular to the issues of land productivity, water management and soil conservation.

Furthermore, the most important step is for the government to identify those factors that can be changed to reverse the processes that lead to land degradation. Possible causes include growing the wrong crops on the wrong land, insecure land tenure, poor infrastructure, lack of inputs, inappropriate pricing structure for agricultural products, subsidies, incentives, taxes or even out dated laws or social customs. Problems like these can be overcome simply by introducing a new technology. Therefore, if governments understand why land is being degraded, it may be possible to introduce gradual and inexpensive changes that will encourage farmers to take up more productive and sustainable forms of land use. In fact, there are no universal panaceas or readymade solutions that can be applied any where without modification. If the problems of land degradation are to be overcome, each country must develop its own conservation and rehabilitation policy, strategy and programmes tailored to its own unique circumstances.

6.2 Action at the Regional Level

At the regional level, farmers who do not have long-term rights to the land they cultivate are seldom, if ever, interested in improving or protecting that land. This applies to millions of farmers in the rural areas. The largest group of farmers affected in this way are those that practice shifting cultivation, that is, clearing small plots of land and cultivating them until the fertility of the soil decreases, and then moving on to clear and cultivate another plot. Without any rights to the land that they are using, they have no incentive to change or improve the fertility of the land.

Special attention must be given at the local level to these and other landless farmers if land conservation programmes are to be effective. Landlessness, whatever its cause, is becoming an increasingly common problem. Furthermore, a sustained effort is needed to improve the security of tenure of those who do not have land. Farmers who have no guarantee that they can stay on the land that they farm rarely take actions that contribute to long-term stability and productivity, such are erosion protection and tree planting. Various possibilities must be explored, including provision for different types of land rights, ranging from full ownership to leases.

6.3 Action at the International Level

International coordination is needed to ensure that the plan to tackle land degradation receive the long-term support that they will require. Therefore, there is an urgent need to develop land, water and forestry management systems that are acceptable to farmers in all countries. The research needed to develop such systems, however, is often expensive and time consuming. Much can be gained by pooling research efforts among countries with similar problems. Research results can be shared by establishing simple research networks or by building a research component into existing networks and programmes.

Furthermore, through the international co-ordination of land degradation problems, participating nations stand to reap many benefits. The overall objective, is to prevent or slow down land degradation so that sustainable agriculture becomes a practical possibility. The benefits the participating nations will derive include improve national and international data on land degradation, improved training and a wide range of donor support.

6.4 Action from Farmers

While the overall responsibility for arresting land degradation lies with governments, better results on land conservation can be achieved over large areas and at a reasonable cost only through the activities of the land users themselves. Land conservation programmes should therefore aim at creating the conditions which will encourage land users at the level of the farm to adopt land use systems and management practices that will lead to conservation. Consequently, for a better result to be achieved, it is necessary to develop agricultural practices which will simultaneously increase yields, decrease risk or offer some other advantages while at the same time, controlling land degradation.

6.5 Action from Non-Governmental Organisations (NGOs)

NGOs have been playing an increasing important role in land conservation in all part of the world. Many are very efficient at the grass roots level and can often involve village organisations in a way that is impossible for government organisations. Their effectiveness in small scale projects is becoming widely recognized and some major donors are now channeling an increasing amount of their funds through NGOs. In most countries of the

world, NGOs provide a largely untapped potential for government to promote and expand their conservation and rehabilitation programmes, a potential which should not be overlooked in the development of national policies and strategies.

7. Conclusions

The importance of land degradation among global issues is being enhanced because of its impact on world food security and quality of the environment. Many countries have adopted policies in various phases for the development of agriculture with the expectation that development of agriculture would lead to overall development of their nation and help in the eradication of poverty. Their increasing efforts to raise agricultural growth have resulted in the form of land and water degradation.

The underlying causes of degradation have been very often the basic socio-economic structure and institutional structures of various countries. Among them are; land shortage, in appropriate land tenure arrangements, poverty, and population growth. A major problem confronting many countries today is the inadequacy of food supply in the face of rapidly growing population. In many countries, the task of producing enough food for the teeming population has received considerable policy attention. Nevertheless the growth rate of food production is still far below the population growth rate. This is brought about by land degradation.

Expects in the field of economics, geography, soil science and agricultural development, as well as environmental management have a duty to draw the attention of policy makers to soil degradation problem and work with them to set priorities for public investment in land degradation problem. A policy framework to mitigate land degradation problems can be tackled at the national, regional and international levels, and also by the land users (the farmers) themselves and by Non-Governmental Organisations (NGOs).

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