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Summary of ICSU ROA Projects on Health and Human Well-being

Project WB 01: HIV/AIDS and Public Health

Project Leader: Dr. Jose Jackson-Malete (University of Botswana)

Background

HIV/AIDS and other infectious diseases such as tuberculosis and malaria have contributed enormously to the reduced life expectancy in many African countries. The socio-economic impact of HIV/AIDS and associated secondary infections and disorders has resulted in a phenomenon of double burden of disease in Africa. Despite the availability of effective drugs to control HIV/AIDS and cure tuberculosis, patients require greater non-medical support to improve their self confidence. Nutritional support is one such valuable tools. Clearly the clinical efficacy of nutritional intervention is likely to be dependent on the extent to which individual infected subjects suffer from functionally significant nutritional deficiencies prior to nutritional intervention. The same argument is generally pertinent to interventions at population level – populations of infected subjects with a high prevalence of nutritional deficiency, such as those in developing countries, are more likely to benefit from health policies aimed at eradicating or diminishing nutritional deficiencies than are populations in developed countries.

The burden of infectious diseases is further aggravated by poor sanitary conditions and the lack of clean and safe water. This situation is most severe in thickly populated communities, especially urban slums. As a result, epidemic outbreaks of cholera and other water borne infections occur regularly.

In addition to the burden of HIV/AIDS and other infectious diseases, changing lifestyle that accompany globalization and increase in disposable incomes had resulted in increasing occurrence of cardio-vascular and other lifestyle diseases in Africa. Hence cancer, diabetes, respiratory and cardiovascular diseases (CVD) are becoming major contributors to the burden of disease on the continent. These are generally chronic diseases acquired through prolonged exposure to behavioural risks during gestation, childhood, adolescence, young adulthood and later adult life.

Objectives

This project is aimed at reducing the double burden of disease inflicted by HIV/AIDS and the related secondary infections and other disorders; and improving environmental hygiene and sanitation to reduce epidemic outbreaks of infectious diseases. The specific objectives include:

- Improving the chances of survival and prolonging the life of people living with HIV/AIDS
- Developing effective strategies to reduce the rate of new infections, including mother to child transmission
- Reduce the chances of opportunistic infections of HIV positive people
- Understanding the scientific basis of the relationship between nutritional status and the capacity to cope with HIV/AIDS and TB
- Assessing and cataloguing the risks of non-communicable diseases and raising public awareness of these risks and the preventive measures
- Improving the general state of hygiene and sanitation, especially in densely populated communities
- Develop human capacity for community education and awareness-raising.

Activities

The activities for this project are grouped into three sub-projects as follows:

1. Comparing the physiology and pharmacokinetic role of food-derived, versus synthetic micro-nutrients on the nutritional status of HIV and TB patients

Activities

- Assess the actual nutritional status of HIV- and TB-infected people from measurements of urinary volume, and urine and serum micronutrient levels,
- Distinguish between the effects of supplemental micronutrients in repleting actually deficient cellular supplies of crucially important metabolites on the one hand, and effects which amount to simply repleting the wholebody supply situation on the other.
- Improve understanding of the relationship between measured blood levels of micronutrients and changes in the various acute-phase proteins, as well as losses of lean tissue mass.
- Investigate the effect and effectiveness of synthetic vitamins in human bodies either singly or as multivitamin preparations taken in conjunction with other food-based vitamins

Expected Outcomes

- Scientific evidence of the relationship between nutrition, HIV and TB
- Networking amongst scientists within Africa and internationally
- Policy development / revision on Nutrition, HIV/AIDS & TB
- Capacity building in Africa
    - Institutional – laboratory development
    - Masters & PhD students & post-doctorals (Long term training in Africa; short-term exchanges with international collaborators)
    - Health-care and other personnel (doctors, nurses, nutritionists / dieticians)
    - Laboratory technicians

2. Determinants and risk factors of non-communicable (lifestyle) diseases among rural and urban populations

Activities

- Determine growth and development of urban and rural children in relation to their physical and psycho-social environments
- Determine the health status of the children and their parents in relation to diet, physical activity, and other social habits such as smoking and alcohol consumption
- Asses the progress over time, of biological and behavioural risk factors for non-communicable diseases such as cardio-vascular diseases and diabetes among rural and urban communities

- Monitor evolution of serum levels of a variety of biochemical and haematological parameters related to cardio-vascular diseases and diabetes among rural and urban communities
- Establish the relationship between lifestyle changes and health outcomes
- Educate the population on risky behaviours that predispose them to chronic lifestyle diseases
- Develop human and institutional capacity to monitor lifestyles and provide advice on the risks associated with various feeding and other social behaviours
- Disseminate research findings among, policy and decision makers, development agencies, non-governmental organizations and the civil society through workshops.

