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Table of Contents

1. Introductions

2. Poverty and Environmental Degradation

3. Militarization and Poverty

4. Militarization and Environmental Degradation

5. The Interlinkages and the Prospects of Conversion

6. Conclusions

Notes

Bibliography

THE DEVELOPMENT TRAP: MILITARIZATION, ENVIRONMENTAL DEGRADATION AND POVERTY AND PROSPECTS OF MILITARY CONVERSION*

1. INTRODUCTION

Less Developed Countries (LDCs) made considerable efforts to speed the process of socio-economic development in the post-colonial era. Immediately after the liberation from colonial administrations, most LDCs initiated very ambitious programmes for development. Different approaches and plans for socio-economic development were experienced. Many countries, after many decades of national rule and planning, however, failed to achieve the objectives of development; and some countries have even failed to maintain the *status quo* of the colonial era.

To corroborate the above argument of the failure of LDCs to achieve development objectives, we need to operationalize the concept of development. However, a precise definition for socio-economic development is difficult to establish, although countries can be easily classified into developed and underdeveloped categories. Development is a multi-dimensional and dynamic process that requires high levels of *per capita* income as well as an egalitarian distribution of income, elimination of poverty and the provision of human basic needs; without jeopardizing the needs and prospects of future generations (sustainability). Economic growth is, thus, a necessary but not sufficient condition for development. The development process also involves social transformation and meeting non-material requirements such as the ability of individuals to participate in economic and political decision making.

A cursory look at the various indicators of development gives clear evidence for the failure of LDCs to achieve development. For example, the worldwide rate of growth of real GDP *per capita* has fallen in the last three decades. In developing countries it fell from 3.9% in 1965-1973 to 2.5% in 1973-1980 and 1.6% in the 1980-1989 period. The growth rate of real GDP *per capita* in Sub-Saharan Africa and Latin America in the period 1980-1989 fell to -1.2% and -0.04% respectively. Child mortality in South Asia exceeds 170 per thousand; life expectancy in Sub-Saharan Africa is 50 years; and more than 110 million children in LDCs lack access to primary education. Furthermore, WHO and UNICEF estimate that nearly 43% of the 14.6 million child deaths each year could be prevented through vaccination at an average cost of 13 dollars per child.¹

Development economists have enumerated various obstacles that halted Third World development. Some emphasized the importance of external factors in the phenomenon, while others attributed it mainly to internal factors. These include political instability, lack of basic infrastructure, inadequacy of well-developed human resource and managerial skills, unfair terms of trade with the developed world, scarcity of natural resources, faulty development policies and planning, military intervention and civil wars, etc.¹

The above mentioned factors clearly stand as obstacles in front of most LDCs' development. This study, however, affirms the existence of a "*development trap*" in most LDCs. It pinpoints three

pivotal factors which inhibited socio-economic development in these countries: militarization, environmental degradation, and poverty. The importance of these factors stems not only from their large contribution to the phenomenon of underdevelopment, but also because each factor is the consequence and cause of the others. These causation and feedbacks between the three factors constitute a real "*development trap*" which reinforces itself on most developing countries.

The main aim of this study is to analyze the direct effects of militarization, environmental stress, and poverty on socio-economic development. The novelty of the study stems from its attempt to explore the interlinkages and feedbacks of the three factors and the indirect effects of this causation on the development process. The focus here is on the theoretical linkages and mechanisms in LDCs, with special emphasis on the African continent. Although development is a multi-dimensional and of interdisciplinary nature, this study relies mainly on economic analysis to explain the obstacles facing the process of development. A forthcoming Occasional Paper will undertake a detailed case study of the Sudan, to provide an empirical verification to the hypothesised linkages, and to corroborate the existence of a self-reinforcing "*development trap*".¹

1.1 Poverty Trends

Poverty refers to the inability to attain a minimum standard of living. This minimum standard of living (poverty line) is estimated by the World Bank to be obtained by an annual income of \$370. Accordingly, it is estimated that more than one billion people in LDCs - one fifth of the world population - are living in poverty.¹ Therefore, there are more hungry people in the world today than ever before in human history, and their numbers are growing.

Each year the number of human beings increases, but the amount of natural resources with which to sustain this population, to improve the quality of human lives, and to eliminate poverty remains finite. The high poverty levels which occurred in the last two decades are, therefore, likely to increase in the 1990s for many reasons. First, LDC's prospects of economic recovery in 1990s are gloomy (debt problems, world recession, political instability, etc.).

Second, the population growth rates of most developing countries exceed the rates of GDP growth, and consequently *per capita* income will fall in absolute terms. Population projections indicate an increase in global population from 4.8 billion in 1985 to 6.1 by 2000, and to 8.2 billion by 2025. More than 90% of this increase is expected in developing regions.¹ The rapid rise in population has also compromised the ability to raise living standards. Third, unequal income distribution in most LDCs means the burden of poverty is spread unevenly within these countries. To demonstrate the rising trends of poverty levels, the number of poor in sub-Saharan Africa was 180 million in 1985, and is projected by the World Bank to reach 270 million by the year 2000.¹ Finally, within countries, poverty has also been exacerbated by the unequal

distribution of land and other assets. Table 1 shows the distribution of poverty among regions of LDCs.

1.2 Militarization Trends

As militarization refers to the process of expansion of the military establishment within a certain society, it can be quantified by a set of economic, political and strategic indicators. These include the level of military expenditure and its shares in government expenditure and total GDP, as well as arms imports, size of the armed forces, and military intervention in the political scene.

The world has, throughout the past five decades, consistently devoted between 4.5% and 7% of its GNP and more than 15% of governmental expenditures to military expenditure. Moreover, according to a 1983 United Nations study, well over 70 million people were engaged at that time, directly or indirectly in military activities worldwide. In 1988, world military expenditures exceeded one trillion dollars, world armed forces numbered 28 million persons and total world arms transfers reached 49 billion dollars.¹ From 1965 to 1985 Third World military expenditure constituted about 15% of the world total but its burden was more than 15% of total governments expenditure. Moreover, although the bulk of the military spending was by the developed countries, the fastest growth was among the poorer countries. In the same period Third World military expenditure increased faster than that of developed countries. Then the trend declined in the late 1980s but was again reversed in 1990.¹

Military intervention in Third World's politics has become a universal phenomenon. Inefficiency of civilian administration, eradication of corruption, and the characteristics of the armed forces as disciplined and modern organizations were the declared motives behind military intervention. Nevertheless, most military governments have failed to achieve political stability, and the frequency of military coups has increased in LDCs, and particularly in Africa. The size of LDCs' military establishments has also increased enormously in the post-independence period. Furthermore, the last three decades have witnessed high incidence of bloody internal conflicts and civil wars in individual LDCs. Therefore, it is clear that most LDCs have witnessed considerable militarization in the post-War era.¹

1.3 Environmental Degradation

The most alarming trend, which receives mounting international attention, is the speed of environmental degradation, particularly the environmental problems that are caused by anthropogenic (man-made) activities. Beside regional environmental stress, three environmental phenomena are of global concern: climate warming, ozone depletion, loss of biodiversity, and acid rain.

Climate warming (greenhouse effect) is caused by atmospheric concentration of long lived gases, such as carbon dioxide, nitrous oxide; and results in an increase in mean global temperatures.¹ The accumulation in the atmosphere of CO₂ and certain other gases traps solar radiation near the Earth's surface. The gases absorb some of the radiant heat which the earth emits after receiving solar energy, and without this absorption the earth would be 30⁰C cooler. Anthropogenic activities, however, amplify the greenhouse effect by emitting greenhouse gases, causing their concentration to increase in the atmosphere. Carbon dioxide (CO₂) results from the combustion of fossil fuels (oil, coal, and natural gas), while anthropogenic methane (CH₄) emissions result

from agricultural activities, and fossil fuel production. The emission of the two gases was responsible for more than 65% of the climate forcing in the 1980s.¹ Global warming threatens the survival of most natural ecosystems, and it could also result in loss of forests, wetland, and the decline and extinction of many species. Moreover,

Changes in temperature and precipitation will affect agricultural and water management practices. Sea level rise will cause coastal flooding and salt water intrusion in bays and coastal aquifers to increase, and will destroy valuable wetland. The frequency of extreme weather events (e.g., heatwaves, hurricanes) is likely to increase, affecting human health and property, and natural managed ecosystems. Higher temperatures may exacerbate air pollution, especially smog (World Bank, 1991; 55).

The trend of global warming is alarming because an effective doubling of CO₂, which is expected to occur around the middle of next century, will result in extra global warming of 1.4 - 4.5⁰C.

Ozone (O₃), the gas that occurs at low concentrations through the air atmosphere, acts as a shield to prevent harmful ultraviolet radiation from reaching the surface of the earth. Human use of Chlorofluorocarbons (CFCs) and halons, however, create reactive chlorine and bromine atoms in the stratosphere. This acts as a catalyst in the destruction of the ozone, as well as creating local seasonal ozone holes over Antarctica. The depletion of stratospheric ozone results in the penetration of biologically-damaging ultraviolet radiations which induce cancer, cataracts, and the suppression of human immune response system.¹ Moreover, agricultural productivity and quality is likely to decline and to be of poor quality.

The third global environmental threat comes from acid rains, which result from the presence of high atmospheric concentration of substances that form acids in reaction with water (mainly, sulphur dioxide and nitrogen oxides). Anthropogenic activities emit big quantities of these substances that exceed natural amounts (e.g., the use of sulphurous coal, home heating, and energy generation). Available evidence does suggest that, particularly in Europe and North America, precipitation is abnormally acidic. This affects food chains, trees, forests, and even stone buildings and monuments.¹

Apart of the global environmental degradation, there are many regional environmental threats both in developed and developing countries. Air and water pollution, lowered capacity of groundwater storage, urban pollution, soil erosion and desertification, deforestation, population

explosion, and many other problems that threaten mankind's very existence on earth. Although the magnitude of environmental stress in various parts of the world is uneven and uncertain, it is evident that most of this degradation is irreversible.

