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Field Project on Strengthening Africa's Capacity in Science and Technology for Sustainable Development: Towards a Green Revolution in Africa

Report of the Workshop on Identification and Assessment of African Green Revolution Indicators and Design

Kampala, Uganda
8-12 December 2003

1. ATTENDANCE AND ORGANIZATION

1. The Workshop on Identification and Assessment of African Green Revolution Indicators and Design was held at the Fairway Hotel in Kampala, Uganda, from 8 to 12 December 2003. The workshop was chaired by Mr. Alex Tindimubona, Coordinator and Team Leader of the Science, Technology and Innovation (STI) cluster of the Sustainable Development Division of the Economic Commission for Africa (ECA). Mr Dezi Ngambeki provided support as a resource person and as the rapporteur.

2. The meeting was attended by Experts in science and technology policies and in agriculture from Japan, India, Zimbabwe, Ghana, Zambia, Tanzania, Kenya, Nigeria, Cameroon, Ethiopia, Swaziland, Lesotho, and Uganda. The list of participants is provided in Annex 1.

2. ACCOUNT OF PROCEEDINGS

A. Opening of the workshop (Agenda Item 1)

3. The opening statement was read by Mr Alex Tindimubona on behalf of Mr Josué Dioné, Director of the Sustainable Division of ECA. The opening statement was followed by a statement by the Honourable Israel Kibirige Ssebunya, Minister of State for Agriculture of Uganda.

Mr Dioné statement

4. In his statement Mr Dioné said that Africa must pursue sustainable food security through an agricultural revolution because of the rural concentration of the population and poverty and the structure of the economies of the majority of African countries. Compared to other developing regions of the world, African agriculture today is considerably under-capitalized. Barely 6% percent of the arable and permanent cropland is irrigated, compared with an average of 33.3% for Asia, 25% for India and 47% for China. Fertilizer use per hectare of arable land in Africa stands at only 8% and 20% percent of the levels reached respectively in Latin America and Asia. Relative to Africa, the number of tractors per thousand hectares of arable land is nearly 3 times greater in Asia and 8 times greater in Latin America. Likewise, road density is more than 2.5 times higher in Latin America and 6 times higher in Asia than in Africa. On the human capital side, Africa is still at an earlier stage of scientific and institutional development than India at the eve of the Green Revolution four decades ago. Institutions of agricultural higher education, research and extension are, in general, poorly staffed, ill equipped and under-funded to provide the scientific and technological foundations of a structural and sustainable transformation of the national food and agriculture systems.

5. Because of this under-capitalization, average productivity of agricultural land in Africa was estimated at only 42% of that in Asia and 50% of that in Latin America during the last decade. Similarly, the productivity of labor in agriculture in Africa stood at only 57-58% of that in Asia and Latin America.

6. Getting agriculture moving for poverty reduction and sustainable food security in Africa therefore requires new efforts to trigger a Green Revolution, conceptualized as a process of Sustainable Modernization of Agriculture and Rural transformation/ African Green Revolution Initiative (SMART/AGRI). Such a revolution must capitalize not only on

conventional green revolution science and technology, but also on emerging promising ones such as biotechnology and ICT. Indeed, many African farmers are still using low yielding agricultural technologies which contribute not only to low production but also to reduced labor productivity and, often, to environmental degradation.

7. A Green Revolution is the only method that has significantly raised agricultural productivity in all continents, and it must do the same for Africa. It is a stage that Africa cannot bypass. It is a critical stepping-stone and platform for achieving a structural transformation of agriculture and realizing maximum benefits from conventional as well as emerging science and technology as applied to agriculture. It will have far-reaching impacts in addressing and helping manage the nexus of interlinked issues of population, agriculture and environment for sustainable development.

8. Although the Green Revolution that provided humanity with a tool to combat impending global hunger and poverty in the 1960s was delayed in Africa, indicators of promising progress in the region have appeared. These include the use of high yielding varieties of a few crops, modern farming systems, and plans for modernization of agriculture in a few countries.