Expected outcomes

- Readily available documentation on risk factors and/or determinants of chronic lifestyle diseases
- Identification of the risk factors and determinants of lifestyle diseases and development of strategies for early correction
- Produce evidence-based policy- and decision-making tools
- Improved human and institutional capacity to monitor lifestyles and provide advice on the risks associated with various feeding and other social behaviours.
- Well packaged research findings to guide policy, and for community education and awareness-raising.
- Available information to guide scale-up of the interventions proven to produce positive results on behavioural change.

3. Environmental sanitation and household water supply

Activities

- Develop simple and low cost technologies to treat water for domestic use. Such technologies will be adaptable for use at the household, village or community scales.
- Develop environmentally sustainable technologies for treatment and economic valorization of waste water, sewage and other household and municipal solid wastes at the level of local communities
- Put in place appropriate infrastructure for centralized waste collection and treatment or recycling
- Create a general understanding of the multi-dimensional complexities driving sanitation practices, especially in densely populated urban and informal settlements
- Enable a good understanding of the country specific health, socio-economic and environmental impacts pertaining to sanitation (non - availability, gender issues, hygiene practices)
- Identify the most important issues and needs at country level that drive successes and failures of sanitation projects (technology, availability, social values, and economic constraints and so on)
- Set country specific sanitation standards in relation to findings, to ensure acceptability, affordability and sustainability
- Test set sanitation standards developed technologies in pilot case studies
- Develop technologies for rain harvesting to supplement household water demands
- Develop capacity to identify and explore ground water resources for domestic use.
- Develop models to monitor and assess ground water dynamics (abstraction versus recharge) and risks of contamination, and provide advice on exploitation policies and protection strategies
- Create capacity in modeling procedures so that effects of climate change variability and population growth can inform development of ground water resources

Expected Outcomes

- Available evidence-based decision support tools with regard to community hygiene and sanitation policies
- A tested package of sanitation practices that are applicable, acceptable and affordable by target user communities
- Simple and affordable technologies for household water purification, and for waste treatment and recycling at household and community levels
- Improved technologies for safe and sustainable utilization of ground water resources for domestic supply
- Improved human and technological capacity for design of simple, reliable and affordable equipment for sustainable exploitation of ground water resources.
- Improved human and infrastructural capacity for waste management
- A set of appropriate ground water assessment tools
- A model predicting possible changes in the availability of ground water due to climate change and population growth and abstraction
- Suitable groundwater sources identified.

Project WB 02: Modern Bio-medicine, traditional medicine and indigenous knowledge systems

Project Leader: Prof. Charles Wambebe (International Biomedical research in Africa, Abuja, Nigeria).

Background

Most African countries, particularly those in the sub-Sahara region remain the most hit by a heavy burden of diseases. Diseases such as malaria, tuberculosis (TB), cholera and many other bacterial and viral infections have caused many deaths on the continent and they keep re-emerging despite several international programmes to control them. Malaria and TB are particularly reputed for developing resistance to drugs and several attempts to counter such drug resistance do not seem to be yielding satisfactory results. It is therefore necessary to seek a more in-depth understanding of the mechanisms and dynamics of the interaction of the disease agents with their hosts and with the drugs used to control them.

As a result of poverty and absence of adequate healthcare services, and perhaps trough the influence of cultural and ties, most Africans rely on traditional medicine for treatment against many disease. While some of these traditional remedies have proven reliably efficient against some diseases, the practice faces several burning challenges. For example, the tradi-practitioners still keep their knowledge secret due to lack of trust. In addition, most of the traditional concoctions have very short shelf life and no standardised doses. The hygienic conditions under which they prepared is often questionable, and the presence or absence of toxic components in the extracts remains unknown. Further more, the exploitation of traditional medicinal species is not sustainable and threatens the continents biodiversity.