The previously mentioned trends of poverty, militarization, and environmental degradation are worrying. What is more important, however, is the causation and interlinkages between the three phenomena. Figure 1 shows how each of these factors can be both the cause and the consequence of the other two.

Poor people are usually forced to put pressure on local environment for survival; this results in environmental degradation and competition over natural resources, which in turn gives rise to social tension and armed conflicts; higher militarization (and consequently high military spending) automatically follows armed conflicts. Higher military expenditure (and militarization) has substantial economic costs, and particularly on economic growth. Therefore, we have widespread poverty and the trap is enforced on LDCs.

On the other hand, the causation can go the other direction. Armed conflicts and military establishments are considered as the most polluting establishments.¹ Thus they lead to environmental degradation that jeopardizes the realization of economic growth due to the depletion of resources. However, economic deprivation and poverty, most often, are the main causes of social tension and armed conflict and the trap is again reenforced. This clearly illustrates the strong linkages between military, economy and the environment. For exposition purposes, however, we will study the causal links between any two of the factors in the following sections. Then we will consider the causal relationship between the three factors in the final section.

2. POVERTY AND ENVIRONMENTAL DEGRADATION

All economic activity is based ultimately on resources from nature, and the environment does not exist as a separate sphere from human actions. Pollution, increasing size of population, diminishing natural resources, destruction of wildlife, the growth of deserts, land erosion, and many other anthropogenic environmental disasters cry out for the revision of our economic activities, and the necessity of environmental protection. This section investigates the causal link between the economy (human activity) and the environment.

2.1 How Does Poverty Put Stress on the Environment?

Although environmental degradation is evident, agreement on the origin and the dimension of the problem is less than universal. In this section we will trace the influence of poverty and unfavourable economic conditions on the environment.

Poverty contributes greatly to environmental stress, which itself leads to increasing the levels of penury (the so-called *poverty trap*). Poor people are forced to overuse environmental resources to survive, and this impoverishing of the environment again threatens their survival. For example, forests cover 22% of the world's total land, but the rate of deforestation is increasing rapidly, and particularly in poorer countries.¹ In poorer countries, agriculture, forestry, and energy production, generate half of the GNP; the export of natural resources constitutes a substantial component of their exports. Therefore, the economic activities which prevail in poor countries contribute directly to resource depletion and environmental degradation in most LDCs.

The reliance of poor people on natural resources for survival, leads to depletion of resources and further environmental stresses. For example, deforestation is causing more destructive floods in Asia, and desertification in large parts of Africa and Latin America. In the African Sahel, deforestation followed by soil erosion changed vast areas of land into deserts. Furthermore, in

poor communities the increasing demand for firewood leads to deforestation, or to the use of dry cow dung for fuel, as in Africa, which deprives the soil nutrients and humus. Thus, soil fertility declines, and the poverty circle closes tightly.¹

The World Commission of Environment and Development (1987: 28) pinpoints other mechanisms that lead poor people to degrade their local environment. The commission argue that "those who are poor and hungry will often destroy their immediate environment to survive; they will cut down forests; their livestock will overgraze grass land; they will overuse marginal lands; and in growing numbers they will crowd into congested cities". Moreover, this rural-urban migration puts more pressure on the environment in cities as well as on the countryside.¹

Figure 1

Some development economists trace a certain pattern of property rights to environmental degradation. Many theories appeared on this issue, such as Hardin's "*Tragedy of Commons*", Olson's "*Logic of Collective Action*", and the "*Prisoners Dilemma*". These theories discourage common property rights, and see them as a cause in environmental stress. Other theories such as Runge's "*Assurance Problem*", however, support this configuration of property rights.¹

The property right theories, however, are misleading in many situations because the same property rights might have different effects in different settings. What concerns us here, is whether or not poverty is associated with a certain configuration of rights that leads to environmental decay? This is a loaded question to say the least. We can, however, notice that in poor communities in LDCs, common property rights over natural resources are dominant. Relative poverty, which reduces the opportunity set of many villagers to act alone, necessitates the joint use of rights, beside the high level of uncertainty with respect to income streams. This communal use of resources has caused some environmental degradation in many LDCs. In the Sahel and Southern Africa, for example, traditional common property rights were responsible for the misuse of resources. But empirical studies in other poor communities did not support the previous claims.¹ Therefore, we can argue that different configurations of property rights have different impacts on both allocation and distribution, and this illustrates the need for understanding the impact of specific configuration of rights.

Overuse of water resources, of land, and the overgrazing of pastures became a common phenomenon in most poor communities. Some degraded systems may recover, but a loss of one inch of top soil may take nature centuries to replace. Poor societies are unable to overcome the negative externalities they produce, unlike rich communities which have access to funds and technical know-how to absorb the wastes they produce.

An important factor in this poverty trap is the rapid population growth in poor societies. Rapid population growth put more pressure on the environment and especially the non-renewable resources, and reduces the environment's ability to dilute the wastes and simply accumulate residuals from production and consumption. Brown (1981: 131) emphasized that "rapid population growth in the Third World countries often has a double-edged negative effect, simultaneously increasing the number of job seekers, while destroying the resources needed to

create jobs". The environment cannot be sustained with these increasing rates of population growth especially in the LDCs.

Market failure in LDCs is another reason for environmental degradation, and there would appear to be a systematic downward tendency in the valuation of such resources, and on many occasions they are considered as free goods. Some economists also argue that falling real incomes of poor farmers lead them to recourse the natural resources.

The above illustration shows some of the mechanisms by which poverty contributes to environmental degradation, particularly the exhaustion of natural resources. This, however, does not deny the role of industrialization, and industrialized nations, in environmental degradation, and particularly the global environmental threats.

2.2 The Environmental Limits to Growth.

The effect of the environment on economic growth and development is another important link in the economy-environment-militarization nexus. It is, however, one of the most apparent relations and does not require extended clarification. Bartelmus (1986; 7) argued "A close connection between environment and development is implicit in the definitions of the environment (as the conditions and influences that interact with man) and of development (as a process to improve human-welfare) just arrived at".

During the 1960s and early 1970s, many developed and developing countries postulated that zero growth of the economy and the population is necessary to avoid the disastrous transgression of the physical "outer limits" of the planet. This view was also held by many international organizations.¹ The emergence of the concept of *sustainable development* in the 1970s, however, changed their postulates.¹

Nevertheless, it is evident that the flow of natural resources (such as water, forests and energy) to production and consumption activities, are very crucial for most productive activities in LDCs and therefore their availability determines the potentials for growth. This constraint on growth is particularly binding for those developing countries that rely on the export of primary products.¹

Many investment projects cause greater environmental damage, particularly in fields of infrastructure, industry and even agriculture. They are likely to involve the deployment of new technologies, equipment and management techniques that are more rather than less costly than the earlier ones.

Moreover, the industries most heavily reliant on environmental resources and most heavily polluting are growing most rapidly in LDCs, where there is both more urgency for growth and less capability to minimize damaging side effects. The environment imperative may also point to more expensive sectoral choices and development options as countries approach the ecological and physical limits to the use of land and mineral resources.¹ Energy generation in LDCs usually involves environmental degradation or resource depletion.¹ The opposition to the depletion of resources, the absence of other viable energy options usually delays energy projects which are very crucial for growth and development (see Figure 2).

3. MILITARIZATION AND POVERTY

3.1 The Economic Effects of Military Expenditure

The previous definition of militarization, as the expansion of military establishment in the society, shows that the concept is very wide. In what follows we will consider a specific aspect of militarization, which is the effect of military establishments. This includes the army during peace (its finance, weapons and equipment) and its effect during war (finance, destruction, etc).¹

Military establishments in LDCs play a complex role in the development process, because of the prevailing high militarization levels, the rising trends of militarization indicators, and the continuous military intervention in economic and political activities. Military expenditure in these countries, and particularly in Africa, has increased rapidly in the last three decades. This has been accompanied by poor economic performance, poverty, deprivation, and escalating wars and conflicts. Thus, the relationship between military expenditure and development has become a relevant policy issue. The main aim of this section is to summarize the findings of the extant research on the economic impact of military expenditure, with special emphasis on Sub-Saharan Africa.

The economic impact of military expenditure in Third World countries has been relatively neglected in spite of a remarkable growth in studies dealing with its impact in advanced countries. However, in the last two decades the publication of data on military expenditure by some international organizations and the escalating trends of these expenditures in many LDCs have motivated a considerable number of empirical studies on the economic impact of military expenditure in LDCs. These studies can be classified into two broad categories. The first category consists of studies which follow a *narrow* approach emphasizing only the direct effects of military expenditure on economic growth. The second category consists of studies which follow a *comprehensive* approach, combining both the direct and the indirect effects of military spending on economic growth and other macroeconomic variables.¹

Benoit's (1973,1978) pioneering study is one of the earliest studies in the first category. The study is widely cited in the literature (though much criticized), and a considerable number of studies have either modified Benoit's model or adopted the policy implications of his study. Benoit used correlation analysis to examine the effect of the defence burden on economic growth for a sample of 44 developing countries pertaining to the period 1950-1965. He found a strong positive correlation between high defence burdens and rapid rates of economic growth. Benoit then used multiple regression analysis to correct for the possibility that the result might be "technically spurious". In his regression analysis, economic growth did not emerge as a significant determinant of the defence burden: "what did appear

Figure 2

to be the main determinant of the size of the defense burden was the expectation of the political and military leaders of the need for forces to deter, to threaten, or to engage in combat"(Benoit, 1978: 275). Thus defence burden seemed to influence economic growth rather than vice versa.

