MEASURING AGRICULTURAL SUSTAINABILITY: AN ECONOMIST'S NIGHTMARE

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INTRODUCTION

A fugitive to Canada arising from the Russian invasion of Czechoslovakia in 1969 had to continue his studies in Agricultural Economics in a capitalist mode and a foreign language. As a result his dreams were not always pleasant. As he sought to explain one of his bizarre experiences he was forced to do a literal translation and reported that he had a terrible night horse. Since the term sustainable development became the buzz-words of politicians, environmentalists, economists and many others, this writer has been riding bucking horses in his sleep whenever the measurement dimensions of sustainable development is contemplated; hence the title of this paper.

The concept of sustainable development became popular in the late 80s following the publication of the report of the Bruntland Commission in 1987 - *Our Common Future.* Here, sustainable development was referred to as that which "*meets the needs of the present without compromising the ability of future generations to meet their own needs*". The concept it was noted implied limitations imposed by current state of the arts and social organization on the environment and by the ability of the biosphere to absorb the effects of human activities. Technology nor social organization is constant and both could be managed and improved for the betterment of all in perpetuity. Other linguistic forms of the concept have been articulated, but more on these later.

The report further observed that species diversity was crucial to the normal functioning of the ecosystems and the biosphere - wild species contributing billions annually to the global economy in the form of crop improvement, drugs and medicines and industrial raw materials. Despite the presence of famous economists on the Commission and the expanding computer industry the best estimate of the contribution of wild species was billions of dollars - highlighting the enormity of the measurement problem. This paper recognizes the problems inherent in measuring sustainable development, reviews the concept and brings to the fore the critical elements to be addressed with particular reference to the agricultural sector.

CONCEPT AND SCOPE OF SUSTAINABLE DEVELOPMENT

Development is a dynamic state characterised by the progressive removal of obstacles to the enjoyment of democratic rights, freedoms and wealth by all segments of the population. It is a multi-faceted, people-oriented concept involving issues of growth in income with equity in its distribution, improvement in the environment and improvement in the quality of life *[McIntosh & Osuji, 1990]*. The converse of placing obstacles or barriers to the realization of these attributes is the antithesis of development. The dynamic and progressive nature of the process of development implies sustainability without which development ceases or the process regresses. In a sense sustainable development is tautologous. Be that as it may, some alternative conceptualizations are presented.

The view of the neoclassical economists that sustainable development implies maintenance of per caput consumption across all

generations or achieving non-declining utility per caput in perpetuity *[cited in Veeman, 1989]* does not fit into the development concept articulated above since it does not preclude constancy of an undesirable situation - sustained poverty, for example *[Davis 1992]*.

Turner's concept that sustainable development involves maximizing the net benefits of economic development subject to maintaining the services and quality of natural resources over time is an advance; but there is more to development than increases in real per caput incomes and that there are renewable and non-renewable (stock) resources which are made substitutable through technological changes *[Turner 1988; Veeman 1989]*.

The world conservation strategy report *[1986]* identifies five broad requirements for sustainable development cited in Brooks *[1990]* as follows:

1. Integration of conservation and development.
2. Maintenance of ecological integrity.
3. Satisfaction of basic human needs.
4. Achievement of equity and social justice.
5. Provision for social self-determination and cultural diversity.

The second requirement - maintenance of ecological integrity subsumes the first - integration of conservation and development. The basic requirements 2-5 encapsulate very well the development concept put forward by McIntosh and Osuji and is not dissimilar from Veeman's three key components - growth, distribution and environment *[Veeman 1989]*.

According to Veeman, the growth component refers to the long-run productive capacity of an economy to supply increasingly diverse goods and services for its population. The distributional component revolves around equity in the distribution of the goods and services generated by the economy. The environmental component is concerned with maintaining the integrity of the natural resource base or enhancing it so as to sustain growth over time.

Agricultural sustainability is but a subset of overall sustainable development. The FAO, 1989, put forward the concept of agricultural sustainability as the capacity of the agricultural production and distribution sector to generate on a continuing basis the goods and services necessary to meet the needs of the present population without jeopardizing the capacity of future generations to meet their own needs. Long-run economic viability while conserving land, water, genetic resources is the hallmark of sustainable agriculture. According to Weil *[1990]* appropriate agricultural policies and practices are those which:

(a) Enhance or maintain the number, quality and long-term economic viability of farming and other agri-business opportunities.
(b) Enhance rather than diminish the integrity, diversity and long-term productivity of both the managed agricultural ecosystem and the surrounding ecosystem.
(c) Enhance rather than threaten the health, safety and aesthetic satisfaction of agricultural producers and consumers.