9. At international level, interest in an African Green Revolution is picking up. Early this year, the concept of a Green Revolution in Africa was conveyed by the UN Secretary General Kofi Annan in his address to the G8 Contact Group, which focused on agricultural development and food security, HIV/AIDS and governance in Africa. Thereafter, the Secretary General has made several specific calls to African countries to promote a Green Revolution, most notably at the Maputo AU Heads of State Summit in July 2003. In line with this call, ECA is poised to undertake a major program on the African Green Revolution within its mandate and tools of work.

10. In spite of past failures, ECA's approach is to raise awareness that Africa must and can design, trigger and implement its own Green Revolution now. To do so, Africa would need consistency in long-term commitment to investment in (i) improving land policies, quality and productivity; (ii) developing and managing water resources; (iii) strengthening scientific capacity; (iv) harnessing both conventional green-revolution technologies and new/emerging ones such as biotechnology, wherever appropriate; (v) building basic production and market infrastructure; and (vi) building the required institutions.

11. As indicated above, preliminary field observations indicate that a Green Revolution is poised to happen in Africa in the near future (5-10 years). The observations show that incipient indicators of the African Green Revolution are starting to appear on the ground, and could be used to design and spread the Revolution. The main objective of this expert workshop is therefore to tease out these indicators, assess them, rationalize them, amplify them and bring them to the attention, use and benefit of African countries.

Statement by the Honorable Israel Kibirige Ssebunya

12. In his opening remarks, the Minister commended the UNECA / SDD for having organized the methodological workshop on Identification and assessment of African Green Revolution Indicators and Design. Such a workshop was timely for the continent could use the Green Revolution Indicators to assess the stages where African Countries are: a) in addressing the food security issues and b) as compared to what happened in India, Philippines, and Thailand.

13. The Honourable Minister recalled that he has been a plant breeder, a researcher, an administrator and a lecturer before entering politics. He said that political instability had constrained the development of Africa, including the development of Uganda, where at the beginning of the 1980s stores in Kampala were completely empty. Progress is being made at rebuilding the economy but there is widespread frustration. The subsistence sector is still large and growing but poverty has been reduced from 65% to 39% during the last 15 years. Uganda's exports totalled $450m/p.a and Ugandan expatriates fund $650m/p.a. Per capita income per year is about $300, below the world poverty line. From 1996, the economy has been growing at 4% per year but recently the economy has been slowing. Population growth is 3.4% p.a. and agricultural production growth is 1% p.a. In this context more has to be done for Uganda to achieve sustainable development.

14. The Minister congratulated the workshop's participants for being present at such a significant meeting. He was even more pleased to note that there were two Asian delegates and hoped that those would highlight the experiences of the Asian Green Revolution about which he himself would like to know more, especially the question: what is it that the Asians did, but the Africans did not do?

15. The State Minister for agriculture expressed regret that his 30 years of hard work in breeding crops could not improve the lives of most farmers. He called it "30 years of bananas". "You wonder what I spent all these years doing, if any change has occurred it must have been marginal," he said. He added that despite the impressive technologies and superior crop varieties available at research stations, the majority of farmers produce too little.

16. Due to poor farming methods the average farmer gets about one ton of bananas per acre yet they could harvest six if they did everything right. Similarly with other crops farmers harvest only a fraction of the potential. Most farmers plant poor varieties at the wrong time, without following the right spacing, and then fail to fertilise their gardens.

17. External development agents have tried to advise Uganda on extension methods and many approaches have been tried, including training and visit (T & V) where farmers were given training followed by extension visits to re-enforce the training; unified extension system where each geographical unit/sub county or parish was managed by one extension officer who tried to address all subjects in crops and livestock; saturation extension programmes where the aim was to reach the whole farming communities in a target village, parish or sub county, etc. The result of these efforts is still pathetic.