In multiple regression analysis, Benoit added bilateral foreign aid and the investment rate to the defence burden in the economic growth equation. The results showed the defence burden had been a significant determinant of economic growth in the 1960-1965 period but not for the whole 1950-1965 period. However, he concluded that "it seems clear that in the sample countries higher defense burdens stimulate growth, at least to the extent of fully offsetting any adverse growth effects that defense expenditure may have had" [Benoit (1978; 276)].

Benoit has spelled out a number of channels through which military expenditures can induce economic growth. These include the provision of inputs to the civilian economy (e.g., housing, public works, education, medical care and technical spin-offs), besides the role of the military establishment as an important force for modernization and "nation building" in LDCs. He pointed also to inflation as a second link between defence and growth, as he presumed that the finance of heavy military burdens leads to the relaxation of strict monetary and fiscal policies which, in turn, leads to more inflation which pulls into economic use unused or underutilized resources which contribute to growth.

The advantage of Benoit's study is that it points to the channels through which the military burden can exert both positive and adverse impacts on the economy. However, his analysis suffers from specification, interpretation and methodological problems, most of which have unfortunately been inherited by the post-Benoit studies.

Nonetheless, many recent studies recognized both the importance of the study in pointing out some conduits through which defence can affect economic growth, and the need for some measures to correct for the limitations of Benoit's analysis. The studies which fall under what we called the "*narrow*" category have mainly relied on estimating single-equation models to quantify the effects of military spending (dependent variable) on economic growth (independent variable). Most of these studies, thus, captured only the direct effect of military expenditure on growth (For example, Alexander (1990)). The second category of the studies of the economic impact of military expenditure have used simultaneous-equation models to estimate and separate both the direct and the indirect effects of military spending on macroeconomic variables (see, Smith and Smith (1980); and Mohammed (1992)).

Most of the single-equation models have implicitly assumed that military spending is exogenously determined and that the relationship goes from military spending to economic growth. In contrast, Joerding (1986) used Granger-Causality to check this assumed exogeneity of military expenditure. The test results showed that military spending is not a strongly exogenous variable. He argued, therefore, that most of these studies were seriously flawed. "Consequently, further research into the relationship between economic growth and military spending should proceed by formulating and estimating dynamic or simultaneous-equation models of developing countries"(Joerding, 1986; 39).

The second "*comprehensive*" approach to the study of the economic impact of military expenditure has emphasized the importance of interdependence among defence, growth, and other economic variables, and the intermediate effects and feedbacks between defence and the other variables. It relies on estimating simultaneous-equation systems based on a well-specified

theory. The simultaneous-equation systems separate and emphasize the various effects and concomitant feedbacks of military expenditure.

Apart from the defence-growth nexus in LDCs, a considerable number of studies have focused on one or more aspects of the warfare-welfare trade-offs. The growth of interest in this subject did not see the development of any consensus, however. For example, some studies concluded that there exists a negative trade-off between education and military spending in LDCs (e.g., Looney (1986). Other studies concluded that military spending did not bear negative consequences for education spending (e.g., Verner (1983); and Harris *et al.*, (1988).¹

To sum up, most of the studies on the economic impact of military spending have adopted one of the two approaches: The first approach relies on estimating single-equation models to capture the direct effects of military spending on economic growth through technical spin-offs of the military to civilian sectors and the resource mobilization effects. This approach is, by necessity, very narrow as it omits various important indirect channels through which military expenditure affects the balance of payments, savings and investment, and the development of human resources; which in turn exert significant influence on economic growth and development. Thus, most of the studies which follow this approach conclude that military expenditure has either a positive or insignificant impact on economic growth.

The second "*comprehensive*" approach combines both the direct and the indirect effects of military expenditure. It also emphasizes the importance of simultaneity, intermediate causation and feedback of the economic variables to measure the full repercussion of the defence sector on economic growth and development. Hence, the estimates of the studies in this category are more appropriate and generally support the existence of a negative impact of military expenditure on economic growth.

3.2 The Economic Impact of Military Expenditure: A Theoretical Framework

The analysis of the economic effects of military expenditure depends on the theoretical understanding of the role of this expenditure. However, economic theory does not offer obvious predictions and postulates on the impact of military expenditure on growth and development, because economic theories do not provide a unique role for military expenditure as a distinctive economic activity. Nevertheless, three broad approaches to the analysis of the economic impact of military spending can be distinguished: Neoclassical, Keynesian and Marxist theories.¹

The neoclassical approach perceives the State as a class-neutral, rational actor which balances the opportunity costs and security benefits of military spending in order to maximize a well-defined national interest. Given the military technology, the economic problem is then to produce an optimum military capability at minimum cost. Thus, high military expenditure is explained by changes in technology. This approach is criticized for ignoring the internal role of the military by regarding only the potential external enemy to the State. This factor is very important for most LDCs where the development of a national consensus seems unreal.

Moreover, this approach requires extreme knowledge and computational abilities on actors (Smith (1977), and Dunne (1990)).

Keynesian theory postulates that military expenditure increases national output through the multiplier operations in the presence of inadequate effective demand. In the long run, if aggregate demand is lower than potential supply, increased military spending could raise capacity utilization and lead to increased rate of profit; and consequently raise investment and growth. Thus, this approach offers some economic justifications for military expenditure, as long as this expenditure is autonomous.

The Marxist approach sees military expenditure as necessary for the development of the capitalist system by maintaining effective demand and moderating the downward pressure on the rate of profit and, consequently, preventing economic crisis and breakdown. However, within the Marxist approach there are a number of strands for the treatment of crisis. For example, the underconsumptionist argument claims that military expenditure is important in preventing realization crisis that arises when the growth of productive forces and output exceeds effective demand and then put pressure on wages. In this case military expenditure prevents crisis as it allows the absorption of capital without decreasing wages and thus maintains profit (see Dunne 1990).

This section outlines the theoretical issues surrounding the defence-growth relationships with emphasis on LDCs in general and the African continent in particular. The emphasis here is on the impact of military spending on macroeconomic variables, and economic growth, rather than on economic development. This is so because growth is susceptible to quantification, although growth is a necessary but not sufficient condition for the development process.

Military spending influences economic growth through many conduits, both directly and indirectly. However, some major channels can be identified. These include its indirect effects on human capital formation, saving and investment, and the balance of payments, as well as its direct growth-stimulating effects. These effects are interdependent and interrelated, but we will treat them separately for exposition purposes, and the total effect on growth is best understood within the framework of multipliers and crowding out.

3.2.1 Human Capital Formation

Human capital (including managerial, entrepreneurial and technical personnel) is an important factor of production. High growth rates can only be achieved by ensuring the availability of physical and human capital as well as other inputs required for national production. Adequate human capital may also increase the productivity of physical capital. Indeed, in LDCs, one of the major obstacles to rapid economic growth has been the absorptive capacity gap resulting from the lack of well-developed human capital. While it is clear that the relationship between military expenditure and human capital formation is very complex, it is also evident that military spending can influence human capital by generating employment, increasing the supply of skilled labour, and indirectly through its effect on government spending on education and health.

Certainly, the military mobilizes labour and offers employment to some individuals. In most LDCs soldiers are drawn from villages and rural agricultural sectors, where they are either unemployed or underemployed, or do not have access to employment centres. These employment benefits to the economy are, however, constrained by two considerations: Firstly, only a small proportion of the (economically active) population enters the army. Secondly, the military also frequently employs skilled labour, which is in short supply in most LDCs, and hence, reduces the amount available for civilian production.

Other economists argue that the military is an important source of technical and administrative skills which can subsequently be of use to the civilian economy. The armed forces provide education, and vocational and technical training during military service, skills which are scarce in LDCs. In this way the military can help to remove the absorptive capacity constraints and stimulate growth (Janowitz, 1964; Benoit, 1978). Moreover, it is often argued that the organizational skills and the modern attitudes and aptitudes of the military tend to break up social rigidities which inhibit human capital formation in LDCs.

While it is clear that the military teaches many skills that can benefit the civilian economy, especially in armies which are staffed by volunteers, these spin-offs should not be exaggerated.¹ Some of the skills taught in the army are military-specific and expensive, while the military, very often, competes with the civilian sector for other scarce specialities (e.g., physicians and engineers). The transferability of the skills is also not automatic because they will not be available to the civilian sector for a large portion of their working life, particularly in countries with volunteer armies. Moreover, as Deger (1985) concluded that there is no reason why the military should be intrinsically more modern than other civilian institutions in removing social rigidities.

The main way in which military expenditure affects human capital formation is through its impact on government spending on education. In LDCs, where private education is minimal, the relationship between military and education spending is, however, not as straightforward as it might appear. Given the nature of military and education spending as publicly provided goods and given the upper limit on LDCs' budgets, there may be a one-to-one trade-off between the allocation of military and education expenditures, and consequently increases in military outlays may hinder the development of human resources. On the other hand, the military provides independently services such as training, education and health, although, as we have demonstrated, this spill-over is limited and expensive. Also studies have shown that in some LDCs increases in military outlays are met at the expense of economic and other welfare services rather than education and health spending.¹

Military expenditure has another indirect effect on human capital formation. If the overall effect of military spending on economic growth is negative, and given the positive relationship between growth and human capital formation, then military expenditure can exert an indirect adverse effect on human capital accumulation.

On the whole, while it is not possible to draw strong conclusions, the evidence does suggest that the employment and technical spin-offs of the military are limited compared with the trade-off between military and education spending and, therefore, military spending has significant adverse effects on the human capital formation.

