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A Review of Agriculture and Health Policies in Uganda with Implications for the Dissemination of Biofortified Crops

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HarvestPlus is a global alliance of research institutions and implementing agencies that have come together to breed and disseminate biofortified crops for better nutrition. HarvestPlus is coordinated by the International Center for Tropical Agriculture (CIAT) and the International Food Policy Research Institute (IFPRI). HarvestPlus is an initiative of the Consultative Group on International Agricultural Research (CGIAR).

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LIST OF ACRONYMS

AETRI	Agricultural Engineering and Technology Research Institute
AfDP	African Development Bank
AMIS	Agricultural Market Information Service
APEP	Agricultural Productivity Enhancement Programme
ARDC	Agricultural Research and Development Centre
ASARECA	Association for Strengthening Agricultural Research in Eastern and Central Africa
CBO	Community Based Organization
CDW	Community Development Worker
CGIAR	Consultative Group on International Agricultural Research
CGMP	Community Growth Monitoring and Promotion
CHDC	Child Health and Development Centre
CIAT	International Centre for Tropical Agriculture
CIP	International Potato Centre
DANIDA	Danish International Development Agency
DATICS	District Agricultural Training and Information Centres
DHC	District Health Committee
DHMT	District Health Management Team
DUCAR	District, Urban and Community Roads
ENHR	Essential Health and Nutrition Research
EPI	Expanded Programme on Immunization
EPI-INFO	Expanded Programme on Immunization - Information
ESD	Epidemiological Surveillance Division
ESIP	Education Sector Investment Plan
EUREPGAP	European Union Retailer Good Agricultural Practices
FAL	Functional Adult Literacy Programme
FEWSNET	Famine Early Warning System Network
FFI	Food Fortification Initiative
FY	Financial Year
GIS	Geographic Information System
GOU	Government of Uganda
HC	Health Centre
HIV/AIDS	Human Immune Virus/ Acquired Immune Deficiency Syndrome
HMIS	Health Management Information System
HORTEXA	Horticultural Exporters Association
HSD	Health Sub-District
HSSP	Health Sector Strategic Plan
IARC	International Agricultural Research Centre
ICN	International Congress on Nutrition
IDA	Iron Deficiency Anaemia
IDD	Iodine Deficiency Disorders

IDSR	Integrated Disease Surveillance Division
IEC	Information, Education and Communication
IFPRI	International Food Policy Research Institute
IMCI	Integrated Management of Childhood Illness
IMMS	Infant and Maternal Mortality Strategy
IPH	Institute of Public Health
MAAIF	Ministry of Agriculture, Animal Industries and Fisheries
MAPS	Market and Agro-Processing Strategy
MDG	Millennium Development Goal
MFPED	Ministry of Finance Planning and Economic Development
MHCP	Minimum Health Care Package
MOES	Ministry of Education and Sports
MOH	Ministry of Health
MTTI	Ministry of Trade, Tourism and Industry
NAADS	National Agricultural Advisory Service
NAARI	Namulonge Agricultural and Animal Production Research Institute
NAEPS	National Agricultural Education Policy and Strategy
NARO	National Agricultural Research Organization
NARP	National Agricultural Research Policy
NARS	National Agricultural Research System
NECDP	Nutrition and Early Childhood Development Programme
NEWS	National Early Warning System
NFNC	National Food and Nutrition Council
NGO	Non-Governmental Organization
NHP	National Health Policy
NHSRP	National Health Sector Reform Programme
OFSP	Orange-Fleshed Sweetpotato
OPI	Outreach and Partner Initiative
PEAP	Poverty Eradication Action Plan
PHC	Primary Health Care
PMA	Plan for the Modernization of Agriculture
PMASC	PMA Steering Committee
PMTCT	Prevention of Mother to Child Transmission of HIV/AIDS Centre
PRAPACE	Regional Network for the Improvement of Potato and Sweetpotato in Eastern and Central Africa
SAARI	Serere Animal and Agricultural Research Institute
SFC	Supplementary Feeding Centre
SHP	School Health Programme
SPVD	Sweetpotato Virus Disease
STI	Sexually Transmitted Infections
TFC	Therapeutic Feeding Centre
TGR	Total Goitre Rate
TPC	Technical Planning Committee

TSU	Technical Support Unit
UBOS	Uganda Bureau of Statistics
UEPB	Uganda Export Promotion Board
UFNSIP	Uganda Food and Nutrition Strategy and Investment Plan
UIA	Uganda Investment Authority
UNFNP	Uganda National Food and Nutrition Policy
UNBS	Uganda National Bureau of Standards
UNCST	Uganda Council for Science and Technology
UNEPI	Uganda National Expanded Programme on Immunization
UNFF	Uganda National Food Federation
UNHP	Uganda National Health Policy
UNHRO	Uganda National Health Research Organization
UNICEF	United Nations Children's Emergency Fund
UNIDO	United Nations Industrial Development Organization
UNNGOF	Uganda National NGO Forum
UNPAN	Uganda National Plan of Action for Nutrition
UPE	Universal Primary Education
URA	Uganda Revenue Authority
USAID	United States Agency for International Development
USL	Uganda Seeds Limited
VAD	Vitamin A Deficiency
VEDCO	Volunteer Efforts for the Development Concerns
VHT	Village Health Team
VITAA	Vitamin A for Africa
WHO	World Health Organization

A REVIEW OF AGRICULTURE AND HEALTH POLICIES IN UGANDA WITH IMPLICATIONS FOR THE DISSEMINATION OF BIOFORTIFIED CROPS

1. INTRODUCTION

Micronutrient deficiency is a widespread health problem in the developing world. Most efforts to combat this issue have focused on providing vitamin and mineral supplements to vulnerable population groups and/or fortifying foods through post-production processing. The outcome of these interventions has not always been successful; particularly as isolated communities are often not reached due to logistical problems or do not regularly consume processed products. Also, supplementation interventions are frequently dependent on external funding and thus their sustainability is questionable.

Biofortification, the breeding of new, micronutrient-rich varieties of staple foods, has been proposed as an additional strategy for combating micronutrient malnutrition. In recognition of the potential of biofortification, the Consultative Group for International Agricultural Research (CGIAR) formed HarvestPlus, an initiative coordinated by International Centre for Tropical Agriculture (CIAT) and the International Food Policy Research Institute (IFPRI) (HarvestPlus 2006) that "seeks to reduce the effects of micronutrient malnutrition (especially Vitamin A, Iron and Zinc deficiencies) by harnessing plant breeding to develop staple food crops (beans, cassava, maize, rice, sweetpotatoes and wheat in the first phase) that are rich in micronutrients" (HarvestPlus 2003). The introduction of these biofortified crop varieties will complement existing approaches by offering a sustainable, low-cost method for reaching people with poor access to health care systems or formal markets. Additionally, their introduction will provide continuing benefits throughout the developing world at a fraction of the recurring cost of either supplementation or post-production fortification (McClafferty and Russell 2002).

Uganda exemplifies the problems of malnutrition and the difficulties encountered during interventions. The country produces a wide range of crops and animal products and is favoured by two cropping seasons per year in the most populated areas; yet the population faces problems of malnutrition, famine, and hunger (Iannotti *et al.* 1998). Many factors contribute to poor nutritional status including: low levels of food intake; high rates of morbidity, particularly malaria and HIV/ AIDS; inadequate maternal and child care practices; poor water, sanitation and health services and low levels of income

and food production. This affirms the importance of taking a multisectoral approach towards alleviating the nutritional problems of Uganda (Iannotti *et al., loc cit*).

Malnutrition is considered a major drain on national assets in Uganda. In 2001, 10 percent of adult women were undernourished and 40 percent of deaths among children were attributable to malnutrition. Over 38 percent of children below 5 years were moderately or severely stunted, 4 percent moderately wasted and 23 percent moderately underweight (UBOS 2001). Micronutrient deficiencies are a major component of this malnutrition (Bachou 2002). Most efforts to alleviate micronutrient deficiency in Uganda have focused on three key micronutrients: iodine, iron, and vitamin A.

No national survey of Iodine Deficiency Disorders (IDD) has been conducted. A survey of four highland and five lowland districts in 1991 showed a total goiter rate (TGR) of 74 percent in children between 6 and 11 years, with markedly higher rates in the upland areas. A second survey in 1999 showed a 16 percent reduction in the TGR (Bachou 2000). During this period the consumption of iodized salt had increased from 69 percent to 94 percent (UBOS 2001), due to a sustained awareness campaign and regulatory processes requiring all imported salt to have an iodine concentration of 100 ppm.

WHO prevalence data (1998) indicate that 50 percent of Ugandan women of child-bearing age (15 to 49 years) have Iron Deficiency Anaemia (IDA) and about 30 percent of maternal deaths are attributable to IDA. Thirty percent of postpartum women were also reported to be anaemic with a high prevalence in the east of the country (Sserunjogi 1998). Only 45 percent of women took iron supplements during pregnancy in the year 2000 (UBOS 2001). Sixty-five percent of children under five were found to have IDA in the survey of UBOS (*loc cit*).

The UBOS survey (UBOS 2001) estimated Vitamin A Deficiency (VAD) in women of child-bearing age at 52 percent, but only 11 percent of women received vitamin A capsules postpartum. For children under five, 28 percent were considered Vitamin A deficient whilst only 38 percent of children received supplements within the six months prior to the survey period.

Micronutrient deficiencies are significantly higher in rural areas than urban areas and with major differences between regions and socio- and educational status (UBOS 2001). Harvey *et al.* (1999) observed that the intake of animal protein was scarce and limited the bioavailability of all micronutrients. It was also observed that the major source of vitamin A was green leafy vegetables, boiled or steamed, and taken with little fat. They

concluded that 50 percent of children had an inadequate vitamin A intake and that the risk of VAD was higher in poor, than in better-off, households.

It is estimated that between 2004 and 2014, VAD will cost the country US$2.5 billion due to untreated illnesses associated with VAD and a further US$382 million due to lost productivity amongst women with anemia (Ministry of Health *et al.* 2004). The cost to the community at large was not estimated.

Whilst emphasis is given in the UBOS report to VAD and IDA, it is most likely that deficiencies of other essential nutrients; e.g. zinc, selenium, magnesium or vitamin C, also occur (MOH undated).

The Government of Uganda is committed to addressing micronutrient malnutrition. This is emphasized in the principal agricultural and health strategy and policy documents; notably:

1. The Poverty Eradication Action Plan (PEAP) of 2000, which is the overall national planning framework under which all other sector policies emerge, operates through sector policies and plans.
2. The Plan for the Modernization of Agriculture (PMA) of 2003 is the sector plan for agriculture.
3. The Uganda National Food and Nutrition Policy (UNFNP) of 2001 and the Uganda Food and Nutrition Strategy and Investment Plan (UFNSIP) of 2005 specifically address micronutrient deficiencies.
4. The Uganda National Health Policy (UNHP), which provides overall guidance for the health sector, is implemented through the five-year Health Sector Strategic Plan (HSSP). The first HSSP ran from 2000/ 01 to 2004/ 05 and the second Plan will run from 2005/06 to 2009/10.

In the 1990's, micronutrient interventions focused on iodine and vitamin A. Initial micronutrient related activities began with a nationwide campaign to combat IDD initiated in December 1994. Efforts to reduce VAD concentrated on vitamin A capsule distribution. Vitamin A capsules are now part of the Government's list of essential drugs and guidelines for vitamin A supplementation are included in the National Standard Treatment Guidelines (Iannotti, 1998; Micronutrient Initiative 2003).

In view of the chronic malnutrition and Government commitment, HarvestPlus and the International Agricultural Research Centres (IARCs) selected Uganda as a pilot country

for the testing of the biofortification approach to the above deficiencies using orange-fleshed varieties of sweetpotato (OFSP) that are rich in β-carotene, the precursor of Vitamin A, to address VAD; and iron-rich varieties of *Phaseolus* beans to combat IDA: projects led by the International Potato Centre (CIP) and the International Centre for Tropical Agriculture (CIAT), respectively.

This paper reviews Government policies and strategies from the aspect of their ability to address malnutrition and micronutrient deficiency and considers means by which biofortification of staple food crops can support this policy. The rationale for focusing on policies and strategies in these sectors is based on the UNICEF conceptualization of the causation of nutritional outcomes (see Figure 1(UNICEF 1998)).

The conceptual framework presents a generalized understanding of how malnutrition is the outcome of specific development problems related directly to the level of dietary intake and the health status of a given individual. It theorizes that inadequate dietary intake (in energy, protein, vitamins and minerals) and disease are the immediate causes of malnutrition. To ensure adequate dietary intake and absence of disease, three underlying conditions need to be fulfilled simultaneously, namely: (i) household food security; (ii) adequate care of children and women; and (iii) access to health services and a healthy environment.

Bouis and Hunt (1999), demonstrate in Figure 2 how inputs to improved nutrition (food intakes, care and health) have a direct impact on the nutritional status of mothers and children. The mediating factors that determine food intake, care and health are food prices, incomes, time demands on women, nutrition education, female empowerment, and health and sanitation. Other policies such as macroeconomic, labor, credit are excluded from the analysis (refer to Section 1 for an explanation of this exclusion). From the food security conceptual framework (Figure 2), three main salient issues emerge:

1. Agricultural production interventions should be targeted toward women, who are the major caregivers and are thus central to nutrition outcomes. These interventions should be designed to increase food supply and accessibility, decrease the time demands on women, increase nutrition education, and enhance female empowerment.
2. Community-based nutrition and health programmes aimed at improving education, nutrition knowledge, health and sanitation practices positively affect the health status of women and children in the community.
3. Maternal nutrition status and health directly impact the child's nutrition and health status, and the elevated needs for minerals and vitamins by women and children

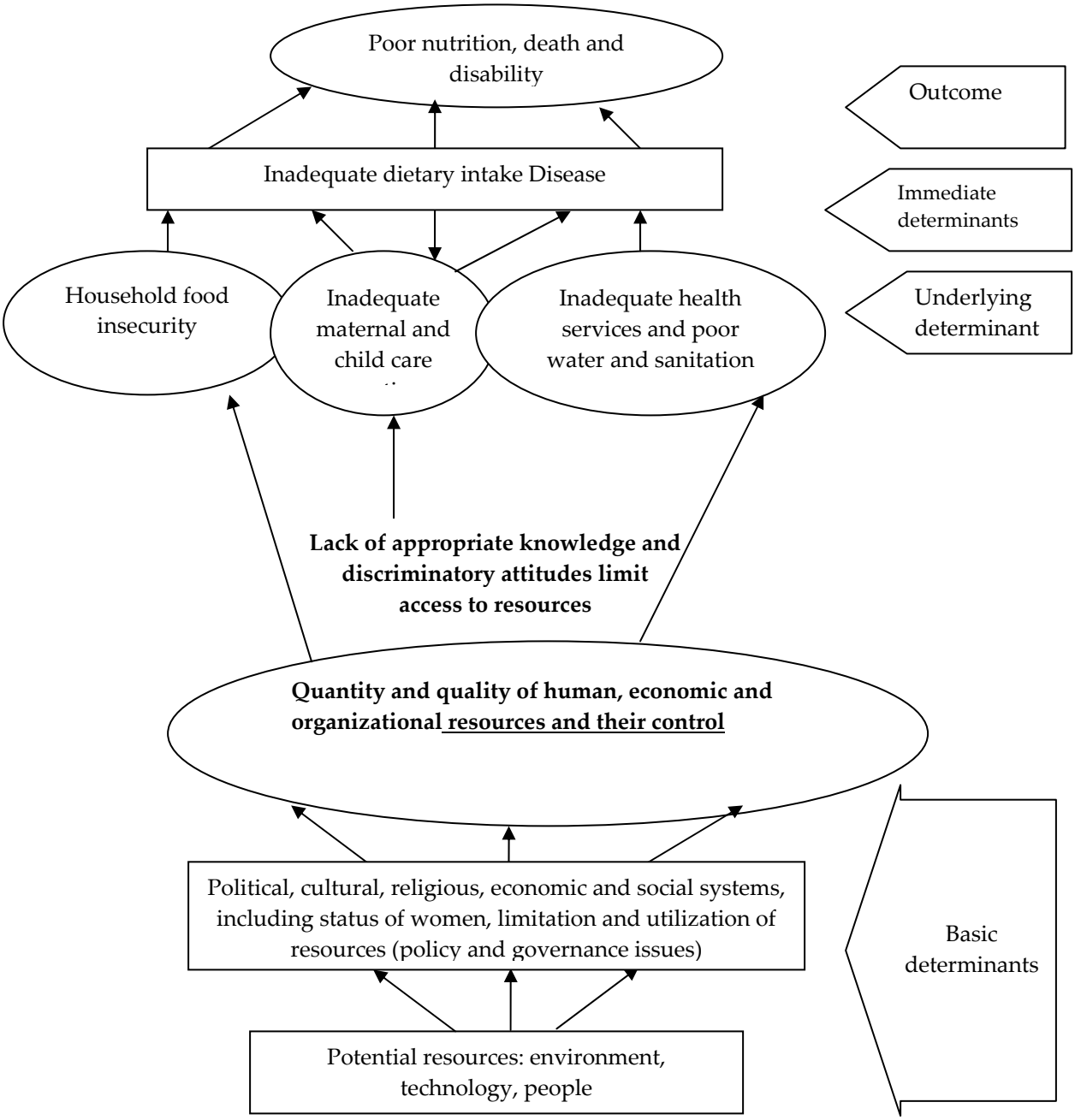
means that any intervention directed at promoting the use of micronutrient-dense food crops should ideally focus on these two vulnerable groups.

In the chapters that follow, the major aspects of Ugandan poverty, health, agriculture, and nutrition are summarized in detail; then progress towards attending the Millenium Development Goals is reviewed. The review of the existing policy context forms the foundation for developing a set of recommendations for how to successfully integrate the introduction of biofortified crops into the current policy environment of Uganda to maximize its contribution to reducing micronutrient malnutrition.

The underlying causes of malnutrition are influenced by, amongst others, the quality of knowledge, the means by which institutions are managed, the role of women in the society, policy and governance issues, the economic structure and potential resources available to the society.