18. Recently, the Uganda Government has put up a new approach to modernize agriculture (PMA) – whose objective is to eradicate poverty, increase research and development, agricultural advisory services, set up NAADS where peasants are being empowered, rural road infrastructure, credit facilities, adding value to agro-processing / post-harvest, rural electrification, sustainable resources base management, etc. In addition, a number of export-oriented strategic programmes have been launched: Coffee, Cotton, Tea, Fish, Livestock, Horticulture, and Irish potatoes. Uganda is also active in developing external markets for these products.

19. In conclusion the Honourable Minister said that Africa needs a successful Green Revolution to pull itself out of poverty and hunger. He encouraged participants to ponder on what needs to be done to achieve it.

b. Adoption of the Agenda and Programme of Work

20. The meeting adopted the following Agenda and Programme of Work with slight modifications.

Monday, 8 December 2003

0900 - 1600	:	Arrivals
	:	Registration
	:	Distribution of Materials
1600 -1800	:	Official Opening

Tuesday, 9 December 2003

0900 -1030	:	Plenary: African Green Revolution Indicators
1030- 1100	:	Tea Break
1100- 1300	:	Parallel Group Peer Review
1300- 1430	:	Lunch Break
1400- 1600	:	Group Peer Review cont'd
1600- 1630	:	Tea Break
1630- 1730	:	Plenary: Validation/Synthesis/Final Rankings
	:	Strategies for African Countries' Self Assessment and Use

Wednesday, 10 December 2003

0900– 0940	:	Plenary: Design Principles of the African Green Revolution
0940- 1030	:	Discussion
1030- 1100	:	Tea Break
1100- 1200	:	Discussion: Choosing Design Blocks/Variables
1200- 1300	:	Group Work: Country Design and Design Teams
1300- 1400	:	Lunch Break
1400- 1600	:	Group cont'd
1600- 1630	:	Tea Break
1630- 1730	:	Plenary: Validation/Synthesis
		: Strategies for African Countries to Design own GR

Thursday, 11 December 2003

0900 – 1730	:	Field Trip to SMART/AGRI Projects

Friday 12, December 2003

0900 – 1000	:	Plenary: Lessons from Field Visit
1000 - 1030	:	Plenary: Lessons from Asia – The Indian Case
1030 - 1100	:	Tea Break
1100 - 1200	:	Plenary: Extension to Other African Countries
		Categorization/Typology of African Countries
		Presentation on the drivers of the Indian Green Revolution
1200 - 1300	:	Wrap up, Recommendations and Way Forward
	:	Closing
1300 - 1730	:	Lunch/Departures
		Compilation of notes for the full report

3. REACTIONS TO THE MINISTER'S SPEECH

21. The Minister's speech underscores the necessity of:

- a sound vision
- an enabling environment
- being cautious with subsidies (free things are not sustainable)
- democracy
- price stability
- helping the middle farmers
- political commitment
- developing the private sector
- decent working conditions for the extension workers (including decent salary)

22. It was also noted that Uganda was providing the right policy environment for a Green Revolution because it had:

a) A holistic approach including production, rural infrastructure and marketing
b) Political commitment for modernizing the agricultural sector
c) Promoted the private sector, suggesting that the modernization is being demand driven
d) Privatized agricultural extension services, indeed if poor farmers are subsidized and sensitized it implies that poor farmers can also afford the private extension – suggesting that extension services are demand driven, provided the farmers were properly empowered, and knew what technologies they need.

23. It was argued that although donors and some experts are against subsidies to African farmers, subsidies should not be interpreted as free things. Farmers get subsidies in exchange for adopting new technologies.

24. In the interest of securing world market share it was also recommended that, besides the strategic raw export crops, as much as possible value added products should be developed through agro-processing.

4. AFRICAN GREEN REVOLUTION INDICATORS

25. This session started with a short discussion regarding:

- The purpose and subsequent use of those indicators
- Methods on how to identify the GR indicators
- Who among the participants should identify indicators of which African Country

26. It was agreed that the purpose of the GR indicators is to assess the preparedness of a given African country to embark on strategies of Sustainable Modernization of Agriculture and Rural Transformation, thus moving towards a real African Green Revolution. However, the process of going about it was far more important than the obtainable individual indices.