3.2.2 Physical Capital

Undoubtedly, physical capital accumulation is an important ingredient in the growth process, and it can be affected by military expenditure through a multitude of interrelated channels, particularly through the impact of military spending on domestic savings and investment. In the case of LDCs, however, this relationship is not straightforward. Domestic savings are not automatically translated into productive investment because they might take the form of idle hoarding, be consumed wastefully or conspicuously, or be invested abroad. In addition, investment is constrained by the absorptive capacity of the economy, and part of it can be financed from foreign sources. In this section we consider this relationship and investigate the various channels through which military spending can influence both domestic savings and investment, and examine the overall impact of military spending on physical capital accumulation.

Military spending influences the level of domestic savings both directly and indirectly, and there is a considerable debate over whether the total impact is positive or negative. One argument claims that if increases in military outlays are financed by extra taxes then, if these expenditures are reduced in the future, it is possible to increase saving propensities. In LDCs, however, the taxable capacity is limited by the dominance of traditional and subsistence sectors and low income levels; beside the possibility of reducing private sector's savings by extra taxation. Moreover, the empirical analysis of the determinants of military expenditure shows that military expenditure is rigid downwards in most of the sub-Saharan African countries.¹ A second argument suggests that the spirit of militarism and the structural change inspired by high military spending, especially during wars or periods of high threat perception, may alter the rate of time preference in favour of saving.¹ This effect could equally, however, operate in the opposite direction.

In LDCs, the option of raising revenues from taxation is often not feasible. Budget deficits resulting from increases in military spending are usually financed by expanding the money supply through borrowing from the central bank. The expansion of the money supply, without corresponding increases in output, leads to increases in the inflation rate. Again the impact of inflation on domestic saving is not clear-cut. It is argued that inflation may lead to "forced savings". However, in LDCs money illusion, expectations of higher rates of inflation and falling real rate of return caused by inflation might lead to higher consumption and lower saving propensities.

Moreover, rises in threat perceptions, caused by increases in military spending, may increase the rate of time discount and consequently reduces the saving potentials (e.g., by rises in hoarding). Military expenditure also can reduce saving indirectly, if it reduces government expenditures on health and education services. This will increase the

private consumption of these social wage goods and, hence, private savings will be reduced. Overall we expect, therefore, that in LDCs military expenditure will reduce the saving propensity, as was confirmed by the empirical studies reviewed in the previous section.

The impact of military expenditure on investment is the second channel through which the military affects physical capital formation. We have shown that military spending can retard savings; but this does not mean an equivalent reduction in investment. For a given level of saving, however, military expenditure crowds out investment in the short run, or causes other elements of aggregate demand to fall. In LDCs, where government revenue and expenditure are generally inelastic, this crowding out (resource allocation) becomes inevitable.

However, increased aggregate demand caused by autonomous increases in military spending will drive up output, capacity utilization and possibly profit rates. Higher profit rates may lead to more investment and higher growth in the long run. This multiplier effect requires the existence of surplus labour and excess production capacity. But in LDCs supply bottlenecks can prevent military expenditure from boosting output and some other components of aggregate demand will have to fall.

Moreover, in countries which do not produce arms, arms imports compete with imported investment goods for scarce foreign exchange and this hinders investment and the growth process; it might also retard technical progress.

As we have shown, military expenditure can have adverse effects on human capital formation and this in turn affects the rate of capacity utilization and the investment potential. Nevertheless, some infrastructural projects built by the military, such as roads or bridges, have spin-offs for the civilian sector. Many of these projects are, however, built in remote areas and do not suit civilian production. The above analysis gives strong reasons to believe that the effect of military spending on investment is negative on the whole.

3.2.3 Balance of Payments

Military expenditure in an open economy, specially in a non-arms producing country, leads to higher imports and deficits in trade balance and the balance-of-payments. Surplus in the trade balance gives a stimulus to growth in various ways. However, the effects of arms imports on the economy depend mainly on the way these imports are financed. Three ways can be identified: outright grants or aid; payment in cash or kind; and credit finance.

In the 1950s and 1960s outright grants prevailed. Superpowers donated sizeable amounts of weapons to LDCs for political and strategic considerations. Countries which received foreign military aid had a lower burden on their trade balance. However, because of economic and trade difficulties in developed countries, the structure of

weapon imports finance has changed. Military aid to LDCs has declined rapidly relative to more commercial transactions.

Weapons purchased for cash or kind have serious economic effects. Foreign exchange is very often in short supply in LDCs, and this is exacerbated by costly arms imports. This will have obvious allocation costs in reducing investment goods essential for growth. In Africa, for example, military expenditures set limits to the possibilities of growth, in particular, in countries facing an acute shortage of development resources. The most immediate effect is the diversion of resources to military installations at the expense of much needed capital goods for development. Clearly, the import of foreign weapons systems does not have any potent economic returns. Moreover, shortages in inputs and spare parts caused by shortages of foreign exchange lead to further depreciation of the existing production capacity.

Credit finance is the third option for obtaining weapons imports. The credits, however, have to be paid back in hard currency, and possibly at high interest rates. This will crowd out investment goods in the future. It has also been argued, notably by Brzoska (1983), that military-related debts are quite substantial and add to the economic burden of weapons imports. More fresh capital will be needed to service the existing debt. This causes more foreign exchange shortages, and the 'debt trap' is reinforced.

In addition, arms imports may also reduce savings indirectly because arms imports are usually exempted from imports tariffs. A second possibility is that export capacity can be reduced by previous weapons imports or military expenditures which drew resources from civilian sector investments. This will again lead to a more precarious balance-of-payments situation.

Nevertheless, it is often argued that weapon transfers might have some advantages. These include technical spin-offs and the attraction of more economic aid. The relevance of such spin-offs was discussed in the preceding section, and evidence for the correlation between economic aid and military expenditure was weak.¹ Moreover, Eleazu (1973) claimed that most of the military assistance programmes to Africa had some built-in destabilizing factors and were responsible for many military coups and political instability. Therefore, we expect *a priori* that military expenditure, and particularly arms imports, to exert a substantial burden on the balance of payments and economic growth.

3.2.4 Growth-Stimulating Effects

The previous sections have pointed out the various conduits through which military expenditure indirectly affects economic growth. In addition to those impacts, military spending also has direct effects on growth. There is a general consensus among defence economists that military expenditure stimulates growth directly through increased capacity utilization. This is achieved by Keynesian-type demand, spin-off and 'modernization' effects; although there is no agreement on the volume and effectiveness of these factors.

If aggregate demand is initially inadequate relative to potential supply, then autonomous increases in military spending could lead to increased utilization of capacity, by increasing employment of labour or utilization of capital. Moreover, this reduces the cost of resources and leads to higher profit rates which drive up investment and growth. In poor countries, however, such benefits are probably small because such countries' major problems stem from the supply side (e.g., shortages of production inputs, foreign exchange, etc).

In many LDCs, the technological spin-offs discussed earlier, and the infrastructure developed by the army and introduced into the economy, might shift the production function upwards and bolster growth. The military also guarantees a suitable environment for production to proceed by preserving internal stability and security. Further, as in African countries, the military establishment engages directly in production activities: crop growing, food manufacturing and even commerce (e.g., the Sudanese Military Economic Corporation). Many economists, notably Benoit (1978), have argued that the military helps in the process of 'modernization'. As an organized force it inculcates modern attitudes and work ethos; it thus creates a structure which is conducive to growth. It also contributes significantly to 'nation building'. These factors are difficult to quantify in economic terms and are best understood in their socio-cultural framework. Moreover, it is also important not to confuse the analysis of the economic impact of military expenditure with the impact of military governments on development.

To sum up, military expenditure has both direct and indirect effects on economic growth. Therefore, the common simple analogy of the tank-tractor trade-off is not very helpful in understanding the impact of military expenditure. Although various effects can be enumerated, the complexity and simultaneity of the channels through which these effects operate prevent making *a priori* theoretical predictions on its final total impact. Thus the pros and cons of military spending need to be researched empirically.

3.3 Military Expenditure and Economic Growth: Empirical Evidence

The previous section outlined the broad theoretical analysis of the impact of military expenditure on economic growth, and the broad distinction between narrow and comprehensive approaches of estimating the effects of military expenditure. This section examines briefly the empirical findings of the extant research on the economic impact of military expenditure in LDCs, and Africa in particular.

Most of the post-Benoit studies (especially those which followed the comprehensive approach) found evidence for the negative impact of military expenditure on LDCs' economic growth.¹ Four of these studies have focused on the African continent: Smith & Smith (1980), Nabe (1983), Gyimah-Brempong (1989) and Mohammed (1992).

Smith & Smith (1980) claim that not only do the military burden and the saving rate influence economic growth, but they are in turn influenced by it. Thus, they used the

Three Stage Least Squares (3SLS) method to estimate a three-equation simultaneous model (growth, saving and military burden) for a sample of 50 LDCs. The data were averages for the 1965-1973 period. The results also show a negative effect on saving and a very small and insignificant positive effect exerted on economic growth. Nevertheless, they investigated the relationship, between military spending and economic growth, across 18 African countries for the 1965-1973 period. Their evidence, however, did not support the existence of a statistically significant relationship between growth and military burden.

Nabe (1983) claimed that both economic and social variables determine development. He, thus, formulated two composite development factors - one economic (EDF) and one social (SDF)- by means of factor analysis to assess the impact of military expenditure on industrialization in 26 African countries over the 1967-1976 period. Nabe, then, constructed a multi-equation model. His model was recursive and triangular, in which the EDF is made a function of military expenditure (M), the SDF is a function of M and EDF, while the GDP manufacturing depends on EDF, SDF and M. The results of the cross-sectional longitudinal and cross-sectional analyses confirmed that military expenditure has an indirect negative impact on GDP manufacturing through both the economic and social development factors.