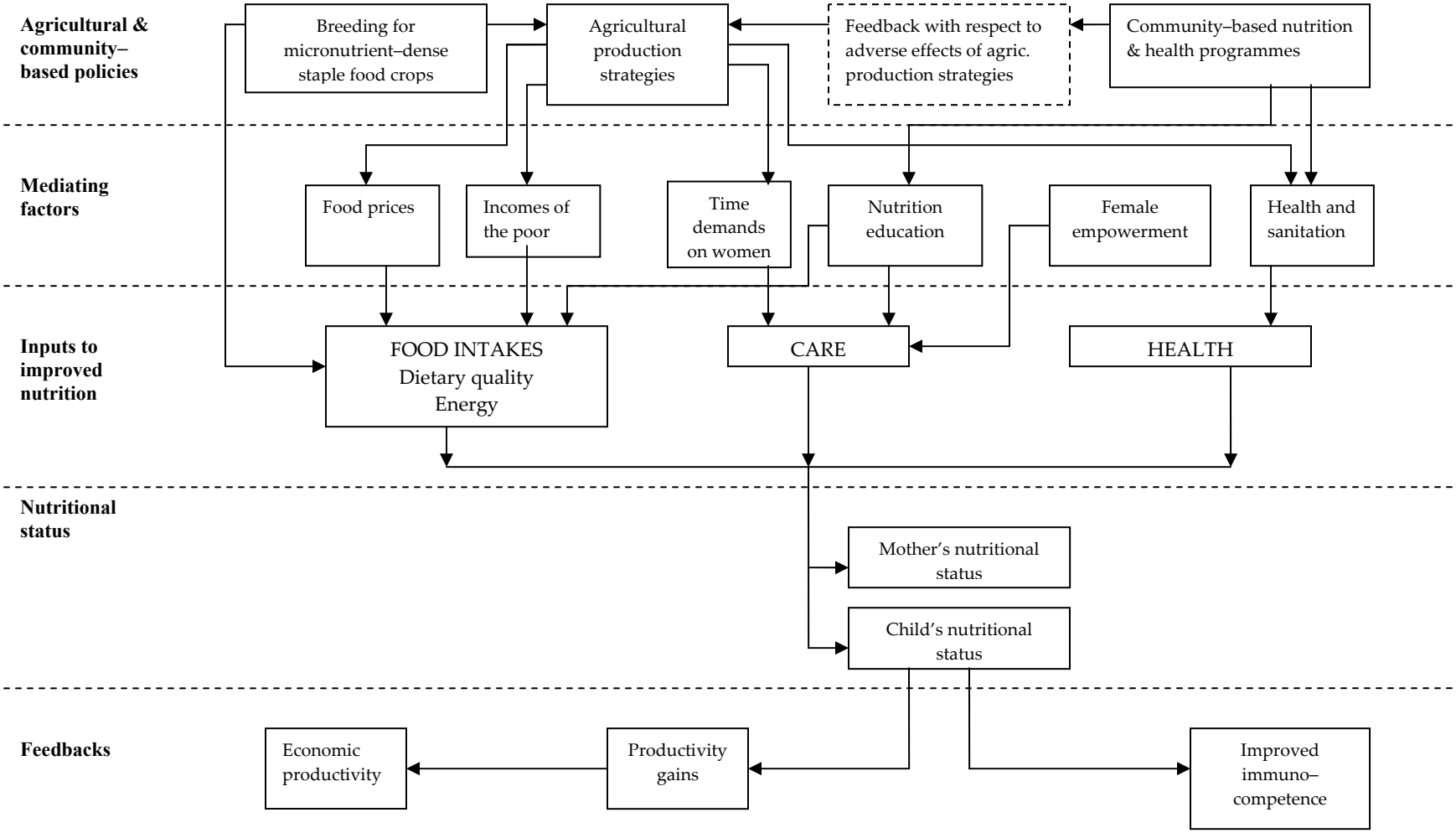
Agriculture is a source of food (including micronutrients) and income, and thus affects household food security. Health is a function determined by the vital environment that supports the physical status of an individual (sanitation, maternal and childcare practices and prevalence of disease).

Figure 1: Conceptual framework for causation of nutritional outcomes



Source: Adapted from UNICEF (1998)

Figure 2: Conceptual framework for achieving food security



Source: Adapted from Bouis and Hunt (1999)

2. UGANDA'S POVERTY ERADICATION ACTION PLAN (PEAP)[1]

Uganda has one of the highest rates of population growth world-wide at 3.4 percent. This is equivalent to adding more than one million addition citizens a year, or a doubling of the population to 52 million by 2025 (Wakabi 2006). The sustained high population growth is major factor undermining the fight to reduce poverty and underlies the increasing pressure on the provision of adequate social services including health, education, water and sanitation, and the environment.

Uganda is a signatory to the Millennium Declaration and its national planning framework, the Poverty Eradication Action Plan (PEAP) and the sector plans derived from it are the instruments that will lead the country towards attainment of the Millennium Development Goals (MDGs) (Odaga and Lochoro 2006). The PEAP was first drafted in 1997 and revised in 2000. In 2001, the Human Poverty Index was estimated at 37.5 percent, with 51 percent of the population having no access to health care facilities (Government of Uganda 2003). The purpose of the PEAP is to provide an overarching framework to guide public action toward eradicating poverty. The PEAP provides a comprehensive development framework and has guided the formulation of government policy since its inception (MFPED 2003). It consists of a decentralized, sector-wide strategy which provides a framework within which sectors (health, education, water and agriculture) develop detailed plans. The plan has five pillars:

1. Economic management
2. Enhancing production, competitiveness and incomes
3. Security, conflict resolution and disaster management
4. Good governance
5. Human development

Agriculture is seen as pivotal component for economic development with poverty being eradicated through the generation of income and markets for industrial production. The second and fifth pillars of the PEAP focus on issues related to agriculture and health; *enhancing production, competitiveness and incomes* includes the modernization of agriculture, while *human development* includes the improvement of education, child and maternal health, nutrition, and the public health system.

[1] This Section draws heavily upon Government of Uganda (2004), Poverty Eradication Action Plan 2004/5–2007/8 which should be referred to unless cited otherwise.

2.1. Pillar 2: The Modernization of Agriculture

The PEAP focuses on agriculture because: (i) although agriculture represents a declining share of the GDP, it employs the largest number of Ugandans in rural areas compared to other economic sectors; (ii) most of the non-agricultural goods and services produced in rural areas are sold locally, so their production cannot expand unless the demand generated by agricultural incomes also expands; and (iii) agriculture is particularly dependent on public goods, including research, extension and marketing support. Thus, agricultural growth is expected to generate benefits to non-agricultural sectors in rural areas and beyond, through the consumption of non-farm products. The Government of Uganda seeks to accelerate agricultural growth by providing improved public goods, including research, extension and marketing support, with the goal of increasing agricultural production and incomes; especially of poor rural households to assist them to escape poverty by producing and selling goods.

Interventions in the modernization of agriculture include research and technology development, advisory services, rural financial services, rural infrastructure development, and sustainable natural resource use and management. These interventions are discussed in detail under the Plan for Modernization of Agriculture (see Section 5, page 38, of this report).

2.2. Pillar 5: Human Development

Efforts under pillar 5 of the PEAP are aimed at improving quality of life through education and health sector reforms, including improvements in the public education system as well as the child and maternal health, nutrition, and general health sectors.

2.2.1. Education

The Government set national goals for education in its Ministry of Education White paper of 1992, in which one priority was "*The creation of national wealth through the development of appropriately trained manpower with the productive skills required for the economic development of an independent, integrated and self-sustaining national economy*" (Government of Uganda 1992). The Poverty Eradication Action Plan supports this goal through its emphasis on the need to establish a literate population with universal access to education. It shares education and social development with Universal Primary Education (UPE) programme and the Functional Adult Literacy programme (FAL).

The 1992 White paper led to the launching of UPE in 1996 with the intention of providing free primary education to four children per family; later raised to all children (Oliput 2002). Major pillars of the UPE were the abolition of school fees at public

schools and a major public relations campaign to encourage all children to attend school; combined with a programme of school building and teacher training. Enrolment in primary school rose from 2.6 million in 1996 to 7.3 million in 2002 (Bategeka *et al.*, 2004) and the UPE became fully operational in 2006.

Improved school enrolment, particularly of girls, is hypothesized to have resulted in healthier children. Ssewanyana and Younger (2005) found that a mother's attendance at primary school was associated with a small improvement in child mortality rates (1 death per 1,000). However, graduation from primary school led to significant reductions in the child mortality rate (9 deaths per 1,000).

The FAL started in 8 districts in 1996, expanding to 26 districts by 1998, and functioning in all 56 districts by 2002 (Okech 2005). It was seen as a major pillar underpinning the modernization of agriculture and poverty eradication. A particular aim was to redress gender imbalances in illiteracy and assist citizens in practical and decision-making processes at both the individual and community level (Carr-Hill 2001). The national average literacy level rose from 56 percent in 1990 to 67 percent in 2001 (Ministry of Education and Sports 2003), with greater improvements seen in women than men. In 2006, 90 percent of FAL participants were women (Muwanguzi 2006).

Despite some significant improvements in literacy skills, several challenges have been identified, particularly regarding agricultural training. A National Agricultural Education Task Force was set-up in 2002. The Task Force cited lack of a coherent policy, insufficient funding, ineffective institutional framework for delivery, inappropriate *curricula* and teaching methods and a general negative attitude towards agriculture. As a consequence, agriculture has been included in the second Education Sector Investment Plan (ESIP) (2002 to 2015) supported by a number of interventions currently being implemented by Ministry of Education and Sports (MOES, 2004). Among these interventions are:

- A revised primary school curriculum in which agricultural education is viewed as a discrete subject and examinable from 2005.
- Pre- and in-service teacher education programmes in some Primary Teachers' Colleges to improve teaching and learning methodologies.
- The promotion of a practical approach to agricultural education in core Primary teachers' Colleges and their cluster schools.
- Training programmes for specialist teachers of agricultural education to promote the use of locally-available teaching and learning materials.
- The incremental provision of equipment and teaching and learning materials for agricultural education and training.

- The introduction of a holistic approach to educational development as recommended in the mid-tern review of the EISP.
- An extensive programme of FAL.
- The establishment of 850 community polytechnics in which agricultural education and training will be a compulsory field of study.
- Development of District Agricultural Training and Information Centres (DATICS).
- The provision of a new approach to agricultural extension provision through NAADS which seeks to empower farmers to demand appropriate services.
- The decentralization of NARO's services as part of its outreach and partner initiatives to take research, training, information exchange and technology dissemination near to farmers.

The wide-ranging and holistic nature of the interventions with a demand driven focus creates an ideal platform for biofortification initiatives. Many activities are coordinated by Community Development Workers (CDWs) and local agricultural extension workers. CDWs cut across all sectors and are involved in community mobilisation in different programmes and projects under various line ministries together with the implementation of the Functional Adult Literacy programme(FAL). FAL classes have proved a good entry point for raising awareness of the Plan for Modernization of Agriculture (PMA). There is also a link with NAADS as FAL learners are often constituted from NAADS groups (or vice versa). In some sub–counties, there is constructive collaboration between FAL instructors and agricultural extension workers (DANIDA 2005). A sustained awareness of biofortification concepts can be introduced through teaching in schools, adult literacy classes and supported by NAADS and the research scientists.

2.2.2. Health Sector Reforms

Civil strife, poor governance and lack of finance during and immediately after the "Amin years" left Uganda's health service in poor condition. The new NRM Government of 1986 began a programme of reform based upon the Primary Health Care (PHC) concept introduced at the Alma Ata conference of 1978. The reforms were based upon market principles ("user pays") defined by the World Bank (1993) and were a pre-requisite for obtaining a World Bank loan (Okuonzi 2004). There were four fundamental principles:

- Health care should primarily be the responsibility of individuals, private organizations and charities.
- Public funding should be restricted to health promotion and disease prevention.

- The Central Government's role should be restricted to policy formulation and technical guidance, with the delivery of services left to the private sector and local authorities.
- The private sector and NGOs should be supported to become the key providers of health services.

The reforms took place in an era of general decentralization of Government (Tashobya and Ogwal 2004). However, by 2000 there were 57 programmes in the health sector, many still vertically integrated and dependent on substantial external funding and thus not integrated and not directly under Government control (Tashobya and Ogwal *loc cit*).

Following four years of consultations, the Government of Uganda introduced the National Health Policy (NHP) in 1999 (Ministry of Health 1999). The NHP is pro-poor and functions through the Health Sector Strategic Plan (HSSP; Ministry of Health 2000) with the goal of delivering the Ugandan Minimum Health Care Package (MHCP; Ministry of Health 2000) to all Ugandan households. The package contains interventions chosen to target the most common diseases using the most cost-effective interventions. The major priorities identified during biannual, joint Government and Donor reviews held since 1999, have included immunization, malaria control, health education, reproductive health, sanitation and HIV/ AIDS (Ministry of Health 2000).

Over the past 10 years, increased resources have been allocated for public health care activities, abolition of user fees in public facilities, expansion of rural health facilities, provision of subsidies to the private-not-for-profit (PNFP) sector, the introduction of the Health Sub-District (HSD) structure, recruitment of qualified health workers and increases in the volume of essential drugs purchased for health centres. The Government of Uganda has also built or upgraded many health care facilities (see section 3.2.2.).

2.2.2.1. Child and Maternal Health

Child and maternal health is a key component of the NHP and, under the leadership of the Ministry of Finance, a Task Force on Maternal and Infant Mortality was set up in 2001. A report to address maternal and infant mortality under a multisectoral approach was developed (Ministry of Health 2002) and resulted in the preparation of the Infant and Maternal Mortality Strategy, IMMS, (Ministry of Health 2004). Fundamental to the strategy is the understanding that health outcomes are not the sole responsibility of the health sector. The key interventions in this strategy are:

1. Improving the quality of health care and treatment of malaria
2. Sanitation
3. Community mobilization
4. Family planning

It was noted in the report that "about 60 percent of all cases of infant mortality were linked to or complicated by malnutrition" (p15) yet malnutrition is little mentioned in the strategy.

2.2.2.2. Nutrition

Poor nutrition is recognized as a major cause of poor health, particularly in children and pregnant and lactating mothers, and regarded as a combined result of low incomes, unequal bargaining power within the household for household resources and heavy burdens on women's time. It is aggravated by insufficient food intake during some seasons: in rural areas at the time of harvest a family may eat three meals a day but during the dry season and at planting when heavy manual work in needed, it may be reduced to only one meal per day (Ministry of Health, undated).

In 1996, the Uganda National Food and Nutrition Policy (UNFNP) and the Uganda National Plan of Action for Nutrition (UNPAN) were drafted by the National Food and Nutrition Council (NFNC). The UNFNP emphasized the elimination of micronutrient disorders, the promotion of breast feeding, nutrition education and efficient nutrition monitoring systems (Bachou 2000). Unfortunately the UNFNP required considerable modification to obtain Parliamentary consent and did not become law until 2001.

Uganda continues to have reproductive indicators that are amongst the worst in the world with over 6,000 women dying from preventable and treatable pregnancy and child-birth complications. Reasons include malnutrition (discussed above), short birth intervals, early marriage and early first deliveries. Eighty-eight children out of 1,000 die soon after birth, a situation that has not changed much since the early 1970's (Uganda National NGO Forum (UNNGOF) 2005).

2.2.2.3. HIV/AIDS

HIV/AIDS afflicts 7.1 percent of the population between 15 and 49 years (Government of Uganda 2005) and has a significant impact on farming systems in Uganda and the rural household economy and family value system, particularly affecting widows and

orphans, with a consequent effect on the family nutritional status (Topouzis 1994). The important link between health and nutrition and HIV/ AIDS is well recognized (Gillespie and Kadiyala 2005) and the Government of Uganda acknowledged the link during the revision of the Health Service Strategic Plan (HSSP) in 2004 (Ministry of Health 2004) and nutrition forms a major platform in the treatment of the disease (Ministry of Health, undated).

Nutritional interventions have focused on generating a general awareness on the importance of good nutrition and the training of counselors and service providers. Particularly active in this field has been the Regional Centre for the Quality of Health Care, Makerere University Medical School, with support from the FANTA project. Awareness publications covering nutritional care and support for people living with HIV/AIDS, the links between breast feeding and HIV/AIDS, the importance of good nutrition in delaying HIV/AIDS and the importance of good nutrition for the efficacy of anti-retroviral therapy have been produced(Food and Nutrition Technical Assistance 2007).

In 2002, Health Workers from 50 Prevention of Mother to Child Transmission (PMTCT) sites underwent training in integrated infant and young child-feeding counseling. The infant-feeding practices among mothers being supported by these trained health workers have greatly improved as a result (Ministry of Health 2004).

The importance of HIV/AIDS on the wellbeing of the individual, household and national economy has resulted in major interventions. These interventions have generally been well coordinated, adequately financed and have national coverage. Additionally, there is an emphasis on nutrition and food preparation. The biofortification approach would fit into these interventions thus obtaining rapid, widespread coverage through an already functioning system. However, care must be taken to avoid biofortified varieties as being seen as being able to "prevent" AIDS or to be viewed only as a food for HIV/AIDS affected individuals.

3. UGANDA NATIONAL HEALTH POLICY (UNHP)[2]

The Uganda National Health Policy (UNHP), enacted in 1999, was formulated within the provisions of the Constitution of the Republic of Uganda (1995) and the Local Governments Act of 1997, both of which decentralized governance and service delivery.

[2] This Section draws heavily upon the Ministry of Health (undated), the National Health Policy, and Ministry of Health (2000), and the Health Sector Strategic Plan 2000/01–2004/05.

The policy is based on Primary Health Care and Sector-wide Approaches (Murindwa, 2004) with the objective of reducing mortality, morbidity and birth rates and the disparities between groups and districts, through the creation of an enabling environment for delivery of a Minimum Health Care Package (MHCP) emphasizing the poor, women and children. The UNHP derives guidance directly from the National Health Sector Reform Programme (NHSRP) and the Poverty Eradication Action Plan and is based on the following principles (Ministry of Health 2000):

1. Access for all to a minimum package of services
2. Equitable distribution of health services
3. Effective and efficient use of health resources
4. Promotion of sustainable health financing mechanisms.

In order to facilitate the UNHP, the Ministry of Health developed the Health Sector Strategic Plan (HSSP) for 2000/1-2004/5 (Ministry of Health 2000).

3.1. The Health Sector Strategic Plan (HSSP)

The health sector saw a general decline in services during the periods of economic and political mismanagement in the 1970s and 80s. Whilst the sector is gradually recovering, the burden of disease remains high. In 1995, over 75 percent of life years lost due to premature death were due to preventable diseases (Ministry of Health, 1999). Prenatal and maternal conditions (20 percent), malaria (15 percent), acute respiratory tract infections (11 percent), AIDS (9 percent) and diarrheal diseases (8 percent) together accounted for over 60 percent of the total national death burden in 1995. Similar figures pertained to children under 5 with more than 60 percent of deaths attributable to malaria (25 percent), malnutrition or anemia (14 percent), diarrhea (13 percent), pneumonia (10 percent) and measles (6 percent). Underlying malnutrition was implicated in 38 percent of cases (Ministry of Finance, Economic Development and Planning 1995).

Uganda has experienced an increase in the occurrence of non-communicable diseases such as hypertension, diabetes, cancer, mental illness and chronic heart disease (Government of Uganda 2004). To address the premature death rate and emerging ailments, the Government, through the HSSP, has highlighted several priority action areas.

The Health Sector Strategic Plan I (HSSP), 2001 to 2004/5, was based on the PEAP, health sector policy and inputs from stakeholders and related ministries to provide a framework for planning, financing, and integrating the planned activities with related support services, outlines objectives, indicators, and means of verification in several areas, including: implementing the MHCP; developing the health care delivery system; integrating support systems and costs; securing financing; and implementing the plan itself. Phase II of the plan, 2005–2010, is now operational (Ministry of Health 2004a).

The National Health Policy and Health Sector Strategic Plan put emphasis on equity of access to health care especially for the most vulnerable, i.e. children, women and the poor. To reduce deaths and the frequency/ severity of illness and disability, and to contribute to improved growth and development of children, the Integrated Management of Childhood Illnesses (IMCI) strategy was launched in Uganda in 1995. IMCI is one of the key components of the National Minimum Health Care Package described in the National Health Policy. The goal of IMCI is to contribute to the reduction of mortality and morbidity of children under five. Uganda National Expanded Programme on Immunization (UNEPI), Nutrition, Malaria programmes and the IMCI unit are working together to achieve the strategy's objectives (DISH 2002).