27. Looking at the case of India, it was noted that India experienced its Green Revolution from 1967, when its Prime Minister Indira Gandhi appointed a new Food and Agriculture Minister and assigned him the task of solving the then historical Indian food shortage problem. The new Minister imported small amounts of high improved-yielding wheat seed from Mexico. After the seeds were multiplied through two subsequent seasons and distributed to farmers, the production was so high that all the available storage was fully utilized and schools had to close temporarily to store the grain.

28. The analysis of the Indian Case shows that the components of their Green Revolution were:

- improved technology – improved high yielding seeds of rice / wheat variety
- adequate supply of inputs – such as seeds, chemical fertilizers, tools and availability of farm credit to purchase the inputs
- irrigation – the availability of tube well and river irrigation more than doubled the production and increased the production of rain fed agriculture three times.

29. In India, after the sudden increase in production of rice and wheat it was found necessary to secure the:

- product market
- price stabilization of the farm produce and
- building of infrastructure including rural roads, and storage facilities in order to sustain the benefits of the Green Revolution.

30. The analysis also shows that in 1983/5, India used the same technology generation procedures as those of their GR and obtained three other revolutions; namely a:

- Yellow Revolution – for the multiplication of oil seeds
- White Revolution – for livestock and milk production
- Blue Revolution – for production of fisheries

31. Following a discussion of possible methods for assessing the indicators for selected African countries it was agreed the whole set of indicator could be grouped into categories known as " TIIP"

- T = Technology / innovation
- I = Infrastructure (Market , roads , energy ….)
- I = Institutions (R+D, Ext, Farmer organization ….)
- P= Policies (Governance, output / input …..)

32. Cross cutting issues include: Gender, Environment, Equity, Pastoral areas/live stock/crop interaction, HIV/AIDs.

33. The workshop discussed the template for assessing Green Revolution indicators, which was distributed to the experts before the meeting so that the basic data necessary for the assessment exercise and the compilation of the index could be collected and assembled. The experts used the following template:

1. Basic Indicators Score /10
   - Population, Area, GDP, GNP per capita, GNP growth rate, Life Expectancy, Adult Literacy (male, female)

2. Agricultural System Score /10
   - Agro-ecological zone(s); farming system(s); major crops/livestock/fisheries with large consumption/market - local or export (list up to 10)
   - Other major resources/assets available - water, fertilizer deposits, minerals, energy, etc.
   - Adequacy/inadequacy of system: value added in agriculture, food surplus/deficit, famine, food imports/exports, etc.

3. Farming Communities Score /20
   - Demographic profile; economic profile; education/culture/awareness of modern methods
   - Level of modernization: subsistence/cash ratio, use of modern inputs/methods vs traditional (seeds/genetic materials, fertilizers, mechanization, irrigation, soil/water management etc.)
   - Community Organization and Management, empowerment and demand response for modernization

4. Agricultural Science and Technology Institutions Score /20
   - Capacity of agricultural research, extension and education institutions; existence and development of improved technologies and methods, especially with respect to the major crops, animals and assets; effectiveness and utilization of these technologies in agriculture; adaptive/on-farm research
   - Links with farmers, private sector, NGOs and CBOs, and with regional and international communities

5. Infrastructure for Agriculture and Rural Development Score /20
   - Feeder/rural road coverage; market infrastructure and information; storage, agro-processing opportunities/linkages; credit and finance; international market access/integration
   - Water, energy, communication, education and health services

6. Policies for Sustainable Modernization of Agriculture and Rural Transformation (SMART) Score /20
   - Existence/implementation of agricultural modernization vision, stance, policies, strategies, and plans
   - Major agricultural and rural development programs/projects/modernized farming systems
   - Integration with industry, markets and inputs
   - Investments/budgets for agriculture (local, foreign); investments in research, extension, education for agriculture and natural resource management
   - Empowerment of farmer communities - e.g. via land tenure, democratization, liberalization, decentralization, participation, communication, voice/articulation of needs and constraints, prospects, plans and accountability etc.