Gyimah-Brempong specified a four-equation simultaneous model, with one equation each for economic growth rate, investment rate, skilled labour rate, and defence burden, to investigate the growth-defence relationship. He postulated that investment is a more appropriate mechanism to investigate the growth-defence relation than savings (because of hoarding); and that economic growth determines military allocations together with security related factors. He estimated the model for 39 Sub-Sahara African countries during the 1973-1983 period, and calculated a defence burden-growth rate multiplier of -0.12.¹

Mohammed (1992) argues that military expenditure can have a direct positive effect on growth through various spin-offs. However, it also exerts a significant adverse influence on investment allocations, human resource development and balance of payments; these variables in turn affect economic growth. Moreover, the total impact of military expenditure depends on its level, trends and the country's socio-economic conditions. He then, chooses thirteen Sub-Sahara African countries for analysis: Benin, CAR, Ethiopia, Kenya, Mali, Niger, Rwanda, Somalia, Sudan, Tanzania, Togo, Uganda, and Zaire. The choice was motivated by the many similarities in political, socio-economic and historical realities.

A five-equation simultaneous model (one each for economic growth, investment ratio, education spending ratio, balance of trade and military burden) is formulated and subjected to empirical investigation by techniques of time-series and cross-sectional estimation, for the period 1967-1985. The results affirms that it is difficult to establish a systematic relationship between military burden and economic variables for the whole sample because the effects of military expenditure on individual countries are different despite the relative homogeneity of the sample. In countries where the military burden

was high and increasing, military expenditure had an apparent negative effect on economic growth, investment allocations, and human capital formation, and it contributed to the huge deficits in their balance of payments; while in countries with low military burden the positive spin-offs dominated this negative role of military expenditure. Moreover, these positive and negative effects were balanced in countries with moderate military burdens and, therefore, the total effect of military expenditure was negligible and insignificant. The overall evidence does, however, suggest that military spending hinders economic performance in most Sub-Sahara African countries.

These findings support the recent empirical evidence on the economic impact of military expenditure on LDCs economic development (e.g., Deger (1986), and Scheetz (1991). Moreover, while the macrostatistical studies of the economic effects of military expenditure on large samples of LDCs are important in pointing to general characteristics of the military-growth nexus, they tend to omit the country-specific conditions which are very important for the understanding of these effects. Therefore, the combination of both cross-sectional and time series analyses provides more insight into the mechanism of military expenditure in LDCs. Mohammed's (1992 & 1993 c) study of the Sudan corroborate this argument.

3.4 Other Developmental Effects

Apart from the defence-growth nexus in LDCs, a considerable number of studies have focused on one or more aspects of the warfare-welfare trade-offs. The growth of interest in this subject did not see the development of any consensus, however. For example, some studies concluded that there exists a negative trade-off between education and military spending in LDCs (for example, Looney (1986). Other studies concluded that military spending did not bear negative consequences for education spending (e.g., Verner's (1983) study of Latin America countries over 1948-79 period, and Harris *et al.* (1988).¹

3.5 The Influence of Economic Conditions on Militarization of the Society

Most of the conflict theories emphasize the importance of economic conditions in explaining conflict, as one important aspect of militarization. For example, Homer-Dixon's (1990; 15-20) frustration-aggression and structural theories of conflict, stress the importance of economic factors to explain civil strife and wars. Different international, regional and national conflicts were motivated by economic factors as well documented in the literature (e.g, the recent conflict in the Gulf).¹

In this section we will briefly focus on one aspect of militarization, which is military spending. The empirical studies on the determinants of military spending confirmed the importance of economic factors (such as level of income, government spending) in determining military allocations.¹ Mohammed (1992: 43-65) investigates the major determinants of military spending in thirteen sub-Sahara African countries, in the period

1965-1985. The differences in the military burdens of the African countries appear to reflect a complex of economic, political and strategic factors, both at the national and the international levels. While the relative importance of the different factors varied from country to country, the need to maintain security and stability, and to counteract threats is found to be the most important factor in most countries. However, while the income level was not binding for most countries, the military spending proved to be sensitive to the

Figure 3

economic conditions. The most important single economic factor is found to be the share of the central government in GDP. Furthermore, this study shows that economic growth *per se*, does not play a systematic role in determining military expenditure in Africa.

Most of the military coups in Africa were also motivated by the desire to improve the deteriorating economic conditions.¹ Food shortages, drought, decrease in agricultural production, and shortages in other human basic needs, contributed to social tension, and consequently high militarization of many LDCs (by military coups).

To sum up, there are very strong theoretical and empirical grounds for the causal link between militarization (conflict or higher military spending) and economic conditions. This causation was confirmed by many empirical studies, and particularly in LDCs, although most of these studies have focused only on one direction of the causal link. Moreover, there are also some indirect conduits through which the economy effect militarization, and *vice versa* (See Figure 3 for the relationship between militarization and the economy). The environment is one of the most important links between militarization and the economy. The next section tackles these causal links.

4. MILITARIZATION AND ENVIRONMENTAL DEGRADATION

The relationship between militarization and the environment has received very little scrutiny. Although some recent studies have shown the negative impact of military establishments and conflicts on the environment, the effect of environmental stress on social tension and conflict remains a potential area of research. This section clarifies the causal relationship between the environment and the military establishments.

4.1 The Effects of Military Establishments on the Environment

As we defined militarization to refer to the expansion of the military establishment in the society, it is difficult to judge its total impact on the environment. In this section the focus

is on the effects of the military establishments on the environment; and distinction is made between the effects during peacetime and wartime.

4.1.1 The Peacetime Effects of the Military on the Environment

Armed forces are established to defend national unity and deter foreign aggression. Their activities during peacetime, however, are injurious to environmental security, to the extent that many researchers describe them as the "great polluters" in modern societies.¹ The armed forces contribute, both directly and indirectly, to environmental degradation in a multitude of ways:

[a] The direct effects include the following:

(i) In most countries, military training, installations, and manoeuvre expropriate vast areas of land which could have been used for cultivation or other economic activities. Military activities also damage wildlife habitats, forests, and soil stability, particularly through the movement of heavy and armoured equipment and the discharge of toxic wastes.

(ii) The spread of arms production is another source of environmental damage.¹ The production and testing of conventional and chemical weapons generate specific harmful wastes that cause enormous damage to the environment and to the health of the workers. The situation is even worse in LDCs because they lack safety standards and the required efficiency.

(iii) Military establishments are among great consumers of resources. These include petroleum, minerals, chemicals, as well as agricultural products. For example, military aircraft alone consume half of all fuel used by aircraft.¹ Moreover, arms production has become increasingly dependent on non-renewable resources (e.g., uranium, titanium, and chromium) causing their long-term depletion. These resources might be very important for economic development of future generations.

(iv) The preparation for war, and sometimes routine activities, involves mobilization of forces and high military presence in certain areas, and is usually accompanied by the massing of equipment and arms arsenals. This population boom damages local environments and generates extensive wastes (sewage and solids).¹

(v) The military share in the destruction of the ozone layer and the greenhouse effect is substantial.

(vi) It is often argued that LDCs' armies, particularly in Africa and Latin America, oppose natural conservation projects. This usually happens when the army controls the government. Their opposition to conservation projects is often motivated by their intention to secure quick revenues to support their regimes,

and this might entail the oppression of domestic opposition to the depletion of resources.¹

[b] The indirect effects of militarization on the environment include the following:

(i) High militarization and military spending, particularly among LDCs, has substantial economic costs. This negative impact on economic growth contributes to widespread poverty. Mass poverty, however, is considered as one of the most significant factors that threaten environmental security.

(ii) There is an indirect effect of the military on the environment through increases in military spending. This usually takes place at the expense of other categories of government expenditures, including environmental conservation projects.

(iii) The military competes with civilian sectors over human resources. One percent of total population, at any time, works in the military sector. Moreover, more than 20% of all scientists and engineers in the world are employed by the military.¹ The opportunity cost of this human resource capital on civilian economy and the environment is substantial, particularly so in LDCs where the lack of well-developed human capital is considered as the most important constraint for economic growth and development.

(iv) Military wastes, which result from the arms race in the North, are exported to LDCs, putting more pressure on their local environments. These include large-scale dumping of toxic nuclear and chemical waste, extensive foreign bases, permanent activities of aircraft, submarines and naval missiles, as well as testing of nuclear weapons.

While it is clearly evident that the military contributes to environmental degradation during peacetime, consensus on the volume of such degradation is less than universal. However, the direct share of the military in environmental degradation is believed to be more than its share in national product.¹

The above negative effects of militarization on the environment do not, however, exclude the existence of some positive ones. In many countries, particularly in Africa, the military fight harmful environmental activities such as hunting or cutting forests.¹

*4.1.2 War Effects on the Environment.*¹

War causes enormous direct damage to the environment, and puts pressure on the environment indirectly through its dislocation of population whose displacement would in turn put stress on neighbouring environments.¹

Modern wars might employ defoliants, high explosives, biological agents or weather modification techniques; they also involve land, air, water, and space. The use of weapons of mass destruction in conflict has grave environmental consequences.

Moreover, as Atles (1992: 71) argues "spectacular technological developments have greatly increased the mobility of conventional arms and the range of firepower". The Gulf war provides an example of how the destruction of resources (burning oil fields) can be used as a military tool.¹ Furthermore, Westing (1989: 131) shows the disruptive environmental effects of wars in the Horn of Africa, particularly the wars between Ethiopia and Somalia, as well as within Ethiopia and Somalia.¹

There are also indirect effects from war on the environment and the economy. For example, soldiers and warfare are playing a significant role in the spread of diseases. Cookson (1992) reviews the evidence for the role of war in the spread of AIDS, and other sexually transmitted diseases. He pinpoints the military-associated factors that have been instrumental in the development of the geographical pattern of clinical AIDS in Uganda.