3.1.1. Micronutrient Initiatives Within the HSSP

In order to control diseases due to nutritional anemia, protein energy malnutrition, iodine deficiency disorders, and vitamin A deficiency, a combination of strategies including awareness building, case management, rehabilitation, supplementation, food fortification and diet diversification is proposed under the Department of Community Health with a multisectoral approach.

Specific nutritional targets by the end of HSSP I included:

- The reduction of stunting in under 5 year olds from 38 percent to 28 percent.
- A reduction in the number of under-weight 5 year olds from 26 percent to 20 percent.
- An increase in mothers exclusively breastfeeding for the first six months from 68 percent to 75 percent.
- To increase and sustain vitamin A supplementation coverage in under 5 year olds from 80 percent to 95 percent.
- An increase in the number of households consuming iodized salt from 69 percent to 100 percent.
- An increase in public awareness on appropriate nutritional practices from x percent (*sic*) to 95 percent.

Specific nutritional interventions during HSSP I included:

- Provide policy and guidelines in conjunction with the National Food and Nutrition Council (NFNC).
- Support capacity building at the national and district level for the reduction in malnutrition.
- Promote nutritional programmes at different levels to reduce micronutrient deficiency disorders.
- Establish an effective national growth monitoring and promotion system nationwide.
- Provide support and supervision to the districts.
- Formulate and enforce nutrition-related legislation in conjunction with the relevant sectors.
- Intensify gender-responsive advocacy and social mobilization for nutrition at all levels.
- Provide guidelines for the monitoring and evaluation of nutrition interventions.
- Target the school-going population through the School Health Programme (SHP).

3.2. Principal Interventions

The principle interventions in the HSSP and responsible agencies are:

3.2.1. The Minimum Health Care Package

The National Minimum Health Care Package (MHCP), enacted in 2001 comprises the health services/ interventions directed at addressing the main contributors to the burden of disease in Uganda, including malaria, STI/HIV/AIDS, tuberculosis, diarrheal diseases, acute lower respiratory tract infections, prenatal and maternal conditions attributable to high fertility and poorly spaced births, vaccine-preventable childhood illness, malnutrition, injuries and physical and mental disability (Ministry of Health 1999).

The MHCP consists of the following components (Ministry of Health 2000):

1. Control of communicable diseases, such as malaria, STI/ HIV/ AIDS and tuberculosis.
2. Integrated Management of Childhood Illness (IMCI).
3. Sexual and reproductive health rights, including essential antenatal and obstetric care, family planning, adolescent reproductive health and prevention of violence against women.

4. Other public interventions, including immunization, environmental health, health education and promotion, school health, epidemic and disaster prevention and improved nutrition by promoting household food security and healthier eating habits, with special emphasis on young children and pregnant and lactating mothers.
5. Special education programmes to protect the population against micronutrient deficiencies, obesity, and other nutrition-related diseases supported by an improved health service infrastructure; community empowerment; and research to on the trends and economic consequences of ill health.

The cost of the proposed HCMP in 2002 was estimated at US$28 per capita whilst only $8 were then available (Ssengooba 2004), much from overseas funding (Okuonzi 2004). To reconcile this great difference, the Government should consider preventative interventions with lower recurrent costs and widespread coverage such as a biofortification initiative.

3.2.2. The Health Management Information System

To support decision-making and implementation of the HSSP, in 1993 the Ministry of Health established the Health Management Information System (HMIS) (Weddi *undated*). The HMIS is located within the Resource Centre of the MOH under the direct supervision of the Director-General of Health (WHO 2003). The HMIS is decentralized in line with health centre decentralization at the district and sub-district levels (WHO *loc cit*) to enable effective collection of data on the health and nutritional status of citizens from all its health facilities on a monthly basis, with the intent that it be used at the district level (Gladwin *et al.* 2003). Under the UBOS mandate to develop and maintain a National Statistical System to ensure collection, analysis and publication of integrated, relevant, reliable and timely statistical information, the data is to be shared amongst various information producers and users (WHO *loc cit*).

A complete overhaul of the data-recording and reporting tools was carried out in 1998 and all paper-based data formats were reviewed during the HSSP I. Formats are now harmonized, integrated and standardized within the sector (WHO 2003). District level data disseminated through monthly reports consists of weekly epidemiological reports, monthly district summary statistics, and monthly reports on the health and nutritional status of citizens from all health facilities, including information on outpatient attendance, outpatient diagnoses of diseases, maternity, immunization and child health (Ministry of Health 2004). The Ministry of Health established a website

(www.health.go.ug) to enable easy access to this information but the site is not updated regularly.

Weaknesses in information management have been acknowledged. In particular, the information system developers emphasized technological, rather than wider organizational issues. Also, it has proved difficult to implement a standardized system of reporting often suitable for centralized reporting system concurrent with a change in management approaches which encouraged collection of information for use at the local level. (Gladwin *et al.* 2003). For practitioners, there is insufficient disaggregation of the data. For example, there is no distinction between "under 5 years" and "over 5 years"; no gender separation, and no indicators of education or wealth levels to assist decision-makers and planners (WHO 2003).

Recommendations on ways to strengthen the National HIS were made by the WHO (WHO 2003) and a number of improvements have been implemented (Gladwin *et al.* 2003, Ministry of Health 2004). Significant amongst these are:

1. Marked improvements in the timeliness and completeness of reporting, including proactive attempts to capture data from the national and regional referral hospitals, including the major hospitals around Kampala. Timeliness of reporting has improved considerably, from 11.5 percent in early 2001 to 77 percent by mid-2003, and average completeness increased to over 93 percent during that time (WHO, 2003).
2. Initiation of quarterly HMIS supervision, coupled with support from Area Teams and better feedback to the districts.
3. Completion of the countrywide Geographical Information System (GIS) (Ministry of Health 2004).

It is noticeable that there are no data specific to micronutrient malnutrition included in this reporting system.

3.2.3. Integrated Disease Surveillance and Response

To further assist in early detection of, and timely response to, disease epidemics, the Government of Uganda commissioned an assessment of current surveillance systems in 2000 (Anon. 2000) and a five-year strategic plan was formulated to serve as the basis for resource mobilization (Ministry of Health 2004). Central to this response was the Integrated Disease Surveillance and Response (IDSR), implemented in 1999 as part of the WHO regional disease surveillance strategy (WHO 1999), and coordinated at the national level by the IDSR/HMIS committee, which includes representatives from the

technical departments in the MOH, the Institute of Public Health (IPH), the Medical Bureaux, the Laboratory Technical Committee, development partners and other stakeholders. For reliable data, an EPI–INFO database was adopted at the national level for data storage and data are analyzed on a weekly and monthly basis in an effort to track epidemics and provide early detection and timely response to outbreaks (WHO 2003).

Field staff supporting the IDSR included surveillance focal persons established in all districts by 2004 and laboratory coordinators, which were appointed in 44 of the country's 56 districts by that time (Ministry of Health 2004). Personnel involved in the IDSR are trained through World Health Organization (WHO/AFRO) and surveillance focal persons meet every six months to review and discuss surveillance issues and provide feedback (Ministry of Health 2004). However, the detection and registration of diseases and data analysis at the district, health sub-district and health facility level still remained problematic in 2005 (Government of Uganda 2005)

3.2.4. The Health Care Delivery System

Strategies within the HSSP to improve the health care delivery system include: restructuring the organization and management of the national health system; improving health service infrastructure; building and strengthening the capacity of health facilities; and decentralizing the management of routine health service delivery within each district. Pivotal in the decentralization process has been the formation of health sub-districts (see Annex 2, Figure 5) (Ministry of Health 2000) and the construction of 400 new level two health centers (HC2s, Parish level) and upgrading of 180 HC2s to HC3 status (sub-County level, including maternity services). In 2004, the Government of Uganda was in the process of upgrading 150 HC4s (County level) to provide emergency obstetric and surgical services. As of 2004, an estimated 72 percent of health facilities were deemed to be 'functional' (Ministry of Health 2004).

The health care delivery system has been highly dependent on both external funding and special initiatives confined to geographical areas, population groups or health interventions. External funding accounted for almost 80 percent of the total health budget in 1997/98 (Mukooyo & Wabwire 2003) but was reduced approximately 50 percent in 2005/ 06 (USAID, 2006). Special initiatives are in decline also.

A basic structure for the delivery of community health care is thus in place and the centres could serve as focal points for specific nutritional interventions or studies.

3.2.5. Community Empowerment

Central to community health care is the empowerment of community members to take responsibility for their own health and participate in the management of their local health services (Ministry of Health 2000). Thus, the HSSP has put in place strategies to increase community capacity for identifying health problems, health planning, health monitoring and resource mobilization; the establishment of health committees and a national health assembly; and the promotion of and support for community-based health services (Ministry of Health 2000).

In 2001, the MOH prepared the Village Health Team Strategy (VHTS), which supports a phased plan of community mobilization. As of 2004, this strategy had been enacted in 11 districts of Northern Uganda and introduced in one sub-county from each of 33 other districts (Government of Uganda 2005). In addition, the Ministry has sought to encourage individual involvement in the management of health services through health committees and health unit management committees (Ministry of Health 2004).

Increased awareness among communities of health, monitoring and resource mobilization provides a basis from which nutrition and biofortification interventions could be launched. But, the costs of such interventions have been high, limiting their expansion (MOH 2005b).

3.2.6. Health Education and Promotion

To increase community and individual awareness and health literacy so as to promote a healthy lifestyle and prevent diseases, the Government of Uganda set–up the Health Education and Promotion Programme in as a priority within the HSSP (Government of Uganda, 2005). In 11 Districts of Northern Uganda, the Village Health Teams strategy for empowering communities to take responsibility for their own health was initiated and has now been institutionalized. Coverage stands at 100 percent. For the rest of the country the process has not moved beyond sensitization of District Councilors. Performance has not been regularly measured since its inception. However, in FY 2003/04, a survey covering 14 districts (mainly in the mid–North and North West of the country) examined health literacy. The results indicated that the most common source of health information was the radio (82 percent of households). FM radio stations cover virtually all parts of the country. The health sector has exploited this communication channel and during FY 2003/04, 18,000 messages were disseminated using 33 FM stations (Ministry of Health 2004).

The established practice of using radio for health messages appears to be pivotal in the dissemination of nutrition information. This mechanism could easily be used to promote the use of biofortified varieties to combat micronutrient deficiencies.

3.2.7. Integrated Management of Childhood Infections

The Integrated Management of Childhood Infections (IMCI) was implemented in 1996, with support from the WHO and UNICEF, following recognition that most child deaths were the result of a few diseases, co-morbidity was highly prevalent, that many effective interventions were available and many opportunities for intervention were missed (World Bank 2006). The IMCI is a broad strategy of cost-effective interventions to address a number of child survival interventions and delivery systems, focusing on improving health system issues that affect care for children in health facilities and the improvement of key family care practices with high potential for improving child survival, growth and development.

The IMCI emphasizes reducing under-five mortality through improving the ability of health workers to enact preventive measures (e.g. immunization), and assess and manage common childhood illnesses, such as malaria, acute respiratory infections, diarrhea and malnutrition, which contribute to over 70 percent of the overall child mortality in the country (Ministry of Health 2000). Specific strategies included child health awareness days, Vitamin A supplementation, improvement of infant and young child feeding practices, and revitalization of the Expanded Programme on

A major consequence of the IMCI is the frequent contact between mothers and children and their health providers. With an emphasis on helping mothers become aware of basic health and nutrition issues for the targeted under-five group, there is again an opportunity for nutritionists to include awareness of the value of biofortified crops.

Immunization and Home-Based Management of Fever. As of 2004, all districts had implemented IMCI, more than 8,000 health workers had been trained and community-based IMCI had reached 30 percent of the villages in Uganda (Ministry of Health 2004).

3.2.8. Community-based Child Health Interventions

Supporting the IMCI is the implementation of specific "Child Days." The programme under the MOH was initiated in 2002 to provide a period of accelerated action bi-annually, in May and November, through the provision of preventive health services at health facilities, regular community outreach sites, and primary schools. Health workers provide routine and catch-up immunization and vitamin A supplementation for all children under five years of age and deworming for children from 1 to 14 years. Women of reproductive age are immunized against tetanus. Health workers also offer

education on healthy family practices such as breastfeeding, hygiene, and malaria prevention (UPHOLD 2005).

In FY 2002/03 and FY 2003/04 immunization coverage was 84 percent and 83 percent respectively. More than 4 million children were reached in twice-yearly national "Child Days" in 2002/03 (UNICEF 2006). The May 2004 Child Days were implemented in all districts, with an average district coverage of 50 percent among the different child-health interventions; except in districts with Internally Displaced Peoples' camps, where Child Days were performed in a campaign mode and additionally included vaccination of mothers against tetanus and distribution of insecticide-treated nets. Coverage of 90 percent was achieved in the latter case (Ministry of Health 2004).

Worms, a significant contributor to malnutrition and anaemia, are included as an integral part of the "Child days" programme. In 2004, the national average de-worming coverage was 64 percent (Anon. 2005).

The high coverage for immunizations amongst the target groups implies a high level of awareness and appreciation by mothers, of their value. The apparently substantially lower coverage for interventions such as Vitamin A supplementation or deworming is thus probably due poor awareness of their value and the broader age group covered. Better awareness would likely improve the situation; but whether the levels reached for immunization would be attained is conjecture and calls attention to the role of biofortification measures. Widespread deworming is highly likely to contribute to the efficacy of crops such as orange–fleshed sweetpotato as the absorption of vitamin A is higher in dewormed children than in children suffering from parasitic infections.

3.2.9. The School Health Policy

The School Health Policy (SHP) was formulated on the premise of the National Health Policy and the Health Sector Strategic Plan and was a further effort to address child health issues (Ministry of Health & Ministry of Education and Sports 2002). It was recognized in formulating the policy that there were many attempts to provide health services to the child and community but the lack of coordination between them. A major platform was to promote better nutrition and feeding practices, particularly in individuals from 4 to 24 years who constitute 52 percent of the total population, and was based on two main strategies: the provision of health education for teachers at all levels (nursery to tertiary) as well as in the schools' communities and the provision of adequate and balanced nutrition in schools, including day-care centres, through: the provision of micronutrients (iron, vitamin A and iodine) in natural foods and through

supplementation; the institution of feeding programmes for both day and boarding schools and the establishment of nutrition education and demonstration gardens for students in all schools (Ministry of Health 2004).

The Policy has yet to be endorsed by the Ministry of Education and Sports and the MOH. However, several aspects of the policy have already been implemented. During FY 2003/04, guidelines on mass screening of school children, malaria control in schools, and oral health were developed and disseminated (Ministry of Health 2006). Nutrition was also a major component of this initiative. As part of the May 2004 Child Health Days, there was mass de-worming of school children up to 14 years of age; tools for monitoring the health status in schools were developed and disseminated; school health supervision was conducted in 24 districts and 50 boarding schools and a proposal for feeding school children was developed and implemented in parts of Northern Uganda (Ministry of Health 2004).

To date, emphasis within the SHP has been centred on putting in place guidelines, tools and supervision. There has been limited progress in implementing the proposed nutrition education or school feeding programmes. A few interventions, usually supported by external donors, have recently been initiated in specific Districts, particularly in the North. These initiatives present a potential opportunity to integrate biofortified crops as a component of larger nutrition education or school feeding schemes. Incorporation during these initial stages would provide an opportunity to gain experience prior to expanding nationally.

3.2.10. Nutrition and Early Childhood Development Project (NECDP)

In August 1998, the Ugandan Parliament passed a resolution to enable Government to borrow US$34 million from the International Development Association (IDA) to finance the Nutrition and Early Childhood Development Project (NECDP). The project was designed to improve the nutritional status and development of children in Uganda, focusing on children under six years of age, by improving food availability, food intake, child health, child early education and child cognitive development. It is also intended to improve incomes of families and communities to enable them look after children (Ministry of Health 2006). The project is coordinated by the Child Health Development Centre (CHDC) within Makerere University.

At the national level, activities related to nutrition included support to the Ministry of Health in developing a curriculum and training manual, training health workers and extension staff on the prevention of micronutrient malnutrition; supporting the Ministry of Education and Sports, National Curriculum Development Centre to develop a national Early Childhood Education Curriculum, training materials and to train Early

Education Teachers; supporting the Uganda National Bureau of Statistics to carry out the Uganda National Household Survey; and supporting districts and communities in the production of community plans for which grants are going to be given.
At the local level, the project was intended to create community awareness on childcare, growth and development; and also to create awareness on income generating activities for which grants may be given.

The CHDC, MOST, the National Agricultural Research Organization (NARO) and the Volunteer Efforts for Development Concerns (VEDCO) implemented a project in Luwero District during 2001 and 2002 that promoted the growing and utilization of the orange-fleshed sweetpotato (OFSP). The aim of the project was to improve the nutritional status of children and women, household food security, and income (Sserunjogi and Harvey 2005).

The project in Luwero was an integrated project involving many disciplines and agencies. Unfortunately, an impact study (Yanggen and Nagujja, 2005) was unable to elicit the effective components of this work; and even the impact of the work was confounded by many other interventions in the district. The CHDC is likely to be a major partner in the promotion of bio–fortified crops as it also has a significant influence on government thinking.

3.2.11. MOST

MOST is a USAID micronutrient initiative active in many districts of Uganda. It provides technical assistance in vitamin A supplementation, food-based activities and anemia prevention and control. In collaboration with the USAID DISH project, MOST has provided assistance in IEC and training workshops for semi-annual vitamin A capsule distributions. MOST is also working with the MOH to develop an anemia prevention and control advocacy plan.

MOST and the Department of Food Science and Technology, Makerere University, are developing an inventory of local manufacturers to determine the feasibility of food fortification.

3.2.12. Micronutrient Deficiencies

Nutritional deficiencies in Uganda are regarded as being related more to poverty, food insecurity, and lack of knowledge than a lack of health services (Ministry of Health, 2004a). Improved health through better nutrition is fundamental to all health interventions. The Government of Uganda has had a long commitment to addressing micronutrient deficiencies as illustrated in several key policy documents such as the

National Food and Nutrition Policy (1993), Ugandan National Programme of Action for Children (MFEP 1993), the National Plan of Action for Nutrition (1995), MOH Three-Year Plan Frame (1993-1996), and the MOH White Paper on Health Policy Update and Review (1993) (OMNI, 1998). These documents proposed strategies to eliminate micronutrient deficiencies in Uganda with a focus on VAD. In an effort to eliminate VAD in Uganda by the year 2000, Uganda's strategy gave highest priority to vitamin A supplementation, for the immediate prevention and control of VAD, and dietary approaches to provide a long-term sustainable approach to eliminating VAD. Dietary approaches included information, education and communication (IEC) activities to promote behavior change and increase the production and intake of foods rich in vitamin A (Lwamafa 1995).

The UNHP has pursued a decentralized, multisectoral approach for implementation of strategies aimed at improving the nutritional status of the population, targeting women in the economic, education and health sectors in an attempt to improve nutrition and health at the household level, with special emphasis on mothers and children. The formulation of policies and guidelines intended to address nutritional priority problems is being conducted with assistance from international and local agencies and the Ministry of Health included nutrition in its sector strategic plans of 2000/01-2004/05, and is currently working on policies and guidelines on anemia, breast-feeding and HIV/AIDS, school health and a number of other nutrition-related disorders prevalent in the country (Ministry of Health 2004a).