Given the value of traditional medicine in Africa, its potential due to the rich biodiversity and the short-comings as pointed out above, it is clear that an integrated approach is required combining modern bio-medical practices with African traditional medicine practice, and applying molecular bioscience to add value to these practices.

Objectives

The purpose of this project is to combine indigenous medical knowledge with modern biomedical sciences to improve healthcare in Africa. An integrated approach will be undertaken to reduce the burden of high impact transmissible diseases such as malaria, tuberculosis, HIV/AIDS and water-borne diseases. The project also aims at valorizing indigenous knowledge in medicine, through accurate documentation and wide publication of demonstrated success in the use of traditional medicines; and to develop appropriate policy frameworks for the protection of Indigenous knowledge systems (IKS) and their intellectual property rights (IPR)

Activities

The activities of this project will focus on the following sub-themes:

(i) Epidemiology and pathogenesis of target diseases:

- Identify the factors influencing the transmission dynamics of the target diseases
- Identify the spatial and temporal trends in the dynamics of the diseases
- Model and predict the emergence of the diseases with changing environmental conditions
- Investigate the molecular basis of infection of the target diseases
- Study the molecular interactions between the pathogens and the host

(ii) Drug resistance patterns

- Understanding the molecular and biochemical bases for disease resistance to drugs.
- Understanding the molecular and biochemical bases for resistance of disease vectors to pesticides.
- Catalogue the frequency of drug resistance in targeted diseases and of pesticide resistance in the corresponding disease vectors.
- Develop the capacity for rational synthesis of new drugs and pesticide formulations, so as to circumvent the development of resistance

(iii) Diagnostics

- Identify biomarkers for use in disease diagnosis
- Develop validate and field testing of sensitive, specific and affordable diagnostics kits

(iv) Vaccine development

- Identify and validate candidate vaccines through pre-clinical and clinical testing

(v) Documentation of indigenous medical knowledge

- Conduct Ethno-botanical surveys of the most widely used medicinal plants for the targeted diseases
- Develop reference database of African medicinal plants

(vi) Safety evaluation, scientific validation and IPR issues

- Carryout toxicological, pharmacological and efficacy evaluation of the natural medicinal products for the targeted diseases.
- Develop policies to protect Intellectual Property Rights of all stakeholders

(vii) Drug discovery and development

- Identify pharmacologically active natural compounds and formulate them into prescription drugs.
- Standardize the formulation, dosage, stability and storage of indigenous remedies.
- Develop policies to protect indigenous knowledge so as to encourage trust and information sharing.
- Establish partnerships between traditional practitioners, scientists, medical practitioners and manufacturers for drug development and commercialization

(viii) Sustainable utilization of biodiversity

- Initiate cultivation of medicinal plants and develop sustainable cropping and harvesting practices that sustain ecosystems for human well-being
- In-situ and ex-situ conservation of endangered species
- Environmental impact assessment

(ix) Genetic resource bank

- Collect and preserve genetic resources, and render them accessible when required
- Devise appropriate mechanisms for protection of Intellectual Property Rights and for meeting standards for bioethics

(x) Socio-economic and policy aspects of new interventions

- Promote practices, attitudes and indigenous knowledge systems that will facilitate wide acceptance of new health interventions.
- Provide science-based evidence for policy formulation.
- Conduct socio-economic impact analysis of, and advocacy for adoption of new interventions

(xi) Capacity building

- Train and upgrade research, technical and field personnel to acquire the relevant skills.
- Strengthen reference laboratories and centres of excellence.
- Improve health system logistics.