4.2 The Effect of Environmental Factors on Militarization

The previous section has tackled briefly the impact of military establishments on the environment. However, the direction of causality also goes from the environment to militarization. The impact of environmental factors on conflict and militarization, although of vital importance has received little attention by researchers. Defining the concept of *security* shows the causal link between militarization and the environment. Westing (1989: 129) suggests that comprehensive human security has two components: *political* security (with its military, economic, and social/humanitarian sub-components); and *environmental* security (with its protection-oriented and utilization-oriented sub-components).

There are different environmental factors that give rise to conflict, and consequently military actions, at the national, regional and international levels. These environmental factors can lead directly to conflict, or through their indirect effects on other forces that induce conflict.

4.2.1 Direct Environmental Effects on Militarization

The environmental threats can be divided into two aspects: (i) threat to the environment from vandalism, excessive pollution and anthropogenic intrusion; (ii) non-sustainable utilization of resources.¹ Thus protecting the environment is one of the most important security goals of all governments. This includes both natural and human resources.

Competition over natural and scarce resources has been the most important factor for arms races and outbreak of wars.¹ These resources include *land* (e.g., the Libyan-Chadian conflict over Ozou strip); *raw material* (e.g., the Sudanese-Egyptian conflict over Halayeb area); *energy* (e.g., oil supplies from the Gulf); *water* (conflict between Syria and Turkey over Ataturk dam); and *food* (e.g., tribal conflicts in many parts of Africa).

Gamba-Stonehouse (1992) emphasises that the potential that conflict may result from competition over the resources mentioned above is not a matter of the distant uncertain future, and that many countries are already poised for conflict on these issues. She adds " This is not a new phenomenon. The request for territorial expansion in hopes of securing resources and trade routes to benefit one or a group of nations has often generated conflict in the past".¹ It is also evident that environmental conflict arises between countries within the same eco-geographical region (Israel-Jordan, Turkey-Syria, Sudan-Egypt-Ethiopia, Iraq-Iran, Iraq-Kuwait, etc.).¹

Environmental degradation, pollution, and over-use of common resources (such as water) do cause conflicts which can lead to wars,¹ or exacerbate conflicts that have other root causes.¹ Two examples are relevant to this argument. The first is the direct threat to Syria from the inevitable loading of fertilizers, pesticides and salts that will be transported down the Euphrates as a result of Turkey's agricultural and irrigation efforts (Great Anatolia Project). These might cause further risks to downstream states (Iraq) and the Gulf ecosystem from these same inputs.¹ The second example is the potential for conflict over the Nile water between Egypt, Sudan and Ethiopia. The present Secretary-General of the United Nations, Dr Boutros Ghali (1985), warns about the potential for conflict over the Nile by saying "The next war in our region will be over the waters of the Nile, not over politics..."¹.

Apart from the regional conflicts caused by environmental factors, there is also growing evidence that global environmental concerns, such as global warming or Ozone depletion, will be a potential for international conflict and an important factor in international relations.

4.2.2 Indirect Effects of Environmental Factors on Conflict

Environmental factors can have significant effects on conflicts, and consequently higher militarization, through various indirect conduits. Population dislocation, and the economic problems caused by environmental degradation are the most important channels through which environmental stress can cause social conflict.

Population dislocation caused by environmental change (such as drought or desertification) creates the problem of refugees. If people living in a depleted country see no prospect of feeding themselves they will start to move. There will be large-scale migrations from the degraded area to better placed areas.¹ This creates population boom which in most cases exceeds the capacity of the hosting environment and creates conflict and competition over the resources. Armed conflict and banditry in western Sudan is an obvious example of population dislocation.

Hassan (1992: 81) explains further the effects of environmental degradation on domestic political dynamics. He argues "as affected communities vacate degraded habitats and transplant themselves in other localities, conflict often ensues between them and the host communities and local authorities. When such rivalries and conflicts become exacerbated, aggrieved communities turn to subnational ideologies, parties and

symbols to fight for their way of life. Extraneous interest groups (such as political parties) also usurp environmental issues for their own gain". Furthermore, the internal population dislocation exert pressures not only on the carrying capacities of the land but also on those of the polities involved. Political systems may also be threatened by the influx of the displaced as they put pressure on the services in cities and cause food shortages. Food riots and urban violence may come to constitute a clear danger to national governments, particularly in Africa.¹

Moreover, population displacement across international boundaries owing to environmental stress has raised the level of tension between several countries.¹ In Africa, for example, the conflicts between Sudan and Chad, and Sudan and Uganda in the late 1980s were clearly exacerbated by the environmental refugees who transgressed interstate boundaries.

Environmental degradation also has obvious effects on the economy, particularly in LDCs which depend mainly on natural resources for their exports and local consumption.¹ People in the affected areas will have lower incomes and they degrade the environment further or move to put pressure on other communities or cities. This mending cycle of decline may cause tensions and food riots or armed conflicts.

Homer-Dixon (1990) presents several suggestions about the effects of environmental change on human conflict. He argues that seven clusters of environmental problems (Greenhouse warming, Ozone depletion, deforestation, acid rains, degradation of land, overuse of water supplies, and depletion of fish stocks) will produce four general types of social effect (decrease in economic productivity, changed agricultural production, population displacement, and disruption of institutions and pattern of social behaviour), which will in turn lead to three types of conflict (frustration conflicts, identity and structural conflicts).

The frustration-aggression theories of conflict suggest that people become hostile when they perceive a wider gap between the level of satisfaction that they have achieved and the level they believe they deserve (or because of absolute deprivation). The group-identity theories explains conflicts involving ethnicity, religion, and nationalism; individuals have a need for a sense of belonging that can be satisfied in a group when it attacks or discriminates against another group (e.g., the Muslim-Hindu conflict in India). The structural theories explains conflicts arising from the rational calculations of actors in the face of external (social or material) constraints.¹

Figure 4 summarizes the hypothesized complicated causal links between militarization (in particular military establishments, both during peace and war times) and environmental degradation and depletion of resources.

5. THE INTERLINKAGES AND THE PROSPECTS OF CONVERSION.

5.1 The Interlinkages of the Development Trap

The previous analysis has shown the alarming trends of poverty, environmental degradation and militarization in LDCs. What has become clear from the analysis, is not only these alarming trends, but also the close interlinkages of the three previous trends and their reinforcement on each other. Deteriorating economic conditions can lead to social conflicts and higher militarization in LDCs. High levels of militarization contribute significantly to environmental degradation, both in war and peace times. Degraded environments constraint LDCs to have rapid economic growth, and consequently increase the levels of poverty.

The direction of causation between the economy, the environment and militarization, however, can go the other way round. High militarization of the society (particularly high military spending) has substantial economic cost, and restricts the economic growth of most LDCs. This increases the degree of poverty in these societies. However, poverty is one of the main factors that leads to environmental stress and degradation. Nevertheless, the environment has been a major source of conflict (and consequently high militarization). The mechanisms of such causation have been explained in the previous analysis (see Figure 4).

LDCs have suffered greatly from the three phenomena for a long time. This causation between the phenomena enforces what we called the "*development trap*". The effects and impact of underdevelopment on the well-being and welfare of LDCs' population are well known and documented.

5.2 The Way Out

All developing countries seek to achieve rapid economic growth and development, preserve their natural environments, and secure political stability, national unity and territories. The achievement of these goals, however, is not an easy task. The last three decades have witnessed the failure of most LDCs to achieve *sustainable development*, development that ensures rapid economic growth, equal distribution of income, without degrading the environment or jeopardizing future generations from their right to achieve development and prosperity.

It is also evident that economic development in LDCs cannot be achieved in isolation from international developments. Therefore, some national and international policies are recommended here for the realization of sustainable development:

Figure 4

5.2.1 International Policies

(i) It is important to restructure global economic relations in such a way that LDCs obtain the required resources, advanced technology and access to markets, enabling them to pursue a development process that is environmentally sound and also leads to rapid growth to meet the aspirations of their growing population. This requires the developed countries to play an effective role in breaking the *development trap* by debt relief, increasing economic assistance, technology transfers, new approaches to trade, etc.

(ii) The "peace dividend" resulting from the end of the cold war should be used to finance development-cooperation and international programmes to respond to global environmental threats.¹

5.2.2 National Policies

(i) LDCs should put human rights, democratization of political institutions, and confidence-building measure at the regional level, as their first priority. This will reduce both national and regional conflicts which had significant negative impact on economic growth and environmental conservation.

(ii) Poverty-elimination should receive a very high priority in governments' policies and development plans. This is, however, easily said than achieved, but there are various strategies or combinations of strategies.¹

(iii) Environmental conservation should be incorporated in all the development plans of developing countries. National governments are also responsible to provide adequate environmental education for the general public.

(iv) It is important to formulate population policies in all LDCs to curb rapid population growth. Raising income levels, improving health care and services, introducing family planning methods and contraceptives, increasing the age for marriage, and compulsory education are helpful tools to reduce high fertility rates.

(v) There is a growing need for the *conversion* of military capabilities, personnel, production and technologies as an effective response to national and international strategy of security and development in harmony with the natural carrying capacity of the planet.

Most of the above policies are long-term policies, and their execution requires huge resources and a great deal of international cooperation. However, the end of the cold war, and changes in the balance of power between the eastern and western blocs, and the changes in eastern Europe, have provided LDCs with an enormous potential to escape from the vicious development trap. This is to be carried out by the *conversion* of military resources and capabilities and resources for civilian uses in fields of economic development and environmental conservation projects. This conversion process has big potentials if incorporated into the national plans of LDCs.

5.3 Conversion

The changing strategic and political international environment, with the end of the cold war and the break-up of the former Soviet Union, has attracted attention to the new threats facing the world: poverty, environmental degradation, and the growing internal conflicts in Africa, Asia and Eastern Europe. The end of the superpowers' rivalry, however, has changed the nature of conflict in the rest of the world, and provided many LDCs with opportunities for reducing levels of military spending.