Pillars of the nutrition interventions have been the Community Growth Monitoring and Promotion (CGMP), initiated in six districts in the FY 2003/04 to provide nutrition counseling for caretakers with children under three years of age (Ministry of Health, 2004), Therapeutic Feeding Centres (TFCs), the Nutrition and Early Childhood Development Project (NECDP) and the Prevention of Mother to Child Transmission (PMTCT). Particular attention has been given to the nationwide problems of iodine (general population), iron (in women) and vitamin A (in young children and pregnant and lactating mothers) deficiencies through supplementation and food fortification (Ministry of Health 2000).

The TFCs and Supplementary Feeding Centres(SFC) were set-up by UNICEF and act as a focal point for nutrition interventions in emergencies. Most of their activities have been confined to northern Districts where they have contributed significantly to the harmonization of management protocols, nutrition assessment methodologies and assessment tools resulting in an improvement in malnutrition management and nutrition and health assessments among the target populations. Significant impacts from this programme have occurred. For example, death rates among children in TFCs

in northern Districts have decreased significantly; e.g. Lira with a decrease from 24 percent in 2003 to 2 percent in 2004 (Ministry of Health 2004).

Whilst there are a number of programmes aimed at improving the nutritional status of the population using a multisectoral approach, there is little evidence of coordination between them; partly because they have been set–up in only a limited number of isolated districts, with particular emphasis on the war–ravaged north. Since nutritional disorders occur in almost all districts, a more general and coherent initiative is required. A nationwide biofortification programme using crops grown throughout the country, such as beans, maize or sweetpotato should preferably be implemented in a coordinated manner based on a common set of principals for working across sectors.

3.2.13 Supplementation

The micronutrient supplementation strategy, coordinated through the HSSP, has been aimed at specific at-risk groups: for iron, women; for vitamin A, pregnant and lactating women and children under six years of age (Ministry of Health 1999).

Uganda has had a programme for iron and folic acid supplementation for women for many years (Mwadime 2002) but anemia still affects 30 percent of mothers, whilst only about 50 percent of mothers take iron supplements during pregnancy (UBOS 2001). More recently, efforts have been made to address other major causes such as malaria and intestinal worms as well as iron deficiency as part of an integrated anti-natal care approach (Mwadime, *loc cit.*). National policies, however, are not implemented consistently throughout the country. For example, Sserunjogi et al. (2003) observed in Busia District, with confirmation by the District Health Office that the health units do not carry out postnatal care for mothers. Neither mothers nor health workers considered the need for such care. Although it is policy in the Uganda health system to have all mothers supplemented with vitamin A within 8 weeks postnatal, it was observed that mothers who brought their babies for BCG immunization were not given the Vitamin A capsule due to lack of supply.

Vitamin A capsules are on Uganda's list of essential drugs and guidelines for vitamin A supplementation for children 6 under five years are included in the National Standard Treatment Guidelines (OMNI 1998). In 2004, the Ministry of Health adopted a bi-annual Vitamin A capsule supplementation strategy in which all children aged 6 months to 5 years received supplementation as part of the nationwide Child Days. In FY 2003/04 the strategy achieved a coverage of 76 percent (this figure is an aggregate of the November 2003 and the May 2004 Vitamin A supplementation during the respective Child Days) (Ministry of Health 2004) compared to 35 percent of children in 2001

(UBOS 2001). Coverage is often better in targeted areas with specific programmes (Africare, BASICS, CHDC, MOST, UNICEF, WHO are involved) supported by external funding than in non-targeted areas. Coverage among women is much lower than for children. UBOS (2001) noted that only 11 percent of women received vitamin A capsules despite although policy is that all women should receive supplementation.

The introduction of biofortification complements supplementation interventions, and could serve a particularly useful role in districts where logistic, cultural and cost considerations result in imperfect supplementation regimes. The findings of Mwadime et al., however, call for vigilance in monitoring any implementation programme to ensure compliance and to identify and resolve bottlenecks.

A study by Mwadime et al (2004) describing the process used to develop a comprehensive programme to control anaemia in pregnant women in four districts of Uganda in 2002 pinpoints the challenges encountered translating policies into consistent practice. They noted four major impediments to successful supplementation programmes: inadequate supplies of iron/folic acid supplements, antihelminthics, and anti-malarials led providers to offer clients supplies inadequate to last until the next visit; late and infrequent use of antenatal services by pregnant women; lack of understanding among women of the importance of taking iron/folic acid, antihelminthics, and anti-malarials during pregnancy; and health workers not being aware of the anaemia (or related) guidelines, in terms of the recommended preventive dosages of iron/folic acid.

3.2.14. The Food Fortification Initiative

Prior to the enactment of the Food Fortification Initiative (FFI) in 2004, food fortification was not a major platform in the Government's health and nutrition strategy, with only limited interest in the iodization of salt. In 1994, statutory regulations under the Food and Drugs Act were passed, and the Uganda standards US 203: 1994 (standards specification for food grade salt) brought into operation. This standard requires all imported salt (90 percent of the country's consumption) to have at least 100 ppm iodine. The Uganda National Bureau of Standards has stationed iodine testers at border points to verify the quality of iodine in imported salts (IDD 2002). UBOS (2001) reported that iodized salt reached 94 percent of households in 2001.

The FFI was seen as a partnership between the Government and the private sector. During FY 2003/04, a number of activities were undertaken under the Initiative; including:

1. The National Food Fortification Working Group commissioned a food consumption survey by the Department of Food Science and Technology of Makerere University to determine consumption patterns for major foodstuffs: maize flour, cooking oil, cassava flour, sugar and milk, following which MOST and the Department of Food Science and Technology, Makerere University, are developing an inventory of local manufacturers of cereal, oil, sugar, and diary products to determine the feasibility of food fortification.
2. The Uganda National Bureau of Standards (UNBS) issued standards and marketing regulations for fortified foods (US 500: 2003) under the Foods and Drugs Act (1964).
3. Equipment and fortificants were provided to the partner industries, and fortification trials were begun.
4. The Uganda Food Fortification Programme was launched in 2004 and maize millers (Maganjo and Unga 2000) began producing maize flour fortified with vitamin A, iron and B-vitamins and Muwano fortifying edible oil with vitamin A (Bukusuba 2005).

3.2.15. Research and Development

The Government of Uganda in 1990 embraced the concept of Essential National Health Research (ENHR) and implementation of an ENHR strategy was started in 1991. An ad-hoc committee on ENHR was set-up within the Uganda National Council of Science and Technology (UNCST) to plan and oversee the activities ENHR. A secretariat to implement the Essential National Health Research (ENHR) strategy, to be known as the Uganda National Health Research Organization (UNHRO) was established by the Ministry of Health in 1997. UNHRO was instituted as an umbrella organization to promote, coordinate and provide guidance for health research and development in the country, as well as provide technical back-up and support to Districts (UNHRO 2000). Objectives of particular interest to this study included:

1. Undertaking research on the trends and economic consequence of disease, disability and ill-health.
2. Conducting studies on the content and relative cost effectiveness of the minimum health care package and its delivery.
3. Promoting research on major biomedical factors that affect the health of the population in Uganda (Ministry of Health 2000).

In 2000, UNHRO conducted a survey of 48 institutions carrying-out health research in Uganda to determine the current state of health research development in Uganda's research institutions. A full analysis is given in the report, UNHRO (2000); but of note

for this study is that only four institutions named nutritionists (a total of seven) amongst their staff. There is a relatively well-developed health research system and a reasonable mass of researchers who are carrying out health research addressing almost all the health research priorities as set out in the ENHR plan the period 1997-2001. However, it was noted that very few institutions were devoted to health research and that publication record of research results was poor.

A critique of the health sector reforms is given by Okuonzi (2004) notes that, despite rapid economic growth throughout the 1990's, progress in improving nutritional indicators has been minimal: percentage children with wasting in 1990 – 1995 was 6.2 percent vs 7.8 percent in 2000 – 2004; infant mortality (deaths per 1,000) 81 vs 88; neonatal mortality (deaths per 1,000) 27 vs 33; maternal morbidity ratio (deaths per 100,000 births) 506 vs 505; and child mortality (deaths per 1,000) 147 vs 151. The authors assign culpability to the introduction of user charges, which discouraged the less–well–off from seeking medical advice (Dieninger and Mpuga 2004). These were abolished in 2001 (Kiyonga 2001). Another contributing factor highlighted is the dependence of the Health Service budget on foreign aid (approximately 50 percent of the total), that results in interventions limited in scope and geographic coverage. Biofortification has the potential of reaching a widespread swath of Uganda, and once established has the potential for being sustained by the communities themselves. Many positive changes have also occurred, particularly in addressing HIV/ AIDS and expanding the immunization programme. These successes are often attributed to effective political leadership and a holistic approach. Awareness creation and buy–in at among the political leadership may prove key to assuring widespread application of the approach.

Government of Uganda expenditure on the health sector has increased from 7.5 percent of the total budget in 2000/01 to 9.7 percent in 2004/05 (MoH 2005b). Interventions at the village level, however, have proven expensive and their sustainability is questionable. Drugs, including micronutrient supplements are frequently found to be unavailable (Sserunjogi et al. 2003). Given limited government resources, it is likely that integration of biofortification will require significant foreign assistance.

4. UGANDA NATIONAL FOOD AND NUTRITION POLICY (UNFNP)[3]

The Government of Uganda has long recognized that food and nutrition security is fundamental to all health inventions and is committed to ensuring security for all

[3] This Section draws heavily upon Government of Uganda (2003), The Uganda Food and Nutrition Policy.

citizens (Government of Uganda 2003). Using the overall national development goals defined in the Poverty Eradication Action Plan (PEAP) as a foundation, the Government enacted in 2003, the Uganda National Food and Nutrition Policy (UNFNP), coordinated by the National Food and Nutrition Council (NFNC) to provide a framework for addressing food and nutrition issues in the country.

The Uganda National Food and Nutrition Policy (UNFNP) and the Ugandan National Plan of Action for Nutrition (UNPAN) were drafted in 1995 by the National Food and Nutrition Council (NFNC), in cooperation with many other stakeholders, most notably the Ministries of Agriculture, Animal Industries, and Fisheries; Health; Finance and Economic Planning; and Education and Sports, and were based on the themes recommended during the International Congress on Nutrition (ICN) in Rome in 1992 (Ionnatti *et al*. 1998). Enacted in 1996, the overall objective of the UNFNP was to ensure food security by increasing food production, and to ensure adequate nutrition for all through sufficient food supply, adequate processing and preservation, storage, marketing and distribution, external trade and supplementary food aid. The UNFNP also highlighted the need to eliminate micronutrient disorders, the promotion of breast-feeding, nutrition education and efficient nutrition monitoring systems at all levels of care. The policy also included the protection of the population against contaminated, adulterated and unsafe foods that might be injurious to health (Bachou 2000).

The UNFNP is multisectoral in its approach and consistent with other related initiatives, including the Plan for Modernization of Agriculture (PMA), the National Health Policy, the National Plan of Action for Children, and Vision 2025.

4.1. Priority Action Areas

The Uganda food and Nutrition policy has twelve priority areas (Government of Uganda 2003)

1. Food supply and accessibility.
2. Food processing and preservation.
3. Food storage, marketing and distribution.
4. External trade.
5. Food aid.
6. Food standards and quality control.
7. Nutrition.
8. Health.
9. Information, education and communication.
10. Gender, food and nutrition.
11. Food nutrition and surveillance.

12. Research.

4.1.1. Food Supply and Accessibility

The Government of Uganda seeks to ensure an adequate supply and access to good quality food at all times for human consumption, income generation, industry, and local and regional markets. UNFNP strategies include a call for the development and implementation of programmes designed to: encourage the production and use of under-exploited food crops to widen the food base; sensitize, educate and train farmers in the use of appropriate technologies capable of enhancing agricultural production; mobilize resources for agricultural research geared toward improving nutrition, increase the availability and accessibility of improved planting materials and agricultural inputs; strengthen the control of pests and diseases; develop water systems to promote crop, livestock and fish farming; and promote the establishment and maintenance of food reserves, minimize postharvest loses and increase self-life (Government of Uganda 2003).

To widen the national food-base nutritionally, the National Agricultural Research Organization (NARO) has embraced the sweetpotato and *Phaseolus* bean. These crops have a wide distribution geographically and international research on their biofortification is advanced. New sweetpotato and bean varieties could address the vitamin A and iron deficiency issues, respectively (HarvestPlus 2006). A detailed description of research to date is given in sections 6.2.1.1. and 6.2.1.2.

Development of the β–carotene rich Orange–Fleshed Sweetpotato (OFSP) is more advanced, (Mwanga et al. 2004). However, adoption and production has been constrained by a lack of planting material, low use of inputs (fertilizer, pesticides), pests and diseases, erratic rainfall and post harvest and marketing issues (González de Uzqueta de Lorza 2006; Rao 2006) clearly indicating that any biofortification initiative must include research and development on the whole production to consumer continuum to be successful.

4.1.2. Food Storage, Marketing and Distribution

Crop production in Uganda is characterized by its seasonal nature of production necessitating some form of storage. Postharvest losses are high, particularly on-farm where it is estimated that 20 to 25 percent of root crops and 5 to 15 percent of grain crops are lost (National Agricultural Research Organization 2006). Current or potential food surpluses are often in areas distant from where most needed to ensure a diversified diet. Market chain development in most sectors is poor. The UNFNP seeks to address these issues through strategies designed to promote household food

reserves, prevent food losses, encourage use of appropriate storage facilities and coordinate the collection and dissemination of information on food marketing and distribution, so as to assure the availability of affordable, safe and nutritious foods (Government of Uganda 2003)

The Government of Uganda regards investment in storage facilities as a private sector activity and it seeks to facilitate private sector investments by providing appropriate incentives, through the Uganda Investment Authority (UIA), and technical information through research and extension services (Government of Uganda 2003). Interest has been primarily in large-scale storage facilities for selected export sector crops (Uganda Investment Authority 2002).

The most common form of on-farm storage involves drying processes and includes cereals, beans, root crops and fruits. Small granaries, 0.2 to 0.5 tonnes capacity, are to be found on 54 percent of farms and 42 percent of households report storing food crops in their residential house ((Uganda Investment Authority 2002). Improved storage practices are required to maintain household or national reserves and to allow farmers to avoid peak sale periods and benefit from sales at other times. The National Postharvest Programme at Kawanda and the Agricultural Engineering and Technology Research Institute (AETRI) of National Agricultural Research Organization (NARO) have concentrated their research into suitable postharvest technologies for use on smallholder farms, where losses in quantity and quality are highest. Particular attention has been given to the development of durable multi-crop storage facilities and improved practices for drying (National Agricultural Research Organization, 2006).

Research and development of marketing chains for small–scale farmers has primarily been through market sector studies. FOODNET has been instrumental in initiating many such studies(FOODNET 2005). More recently, there has been a move to look at development of the market chain, particularly lead by the CGIAR centres. These initiatives have tended to look at segments of the market chain and there is a need to review and integrate activities in order that the whole chain and all players are involved.

4.1.3. Food Processing and Preservation

A major factor contributing to the high postharvest losses in Uganda is the lack of appropriate storage facilities, including inadequate cold storage facilities for perishables such as fish, meat, fruits and vegetables, and inefficient primary processing facilities (Government of Uganda 2000). A major platform of the UNFNP is thus to conserve expected increased or seasonal food production through the promotion of

adequate safe, high quality and nutritious foods with long shelf lives (Government of Uganda 2003). Products would then be available in times of scarcity and also help alleviate poverty through the generation of income and employment from sales to local, regional and international markets.

Planned strategies include: assessing the food processing industry and preservation methods in the country; promoting appropriate food processing technology; documenting, promoting and improving indigenous food processing techniques and their use at the household level; promoting fortification of selected foods with nutrients that are commonly deficient in the national diet; and promoting local processing and the use of locally-produced raw materials (Government of Uganda 2003)

Within the context of biofortified crops, the National Postharvest Programme of NARO has developed of technologies such as graters and chippers and local baking ovens for home or local processing of root crops and carried-out trainings in the production of non-traditional, value-added goods, such as juice, mandazis, donuts, chapattis and cakes using OFSP. Despite much enthusiasm within the farmer groups, uptake and sales have been poor, at least in part due to the limited collection and dissemination of related market information (Yanggen and Nagujja 2006).

With bio–fortified crops, there is a need to consider in detail strategies for their conservation and preservation. Two aspects are of particular importance: preservation of the beneficial micronutrients and practical, economically viable storage and processing practices. Taking OFSP as an example, trials by Stollman (2005) and Bechoff (2006) have indicated that some treatments, particularly exposure to light and high temperatures can cause almost complete loss of β–carotene. Processing and preparation techniques that reduce these losses need to be implemented. The small quantities produced and the apparent lack of sales for some home–produced products also draws attention to the need to consider scale when evaluating processing opportunities. The development of fresh root sales would appear to have immediate potential although Wheatley (2006) does not foresee major long–term growth in fresh root sales in the east African region.

4.1.4. External Food Trade

The Government of Uganda seeks to diversify food exports in order to broaden the foreign exchange base without negatively affecting national food security needs, and also to regulate the quality and quantity of food imports. Relevant strategies include strengthening farmer advisory services, monitoring and documenting the national food supply and demand, and creating awareness among food importers, exporters and

consumers regarding the quality and safety of food items for trade (Government of Uganda 2003)

Both the public and the private sectors support small-scale producers in the dairy, fruit and vegetable sectors. Public support is enacted mainly through organizations such as the Uganda Export Promotion Board (UEPB), which identifies markets and supports farmers organizations, the Uganda National Bureau of Standards (UNBS), which formulates and promotes the use of national standards and develops quality control/assurance systems, and NARO, which is responsible for research and development of crops and livestock.. Private support for the production and marketing of fruits and vegetables is provided by groups such as the Agricultural Productivity Enhancement Programme (APEP), the Horticultural Exporters' Association (HORTEXA), the Volunteer Efforts for the Development Concerns (VEDCO), and the Uganda National Farmers Federation (UNFFE) (Uganda Export Promotion Board 2006).

HORTEXA in particular has played a major role in helping growers upgrade their production and postharvest handling methods to meet international export requirements (Agriterra 2004), particularly to Europe. Among the key crops produced by HORTEXA members is the sweetpotato, which are often air-shipped as a filler to meet tonnage quotas on planes containing higher value crops such as hot pepper (PRAPACE, 2004). Approximately 95 percent of Uganda's horticultural exports are destined for countries within the European Union. However, since there is zero demand for compliance from commercial partners of Uganda exporters (World Bank 2005), there is little need in the short to medium tern to comply with the EUREP-GAP regulations and standards initiated in 1997. The Ministry of Agriculture, Animal Industries and Fisheries (MAAIF) has, however, drafted a programme to meet these new standards and as of March 2003, MAAIF began coordinating multisector efforts to establish a production, marketing and quality control system for compliance with EUREP-GAP. These efforts include training of staff to inspect crops in the field and in each consignment prior to export, as well as accreditation of diagnostic laboratories and facilitation of export villages.

4.1.5. Food Aid

Uganda has requested external food aid almost continuously over the last 30 years, primarily due to civil strife and adverse weather conditions. This is regarded as non-sustainable and could lead to dependence on external food supplies. The UNFNP seeks to develop sustainable mechanisms for meeting temporary emergency food needs from national resources, and building a capacity for donating food to people in other countries facing starvation (Government of Uganda 2003).

