

## SCIENCE AND TECHNOLOGY FOR SUSTAINABLE LIVESTOCK DEVELOPMENT

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### INTRODUCTION

Over 98% of National herds in Sub-Saharan Africa are kept traditionally. The animals are left to wander about in search of water and pasture and do not have demarcated area for grazing. This is unlike wildlife which have vast areas reserved as Game Parks, Game reserves, National Parks etc. Sub-Saharan Africa with 168 million livestock units (162 million cattle, 127 million sheep, 147 million goats, 13 million camels, 11 million pigs 8 million donkeys, 3 million horses, 1.5 million mules and 631 million chickens - (FAO 1989) and with 0.37 Livestock Units per person being only second to Latin America and Caribbean region with 0.67 livestock units per person, still imports 140,000 tons of meat and 1.2 million tons of milk per annum and has about 20% of its children under five years of age suffering from protein deficiency related diseases.

Sub-Saharan cattle herd is characterized by very low productive coefficients with a calving rate of less than 40% (cf 80%), a calving interval of 18-24 months (cf 10 months), takes 4-5 years to achieve slaughter weight (cf 12 months) and produces less than 500 litres of milk (cf 3500-4000) per lactation. Worse still the survival rate of the 40% calves born is less than 75% (FAO 1989). Livestock

keepers therefore are forced to keep large numbers of cattle in order to meet their requirements of food, energy, manure, security etc regardless of the adverse consequences of land degradation. Equally true they would be unwilling to market their animals if they can not be assured of a calf a year as well as the survival of that calf.

As such livestock population has built up in most African countries (e.g. Cattle: Ethiopia 31 million, Sudan 22.5 million, Tanzania 13.5 million just to mention a few) and is now posing a big threat to environment. (FAO 1989).

Factors contributing to poor production coefficients of Sub-Saharan herd are primarily the poor environment (nutrition), diseases and genetic make up. The challenge to the profession therefore is to make our livestock more productive and design conservation based livestock development strategies.

### SCIENCE AND TECHNOLOGY FOR SUSTAINABLE LIVESTOCK DEVELOPMENT.

It is an undisputed fact that rapid advances in science and technology have raised a quarter of humanity to an unprecedented level of prosperity. Yet the vast majority of people in the

developing countries have hardly been affected by these developments. It is abundantly clear that science and technology are the most powerful tools to solve the dual problems of economic deprivation and the deteriorating environment endured by 75% of humanity. The recent advances in tissue culture, genetic engineering and biotechnology just to mention a few, can be instrumental in raising agricultural production, reversing land degradation and conserving biodiversity in ecologically fragile zones.

While biotechnology is not a panacea to sustainable livestock development, scientists should determine which among the technologies of the future will most appropriately address the basic constraints of sustainable livestock development.

Biotechnology which is broadly defined as "Any technique that uses living organisms to make or modify products to improve plants or animals or to develop microorganisms for specific uses" can offer immense opportunities for sustainable livestock development in the following ways:

#### Diagnostic purposes

Traditional methods of disease diagnosis including pathogen isolation and serology have a number of shortfalls including lack of specificity, labour intensive and time consuming. The uses of enzyme linked calorimetric assays, Nucleic acid probes to identify genetic material from microorganisms/animals or immunoassay to identify subunit proteins of micro-

organisms are highly sensitive, specific and rapid (Dangler and Osburn 1989).

#### Vaccine production

Conventional vaccines prepared from subunit or whole organisms pose problems related to efficacy, stability, safety and production costs (Chambers and Cohen 1989). Genetically engineered (recombinant) vaccines which are comprised of known antigenic determinants linked to infection - competent viral vectors are better since they are cheaper to produce, using standard fermentation techniques rather than the costly tissue culture techniques (Bachrach, 1981) and are safer because they consist of only one or a small number of antigenic components (subunits) as opposed to the entire organism. However, despite the apparent advantages offered by genetically engineered vaccines, their recombinant nature raises a lot of biosafety considerations (Chambers and Cohen, 1989).