These concepts of sustainable development and its subset sustainable agriculture provide the vessels for excursions into the measurement of sustained agricultural development.

MEASUREMENT OF SUSTAINABLE AGRICULTURE

The measurement issues are addressed from three perspectives:

(a) Measures of growth.
(b) Measures of equity in the distribution of products of the growth process; and
(c) Environmental impact.

Reference is then made to an alternative to the gross national product approach to measuring economic development.

AGRICULTURE AND ECONOMIC GROWTH

Sir W. Arthur Lewis in his "Theory of Economic Growth" *[1955]* confined his domain of inquiry to the growth in output per head as distinct from any consideration of distribution or consumption. He rightly contended that the output might be growing while the mass of population could be getting poorer and consumption is declining. The interrelationship between output,

consumption saving and govern-ment activity was clearly recognized.

The current measure of economic growth is the Gross Domestic Production (GDP) - the total value of all goods and services produced by the economy for a particular period of time. Changes in the level of GDP adjusted for price changes (inflation rate) and population growth make for the derivation of real GDP per caput an indicator of economic growth status - declining, constancy or increasing.

In making comparisons between successive periods of economic activity there are serious accounting problems. As Lewis 1955 questioned, "Is increasing expenditure on retail distribution or advertising or transportation to be taken as an increase in output, or merely as a cost of increasing specialization? If work which was formerly done by the consumer for himself/herself (e.g. making clothes) is now transferred to factories, is this an increase of output? And what is the output of a set of vehicles (some air-conditioned) caught in a traffic jam with engines running on leaded gasoline? Could the GDP based on factor costs adequately monitor the real situation? Further, as Morgenstern *[1972]* questioned, "How is productivity of an orchestra, a school, a law firm, a church (input-sinners-output saints) measured?" Women's legitimate concern that their contribution is unrecognized in the current estimates of economic growth is valid.

The growth dimension encompasses the accumulation of physical capital, human capital, cultural capital and so on *[Lewis 1955].* Current accounting measures ignore the role of the natural resource base both in terms of services rendered and allowances depreciation/ appreciation. These issues are of particular relevance to the agricultural sector. The measurement of the physical output of the sector is difficult and costly; but technically accomplishable. What confounds is the measurement of natural resource inputs (e.g. soil fertility) into the production process leading to depreciation, e.g. soil erosion or appreciation (forestation) of the resource. Nor are the extra-market values (tourism) contributed to growth accounted for. Agricultural production activities often conflict with other uses of the natural resource endowments - at what cost increasing urbanization?

The felling of the Amazon forest for cattle production creates growth but at an inestimable cost on the environment. Through plant and livestock breeding the agriculture sector has enhanced the productive capacity of various species; but have in the process limited the genetic variability of these species, while increasing the input requirements in production.

THE DISTRIBUTION PERSPECTIVE

A serious indictment on the capitalist mode of production is the inequity in the distribution of the outputs. Increasing inequity of income distribution in the face of same prevailing prices for all implies a movement further and further away from Pareto optimality. Similarly, the terms of trade between the agriculture and other sectors and its competitiveness at the international level are critical to its sustainability. In some English-speaking Caribbean countries the trend in production of major export crops (sugar, cocoa, citrus) has been downward; often without compensating use of the available resources. A major limiting factor is the maldistribution in the basic land resource. In this connection government policy is critical in bringing about a resolution to the problem. But what pattern of land tenure is optimal for efficient resource use while maintaining environmental integrity? What technological combination would ensure that labour is not displaced at a rate faster than it can be absorbed in other sectors? The application of mathematical programming techniques might be successfully applied to the latter; but can these hold for the former?

MEASURING ENVIRONMENTAL IMPACT

The fundamental question is whether growth in the economic and agricultural sector impacts adversely on the natural resource base such that growth cannot be sustained indefinitely. Fortunately, the agriculture sector possesses a high proportion of renewable resources and technology could be adopted that allows rejuvenation of soils, the improvement in nutritional content through breeding, land reclamation and desalination and forestation, to name a few. There are however, the agricultural production practices

which lead to excessive extraction rates (fishing), and environmental degradation through excessive use of herbicides, pesticides and fertilizers, poor siting of crops and inappropriate use of mechanization.