Currently, most food aid is required in the northern part of the country—where micronutrient deficiencies are most critical— for the estimated 1.4 million Internally Displaced Persons (IDPs., The present approach to food aid is to procure as much as feasible internally without unduly disrupting market forces (FAO, Food Security Meeting minutes). With increasing numbers of IDPs returning to their villages, there is an emphasis to provide a minimum of food rations along with tools and inputs (particularly planting material) to rapidly establish their own production, whilst reconstructing their villages. This provides an opportunity for suitably adapted, bio–fortified crops to be introduced at the onset of the resettlement period and become established in the farming systems.

4.1.6. Food Standards and Quality Control

The major goal of the UNFNP is to ensure that food meant for consumption is nutritious and safe. The setting and enforcement of standards is the responsibility of the Uganda National Bureau of Standards (UNBS) which has developed and updated Food Safety Standards and harmonized them with the Codex Standards (Zaramba 2002). The UNBS is continuing to put in place standards related to food hygiene and safety which will be incorporated in the proposed Food Safety Law (Kisamba-Mugerwa 2003).

Whilst the UNBS is the apex body concerning standardization and implementation of food standards, other activities are scattered amongst many ministries and agencies and uncoordinated. Combined with outdated legislation and poor facilities, enforcement is difficult (World Trade Organization 2006).

In order to address the weak implementation of food standards and quality assurance, the United Nations Industrial Development Organization (UNIDO) initiated an integrated programme to enhance the competitiveness and sustainability of industrial development in Uganda, with emphasis on agro-industries and small-scale enterprises (UNIDO, undated). This programme has sought to establish a structured and comprehensive food safety and quality assurance system by creating a national coordination system for food inspection and quality control, updating the regulations, and building capacity in relevant institutions. Specific measures also aimed to develop and implement good product handling and quality management practices in selected food-processing enterprises. Under this plan, further initiatives will seek to introduce

upgraded and clean technologies in the food sector to serve as pilot operations and to promote postharvest technologies (UNIDO, undated).

The UNBS has drawn-up a number of standards directly relevant to fortified and biofortified food. Notable amongst these are standards for US508:2003 "Nutrition and Health Claims;" US500:2003 "Guidelines for Nutrition Labelling;" and US 45: 2003 "General Standards for Food Additives." Standards for specific products such as sugar, fats and oils or maize meals have also been promulgated (UNBS 2006). A nutrient declaration, defined as 'a standardized statement or listing of the nutrient content of the food' is mandatory for foods in which nutrition claims are made. This statement includes energy value, protein, available carbohydrates, fat and other nutrients exceeding 5 percent of the recommended intake. Recognition is made in standard US 500:2003 for crops where 'a nutrient is present naturally,' but tolerances are tight.

As of 2003, the UNBS had begun development of in-house organic certificates and other quality assurance certificates for issuance to the fruit and vegetable sectors (UNBS 2006).

If biofortified processed products are to be promoted, either in their entirety or as an ingredient, then the product must conform to the above standards. Difficulties may arise in consistently meeting the standards due to variation in micronutrient content between varieties of the same crop, agro–climatic factors, or processing (particularly drying) procedures. Researchers and potential users of biofortified ingredients will need to work very closely with UNBS to set meaningful standards and ranges, given the present tight tolerances.

4.1.7. Nutrition

A major platform of the UNFNP in 1996 was to address micronutrient deficiencies, notably vitamin A deficiency. The strategy included vitamin A supplementation for the immediate prevention and control of VAD, and dietary approaches to provide a long-term, sustainable approach to eliminating VAD. Dietary approaches include information, education and communication (IEC) activities to promote behavior change and increase the production and intake of foods rich in vitamin A; capacity building and public health measures (Ionnatti 1998). The 2005 Uganda Food and Nutrition Strategy and Investment Plan continued to promote the holistic approach and put greater emphasis on anemia (GOU 2005a).

The failure to have substantially reduced the incidence of vitamin A and iron deficiency anaemia (cf. UBOS 2001 with MOH 1993) indicates that consideration should be given to a more integrated strategy putting greater emphasis on food based approaches in addition to supplementation and biofortification. Biofortified crops could form a major part of such an approach.

4.1.8. Health

The UNFNP seeks to ensure that the population is healthy enough to benefit from good nutrition. Strategies under this policy statement include: ensuring that children, adolescents, mothers and the elderly are targeted for priority health care; strengthening integrated management of childhood illness in order to promote good nutrition and prevent malnutrition; enhancing community participation in health- and nutrition-related matters; and intensifying interventions for the control of the top ten causes of morbidity and mortality with particular emphasis on HIV/AIDS and malaria. These strategies are being implemented under the Minimum Health Care Package of the HSSP and re-enforced under phase II (Ministry of Health 2004a).

4.1.9. Information, Education and Communication

Despite the existence of some communication and education on food and nutrition issues, the public message to date has been inconsistent and confusing, due to uncoordinated and often contradictory efforts by different agents and agencies, thus, the UNFNP seeks to improve knowledge of food and nutrition issues in the general population through the development of an efficient nutrition communication strategy by providing information and promoting proper food and nutrition practices in rural and urban communities (Government of Uganda 2005). Initiatives include encouraging the establishment of demonstration farms and gardens in schools and other institutions; organizing food and nutrition promotion activities such as agricultural shows and demonstrations of food preparation; and mobilizing communities to identify and solve their food and nutrition problems through mass media, clubs, groups and theatre development.

Many of the nutrition interventions have been limited in geographical scope or pilot initiatives with focus groups. Thus, national awareness campaigns have not been well organized. In addition to the Ministry of Health and the Ministry of Agriculture, Animal Industry and Fisheries (MAAIF) also address nutrition issues. The National Agricultural Advisory Service (NAADS) programme and the Plan for the Modernization of Agriculture (PMA) also include efforts towards nutrition education, but a clear nutrition communication strategy has not yet been put in place under these programmes. Any biofortification initiative would need to work with the relevant ministries at the national level in a coordinated manner.

4.1.10. Gender, Food and Nutrition

The UNFNP recognizes the influence of gender on nutrition status. The Government of Uganda seeks to ensure that both men and women achieve optimal nutrition status through improved food security and nutrition, taking into account their productive and reproductive roles. A key to more effective future food security and nutrition interventions will be to develop gender-specific approaches based on a clear understanding of the different needs of men and women (GOU 2003).

4.1.11. Food Nutrition and Surveillance

The collapse of the Nutrition Surveillance System in the mid-1990s was recognized in the National Health Policy of 1998 (Ministry of Health 1999) and nutrition surveillance was included in the HSSP beginning 2000 (Ministry of Health 2000). Nutrition surveillance systems also exist within MAAIF and the Government has set up a surveillance system to coordinate organizations dealing with food and nutrition. However, as of 2004, the systems were not yet well coordinated (Ministry of Health 2004).

The MAAIF hosts a National Early Warning System (NEWS) responsible for monitoring agricultural production through conducting pre- and postharvest crop assessments. Because of limited funding, this fieldwork has consisted of interviews with key informants. In addition the Nutrition Division of MAAIF collects and analyses data on child anthropometry and body mass indices of mothers for NEWS (Suresh and Ergeneman 2005). Also cooperating with government is the Famine Early Warning System Network (FEWS NET) which, together with the WFP, conducts surveys to asses the status of specific vulnerable groups, and conducts food needs assessments that help optimize the outreach of food assistance programmes (FEWS NET, 2005 2006). Suresh and Ergeneman (*loc. cit*.) noted several shortcomings in the two surveillance systems, most noticeably a lack of coordination (and even competition) between them.

Under the UNFNP, the government seeks to develop a monitoring system to provide timely information that can be used to stabilize the food and nutrition situation in the country. Some of the strategies to achieve this include: establishing sentinel sites for the collection of data on food and nutrition; training relevant personnel and communities in data management; publishing and disseminating timely, regular reports on the food

Surveillance systems tend to focus on areas of food insecurity, most notably the war–torn North and the climatically adversely affected East. Data needs to be collected from the west and south east of the country where deficiencies were observed (UBOS 2001) and where significant potential exists for widespread cultivation of biofortified crops such as sweetpotato and beans.

and nutrition situations at all levels; and establishing a coordinated national food and nutrition information network (Ministry of Health, 2004).

4.1.12. Research

Under the UNFNP, knowledge gaps have been identified in the areas of food security and nutrition (GOU 2003). The UNFNP recognizes that effective promotion of good nutrition should be based on reliable information from supply and utilization research, covering the food nutrient contents, consumption habits, and nutrition-related disease patterns. The UNFNP aims to promote effective research programmes geared toward improving food security and nutrition in Uganda by conducting action-oriented research, mobilizing resources for research, and publishing research findings. Priority will be given to action-orientated research that will provide local solutions to food and nutrition issues to activities that benefit the population.

Whilst the need to explore approaches to micronutrient deficiency other than supplementation is acknowledged, scant evidence exists that such approaches are being widely promoted. There is a need for the current state of biofortification research and development to be brought before the UFNC. This could best be achieved through the inclusion of a respected nutrition researcher on the council.

4.2. Uganda Food and Nutrition Strategy and Investment Plan (UFNSIP)

The Uganda Food and Nutrition Strategy and Investment Plan (UFNSIP), enacted in 2005, was formulated to guide the implementation of the Uganda Food and Nutrition Policy (UFNP). The principal objective of the UFNSIP is to improve and assure nutrition security for all Ugandans, particularly through nutrition-related interventions (Government of Uganda 2005a). Interventions relevant to the promotion of biofortified crop varieties include:

1. Addressing the food and nutrition needs of the child in the womb and during the first two years of life. The target group comprises about 25 percent of the population, and includes children and mothers. The actions will include: educating pregnant and lactating women on the components of a balanced diet; providing education on the kinds of food that increase intake and absorption of vitamins and minerals; preventing low birth weight through prenatal food and micronutrient supplementation; encouraging exclusive breastfeeding for the first six months; and

addressing micronutrient deficiencies through direct interventions and food-based approaches.

2. Addressing the food and nutrition needs of school-going children by strategies including: establishment of school children feeding funds; review of training institution curricula to improve food and nutrition education components; and facilitation of the establishment of demonstration farms and school gardens.
3. Addressing the food and nutrition needs of the poor, through strategies such as: promoting appropriate agricultural technologies and crops that provide nutritional advantages; developing markets; and developing a system for collecting, collating and disseminating information on food marketing and distribution.
4. Instituting the Uganda Food and Nutrition Council as a national food and nutrition coordinating body to ensure that sectors are accountable for the implementation of their respective components of the UFNP.
5. The Uganda Food and Nutrition Council (UFNC), comprises 14 members drawn from concerned ministries, institutions and the private sector and is appointed by the minister responsible for agriculture (GOU 2003). The UFNC operates with the relevant multisector committees dealing with food and nutrition at the local government level (Government of Uganda 2003).

The areas of intervention detailed by the UFNP and UFNSIP present a window of opportunity for encouraging the use of agricultural technologies capable of providing nutritional advantages to poor and vulnerable communities in Uganda (e.g. biofortified crops). To date little has been done. It may prove beneficial to forge linkages and partnerships between HarvestPlus and the Uganda Food and Nutrition Council, the Ministry of Health, MAAIF, NGOs and local governments. While working within the existing policy framework, HarvestPlus could facilitate the achievement of policy objectives by helping educate mothers on foods that could increase the vitamin and mineral intake of children (particularly OFSP and mineral–rich beans). Ongoing nutrition education programmes must be intensified to encourage mothers to switch to more nutritious varieties. The use of a food–based approach to the problem of micronutrient malnutrition could receive a much needed boost from the establishment of school feeding programmes in target areas; key partners in this effort would be the Ministry of Education, local governments and NGOs. Sensitizing the health sector on the cost effectiveness of using a food–based approach in addition to supplementation and fortification could be one avenue of increasing the use of biofortified food crops. Research into breeding of improved varieties rich in bio–available micronutrients that are adapted to local conditions could be enhanced through partnerships with the NARS and the MAAIF, as well as participatory research in which the eventual consumers are involved in identifying appropriate varieties. Above all, the long–term nature of the intervention needs to be emphasized in order that the UFNC can include it in its long-term planning.

5. PLAN FOR MODERNIZATION OF AGRICULTURE (PMA)[4]

The increase in food production nationally over the past half century has been less than the population growth rate. The *per capita* availability of food declined from 1060 grams per day in 1968 to 1969 to 580 grams day in 1985 to 86; a fall of 46 percent. Grains (Sorghum, millet and maize) constituted 44 percent of food supplies in 1960, but had fallen to 27 percent by 1990, balanced by an increase in starchy foods (Banana, cassava and sweetpotato) from 56 percent to 73 percent over the same period (Mubiru 2000).

The Plan for Modernization of Agriculture (PMA), enacted in 2001, is part of a broader strategy of poverty eradication contained within the PEAP. In addition to addressing the falling per capita availability of food the modernization of agriculture in Uganda will contribute to the welfare of the poor by, amongst others, increasing incomes of the poor by raising farm productivity, increasing marketable agricultural production and creating on- and off-farm employment. The PMA recognizes that poor health and high

[4] This Section draws heavily upon Government of Uganda (2000), Plan for Modernization of Agriculture.

incidence of disease and poverty are fundamentally connected, and poor health is a major determinant of farmers' livelihoods since it affects their capacity to work and adopt 'modern' agricultural practices (DANIDA 2005). The PMA is not conceived as a traditional agriculture sector investment programme; rather the PMA is an outcome-oriented, multisector framework anchored to the government's decentralized structures. The PMA attaches critical importance to the role of education in promoting the attitudinal change necessary to improve the performance of, the agricultural sector (Ministry of Education and Sports 2003). Health and nutrition issues are not specifically mentioned but fall within the PEAP.

The vision of the PMA is *"Poverty eradication through a profitable, competitive, sustainable and dynamic agricultural and agro-industry sector*." The "results-focus" of the PMA means that programmes will only be considered successful if they contribute to the reduction of poverty (Ekwamu and Ashley 2003). Improving the welfare of poor, subsistence farmers will require that they re-orient production towards the market, allowing them to earn higher incomes. Successful implementation of the PMA will depend on the actions of a wide range of stakeholders, including central government ministries and parastatal bodies, local governments, the private sector, civil society, educational and research institutions, and development partners. The implementation of the PMA is guided by a PMA Steering Committee (PMASC), and a PMA Forum was implemented to allow stakeholders to have a say in PMA matters (Government of Uganda 2000).

The specific objectives of the PMA are to:

1. Increase incomes and improve the quality of life of poor subsistence farmers by increasing productivity and marketed production shares.
2. Improve household food security through the market rather than emphasizing self-sufficiency.
3. Provide gainful employment through the secondary benefits of PMA implementation, such as agro-processing factories and services.
4. Promote sustainable use and management of natural resources by developing a land use and management policy and promoting environmentally friendly technologies.

5.1. Priority Action Areas

Agricultural transformation is seen to start by increasing the productivity per unit area through adoption of high-yielding, pest- and disease-resistant crop varieties, use of appropriate crop and animal husbandry practices, maintenance of soil fertility through use of organic and inorganic manures, and the development of soil water management skills (Ministry of Agriculture, Animal Industries and Fisheries/ Ministry of Finance,

Planning and Development 2000). Strategies (see below) are being implemented in which agricultural research and advisory services stress the screening and adoption of proven production and postharvest technologies. In order to achieve this, the PMA focuses on seven priority pillars:

1. Agricultural research and technology development.
2. National agricultural advisory services.
3. Agricultural extension.
4. Improving access to rural finance.
5. Agro-processing and marketing.
6. Sustainable natural resource utilization and management.
7. Rural physical infrastructure.

The following discussion of the PMA priority areas will focus on those strategies relevant to the development, dissemination and use of biofortified varieties, and the extent to which the government is committed to achieving these strategies.

5.1.1. Agricultural Research and Technology Development

In an effort to make agricultural research more needs-oriented, the Government of Uganda carried out an extensive review of the entire National Agricultural Research System (NARS), under the auspices of the PMA in 2001. The overall objective was to create a more decentralized and demand-led NARS. Based on the findings of this review, a National Agricultural Research Policy was produced and approved by Government in 2004 (Ministry of Agriculture, Animal Industries and Fisheries 2004). The new policy will ensure that: (a) technology decisions are made only after the issue has been discussed by representatives of all groups likely to be affected by the activities/decisions; (b) each new technology will be considered in terms of its costs and benefits, including the opportunity costs of the required inputs and the market prospects for increased output; and (c) researchers and advisors will examine potential risks and labor requirements and their possible effects on different categories of people in rural households and will discuss their findings with the relevant groups (e.g. farmers) prior to enactment. In this way, it is hoped that the future technologies developed and made available under the NARS will better reflect and address the problems experienced by various categories of farmers, especially resource-poor individuals such as women and children (ASWG 2003).

Enactment of the National Agricultural Research Policy was delayed until June 2005. However some activities within the Agricultural Research Programme began at the start of fiscal year (FY) 2004/05 (Government of Uganda 2004; TJRPMA 2004). Recent efforts

by NARO to increase its outreach activities and decentralize research under the new NARS policy have resulted in the initiation of an Outreach and Partnership Initiative (OPI) for establishing Agricultural Research and Development Centers (ARDCs), which are located in key ecological zones, where they intend to: 1) improve the efficiency and effectiveness of agricultural research services; 2) promote and solicit for specific zonal agricultural demands; and 3) assess technologies suited to particular zones. The OPI initiative has resulted in a high level of participation from farmers and other individuals in the private sector, and the ARDCs are run by steering committees composed of district officials, politicians and farmers who are tasked with planning and implementation from the zonal to sub-county levels. At each level, workshops quite often precede research activities, and in many cases, the private sector has become involved in promoting the new technologies (ASWG 2003).

5.1.2. Agricultural Extension: The National Agricultural Advisory Service (NAADS)

The National Agricultural Advisory Service (NAADS) equates to the first pillar of the PMA and began operations in 2001, but was officially promulgated in the National Agricultural Advisory Services Act (2005). The mission of the NAADS, which replaces the previous extension services, is to increase farmer access to information and technology through effective, sustainable and decentralized advisory services with increased private sector involvement (Government of Uganda 2000). The NAADS is strongly orientated towards commercializing agriculture and improving the linkage between farms and markets and focuses on a decentralized, demand-driven approach to the provision of extension services. Farmer contributions and matching grants from local and national government authorities, along with farmer contributions, are used to contract private service providers to advise them on technology, thereby replacing the old bureaucratic extension system with a programme that offers the farmers a much greater level of ownership and accountability (ASWG 2003; Faye and Deininger 2005).

The NAADS Programme initially covered 6 districts in 2001/02, but an aggressive roll-out from 2004 into early 2006 brought the total coverage to 47 districts and 344 sub-counties (ASPS II 2005). The programme expansion was planned in a geographically-phased manner to ensure that sufficient capacities, both in terms of staff and target groups, were available for successful implementation. According to this plan, all districts should be incorporated into the NAADS Programme by the end of 2008 (ASWG 2003).

As of July 2003, 5005 farmer groups had registered with the NAADS, and a further 3633 groups had registrations pending. Notably, approximately 60 percent of the group

members were female. In addition, 2243 technology development sites had been developed at an approximate cost of 540 million Uganda Shillings, and were being utilized by 42,918 farmers. A total of 51 different improved technologies relating to a range of enterprises, including temperate fruit trees, honey production, livestock and fish, were being tested at these sites (ASWG 2003).