TOTAL /100

34. The experts discussed this template and agreed that the gender dimension was missing and should be added. They also discussed the relevance, importance and the best way to assess each sub-indicator.

35. After discussions the participants broke up in sub-regional parallel groups covering three subregions: East Africa, West and Central Africa and Southern Africa. They adopted a methodology and arrived at indicators and indexes for nineteen African countries. The experts stressed, however, that the indicators are not comparable across subregions since various interpretations and weights were given to the indicators in each group.

36. Participants requested ECA to refine the methodology, define the benchmarks and harmonize and normalize the scoring in order to make the indexes comparable across countries. ECA underlined the fact that, at this stage, the process is more important than the final result and that it will pursue the work that has been undertaken.

37. Supporting country profiles are given in annex 2.

38. The scores for each subregion and the 19 countries are the following:

East Africa

Indicators	Uganda	Kenya	Tanzania	Ethiopia
1. Basic Indicators	4.75	5.33	4.91	3.41
2. Agricultural System	2.9	3.62	2.5	3.75
3. Farming Communities	9.0	8.6	7.99	5.67
4Agr. S&T Institutions	3.75	7.0	5.75	6.25
5. Infrastructure	10	9.8	10.8	4.8
6. Policies for SMART	14	16	10	8.0
Total	44.4	50.4	42.0	31.9

West and Central Africa

Indicators Country	1 (10)	2 (10)	3 (20)	4 (20)	5 (20)	6 (20)	Total
Burkina Faso	5.0	7.0	2	8.5	1.5	O	24
Mali	4.5	7.5	4	10	1.5	1.0	28.5
Niger	3.0	7.0	2	7.0	1.5	0.5	21.0
Senegal	6.0	6.0	5	11.5	4.0	1.0	33.5
Benin	6.5	7.0	4	17.1	3.5	1.0	39.1
Cameroon	6.5	9.0	1	10.7	1.5	0	28.7
Chad	3.0	6.0	1	-	1.5	0	14.4
Cote D'ivoire	6.5	8.0	3	9.0	2.0	0.5	29.0
Ghana	6.0	7.0	1	7.5	-	0.5	27.5
Nigeria	6.0	7.0	1	12.0	6.0	0	31.0
Togo	4.5	7.0	1	-	6.0	0.5	23.8

Southern Africa

COUNTRY/ INDICATOR	1	2	3	4	5	6	TOTAL
ZIMBABWE	6	7	15	17	15	14	74
ZAMBIA	7	8	14	10	11	17	67
SWAZILAND	8	6	13	12	12	11	62
LESOTHO	7	5	10	10	11	12	55

5. PRINCIPLES AND STRATEGY FOR DESIGNING A GREEN REVOLUTION IN AFRICA

39. The concept of the "Green Revolution" that ECA is promoting is an extension of the scientific achievements of the 1950s to the 1980s in the dramatic increase of crop yields, mainly cereals such as wheat, rice and corn, based on modern varieties and other traditional inputs, in several parts of the world. ECA's definition of an AGR takes into account the use of (1) modern biotechnology – such as genetic marking, gene transfer and tissue culture technologies; (2) African complex farming systems, including the integration of crops and livestock production; (3) the increasing role of the private sector for the provision of the necessary inputs and for agro-processing; (4) the development of markets for agricultural outputs; (5) the progressive globalisation of agriculture, including agricultural technologies, agricultural information, financial capital, foreign investments, knowledge, expertise of expatriates, food aids, food import, etc., and (6) sustainability concerns.