The interplay of environmental enhancing and degrading factors makes for serious measurement problems. The erosion of hillsides contribute to soil deposition in low-lying areas. Extensive inflows of organic matter into continental shelves facilitate the rapid growth of plankton, thus beginning a chain of events which culminate into rather productive fishing zones. The process of erosion and deposition may well be the answer to the rising sea level occasioned by global warming.

Income or expenditure has been used to measure relative poverty between and within sectors and in establishing poverty lines. There is a tendency of reported incomes to be understated while expenditures are overstated. Evidence of expenditure being above income is not uncommon in survey data. The poverty line - the level of income (welfare) below which a household is designated poor is a value judgement that is specific to the particular society. Comparisons with other societies may lead to erroneous conclusions.

A study on poverty in Trinidad and Tobago has shown that the percentage of poor in 1988 was much higher than in 1981/82 *[Teekens 1989, Henry 1989]*. This change corresponded with a decline in the economy occasioned by depressed oil prices. The agricultural sector was among the hardest hit by the recession. A possible reason for this is that the sector became the receptacle for those retrenched from other sectors. The sector has witnessed some positive growth. How to reconcile the growth component in the face of increasing rural household vulnerability is the burning issue.

NEW DIRECTIONS

The inability of the GDP to measure environmental services and ecological and geological capital depreciation has led to the search for new methods to measure sustainable development. Daly, *[1988]* cites three major elements of the development process; namely accumulation, service and throughput. Accumulation represents the total inventory of goods of producers and consumers as well as human capital. Two forms of accumulation could be identified - funds and stocks. Funds are organic entities which depreciate as a whole (e.g. machines). Stocks are commodities, portions of which are used up in sequence in the production or consumption process (e.g. petrol). Stocks and funds yield service over time and provide satisfaction of wants. Throughput refers to the flow of matter and energy from one state (form) to another during economic activity resulting in the accumulated stocks and funds and environmental waste. In sum, service represents benefit, throughput is cost and changes in funds and stocks is net accumulation.

This conceptualization has led to the need to keep three accounts - a benefit account, a cost account and a capital account. The benefit account seeks to measure the value of services derived from all stocks and funds used in production, rented or consumed. The cost account measures the value of depletion, pollution and disutilities of some kinds of labour. The capital account places values on accumulated stocks and funds including natural endowments mineral deposits, ecosystems and those produced.

The triad of accounts allows for comparison of benefits and costs - are the extra benefits of further accumulation worth the extra costs? The satisfactory level of accumulation is the points at which the marginal benefits of services rendered by the extra stocks and funds is equal to be marginal cost of the extra throughput required to maintain the extra stocks and funds *[Daly 1988]*.

This accounting model is intuitively appealing; but making it operational presents several nightmarish problems - some similar to those encountered in computing the GDP. On the benefit side what value would be put on household chores including service by the consumer for himself/herself (Lewis' example of making clothes)? And is the accounting of the services of the church (input sinners-output saints) made any easier by this approach? Or are Bob Marley's disciples justified in bombing (decapitalisation act) the church when they learn that the preacher is lying?

The cost and capital account is equally problematic. Agricultural systems extract soil nutrients as well as add, change land capability and improve plant and livestock species. The products of agriculture are biodegradable put several inputs in the production process are not and often highly toxic. How would values be assigned to these entities? How would assets (mines) yet known be treated in the capital account? Was there an increase in the capital account when the Caribbean became known to the Europeans?

The concepts of compounding costs and discounting future revenues have been applied to problems of resource valuation according to the following equations:

$$C = c(1+r)^t \quad \ldots \quad (1)$$

$$V = \frac{R}{(1+r)^t} \quad \ldots \quad (2)$$

in which C refers to the final value of an original cost outlay of c incurred for t years; V is the present value of future revenue R and r is the rate of interest *[Heady 1964]*. The critical element in the equations is the interest rate. Interest rate changes with time and as t tends towards infinity the determination of the interest rate becomes more problematic. Capital investment is a function of the rate of interest and the rate of interest selected for capitalization leads to extreme variability in estimated present values. The investment decision made by each farmer reflects his/her appreciation of interest rate movements within a limited time horizon. Sustainability with its implied indefiniteness holds insurmountable measurement problems. The impossibility of arriving at a precise measure of sustainability is one that the economist may accept as they now do the law of conservation of matter and the entropy law.

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