In the districts and sub-counties that had not yet been included in the NAADS Programme, graduates of the programme were employed to provide advisory services to farmers. MAAIF provided logistical support, mainly in the form of motorcycles and training, and most of the operational expenses were covered by the local governments. As of December 2004, the NAADS was serving approximately 17,000 farmer groups, with an average of 19.7 farmer households per group. Thus, some 400,000 rural households (approximately 2.5 million individuals) had received or were receiving advisory services from NAADS at that time (Faye and Deininger 2005).

The formation of farmer groups under the NAADS programme has resulted in: (a) improved organization and financing of beneficiaries (farmers) at the local level, allowing them to demand better service provision; (b) improved access to information, including better technology at the technology development sites; and (c) farmers having greater input into planning processes at the local government level, resulting — theoretically, at least — in plans that should meet local-level needs more effectively (ASWG 2003).

The NAADS programme is strongly oriented toward commercializing agriculture and improving the linkage between farms and markets. This may create a bias toward "high–valued" commodities, such as coffee, cotton, fruits, vegetables and livestock, while potentially devaluing staple food crops like sweetpotato and beans. An evaluation of extension services in Uganda by Faye and Deininger (2005) found a statistical link between farmers receiving extension services and diversification into non–food staple commodities, but found no significant differences in productivity between farmers receiving extension services in NAADS districts and non–NAADS districts (where traditional extension services were still available). Despite its apparent emphasis on crop diversification away from staple food crops, NAADS has the potential to improve future productivity, and may form a viable avenue for promoting improved food crop varieties, including biofortified crop varieties.
In order for biofortified crops to gain NAADS support, it may be necessary for the crop developers to participate in strategic partnerships and offer supplementary funding. Such strategic partnerships have proven successful in the past for dissemination of new varieties, such as OFSP in Soroti District (Stathers et al. *2006).*

5.1.3. Agricultural Processing and Marketing

The income-orientated nature of the PMA requires the development of markets and the inclusion of farmers in the market chain. Also, to maximise farmers' returns it is proposed to add value to agricultural products through processing (Government of Uganda 2000).

Strategies proposed for improving marketing include: 1) improving road infrastructure; 2) implementing measures to encourage the growth of a competitive transport sector; 3) establishing/rehabilitating rural markets; 4) adopting and implementing a decentralized, flexible information system; 5) improving international market access by improving policy formulation, monitoring and enforcement, especially in the area of international trade negotiations; 6) developing quality standards; 7) strengthening trade-related institutions; 8) facilitating the private sector in developing procurement contracts; 9) initiating bilateral trade negotiations; and 10) establishing an agricultural commodity exchange (Government of Uganda, 2000).

The Government also plans to pursue a number of strategies to improve storage and agro-processing: 1) developing new infrastructures, including countrywide provision of low cost energy sources and water supplies; 2) strengthening market information on production, supply and demand; 3) training; 4) establishing and enforcing quality standards for agro-industrial products; 5) revising tax rates and tax administration arrangements for the agro-industrial sector; 6) implementing policies and laws related to contracts and contract enforcement; and 7) promoting rural electrification through a rural electrification fund (Government of Uganda, 2000).

In support of these goals, a NAADS agricultural marketing strategy was developed, and interventions have been initiated at the district (e.g. the Agricultural Marketing Information Service; AMIS) and national (e.g. market linkage exercises/workshops) levels. It is hoped that, among other things, these interventions will help reduce the large seasonal fluctuations in produce prices. Other planned interventions, such as the Agricultural Commodity Exchange and the Warehouse Receipts System, are also aimed at reducing seasonal price fluctuations (Government of Uganda 2000).

Under the PMA, Marketing and Agro-Processing Strategy (MAPS) was developed by a task force including representatives of the government, the private sector and civil society (ASPS II 2005). The improvement of marketing is regarded as essential for the success of the PMA (Ekwamu and Ashley 2003). While the primary responsibility for

agricultural marketing and agro-processing is seen as belonging to the private sector, the MAPS envisages a number of public sector interventions to support their efforts.

A Market Information and Dissemination and Sensitization Strategy was undertaken by IITA/ FOODNET and launched in 2003 (Ekwamu and Ashley 2003) and a Market Information Strategy was piloted in the 6 original NAADS Districts, in an effort to improve the availability and timeliness of information on output prices, volumes, quality and market requirements at sub-county markets, for use by farmer groups, service providers, traders and local processors (Ministry of Agriculture, Animal Industry and Fisheries 2004). Potential users of the information are being trained on how to analyze, interpret and use the provided data and the system will be expanded to all of the NAADS programme districts (ASWG 2003).

In 2003, NAADS established an Agricultural Commodity Exchange, albeit operating in only a limited way at the present time (TJRPMA 2004). As part of the MAPS, a Warehouse Receipts Bill was drafted, finalized and sent to Parliament (ASPS II 2005). The warehouse receipts concept will allow farmers or traders to access capital through collateral storage in registered warehouses. Once a farmer meets the volume and quality conditions issued by the collateral manager, he/she will be given a receipt that may then be exchanged for capital at a registered bank. In this way, inventory credit may be used to purchase inputs or expand enterprises (ASWG 2003).

Finally, in an effort to match agricultural produce quantity and quality to the needs of the market, the Ugandan Cooperative Alliance (UCA) has sought to revive the cooperative movement by forming Area Marketing Cooperative Enterprises comprised of primary cooperative societies, farmer associations, and large-scale farmers at the sub-county level (Government of Uganda 2004).

A number of schemes of potential benefit to improving farmgate prices and overcoming price fluctuations are now being tested. However, for biofortified crops to benefit to a number of measures need to be taken; particular attention needs to be paid to differentiating biofortified varieties from traditional varieties through promoting their health benefits.

In the case of the highly perishable sweetpotato, further measures are needed. If seasonal price fluctuations and high transport costs are to be evened–out, then some form of local processing (probably drying) or fresh root storage system will be necessary. Drying and further processing has been shown to cause a loss of β–carotene (Stollman 2005; Bechoff 2006). If products are to be acceptable to the Uganda Bureau of Standards then NAADS and other extension bodies must be sensitized to the situation and assisted in drawing–up specific, standardised guidelines.

5.1.4. Access to Agricultural Inputs

The current productivity observed in the Ugandan farming community is very low, in many cases much lower than the genetic potential expressed under optimal conditions in research stations (NARO, Annual Reports, 2000–2005). This low productivity is due to soil fertility depletion, heavy reliance on basic indigenous technology including the use of unimproved and low-yielding planting material, limited practice of crop protection, high postharvest losses arising from inadequate storage and processing capacity, etc. (Ministry of Finance, Planning and Economic Development, 1998). Accordingly, the PMA seeks to improve agricultural input market access through various strategies, including: 1) improving the availability and timely distribution of high yielding, quick maturing, pest- and disease-resistant planting and stocking materials; 2) encouraging the participation of the private sector in seed multiplication, processing and marketing; 3) promoting the use of fertilizers by farmers; and 4) developing an effective network of stockists to make vital inputs available and accessible to the farming community (Government of Uganda 2000).

Seed is a crucial input determining yield (Muhhuku 2002). If bio–fortified varieties are to attain rapid, widespread distribution through an efficient seed scheme must be in place. For grain crops this will be available with the setting–up of USL and the proposed close linkages with NARO and NAADS. However, to date neither the USP nor USL have dealt with vegetatively–propagated crops which are more prone to carrying disease from one generation to the next, have a slow rate multiplication and are often highly perishable. A case in point is sweetpotato, where experience throughout East and Central Africa have demonstrated that the maintenance of stocks to have a timely and adequate supply of planting material at the onset of the rains is a major production constraint. Uganda Seeds Limited has hitherto only been concerned with grain crops, thus alternative schemes must be developed for the vegetatively propagated crops.

A major factor influencing yield is seed quality[5]. The seed industry in Uganda is largely undeveloped, with farmers relying almost entirely on their own low-yielding seed supplies. The Government of Uganda recognizes that both the public and private sectors have critical roles to play in the development of the seed industry. The major interventions include:

[5] For the purpose of brevity, 'seed' includes other forms of planting material such as vines or cuttings.

Uganda Seeds Limited (USL), a limited liability company wholly owned by Government, was incorporated in 1999 to assume the functions of Uganda Seed Project formerly under the Ministry of Agriculture, Animal Industry and Fisheries (MAAIF), which is in line with the conditionality of the African Development Bank that funded the former Government project, Uganda Seeds Project, on condition that Private Sector Participation would be introduced in the operations of Uganda Seeds project to ensure sustainability and efficient delivery of improved seeds to the farming community in Uganda (United Nations Industrial Development Organization, *undated*).

- Within the framework of NARO and NARS, the public sector is being encouraged to play the lead role in seed research, including production of foundation seed and development of a national gene bank.
- The private sector is being encouraged to multiply foundation seed and engage in seed certification, processing and marketing.
- A seed certification service for quality control and issuance of phyto-sanitary certificates has been set up through the MAAIF.
- MAAIF and NAADS are cooperating to facilitate seed stockists and the adoption of improved seed varieties by farmers.
- Institutional arrangements are to be put in place to maximize the opportunities offered by the international development of improved seeds and planting materials, while minimizing the potential dangers of such importation.

5.1.5. Rural Physical Infrastructure

The improvement or implementation of physical infrastructures, such as roads, electricity, water and communication, are critical for the modernization of agriculture. Towards this end, the Government of Uganda has increased the capacity and resources provided for construction and maintenance of community roads, conduct needs assessments to guide rural electrification programmes, and develop and maintain new water and irrigation infrastructures to enhance agro-processing, increase market access, improve the quality of life of rural people, and narrow the rural and urban divide (Government of Uganda 2004).

The strategy for road development is the District and Community Roads Strategy. Originally main roads were considered a priority but increasingly district and community roads have seen on-going maintenance and rehabilitation which should assist in the marketing of agricultural produce. In FY 2004/05, the reform process with respect to the district and community roads was completed through securing

Cabinet approval of the White Paper on District, Urban and Community Roads (DUCAR), followed by implementation of key elements including the establishment of Technical Support Units (TSUs) (TJRPMA 2004).

Poor road infrastructure has long been considered a constraint to market access in Uganda and this is particularly true for the highly–perishable sweetpotato crop, often grown in isolated and marginal areas. If sweetpotato growers are to derive maximum benefit from the OFSP then they need ready access to the densely populated urban areas, most notably Kampala. The improved road situation should greatly assist the distribution of OFSP and allow larger–scale production in isolated and/or more distant areas.

5.1.6. Agricultural Education

The importance of an educated and trained farming sector is recognised in the National Agricultural Education Strategy (Government of Uganda 2003b). This strategy was presented to cabinet for approval in June 2004 as the National Agricultural Education Policy and Strategy (NAEPS). During FY 2005, the Ministry of Education had planned to incorporate the NAES into the Education Sector Strategic Plan, but this had not yet occurred as of mid-2005 (ASPS II 2005). Priority areas under agricultural education include:

- Development of an education policy.
- Delivery of agricultural education in primary and secondary schools, as well as tertiary institutions and universities.
- Delivery of agricultural education to farmers, youths, extension workers, trainers and teachers through the Agricultural Development Centres and local groups. Such education is expected to be participatory, and will be implemented via role models such as farmers, teachers and extension agents within each community. Other potential activities include farmer forums, seminars, workshops, competitions, exhibitions, exchange visits or study tours and twinning arrangements between local and overseas institutions. The mass media will also be utilized.

To improve the delivery of agricultural education to primary and secondary schools, 1,400 primary school teachers in 14 districts have been trained on an agricultural education syllabus, and two agricultural colleges have been rehabilitated (Government of Uganda 2005d). With regard to the informal education under the Functional Adult Literacy (FAL) Programme, there was a 15 percent increase in the

number of learners between FY 2002/3 to 2003/4, but the PMA Technical Committee on Gender noted concerns in the greater number of females (76 percent) versus males (24 percent) and recommended strengthening incentives for male targeting (TJRPMA 2004).

Schools have proved to be a focal point in community development and experience with OFSP have shown them to be a useful avenue for transferring knowledge to school children and the surrounding community. Integration of biofortification into the school curricula (biology, home economics, geography, agriculture) and also school gardens and community projects could be explored with the Ministries of Education, Health and Agriculture.

A review of the PMA carried–out in 2005 (DANIDA 2005) noted variable success in implementing the plan. In part, this is due to PMA still being very much in its infancy with many of the desired changes long–term in nature. Ekwano and Ashley (2003) noted that several of the pillars had not been put in place by 2005.

The review also concluded that a poor understanding of the PMA exists in some sectors. Although cross–sector strategies are forming, more coherence is needed. For a biofortification intervention to succeed, cross–sector strategies and activities are essential, most notably involving the Ministry of Agriculture with the Ministries of Health and Education and Sports. The potential of NAADS to serve as a pivotal point for such activities should be explored.

A major tenet of the PMA is the lifting of households out of poverty through income generation; and hence market development is a major component. Experience OFSP emphasizes the need to develop markets for both for the sale of commercial roots and for planting material if farmers are to risk venturing into a new crop and increase production (Yanggen and Nagujja 2006).

6. CURRENT DEVELOPMENTS WITH BIOFORTIFIED CROPS IN UGANDA.

6.1. Sweetpotato research

The sweetpotato forms one of the most important crops in densely populated Eastern Africa, and is a major subsistence food crop throughout Uganda. Because of the

important role sweetpotato plays in the nutrition, food security and economy of Ugandans (Bashaasha *et al.* 1995), the Government of Uganda, through NARO, has prioritized research on this crop. Research, conducted by NARO's Sweetpotato Programme, has focused on breeding for increased yield and quality, resistance to Sweetpotato Virus Disease (SPVD), high β-carotene content; and methods for the control of the sweetpotato weevil.

From 1995 to 1999, NARO released twelve high-yielding sweetpotato varieties, one of which, NASPOT 5, was orange-fleshed (Mwanga 2004). NARO, in collaboration with the McKnight foundation and International Potato Center, is currently working on developing Ugandan and sub-Saharan African sweetpotato varieties with the highly desirable traits of high yield, high dry-matter content, orange flesh, and resistance to viruses and weevils (Mwanga *et al.* 2005). To date, the project has generated 136,000 botanical seeds, derived from poly-cross nurseries, for seedling screening. Efforts to generate breeding populations with virus resistance and other desirable traits have also progressed.

Good progress has been made in generating sweetpotato materials that combine high dry matter, high storage root yield, high biomass yield; combined with Sweetpotato Virus Disease (SPVD) resistance in non-orange-fleshed materials. Intermediate and advanced yield trials have been performed, and superior OFSP clones have been planted on farms for participatory evaluation in the districts of Mpigi, Wakiso, Nakasongola, Busia, Kabale and others. Such widespread testing has facilitated the generation of new OFSP materials that combine disease and pest resistance, and are suitable for the agroecological situations specific to each locale. Based on the results of these trials, two new orange-fleshed varieties were officially released in April 2004. These varieties, Ejumula and SPK004, have high beta-carotene levels and have been accepted by producers, consumers and processors in some parts of Uganda (Mwanga *et al*. 2004).

The improved varieties generally have not yet reached the vast majority of farmers due to limitations on vine supplies and the lack of a formal seed multiplication and distribution system (González de Uzqueta de Lorza 2006). Yanggen and Nagujja (2006) investigating potential reasons identified the lack of commercial value for the roots and, like González de Uzqueta de Lorza (*loc. cit.*) concluded that a major factor in a vine distribution programme must be the commercialization of the sweetpotato roots.

In 2004 the sweetpotato programme generated 76,000 breeding populations (seeds) in controlled crosses and 214,800 seeds in open-pollinated poly-cross nurseries (30.8

The breeding advances show great promise and better adapted varieties will be ready for release in 2007. However, to capitalize on their increased productivity and quality much work still needs to be done on vine distribution systems. Many of the vine distribution activities have been carried–out by NGOs and other aid or development organizations. In many cases the planting material has been given free or at subsidized rates. This has prevented farmers from appreciating its commercial value and producing vines for sale. Also recipients have not appreciated its value and failed to keep planting material for the subsequent season. Such an approach is not sustainable. Experiences to date would suggest that creating a market, and hence value, for planting material through awareness activities and then building on existing farmer practices is the most promising approach. For effective promotion of planting material there needs to be a sustained awareness campaign on the value of orange–fleshed varieties and also, importantly, the value of healthy planting material and its maintenance over the dry season.

percent were orange-fleshed. As of 2005, approximately 30,000 high-density seeds had been sent to Kenya, Zambia and Tanzania for seedling selection (Mwanga *et al.* 2005).

Three new OFSP varieties with superior virus resistance to existing orange-fleshed varieties are due to be released in early 2007.

To support the breeding programme a collection of local land races is being made. To date, 379 accessions, 18 of which are orange-fleshed, have been collected from 18 districts. These may be used in future breeding work (Mwanga *et al.* 2005)

These seed studies have led to preliminary plant studies and farmer participatory breeding, along with more advanced on-station trials at various locations (e.g. NAARI Kachwekano, Ngetta ARDC and SAARI), and on-farm trials in the districts of Mpigi, Kabale, Kamuli, Iganga, Busia, Ntungamo, Palisa, Kumi and Soroti (Mwanga *et al.* 2004).

To enable the expected increase in production to be used over an extended period, farmers in two major production regions, Luweero and Soroti Districts, have conducted research into the use of pits and clamps for the conservation of fresh roots. In addition, farmers have been trained in different sweetpotato processing techniques and products, particularly the drying of fresh roots as 'chips,' which can then be used for further processing and investigated methods of storage (Rees *et al.* 2003). Also, work has been carried-out on introducing OFSP into local confectionary and drinks (Stathers 2005; Stathers *et al.* 2006). Much of this work has been carried-out with orange-fleshed varieties, but more work needs to be on the effects of drying and processing on the β-carotene content.

6.2. *Phaseolus* Bean Research

The common or *Phaseolus* bean, which is the most important legume food crop grown in Uganda, offers unique opportunities for improving micronutrient nutrition because it is widely grown and consumed, it is rich in protein (>20 percent), minerals (zinc and iron) and calories, and it is relatively cheap and highly marketable (David *et al.* 1999). This crop forms a basis for food security in Uganda, because it has a short growing cycle and may be easily adapted to different cropping or farming systems. In addition to household nutrition and food security, beans are also important for income generation, especially by rural women. Thus, the Government of Uganda has mobilized multiple resources for research and development, in an effort to develop and disseminate improved bean varieties and technologies to farmers.

Bean research is coordinated by the National Bean Programme with falls under the umbrella of NARO and works closely with the International Centre for Tropical Agriculture and other regional and international organizations; notably the East and Central Africa Bean Research Network (ECABREN) a research network within the Association for Strengthening Agricultural Research in Eastern and Central Africa.

The first improved bean variety, K20, was released in 1968 (David *et al.* 1999). Between 1968 and 1994 there were no major releases. Between 1994 and 2001, nine improved bush bean varieties and five climbing bean varieties were released and disseminated by NARO in collaboration with CIAT and other partners (Kalyebara and Mugisha 2005).

More recently, several promising multi-resistant lines have been identified recently through collaborative efforts by CIAT, bean networks, the National Bean Programme and other partners. These materials are now in various stages of development and release. In Uganda, 18 bush bean lines have been evaluated in advanced yield trials at five locations. Two lines, RWR 2075 and RWR 1946, have reached pre-release level and are being multiplied (African crops 2005).