40. Mr Dezi Ngambeki made a presentation on the principles and the strategy for designing a Green Revolution in Africa. This presentation can be summarized as follow:

A) Principles

1. Geo-political and Geo-economical favorable environment

- Political Leadership
- Continued commitment by all sectors
- Vision, direction, attainable goal
- Mobilization of resources
- Substantial domestic market
- Opportunities for export markets

2. Critical Mass of Science and Technology Institutions and Human Resource Capacities of Research for Development.

- Capacity of Public and Private Agricultural Institutions,
    - Public agricultural research systems for technology generation
    - Stations, and regional coordination sites
    - Universities with agricultural Research
    - Private agricultural Research Institutions
- Priority focused programmes
- Human Resource capacity of Research for Development
- National Capacity to mobilize adequate material and Financial Resources minimum 2 % of GDP.

3 Formation of Focused / consistent long term standard policies

- Long-term vision – 20 – 50yrs strategic master plan
  - Short-term, medium term policies
  - Development objectives / work plans
- Science and Technology Development policies, which are linked to National Education policy.
  - National Education policy – Education builds up capacities of users of science and technology potential
  - Entrepreneur skills to political investors / developers
  - Stimulates communities to make demands and consume processed products
  - Science and Technology policy – provides strategies for generating more advanced technologies – such strategies or more focused policies are [adaptation of improved technologies, Biotechnology and Bio-safety policies] or deploying national experts to acquire skills from advanced laboratories in developed countries
- Development policy guidelines/ work plans / objectives / activity
- Investment / Development budgeting policies / instruments

4. Planning the sustainable use and conservation of Natural Resources

To cause a Green Revolution in Africa and to maintain Green Revolution benefits – The Natural resources [land, soil fertility, water, forests, wildlife and wetlands] must be used in a sustainable manner to satisfy the benefits / needs and aspirations of the present and future generations.

- Land use planning according to type of use [settlement, grazing, intensive cultivation, forests, wildlife] should be mapped against the relative soil fertility transect and the population density.
- Land tenure system and land reforms / socio-economic reforms.
- Land and socio-economic reforms should incorporate their cultural, social political and economic perspectives.
- Replenish soil fertility for sustainable use and benefits of the present and future generations
- Water planned for agriculture, human, and wildlife

5. Long term National Investment Plans

- In harnessing the Natural resources – land, water, forest for the development of National irrigation system
- Provision of social and economic services
- Development of farm enterprise
- Development of feeder road network

6. Use of appropriate methodologies and procedures

- Use of appropriate methodologies and procedures. Identification of priority commodities, their major constraints, technological gap and possible technical interventions
- Technology generation, validation and transfer must be demand driven. That is as technical solutions addressed to stakeholders / target beneficiaries needs.

- Technology generation can use basic ideas or as adaptation of imported technologies refabricated to address local beneficiary's needs and priority settings – using participatory technology development and transfer process.
- But the commodities produced by the local beneficiaries of that technology must be market oriented.
- The applications of Science and technology of simple and / or advanced levels of Green biotechnology carries the achievements of agricultural Research and development through a lot of mileage.
- Conduct participation and networking in On-farm Research programme bringing about better Researchers-Extension – Farmer linkages.

7. Tuning up the Rural Communities

- Tuning up the rural communities to participate in technology generation and to receive / adopt improved technologies.
- Analysis of developmental themes of common interest between communities, Researchers, extensionists, policy makers and donors.
- The themes may be in agriculture, education, health and / or under natural resource management.
- Criteria and selection of target regions / geographical areas
- Mobilization, sensitization and empowerment of farmer communities
- Formation of farmer groups

8. Designing of farming systems and farm enterprises

Designing of Agricultural systems and Farm enterprises. The African agricultural / farming systems are most times subsistence and very complex and with a very low productivity. These systems must be redesigned to make them productive and compatible with modern farming methods.

- Demarcate the whole country into agro-ecological zones based on prevailing rainfall patterns, vegetation, and cropping systems.
- Re-design both the farming enterprises, cropping pattern, farm operations and the entire farming systems. Re-design also the farming activities.
    - Use both community participatory methods, field technical assessment coefficients, then design technically, economically and socially viable activities.
    - Incorporate agro-ecological parameters (temperature, rainfall, Eva transpiration and water harvesting).