Military spending has become an economic burden on societies, the post cold war situation allows most nations to realize a substantial peace dividend. This peace dividend should be used to fund structural adjustment and conversion programmes and investments in critical human, environmental and infrastructural needs. The questions of reducing military spending and conversion (the use of military resources for civilian purposes) has been the subject of considerable research over the years, and attracted considerable concern and interest, both in the developed and developing countries.¹

Conversion, despite being a rather vague concept, is commonly understood as "the transformation of military resources into civil activities and production" (Dunne and Willett,

1992). It means more than simply the reduction of military production. It involves a structural reconstruction of the national economy, and its productive sectors.¹ Thus, conversion is a simultaneous and integral part of the arms reduction efforts, because the employment creation potentials of conversion can outweigh the anxieties of unemployment due to arms reduction.

Batchelor & Mohammed (1992) distinguish three broad approaches to conversion: *macroeconomic*, *microeconomic*, and *political* conversion approaches. The macroeconomic approach focuses on the negative relationship between arms spending and economic growth, and emphasises the macroeconomic benefits that will result from the conversion of the defence industrial base to civilian production. Writers such as Melman (1985), and Smith (1977 & 1980) have argued that reducing defence expenditure will help to facilitate the transfer of resources to other government current and capital expenditures; and that equivalent levels of investment in the civil sector create more employment than in the military sector. Therefore, cuts in military spending will result in a tangible 'peace dividend'. A recent macroeconomic study by Barker, Dunne and Smith (1991), for example, suggests that cuts in UK defence spending, if accompanied by compensation policies and the transfer of resources to the civil sector, could result in a net gain in employment opportunities.¹

The microeconomic approach focuses on company or plant-based conversion, which involves the re-use or transformation of existing military resources for civilian purposes. Related to microeconomic conversion is the strategy of diversification, in which defence industries attempt to minimize their vulnerability to fluctuations in the defence market by engaging in non-military production in addition to their existing military production

activities. This microeconomic approach has not been particularly successful, partly because of the differences between commercial and military production criteria and cultures. Companies or plants seek technical solutions using existing defence industry ownership patterns, social relationships, culture and management styles, and capital/labour endowments; and partly because these companies or plants tend to rely upon government or local government markets to guarantee survival.¹

The political conversion approach emphasises the transformation of resources tied up in defence production within a broader socio-economic and political context. It is thus not as narrow as the above 'economic approaches', and encompasses the demilitarisation of society (e.g., demobilisation, reduced defence expenditure and arms cuts). In this sense conversion is seen as an opportunity, or a lever, to effect changes in the structure of society; and to challenge existing industrial and technological priorities and the social relations of production inherent in military activities. Therefore, this approach recognized the need for a plan to meet basic human and environmental needs, and the urgent requirement to shift national resources away from military-defined objectives and instead to target 'national needs' such as industrial renewal, environmental restoration, sustainable economic development, social investment, and renewable energies. Such a national needs policy, although initiated by the government, should operate in partnership with industry, finance and local and regional authorities, workers and consumers.¹

Most of the policies suggested in the above section take longer time and require considerable resources. Conversion can, however, help LDCs to escape the *development trap*, by its immediate impact on the economy, the environment, and its reduction of high militarization levels. Gleditsch (1992; 37) shows that conversion can achieve its goals in a short time and at modest costs. Converting conscripted labour is almost without cost because conscripts can go back to their regular professions. Most conventional weapons can be disarmed fairly simply, and can be stored at very low cost. Many military land areas can be reclaimed for civilian use after minimal cleaning up. The extreme cases only need to be tackled.¹

First, conversion provides huge potentials for environmental conservation, both from the point of view of better use of resources for development of sustainable environment, as well as for the clean-up of the environment already ruined by military activities.¹ Moreover, conversion can assist environmental conservation in the following areas: environmental monitoring, chemical analysis, cartography, medicine, microbiology, and radiology, besides the deployment of members of the armed forces for disaster relief and other emergencies.¹ However, this does not mean that transfer of resources from military to civilian purposes will automatically serve environmental purposes, unless such considerations can be built into the conversion process.¹

Deger and Sen (1992: 165-194) show the potentials of military R&D conversion for environmental projects. Their analysis suggests that, if a 10% reduction in government funded R&D for the military is transferred to pollution control R&D - a major input into environmental protection. Pollution control research activity rises by 13 times (over

1300%) in the United States, over 5 times in France, about three and half times in the U.K. and more than double in Japan, as a result of such transfer of resources following even modest conversion. They conclude that

Huge amounts of resources trapped in the military sector, with special reference to R&D, can be released towards protecting the environment, the ecological system and increasing the chances of sustainable development. The world is not resource-proof if only current disarmament can be translated into permanently halting the arms race and converting military facilities for civilian use.

Second, conversion provides an opportunity for economic development plans which address the need to counter poverty. The reallocation of resources from military to civilian sectors should take place both domestically (within developing countries: switching from military to civilian budgets and priorities) and internationally (by channelling resources devoted to military programmes in industrialized countries to development assistance). Furthermore, a number of empirical studies have confirmed the negative impact of military spending on economic growth and development in LDCs, therefore, reducing military expenditure and reallocation the funds thus released for socio-economic development projects will help in the eradication of poverty and the achievement of sustainable development.

There are, however, a number of *political, institutional, economic, and technological* problems associated with disarmament and adjusting to lower levels of military spending, but not all of them apply to LDCs, and particularly Africa.¹ One of the main contemporary problems associated with conversion of defence industries, irrespective of the country involved, relates to the nature of the military industrial production process - producing a product for one monopsonistic customer (usually the ministry of defence) which is based on 'a performance at any cost' principle, and a product development culture which is determined by the inherently closed nature of military secrecy.¹ These significant barriers of entry to, and exit from, the defence market; together with the obvious adjustment costs at industry, company, regional and local community levels associated with restructuring or converting defence industries provide some of the reasons why very few countries in the world have fully succeeded in converting defence industries to civil production.

Unemployment is usually cited as the real obstacle to reducing military spending and conversion. However, this problem can be solved if the released resources have been directed to civilian productive projects which create jobs, or other areas of public expenditure. Cronberg (1992; 139-64) explains more problems and barriers facing conversion: managerial reluctance to convert, the specific nature of the military product concept, and the closed organizational culture surrounding military production. Moreover, the vested interest of the 'military industrial complex' acts as another obstacle in the face of the conversion process.

Nevertheless, despite the numerous obstacles and problems of adjustment, the evidence suggests that it is possible for LDCs to achieve reductions in military spending

and to implement conversion policies; and that this process of demilitarization has significant long-term economic benefits, without compromising State's security. This is particularly relevant for most LDCs, and especially the African countries, for the absence of military industries, which means that there are fewer economic and technological obstacles to conversion, despite the existence of some political obstacles. What is needed is proper planning for conversion, and a clear grasp of the importance of formulating strategies for the use of military personnel during peace time in civilian projects. The use of military facilities (such as airports) for civilian use should also be planned as a dual-use strategy.¹

The promotion of models for regional confidence building and cooperation in LDCs is needed if military reduction and conversion policies are to become a reality. The developed countries also can play an important role by drastic reductions in arms trade, especially for LDCs; international register of arms exports and production are also crucial.

Finally, there is now a growing body of literature which is concerned with the problems and issues of conversion. Some of the recent studies, while acknowledging the short-term adjustment costs of conversion, have also presented evidence to suggest that reductions in military spending and the conversion of defence industries represent an economic opportunity rather than a problem.¹

6. CONCLUSIONS

This paper explores the obstacles facing LDCs in achieving development. It pinpoints three important factors that inhibit development: militarization, environmental degradation and poverty. Then it shows how these three factors cause each other in a way that constitute a real "*development trap*". The interlinkages and causation between these factors reinforces the trap even more tighter on LDCs.

Poor people are usually forced to put pressure on local environment for survival; this results in environmental degradation and competition over natural resources leading to social tension and armed conflicts; higher militarization (and consequently high military spending) follow automatically armed conflicts. Higher military expenditure have substantial economic costs, and particularly on economic growth. Therefore, we have widespread poverty and the trap is enforced on LDCs.

On the other hand, the causation can go the other direction. Armed conflicts and military establishments are considered as the most pollutant establishments. Thus they lead to environmental degradation that jeopardize the realization of economic growth due to the depletion of resources. However, economic deprivation and poverty, most often, are the main causes of social tension and armed conflict and the trap is again reinforced. In either event, the "*development trap*" results, from which there is no hope of escape unless one of the links of the causal chain is broken.

The elimination of poverty, long the objective of national governments and international organizations, is making slow progress at best. Improving degraded environments can also be a difficult long-term process, and may for all practical purposes be impossible. Therefore, the study proposes the reduction of military spending as the most practical policy option for LDCs, and the conversion of the resources thus saved to socio-economic development and environmental conservation.

The last section of the paper discusses the difficulties which faces the conversion process, and how LDCs can surmount them. It also shows the short-term and long-term prospects of the conversion process.

Mohammed's (1993 d) study on the Sudanese case is devoted for the verification of the existence of the "development trap" in the Sudan. Most of the causal linkages specified in this study require empirical corroboration, a task to be carried in the forthcoming study. However, the generalization of such a model on other LDCs can be carried without difficulties for the similarity in the trends of militarization, poverty and environmental stress. Nevertheless, more empirical research on individual LDCs is highly encouraged and have vital global and regional policy implications.

Table 1: Poverty in Regions of LDCs in 1985.