Expected outcomes:

- Capacity building (human resource and physical infrastructure)
- Database of African traditional medicines
- Low cost, sensitive and specific diagnostics
- Phytomedicines (single & multi-component products)
- Propagation protocols for medicinal plants
- Disease prediction models
- Drug resistance maps
- Vaccines and new drugs

Project WB 03: Food and Nutrition Security

Project Leader: Prof. Sunita Facknath, University of Mauritius

Background

Global production of food is stated to be adequate, with projected figures for increase in yields of 20%. But this is not the case for Africa, where crop and livestock yields are low, and dwindling further and there is insufficient food availability. Declining soil health and fertility management, land use changes, pest and disease problems, and the effects of changing climate exacerbate the threats on food production in Africa.

Food and nutrition security remain Africa's most fundamental challenges for human well-being. Several countries in Africa are presently facing a food crisis. For several decades, there have been steady declines in agricultural productivity and remarkable decreases in per capita food availability. In one third of African counties, the mean daily calorie availability per capita is below the recommended intake level of 2100 calories per day, while in Burundi, the DRC, Eritrea and Somalia, the calorie availability is below minimum intake level of 1800 calories per day. As a result of low food availability and profound poverty, an estimated 200 million people on the African continent are undernourished (in terms of macronutrients and micronutrients) and are unable to meet their dietary energy requirements.

However, Africa has a potential for increasing its food production and reducing food losses at post-harvest and storage, as well as at the level of consumption.

Objectives:

The main objective of the project is to improve food supply systems on the continent to ensure availability, accessibility and utilization of safe and nutritionally balanced food in sufficient quantities to all people at all times. The specific objectives are set out within the respective sub-projects.

Sub-projects:

1. **Sustainable improvement of food production**

   Objectives: The main objective of this sub-project is to increase food production in a manner that is environmentally and economically sustainable. The specific objectives would be:

   - to revalorize indigenous/traditional knowledge (ITK) on sustainable methods of food production by studying their scientific bases, and developing and replicating productive traditional technologies
   - to modernise and professionalize production through research and development into new technologies/systems (biotechnology, tissue culture, organic agriculture, precision agriculture, mechanisation, etc.)

   Activities:

   - Transfer and domesticate modern technologies for improved agronomic practices such as zero tillage, mechanisation, integrated pest and nutrient management including fertigation, precision agriculture, etc, to improve the productivity of traditional crop varieties;
   - Develop new and high-yielding and pest/disease-tolerant crop varieties using modern biotechnologies;
   - Develop organic agriculture (with organic standards, norms and certifying bodies);
   - Develop freshwater and marine aquaculture (intensive and extensive);
   - Develop Fair Trade agricultural produce;

- Develop agroforestry (added benefits of carbon credits);
- Develop improved scientific methods for cultivation of less-known vegetables and fruits;

Expected outcomes

- A Manual describing scientific basis of ITK methods;
- Adoption of improved technologies by farmers;
- Package of site-specific technologies for sustainable increase in crop production;
- Improved crop yields;
- Increased production of planting materials using tissue-culture technology
- Availability of pest and drought-tolerant varieties of selected crops, including GM crops where appropriate;
- Established organic standards, norms and legislation, as well as certification bodies for organic products;
- Increased production of organic crops;
- Development of competitive products for international markets (Fair Trade markets);
- Package of cropping practices and techniques for less-known vegetables and fruits

2. **Sustainable increase in livestock production (including fisheries and non-conventional mini-livestock)**

Objectives: The main objective of this sub-project is to improve the quality and quantity livestock production in a sustainable manner, as a strategy to attain food and nutrition security on the continent. The project will also explore non-conventional livestock production. The specific objectives would be:

- to reduce the impact of economically important livestock diseases and pests on human food and nutrition security
- to increase the scope of diversification of the farmer's sources of food and income generation;
- to promote the conservation of biodiversity through the introduction of non-conventional livestock species in their production systems.
- to explore the potential use of local and readily available feed resources to formulate balanced and low cost diets for improved livestock nutrition
- to reduce environmental degradation through over-grazing

Activities:

- Investigate appropriate and efficient control strategies against animal diseases of economic importance, for example, tick and tick-born diseases such as the East coast fever of cattle and the African swine fever, contagious bovine pleuro-pneumonia, food and mouth disease, and new castle disease (in poultry)
- develop technologies for producing disease-tolerant livestock breeds, especially of cattle
- Explore the potential for practice of ethno-veterinary (use of local herbs as prophylactic treatment of livestock against gastrointestinal micro organisms)
- Develop technologies for feed formulation from local feed resources to produce balanced and low cost feeds for lean meat production in monogastric animals (poultry and swine) and for lean meat and high milk production in ruminants (cattle, sheep and goats)
- produce balanced and low cost feed for fisheries and mini-livestock species from readily available local sources, including agro-industrial by-products or wastes