As part of HarvestPlus, a new multi-institutional programme of the CGIAR to reduce micronutrient deficiency, CIAT scientists have sought to identify bean germplasm with higher iron and zinc contents. To date, 38 'fast track' lines with moderate to high levels of iron and/or zinc have been identified from screening about 100 cultivars and land races widely grown in east and central Africa. These 38 fast track lines were distributed to several countries in east, central and southern Africa for agronomic evaluation in

2004 and 2005. In Uganda, an observation nursery was sown at Namulonge in September 2004, and the fast track lines were evaluated for agronomic and morphological traits, along with their seed attributes and reactions to field diseases. Twenty-one genotypes were selected for further testing in a replicated trial during 2005, and were included in an ASARECA Biotechnology-funded screening for reaction to bean common mosaic necrotic virus (BCMNV) and bean common mosaic virus (BCMV) at Namulonge and Senge (Uganda).

In Uganda, only 10 to 15 percent of bean seed is purchased (CIAT 2003). The remainder is either farm-saved or passes through some other form of informal system. In 2003, the National Bean Programme initiated a participatory project aimed at increasing dissemination of the available improved varieties. Under this project, seeds are being multiplied and distributed to farmers using farmer-to-farmer seed loan schemes in the districts of Mbale (Eastern Uganda), Kabale (South-western Uganda), Mubende (Western Uganda) and Luweero (Central Uganda). In this way, farmers and other end users were involved in the testing and selection of the most desirable lines (NARO, 2003).

Rapid progress is being made towards identifying parental material with the twin traits of disease resistance and enhanced nutrient content. As for sweetpotato, a mechanism is urgently needed to ensure the rapid dissemination of any new varieties and long-term seed production.

7. PROGRESS TOWARDS ATTAINING THE MILLENNIUM DEVELOPMENT GOALS

Biofortified crops can contribute towards the attainment of all of the Millennium Development Goals (MDGs)(United Nations 2007). The two primary crops concerning Uganda, beans and sweetpotato, are usually regarded as women's crops. Promotion of these two biofortified crops specifically contribute towards the following MDGs:

1. The eradication of extreme poverty and hunger;
3. Gender equality and the empowerment of women;
4. Reduce child mortality;
5. Improve maternal health; and
6. Combat HIV/ AIDS.

Less directly through improved income and child health they can contribute to: a) goal 2. Achieve universal primary education; and through good agricultural practices and

partnerships with the many types of organization shown to be necessary for successful adoption b) goal 7. Ensure environmental sustainability, and c) goal 8. Develop a global partnership for development.

7.1. Uganda's Progress Towards Attainment of the MDGs

Uganda had made mixed progress towards attaining the MDGs (Ministry of Finance, Planning and Economic Development 2003). Better progress has been made in those spheres directly related to the PEAP: income poverty reduction, universal primary education and gender parity in education, HIV/ AIDS and increasing access to safe water. Substantial challenges remain in ensuring gender parity in secondary education; combating infant, under-five and maternal mortality, reducing malaria and improving environmental sanitation (MFPED *loc cit*.).

An evaluation of the Plan for the Modernization of Agriculture (DANIDA 2005), whilst endorsing the validity of the PMA concept and vision that rural poverty is seen to be best addressed through the commercialization of agriculture, notes that with rising poverty after 1999, its concentration amongst rural farmers, and slow economic growth mainly as a result of a weaker performance in agriculture, the goals set will not be achieved unless constraints to widespread agricultural growth are addressed. The DANIDA review recommended, in particular, a roadmap for the PMA for the next five years with quantitative targets and indicators of success; differential strategies for farmer categories; a need to address marketing issues across all relevant pillars and with NAADS in particular; incorporate environmental issues as a cross-cutting issue; and the mandates of District and sub-County Technical Planning Committees should broadened to include coordination of the PMA activities.

There has been a failure of the health sector reforms to reduce the very high levels of child morbidity and mortality and improve maternal health (Ministry of Finance, Planning and Economic Development 2003). Basic indicators of health care for mothers and infant children (e.g. the share of fully immunized children fell from 47 percent in 1995 to 37 percent in 2000 (Moller 2002) and prenatal care coverage fell during the years1988 to 2000 (Ssewanyana and Younger, 2005) raising the question of whether clinics are an ideal access point if mothers are apparently not attending. An encouraging development is the significant fall in infant mortality and improvement in mother's education, suggesting that mothers with young children are becoming more sensitive to awareness campaigns.

In his review of the health sector reforms in 2004, Okuonzi (2004) suggests that basing health service supply on market principles is incompatible with maximising welfare

and reforms should be developed separately from market economics and use genuine indicators that comprehensively measure the reality of people's lives. Fees were lifted in 2001. Ssengooba (2004) suggests that there is a need to re-examine the Minimum Health Care Package with the modest resources available (US$8 per person as opposed to US$28 calculated as necessary for full implementation of the package) and focus on the needs of the poor and vulnerable; an approach that would emphasize pro-community planning and financing as opposed to a facility-based approach..

The improvement in the education sector at all levels including adult literacy can be attributed to government commitment, strong ministerial leadership and timely and concerted external support. (Ministry of Finance, Planning and Economic Development, 2003). Future policy is aimed at gender parity, particularly at the secondary school level, and enrolling girls earlier in school (MFPED *loc. cit*.).

External funding which supports many activities is complex and the various donors impose widely differing standards for accessing funds, and both subtle and overt political agendas. Recent work at the Ministry of Health, for example, has shown that up to 70 percent of donor funding in the country may not be targeting the key inputs for the minimum package of services as laid out in the Health Sector Strategic Plan and the Health Financing Strategy (Tashobya and Ogwal 2004). A biofortification programme must work closely with the various sectors and donors to ensure compliance with the government's objectives.

7.2. Ugandan Development Policy: Comprehensive But Not Integrated

The overriding aim of government policies such as the PEAP, PMA, UFNP and the National Agricultural Research Policy (NARP) is the alleviation of poverty and the maintenance of economic growth, thereby directly increasing the ability of the poor to raise their incomes. Issues concerning micronutrient deficiencies are addressed in the UNFNP, UFNSIP HSSP and UNHP. There is little distinction among the various strategies to eradicate micronutrient deficiencies; most address the issue as part of general health care delivery.

The majority of the related policy statements include the major ingredients required to tackle the problem of undernutrition in children and the population at large; they address issues related to inadequate knowledge, food insecurity, disease, inadequate health services and poor sanitation. However, in order to gain maximum impact on nutrition, it will be necessary to integrate and link the key sectors of health, agriculture and education (Bonnard 1999). This has not yet occurred in Uganda, where many

nutrition intervention programmes are implemented in isolation, are often funded externally by many different donors, and with each group having little knowledge of the activities and programmes being undertaken in other sectors. Thus, to ensure the desired nutritional outcomes, it will be necessary to establish and reinforce complementarities between agricultural and health programmes and interventions. These links can be formed within a single programme or intervention, or through collaboration among partners, agencies and institutions. In this way, the eventual solution to micronutrient malnutrition must be multi-dimensional. Biofortified crops which are regarded as novel and by their nature cut across many disciplines require an integrated approach, a particular aspect of which should be the creation of awareness at all levels from ministerial to community. Unfortunately, although nutrition is highlighted in many policy documents, unless strategic plans and projects are specifically nutritional in nature, there is little emphasis on the ground. This is also reflected by the dearth of reference to nutrition in the many reports and assessments. Nutritionists need to be members of the major policy and coordinating committees such as the PEAP and the PMA.

8. RECOMMENDATIONS FOR PROMOTION OF BIOFORTIFIED CROPS TO IMPROVE NUTRITION

Experience to date when introducing biofortified crops in Uganda and elsewhere in East Africa and conclusions that draw from the policy review, our conceptual frameworks on nutritional outcomes (Figure 1 in Section 1 of this report) and on the food security concept developed by Bouis and Hunt (1999) allow for key recommendations regarding the promotion of biofortified crops to be made.

8.1. Key Biofortification Experiences To-Date

The only major biofortification field activities to date in Uganda have been promotion the high β-carotene sweetpotatoes. Whilst, activities began 10 years ago, in the last five years a number of constraints likely to affect the introduction of all biofortified crops have been identified:

- *Weak inter-sector linkages*: The problem of malnutrition requires a multisectoral approach, but weak linkages among the key sectors of health, agriculture and education limit the required cooperation. To date almost all biofortification activities have been conducted through research activities within the Ministry of Agriculture, with a little contact with the Ministries of Health and Education at the district or sub-county level. There is an urgent need to increase awareness of the potential and

ongoing activities in the field of biofortification at the highest levels and on a permanent basis through inclusion in the appropriate committees and programmes.

- *Limited number of acceptable biofortified varieties*: A principal aim of the HarvestPlus initiative is to introduce sweetpotato varieties high in β-carotene. Conventional breeding techniques require from seven to ten years. Thus, as an interim measure local landraces high in β-carotene and with local adaptation have been identified, cleaned of disease and released. To date, only two varieties, Kakamega and Ejumwlah have been released. This limited range has given farmers little choice and both varieties have drawbacks that limit their acceptability and adoption. Whilst Kakamega has good all round agronomic characteristics, it has a lower dry matter content than desired and is relatively low in β-carotene and may contribute negligible amount to the diet when processed (Stollman 2006). Ejumwlah is susceptible to virus attack and thus its area of cultivation is limited to the North and East where virus pressure is low. Other important issues are taste and preferences. In Uganda, white varieties of sweetpotato remain popular among most households; a change in perceptions and belief will be needed in order to shift consumption habits from white to orange-fleshed varieties. The anticipated introduction of up to five new varieties with high β-carotene content, high dry-matter content and resistance to virus attack should give greater choice and adaptation and alleviate the situation (Mwanga *Pers. Com*.)

- *Market*: Adoption assessments by Yanggen and Nagujja (2006) and González de Uzqueta de Lorza (2006) have both identified a lack of consistent markets for the commercial roots to be a major constraint to farmer uptake of the new varieties. The OFSP may either replace existing white or yellow-fleshed varieties or be orientated to new markets. The predominant market is the fresh market and Rao (2006) noted that there was reluctance by traders selling to the Kampala market to accept the orange-fleshed varieties. Indeed, many would mix them with white-fleshed varieties. Rao(2006) and Yanggen and Nagujja(2006) also noted a dearth of orange-fleshed varieties in the main Kampala markets suggesting the need for a sustained awareness campaign run in parallel with production increases and the development of market linkages.

8.2 Recommended Actions

8.2.1. Breeding and Release of Improved Biofortified Crop Varieties

Studies have shown that increasing the availability of dietary minerals and vitamins through breeding of micronutrient-dense staple crops holds great promise for increasing the productivity and food intakes of vulnerable populations (This would contribute significantly towards reducing the cost of supplementation and food fortification in Uganda, and should largely help reduce micronutrient malnutrition (Bouis and Hunt 1999). To reach this outcome, however, it will be necessary to increase the number of biofortified varieties available to farming households. This can be done through breeding for increased nutritional traits and the release of additional pest- and disease-tolerant varieties suited to different agroecologies and/or consumer tastes. The mandate for breeding new varieties and testing and evaluating new technologies rests with NARO and the CGIAR centres. The latter must produce and identify promising germplasm populations, which can then be transferred to the NARS (e.g. NARO) for generation, participatory breeding and research trials of varieties adapted to specific needs and conditions. Strong collaboration between CGIAR research centres and NARS institutions, perhaps in concert with development partners, will facilitate the development of varieties suited to different agro-ecological conditions, while potentially reducing the cost of breeding activities. In addition, it would be helpful to strengthen the enforcement of variety release regulations and seed certification programmes, thus streamlining the variety release process.

8.2.2. Utilization of the NAADS Programme

The new decentralized, farmer-based extension approach of the NAADS programme can be used to enhance the uptake and utilization of biofortified crop varieties by target populations. NAADS is operational at the sub-county and district level in 47 districts of Uganda, where it works through farmer groups. The advantage of utilizing the NAADS programme is that it supports the establishment of farmer-owned technology development sites that act as focal points for multiplication, demonstrations, training and dissemination. These can act as entry points for carrying out adaptive and participatory research trials, thus ensuring that the biofortified varieties are suited to local farming conditions, tastes and preferences. These sites can also be used for multiplication, demonstrations and training of farmers on cultivation of the new biofortified crop varieties. Therefore, it will be important to form and/or strengthen linkages between institutions promoting biofortification and the NAADS. However, the NAADS programmes appear to contain some built-in bias toward cash crops versus food crops. Thus, effective extension of biofortified food crops will also require engagement, with and support from, community and non-government organizations.

8.2.3. Availability and Provision of Clean Planting Material

The lack of a strong seed system in Uganda, especially for vegetatively-propagated crops like sweetpotato, is a constraint to adoption of new varieties. Thus, to further facilitate the adoption of biofortified varieties, it will be necessary to improve the availability of bean seeds and sweetpotato planting materials (roots and vine cuttings). A large-scale multiplication and dissemination strategy of accepted varieties should be put in place. The establishment of decentralized farmer-based multiplication systems would build the farmers' capacity to generate planting material, bring seed closer to other farmers and improve the sustainability of interventions promoting the use of biofortified varieties. Two options for improving the seed system present themselves: the provision of foundation seed by the NARS, and setting up of secondary (regional) and tertiary (local) multiplication sites (for the case of OFSP) in collaboration with NGOs that have strong relationships with Community Based Organizations (CBOs) and farmer groups.

8.2.4. Nutrition and Health Education

As nutrition and health education and behavior change programmes can complement an agricultural interventions aimed at improving nutritional outcomes, it will be important to increase awareness of the serious consequences and causes of malnutrition. Training can introduce new behaviors and help break down stereotypes against low-status, but nutrient-dense, foods (Bonnard 1999). Such programmes could be useful in educating consumers on new food varieties (e.g. the OFSP and iron-rich beans) and how they can benefit children. Training modules that focus on sweetpotato and bean growing techniques and their health and nutrition attributes should be formulated. Agricultural education programmes combined with improved nutrition feeding practices could be incorporated into the Functional Adult Literacy programme of the Ministry of Gender, Labour and Social Development. Notably, these interventions should be adequately targeted to pre-school-aged children and pregnant and lactating women. Toward this end, it might be useful to explore other avenues for education on biofortified crops, including the use of radio, media campaigns, field days, launches, workshops and exhibitions.

8.2.5. Establishing a Community-Based Health Programme

Tontisirin and Gillespie (1999) argued that success of a nutrition-based programme depends on community participation, which gives a sense of ownership and improves the sustainability of the intervention. Fortunately, the current health policy framework of Uganda highlights support for community-based services, offering an opportunity to

ensure that nutritional interventions reach the targeted communities. The establishment of district and village health teams (VHT) provides an avenue for carry out agricultural interventions aimed at improving nutritional status. VHTs can be useful in sensitizing the community, carrying out village-based campaigns, improving awareness, providing nutrition education to caregivers and mothers, identifying health problems associated with micronutrient deficiencies, getting feedback on interventions, and improving community awareness of the benefits of biofortified varieties to children, lactating and pregnant mothers. Therefore, collaboration between VHT and nutrition programme actors should be initiated for increased effectiveness of nutritional interventions.

The bi-annual Child Days overseen by the Ministry of Health are a good opportunity to target mothers of young children (< 3 years of age). On such days, mothers can be given information on the causes and effects of malnutrition, the benefits of biofortified foods, and confounding factors such as intestinal worms, dietary oils, and proper sanitation practices. Health workers will need to be sensitized and encouraged to pass on this information during the Child Days. In addition, planting material or seeds could be given out, preparation of complementary weaning foods from biofortified crops may be demonstrated and informational leaflets/brochures could be made available. This should be done at the various health centres, with special attention given to Therapeutic Feeding and PMCT Centres.

The Ministry of Education has instituted the school feeding programmes, which could be used as entry points for nutrition education for parents, children and teachers, with the school acting as the focal point for information dissemination to surrounding communities. These programmes could include the incorporation of nutrition modules in educational projects aimed at child nutrition (midday school meals, micronutrient supplementation, de-worming) the integration of health and nutrition education into existing curricula, and the establishment of school gardens, demonstration plots and rapid multiplication plots that could eventually provide seeds and planting material to the students' families and the community at large. This could be implemented in collaboration with the Ministry of Education and district health teams.

9. CONCLUSIONS

The need for an alternative approach to address the severe micronutrient malnutrition afflicting a large portion of the population is evident from the failure of existing approaches to significantly improve the situation. Particularly of concern is the failure to cover all children on 'child days,' and mothers during visit to antenatal clinics. Logistics and a lack of capsules, almost all of which are funded by outside agencies, are

major challenges to sustaining supplementation programs. The health system is already financially constrained with only US$8 available per person; instead of the US$28 calculated as necessary to implement the Minimum Health Care Package. Biofortification presents a complementary approach to supplementation and fortification, and food has the advantage of providing multiple micronutrients as well as macronutrients (energy, protein). Farmers can retain planting material once acquired, thus reducing the recurrent costs of such an intervention.

Multisectoral coordination across sectors and between local, regional, and national governing bodies is a challenge. Government policy calls for greater decentralization and sector-wide approaches. Such approaches are necessary for a biofortification intervention and particularly involve the Ministries of Agriculture, Health and Education. However, there are clearly difficulties in coordination of activities between different line ministries at all levels; difficulties that are likely to be exaggerated in the case of biofortification due to a lack of awareness. There is a need to include expertise in nutrition and biofortification on all committees at the highest national levels and assure that leading district leaders become informed about the potential benefits of biofortification. A strong media awareness campaign can assist in reaching farmers, community leaders, and even policy makers concerning value of biofortified crops and how to access them.

This review of government strategies and policies in poverty, agriculture, health, and education clearly indicates the government's commitment to reduce poverty and malnutrition. Its food security and nutrition strategies recognize the extent of micronutrient malnutrition and its negative impact on human health and productivity. What is also clear from recent assessments of these policies is that there is a gap between commitment and the capacity to implement nutrition-focused interventions. Specifically, country-wide implementation of vitamin A capsule supplementation programs has proved difficult, and dietary diversification strategies and communication campaigns have been implemented in limited number of sites. The good news for biofortification is that the approach readily fits into the existing policy framework; the bad news is that as an approach, it will be competing for resources with many other commitments to improve health, nutrition, and income. Hence, it is imperative to integrate the biofortification approach into existing programs as much as possible and demonstrate on-the-ground cost-effectiveness of biofortification in comparison to alternative interventions. The potential for biofortified crop/OFSP varieties to be grown and maintained by the households themselves, thus providing a cost-effective and sustainable supply of needed micronutrients in the diet, needs to be demonstrated to policy-makers and practitioners.

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ANNEX 1. INSTITUTIONS IMPLEMENTING AGRICULTURAL POLICY

Institutional arrangements for the Plan to Modernize Agriculture (PMA)

The PMA is a multisector framework that is overseen by a multisector steering committee (SC). The SC includes key stakeholders from the private and public sectors, civil society organizations, district representatives and donor organizations. The SC is formed of sub-committees designed to provide information and analyses to inform SC deliberations and decision-making. A secretariat facilitates the SC, supports the sub-committees of the PMA, and co-coordinates the Poverty Reduction Support Credit preparation and monitors implementation of the PMA and work in PMA-related areas. The PMA agenda is presided over at the district and sub-county level by the Technical Planning Committee (TPC), a multisector group chaired by the Chief Administrative Officer of each District. There is no direct link between this structure and the district government structure. However, the PMA SC is advised by the PMA Forum, a loose network of implementing agencies and other PMA stakeholders. The SC is directly linked to government bodies through the specific line ministries represented on the SC. This lack of a decentralized relationship may be seen as weakening the potential influence of the PMA on decision-making by the Sector Working Groups involved in drawing up budgets for each of the sector development plans.