#### Medically important proteins

Recombinant DNA technology has made it possible to produce medically important hormones such as insulin (Goeddel *et al.*, 1978), human growth hormone (hGH) (Goeddel *et al.*, 1979; Itakura *et al.*, 1977) and bovine growth hormone (bGH) alias known as bovine Somatotropin.

As with other genetically engineered products, there is still great controversy on the use of the bovine Somatotropin since no one knows the long term effect on the cow and the consumers.

## **Genetic improvement of livestock**

Improvement of genetic quality and productivity through selective breeding programmes has been painfully slow because the selection and breeding for desirable traits has had to be based on the genes already present in the breed (Gorham, 1989). It has also been a desire to increase reproductive efficiency and increase resistance. Disease resistance, directed either to the pathogen or to the host making it more responsive to vaccines has been an area of special interest to the profession. Genes that influence disease resistance have been linked to a family of closely associated genes found in all mammals and known as the "Major histocompatibility Complex (MHC): Some of these genes are responsible for the recognition and regulation of the immune response to foreign antigens and expression of resistance to infectious agents (Davis *et al.*, 1985; Lunney, 1985; Lunney *et al.*, 1986; Peterson and Rask 1986; Silver and Goyert, 1986). These genes are divided into two groups: those coding for membrane molecules expressed on all cells (class I) and those coding for membrane molecules expressed on antibody producing cells and antigen presenting cells (class II). In the case of bovine lymphocyte antigens, they are known as BOLA and they correlate with the genes within the family that control the immune response. They function by the production of lymphokines and interferon, specific immunoglobulin molecules and molecules which block cellular receptors for replication of specific pathogens. Some of the diseases which may benefit from this new technology include Bovine Leukemia

(Lewis and Bernaco 1986) and porcine trichinosis (Lunney and Murrell, 1987).

The above developments will increase efficiency on disease monitoring, control and productivity to an extent that people will see the need to keep fewer but more productive animals and thereby sparing the environment.

Along with the above technological developments, mixed farming as well as agro-forestry offer much hope towards sustainable livestock development. Livestock contribute directly to sustainability of farming systems by providing manure, which is the principal soil amendment and fertilizer available to a large number of African farmers. Legumes should be grown not only to feed livestock but also to provide nitrogen for crop production. Thus the planting of legume-based pastures and leguminous trees as forage for ruminants, coupled with the feeding of livestock with crop residues offers greater opportunity for sustainable livestock development.

However, apart from the environmental pollution, one of the major misgivings of the application of Science and technology is the erosion of global cultural diversity as cultures are homogenized by a value system of science and technology. Africa therefore, should not only reinforce science and technological innovation into its indigenous culture but should also ensure that it conserves a distinct form of its cultural diversity.

## MANPOWER NEEDS

Scientists are the most valuable component of an effective African policy for science and technology. While Africa has a reasonable number of science graduates, its core scientists have opted for better job opportunities outside their own countries. There is therefore a need for an attractive scheme of incentives and remuneration for qualified African Scientists to minimize or reverse the current brain drain.

This situation is further made worse by the fact that Africa graduates old persons and retires young persons and as such their productive scientific life is roughly 30% of what it should be. They are made to retire at an age when they are most productive researchwise i.e. Science Managers. It is apparent that this is not a good return for investment. In view of the aforesaid it is recommended that:

The retirement age for Scientists should be between 60 and 65 years so as to fully exploit their potential.

African countries should substantially increase financial and human resource for science and technology from the current average of 0.35% allocation for research and development to a minimum of 1% of the Gross National Product (GNP) and by at least increasing the present number of scientists three fold.

Science and technology programmes and priorities should fully be integrated into the National development plans. Special consideration should be given to raising the status of scientists and improving their

working environment.

The teaching of basic sciences as well as scientific and technological education at the secondary school level should be strengthened.

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