Region	Extremely Poor		Poor extremely		Social Indicators	
	No. (mn)	Index (%)	No. (mn)	Index (%)	Under 5 Mortality (per 1000)	Life expectancy (years)
Sub-Saharan Africa	120	30	180	47	196	50
East Asia	120	9	280	20	96	67
China	80	8	210	20	58	69
South Asia	300	29	520	51	172	56
Middle East &	40	21	60	31	148	61
North Africa	50	12	70	19	75	66
Latin America &	633	18	1,116	33	121	62

the
Caribbean

All
Developing
Countries

Sources: World Bank *World Development Report 1990* (Table 2.1; 29).

NOTES

1. For the recent social and economic performance see the World Bank *World Development Report 1990 & 1991*.
2. For example see Myers (1989 b: 25).
3. See Mohammed (1993 e).
4. World Bank *World Development Report (1990; 7)*.
5. The World Commission on Environment and Development (1987: 101).
6. World Bank *World Development Report (1990: 5)*.
7. USACDA *World Military Expenditures and Arms Transfers 1989*.
8. See Deger (1991), pp. 115-35, for a recent survey on the trends of world military spending.
9. See Mohammed (1992 & 1993 c) for the frequency of military coups and the size of the armed forces in Africa.
10. Myers (1989 a: 73).
1. Lodgaard (1992; 117); and World Bank *Technical Paper No. 139 (1991: 55)*.
2. See Myers (1989 b: 23).
3. Prins (1990: 727).
4. Wolpin (1986).
5. Brown (1981: 39).
6. Mohammed (1989: 3).
7. Hardoy & Satterthawite (1985: 171) point to the effect of this migration on the internal (home) environment, cities, and region's environments.
8. Runge (1986: 628).
9. An example of these studies, is Wade's (1987: 95) findings on Southern India.

20. For example, the UNEP postulated that "The only view rich and poor countries seemed to share was the conviction that environmental conservation and economic development are in conflict with each other" (UNEP, 1978).

2. The UNEP then introduced the concept of *ecodevelopment* defined as "development at regional and local levels... consistent with the potentials of the area involved, with attention given to the adequate and rational use of the natural resources, and to applications of technological styles ... and organizational forms that respect the natural ecosystem and local sociocultural patterns" (UNEP, 1975, para. 100).

22. The constraint of the above resources also manifest itself in the form of rising costs and diminishing returns, rather than in a sudden loss of a resource base. See, the World Commission on Environment and Development (1987: 45).

23. The South Centre, Geneva, (1991: 1).

24. With acidification, and with deforestation for fuelwood in many developing nations. This is also true for the absence of nuclear energy generation.

25. The effects of the political aspects of militarization (e.g., military intervention in politics) are not included in the analysis. The emphases here are on the direct effects of military establishments on the economy and the environment.

26. Mohammed (1992) provides an extended literature survey and evaluates the studies in each of the two categories.

27. An example of other studies on warfare-welfare trade-offs is Dixon and Moon's (1986) study on the military burden and the provision of basic human needs. The regression analysis corroborated that, when controlling for the size of the military establishment, military spending tends to inhibit welfare outcomes in LDCs.

28. Dunne (1990) reviews different approaches to the study of the economic impact of military expenditures: neo-classical, critical liberal and Marxist approaches. See also Deger & Smith (1985) for the classical and Keynesian approaches.

29. The skills range from driving and repairing vehicles, metal and woodworking, construction and improved agricultural techniques, to engineering and other sciences. Note also that most LDCs (and particularly African countries) have volunteer armies. [See Ball (1988: 308), Figure 8-1].

30. Harris *et al.* (1988). However, in a sample of 26 African countries for the period 1967-1976, Nabe (1983) concludes that military expenditure impeded social development efforts in education in these countries.

3. Mohammed (1992)

32. See Deger & Smith (1983: 388).

33. Hess (1989) found that arms imports had a significant positive impact on receipts of foreign aid in a sample of 76 LDCs for the period 1978-1984. However, he concluded that this is conditional on the composition of nations in the sample. Indeed, the significance of arms imports vanished when the Middle Eastern countries were omitted from the sample.

34. For example, the empirical evidence provided by the following studies confirm the negative impact of military spending on economic growth: Faini et al.(1984); Deger & Smith (1983); Deger & Sen (1983); Deger (1985); Deger (1986). Mohammed (1992) provides a detailed evaluation for these studies.

35. Mohammed (1993 a & b), however, revised his analysis and claimed that his reported results are weak and do not support his conclusions because the calculated multipliers were based on statistically insignificant coefficients.

36. An example of other studies on warfare-welfare trade-offs is Dixon and Moon's (1986) study on the military burden and the provision of basic human needs. The regression analysis corroborated that, when controlling for the size of the military establishment, military spending tends to inhibit welfare outcomes in LDCs.

37. See Atles (1992), Gamba-Stonehouse (1992), and Westing (1989).

38. Maizels & Nissanke (1986), and Ball (1988).

39. At least, this was the declared motive for three successful military interventions in the Sudan (1958, 1969, and 1989).

40. Atles (1992: 65).

41. See Brauer (1991) for the recent trend of arms production in the Third World.

42. Atles (1992: 71).

43. Chourci (1992: 70).

44. For example, Rocha (1990) reveals the intensions of the Brazilian army against preserving rainforest.

45. Of which 59% are in uniform. See Westing (1988: 257).

46. See for example Westing (1988).

47. Lewis (1990) shows the role of the Kenyan army (the anti-poaching squads) in protecting wildlife.

48. Wars usually take place as a result of higher militarization, or it can be both the cause and the manifestation of higher militarization.
49. Hassan (1992: 81) gives examples of conflict in South Asia which was caused by population displacement owing to environmental stress.
50. Deger & Sen (1992: 167). Moreover, this damage caused to the Gulf's environment in 1992 corroborates Atles's previous argument.
5. Similarly, Karliner (1989; 798-801) clarifies the environmental consequences of civil wars and US intervention in Central America (e.g., Nicaragua and El Salvador).
52. Westing (1989).
53. The World Commission on Environment and Development (1987: 290) concluded that "Environmental stress is both a cause and an effect of political tension and military conflict. Nations have often fought to assert or resist control over raw materials, energy supplies, land, river basins, sea passages, and other key environmental resources. Such conflicts are likely to increase as these resources become scarcer and competition over them increases".
54. Gamba-Stonehouse (1992; 102). Gleick (1990) provides many examples of how resources have been used as strategic goals, have been targets during conflict, and have been tools of war.
55. Atles (1992) has examined how environmental factors have contributed to belligerent political behaviour and the outset of war.
56. Deger & Sen (1992: 168). See also Westing (1989) for the regional threats of water pollution.
57. Starr (1991) reviews conflicts emanating from water competition, with especial emphasis on the Middle East. See also Lodgaard (1992: 116).
58. See Gamba-Stonehouse (1992: 109). Homer-Dixon (1990: 3) also shows the effect of environmental factors on the conflict over the Euphrates river and on the internal conflict in the Philippines.
59. Quoted from Myers (1989 b: 32).
60. Holst (1989: 126)
6. The 1985 Uprising in Sudan is an example of the effects of food shortages on the stability of African regimes.
62. Similar argument is given by Myers (1989 c: 138).

63. The World Commission on Environment and Development (1987: 7) emphasized that "Already in parts of Latin America, Asia, the Middle East, and Africa, environmental decline is becoming a source of political unrest and international tension".

64. See Homer-Dixon (1990) for the excellent theoretical discussion of the causal links between environmental change and conflict.

65. Conversion-Opportunities for Development and Environment (1992: 8).

66. Of course the elimination of poverty is not an easy task. See the World Bank: World Development Report 1990, and Hassan (1992: 93) for some recommended measures to eliminate poverty.

67. Gleditsch and Mavaer (1992: 11).

68. Belousov *et al.* (1992: 82).

69. The approach was criticized mainly for its implicit assumptions (e.g., substitutability of labour between defence and non-defence sectors; and the ability of defence industries to adjust to structural changes without government aid). These assumptions ignore that conversion may lead to structural unemployment; and the obstacles which face adjustment from the specific industrial structure and culture of the defence sector. See Willett (1990:472) for an evaluation for this approach.

70. Kaldor (1991) argues microeconomic conversion, which promotes product rather than process innovation, tends to reinforce industrial and technological patterns of production rather than transforming them, and as such represents a missed opportunity in terms of the potential for more broad-based economic restructuring.

71. Dunne & Willett (1992).

72. Most LDCs do not have nuclear, chemical, or biological weapons, and do not have well-developed military industries. Therefore, the extreme cases and obstacles of conversion do not apply on most LDCs.

73. There are many ways in which the military pollutes the environment: through radiation, through disposal of waste, through testing of nuclear weapons; chemical leaks and fires; biological dangers from germs; electronic pollution; waste from bases; military exercises. See Deger & Sen (1992: 190) & Conversion-Opportunities for Development and Environment (1992: 11). Moreover, Kalashnykov *et al.*(1992: 269-277) describe a simple and inexpensive technique for the conversion of conventional ammunition (bombs), involving comparatively low environmental pollution.

74. Perelet (1992: 231-241) gives many examples of making effective use of military products, facilities and personnel. Examples could be the use of military satellites for

environmental monitoring, or troops for eliminating negative consequences of technological accidents.

75. Gleditsch (1992: 23) throws more light on this issue.

76. See Batchelor & Mohammed (1992), and Kaldor (1991).

77. In Africa, this is relevant only for Egypt, South Africa and Nigeria, where the military industrial base is well-developed. See also Dunne & Willett (1992).

78. Conversion-Opportunities for Development and Environment (1992: 15). See also the recommendations of that report.

79. See Gleditsch [ed.] (1992); Dunne (1991); Dunne & Willett (1992), Paukert & Richards (1991), and Barker *et al.* (1991) for further discussion of the issues associated with conversion.

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