Organization of the National Agricultural Advisory Service (NAADS)

The overall organizational structure of the National agricultural Advisory Service (NAADS) is shown in Figure 3. The implementation of NAADS, however, by districts and has necessitated the integration of the programme within local government structures (Figure 4). At the sub-county level, the production department is overseen by the sub-county NAADS coordinator; since service delivery is contracted to private sector service providers under NAADS, no other public officer is needed. The sub-county NAADS coordinator is responsible for overseeing advisory service (extension) delivery under the sub-county Chief, who reports directly to the District NAADS Coordinator (See Figures 3 and 4).

Figure 3: Organisational structure of National Agricultural Advisory Service (NAADS)

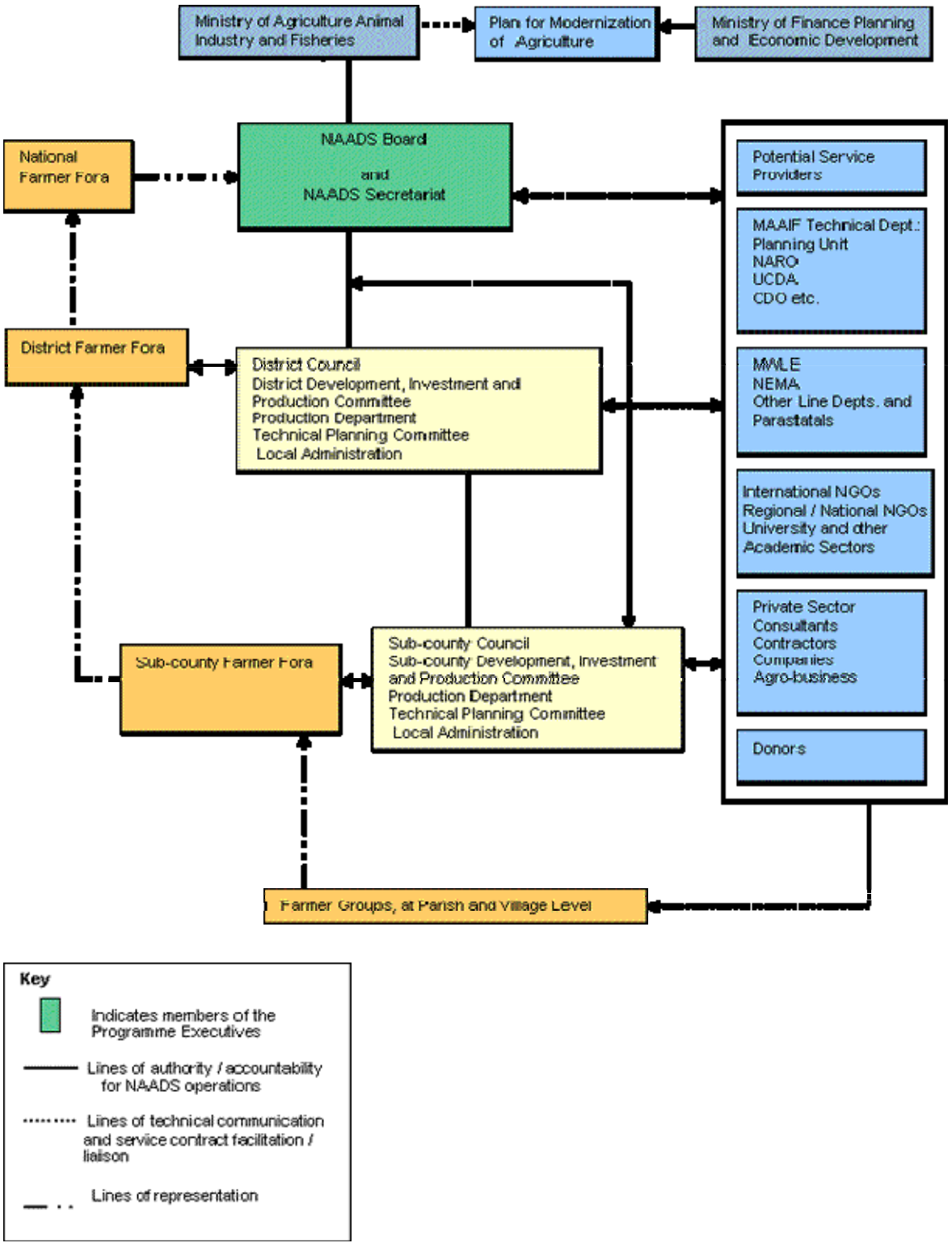
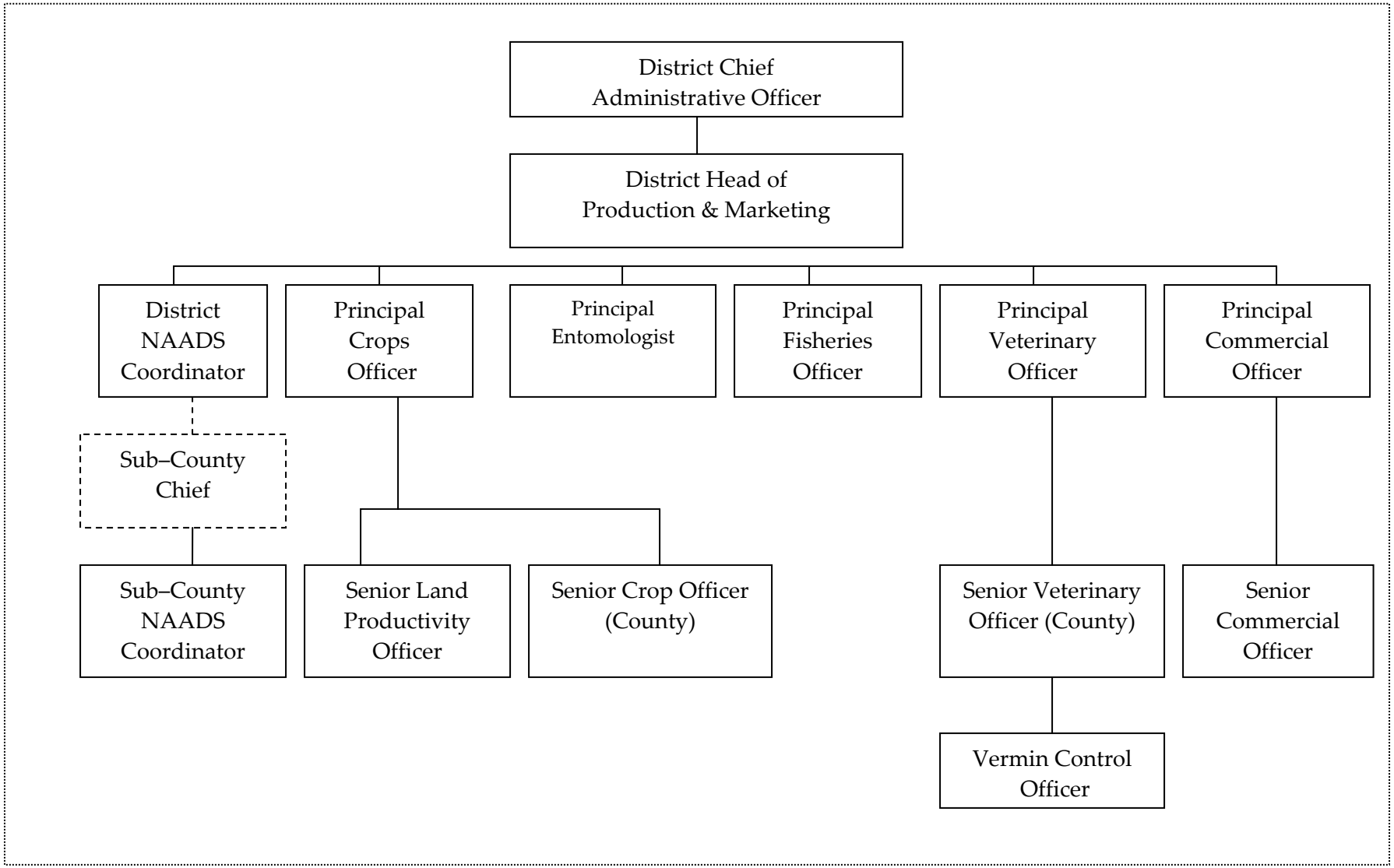


Figure 4: NAADS and District Government Structure



ANNEX 2. INSTITUTIONS IMPLEMENTING HEALTH POLICY

The Ministry of Health (MOH) is responsible for implementing the National Health Policy (Ministry of Health 1999). The mission of the Ministry of Health is to:

- Provide policies, guidance and standards, facilitate district health services and manage nationally based health services.
- Ensure the attainment of a good standard of health by all people in Uganda in order to promote a healthy and productive life.

The functions of the MOH are to:

- Establish policies, guidelines and standards for the delivery of a minimum health care package at the district and national levels.
- Coordinate and facilitate all health sector stakeholders in their efforts to achieve the national goals for health.
- Provide sufficient referral and tertiary health care services, ensuring that patients who cannot be successfully treated at the district level receive appropriate medical attention.
- Ensure that sufficient health professional training is undertaken to meet national requirements, and regulate the employment of all health professionals to ensure minimum standards of professional practice.
- Coordinate research activities in order to support health policy and programme improvements.
- Develop health infrastructure and quality assurance systems to facilitate district and national planning and policy implementation, monitoring and evaluation.
- Provide efficient and effective systems and intervention for the avoidance or early identification and control of epidemics.

In 2002, the Ministry of Health was restructured to support its new mandate and core functions (Jeppsson *et al*. 2003). Figures 5 & 6 show the current organization structure of the MOH at the national level and district levels respectively; the health service commission reports directly to Parliament and is responsible for reviewing the terms and conditions of health workers. Semi-autonomous institutions include these shown on the right hand side of 5.

Under the 1997 Local Governments Act (Ministry of Local Government 1997) health service delivery was decentralized to the district and sub-district levels. The district health system has been streamlined and is now managed by the District Council through the District Health Committee (Ministry of Health 2004a) The District Health Management Team, headed by the District Director of Health Services, is composed of

the heads of the Health Sub-Districts (see below) and the various section heads. Figure 5 shows the structures for district health services delivery and the linkages among the political, administrative and technical arms of the various levels of the health care delivery system. Each Health Sub-District (HSD) consists of lower Health Centre III, II and village committees, with the HSD headquartered at the local Health Centre IV. The HSD takes responsibility for a higher level of health services nearer to the population; the HSD leadership may be based in the government, an NGO or at a private health facility, and the leader is designated a member of the District Health Management Team (DHMT). At each village, a Village Health Committee is responsible for identifying community health problems, mobilizing resources, serving as a link between health workers and the community, maintaining a register of household members and their health, and promoting health programmes like immunization, sanitation, and malaria control (International Monetary Fund 2005).

Whilst devolution of the health sector activities theoretically allows for practical interventions, the lack of coordination between the different parties and also the lack of field staff and training will necessitate considerable time being spent on training of staff, both Government and NGO, on the principles of biofortification and its implementation. Sufficient time and budget must be allowed in project planning.

Figure 5: Micro-level structure of Ministry of Health

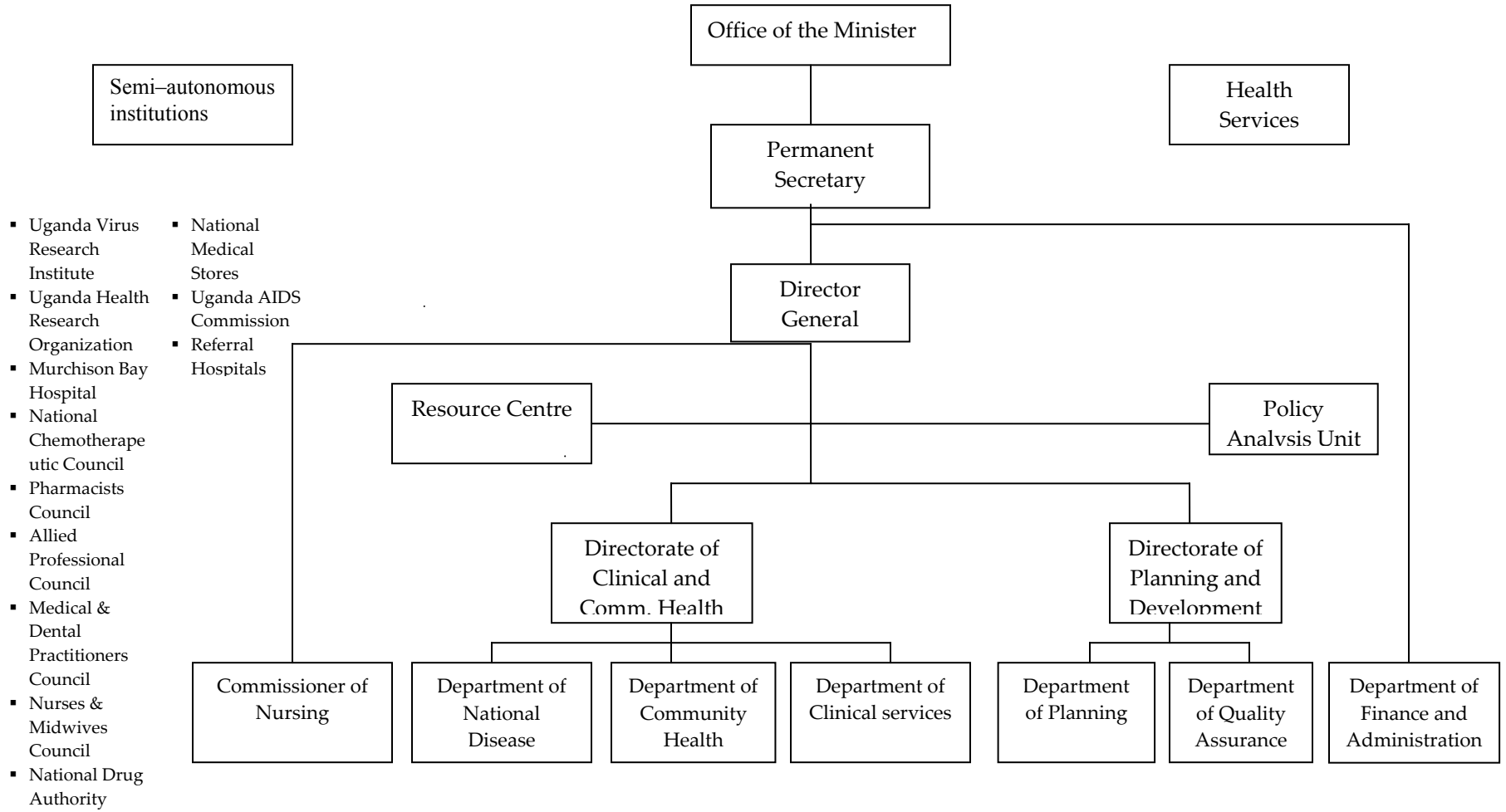
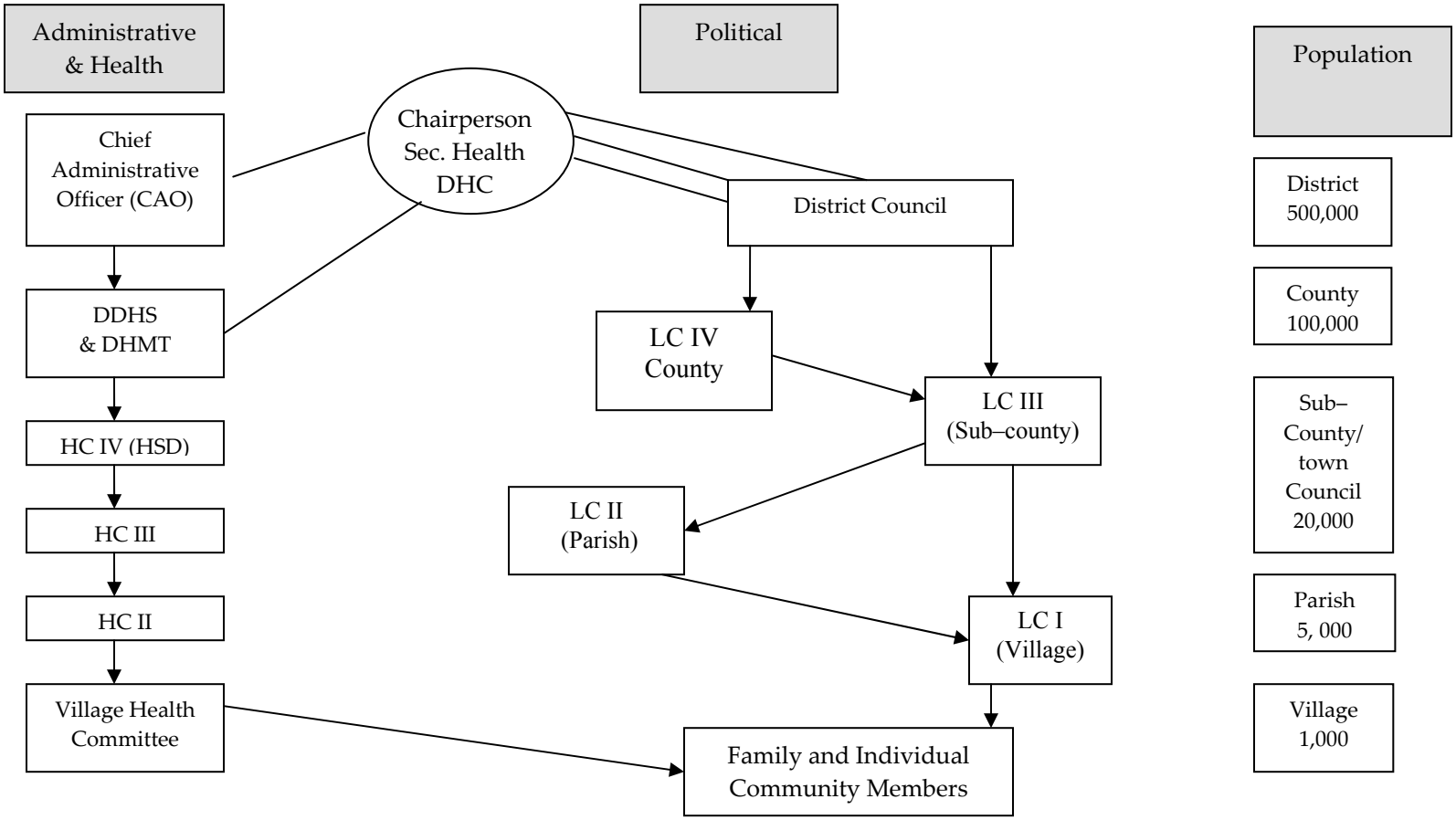


Figure 6: District structure for the delivery of public health services



CAO= Chief Administrative Officer
DDHS= Director of District Health Services
DHC= District Health Committee
HSD= Health Sub–District
HC= Health Care
LC= Local council