- Investigate intensive livestock production options that favour conservation of biodiversity
- Develop production techniques for less-known sources of meat, e.g. snails, frogs, etc
- Explore the practice of integrated agro-forestry to promote sustainable production of small ruminants (sheep and goats)
- Develop forage farming to sustain zero grazing

Expected outcomes

- Improved livestock health
- Increased production of meat, milk and other animal products
- Package of production technologies for less-known sources animal protein, such as edible snails and frogs
- Increase in revenue generation (reduction in poverty) through improved livestock production
- Sustainable production of non-conventional livestock species,
- Improved conservation of biodiversity in the wild.
- Improvement of research infrastructural development,
- Increase in trained human resources,
- Improvement in institutional capacity

3. Improving post harvest technologies

Objectives:

- to revalorize indigenous/traditional knowledge for post harvest and storage methods
- to develop adequate and modern tools and technologies for conservation, preservation and processing food after harvest;
- to develop environmentally sustainable and healthy food packaging technologies
- to develop appropriate food storage facilities

Activities:

- Investigate the scientific bases of indigenous knowledge claims, and develop and replicate efficient technologies among farmers;
- Develop facilities for monitoring and quality control of processed and stored food (for example, the effect of sun drying, and presence of mycotoxins and other toxins);
- Develop a strategic plan for setting up and operating centralised (co-operative) storage facilities available to farmers at guaranteed minimum cost;
- Develop a mechanism to encourage cottage industries (family-based, on-farm) for eventual up-scaling to industrial levels

Expected outcomes

- A Manual describing the scientific basis of indigenous/traditional knowledge and technologies for post harvest handling and storage of food;
- Generic methods for preservation, conservation and processing food after harvest (to be modified and adapted to country or community specificities
- Analytical facilities (laboratories, equipment, trained manpower)
- Adequate modern storage facilities at community, village, district, country levels
- Transfer of technology to industrial scale
- Training of farmers on storage techniques and tools.

4. Food safety and quality nutrition

Objectives: The main objective of this project is to improve food safety and quality nutrition. This includes improving the safety of meat and meat products (free from toxins and infectious agents responsible for zoonotic diseases). The specific objectives include the following:

- to develop capacity for traceability and analyses of food for nutrient and micronutrient content, pesticide residues, nitrates, mycotoxins and other toxins, and anti-nutritional factors;
- to develop capacity for monitoring food quality and compliance with Hazard Analysis and Critical Control Points (HACCP) standards;
- to promote awareness of appropriate methods of food preparation (to retain nutrients and other health factors);
- to study dietary management of diseases and disorders (including mental health – behavioural and cognitive);
- to determine food requirements of people at all stages of life;
- to develop methods for preparing complementary foods using local foods;
- to promote breast-feeding in communities in the context of HIV/AIDS

Activities:

- Develop human and institutional capacity for analyses of food for nutrient content (including micronutrients), pesticide residues, nitrates, mycotoxins and other toxins and anti-nutritional factors (especially in indigenous foods) through training and establishment of well equipped laboratories;
- Explore opportunities in emerging technologies to improve the speed and efficiency of screening procedures for timely detection of food contaminants (toxins and human pathogens);
- Develop capacity for traceability of food and for monitoring of food quality and compliance with HACCP standards;
- Determine food and nutritional requirements of different household members;
- Promote awareness of appropriate methods of food preparation (to retain nutrients and other health factors);
- Determine relationships between feeding patterns/habits and diseases or disorders (including mental health);
- Develop methods for preparation of complementary foods using local food stuffs;
- Promotion of breast feeding in the context of HIV/AIDS
- Explore the potential for practice of ethno-veterinary (use of local herbs as prophylactic treatment of livestock against gastrointestinal micro organisms) to reduce the risk of zoonotic diseases

Expected outcomes

- Equipped laboratories and trained staff with analytical skills and capabilities to test for HACCP and other standards and norms;
- Established mechanisms for food traceability;
- Database of nutrients, micronutrients, and anti-nutritional factors in different foods;
- Educational and outreach promotional materials describing appropriate methods of food preparation that will help retain nutrients and other health factors;
- Data and information on the food requirements of all household members in al stages and conditions of life(e.g. pregnant , lactating women; infants, children, active men, old people)

and for people with malaria, HIV/AIDS, and other infectious diseases, non-communicable diseases and mental health, etc);

- Data and information on the effect of diseases and parasitic infestations on food utilisation/assimilation;
- A Manual for preparation of complementary foods for infants, using local foods;
- Properly packaged information for sensitisation with regard to breast-feeding in the context of HIV/AIDS.
- Improved consumer confidence with regard to consumption of safe, healthy and nutritious food, especially meat, milk and other meat products

5. Adaptation of agricultural production systems to climate change

Objectives: The main aim of this project is to mitigate the impact of climate change phenomena on agricultural production in sub-Saharan Africa. The specific objectives aim at:

- predicting dynamics of plant and animal diseases and pest outbreaks in response to climate change, and adjusting control protocols accordingly
- monitoring the impact of temperature rise on the physiological performance of crops and livestock and developing appropriate adaptation strategies
- developing human and institutional capacity to reliably predict climate change trends and inform policy- and decision-makers
- developing decision support tools to guide policies on efficient water management in agriculture
- building capacity to apply modern biotechnologies in developing drought-tolerant, short-cycle and high-yielding crop varieties, as well as livestock breeds with high water use efficiency.

Activities:

- Application of conventional breeding and modern biotechnologies to develop drought-and heat-tolerant livestock breeds
- Application of conventional breeding and modern biotechnologies to develop short-cycle and/or drought-tolerant crop varieties
- Climate change simulation and screening of newly developed plant varieties and livestock breeds for acclimatisation to atmospheric temperature rise.
- Develop models for predicting changes in habits and/virulence of plant and animal pests and pathogens as a consequence of climate change
- Develop soil moisture conservation technologies
- Human and institutional capacity development in irrigation engineering to produce water-efficient technologies
- Design, test, and demonstrate water-efficient irrigation systems

Expected outcomes

- Improved resilience of crop and livestock production systems to drought and high temperatures
- A package of crop and livestock production techniques adapted to climate change phenomena

- A good understanding and appreciation of the trends and threats of plant and animal pests and diseases as affected by climate change, including prediction of the emergence of new diseases or loss of virulence of existing ones.
- Policies and guidelines for water management in agricultural production systems
- Well trained engineers to design and produce efficient and low cost (affordable by farmers) irrigation equipment for more efficient water use in agriculture
- Extensive adoption of water-efficient irrigation techniques

6. Improving accessibility to food

Objectives: The main objective of this sub-project is to develop mechanisms of facilitating access to food among African communities. Specifically, the project will aim at:

- establishing a fair trade system;
- developing strategies for wealth-generation to ensure access of all people to adequate food;
- promoting intra-household food distribution;
- advocating for improvement in infrastructure for food distribution (transportation, roads, rail, etc.).

Activities:

- Develop mechanisms for setting up well-organised government–regulated auctions at village, district, national levels to prevent exploitation of farmers by middlemen, and also to ensure quality of food;
- Develop and promote income generating activities (for example, off-season planting, alternate activities) at household level;
- Determine food requirements of different members of a household;
- Education and training to ensure appropriate distribution of food in households;
- Advocacy for infrastructural development to facilitate food distribution;
- Conduct socio-economic studies to provide evidence that would inform internal food and external food trade regulatory policies

Expected outcomes

- An established mechanism for fair trade;
- A policy paper on improvement of infrastructure for food distribution;
- A strategic plan for wealth generation to ensure access of all people to adequate food;
- Guidelines for appropriate distribution of food within households;
- Training materials for household members on food and dietary requirements;
- Increased household income and assets;
- Inclusion of infrastructural needs (transportation, roads, rail, etc.) in Government development plans.