9. Designing Green Revolution core components

- Biological and improved crop / livestock component
    - Identification of elite germplasm (collection, analysis of characteristics, gene bank)
    - Selection of priority commodities
    - Formulation of protocol of conventional breeding methods
    - Identification of biotechnology facilities for crop propagation, genome mapping, gene transfer and transgenic applications + their expected outcome.
- Designing the rate / method of application of inorganic and organic fertilizers.

- Designing mechanical farm tools
- Designing the simple and complete water control irrigation and water harvesting systems.

10. Designing an On-farm Research Programme
    - Net working of On-farm testing sites and outside the country.

B) Strategy

41. In order to cause a Green Revolution to happen in any African Country, there should be a sequence of strategic initiatives.

First, there should be an interface between key actors among the stakeholders – that is between researchers, political leadership and entrepreneur spirit of industrial and commercial sectors.

1. The researchers can be organized into multi disciplinary "Research teams" based of stages of technological development / transfer – put in place.
2. The "design team may be led by GR design or/ initiator. All research teams should keep net working.
3. From the political leadership – GR may be championed by somebody between PS, minister or Head of Government business from the Executive Arm of Government put in place
4. The development related entrepreneur spirit from the industrial and commercial sector is expected to make quick investments where economically viable opportunities arise.

Second, the GR design team begins with pilot areas to tune up and framer communities and solicit their participation for involvement in;

- Problem analysis / technological needs
- Technology generation, evaluation and promotion.

The design team also takes the lead responsibilities for identification of entry points for technological interventions.

Third, generation of the Green Revolution core technological ingredients by biological / biotechnological research teams using simple to advanced applications:

- Biological Component, Chemical Component, Biological Component

Fourth - designing of the principle GR components by design team
Fifth - designing a complete on-farm Research Programme to test the technologies
Sixth, Implementation work plan for African Green Revolution
Mobilize and Organize a Stakeholders within / out side country

(a) Set partnership modalities.
(b) Priorities for science and technology policies/programs.
(c) Identify/agree on germplasm, biotechnology exchanges.

(d) Identify strategic research and testing centers.
(e) Divide/agree on roles and reciprocity of product and services.
(f) Develop a plan of action for networking.
(g) Lobby for national governments and donor communities for human, material and financial support.

Seventh, Launching of Green Revolution plans

42. The participants commended the GR design principles and sought points of clarification to how the principles may be applied in practice.

43. It was noted that the GR design principles that had been presented to them were useful and practical. Already a lot of the ingredients for those principles are there in various African countries. Moreover in recent years besides having success stories, there has been mini Revolutions in some parts of Africa. For example:

(a) The maize revolution in West and Central Africa
(b) The New WARDA Rice revolution in Guinea and moving along similar agro-ecological zones in some parts of Ghana and Ivory Coast and Nigeria
(c) The cassava revolution in West Africa

44. Application of the Green Revolution design principles can help the present research teams in different African countries to improve their work and get better results by:

(a) using similar/common methodologies
(b) exchanging information between countries and disseminating the information within their countries to eliminate duplication, isolation and ambiguities
(c) using the principle of tuning up and empowering the communities can make the research teams move fast. For example it was noted that in Tanzania and Kenya when national teams noticed that on-farm research gave farmers many varieties to choose from. But when the farmers had chosen, they were already empowered for they then demanded to have the seeds of those varieties which they had chosen.

45. It was agreed that produce marketing is very important for the success of a GR design. So marketing besides being cross-cutting, should also be promoted to become a principle for GR design.

46. The participants recommended that the GR design principles and process should be implemented immediately in order to solve the African problems of:

(a) Food shortage/famine
(b) Poverty

47. However, one wonders why in the past successful programmes have not progressed to culminate into a Green Revolution in Africa.

48. It was suggested that the country GR design teams must follow similar methodologies and apply similar principles. At the stage of situation analysis the focus should be put on the production system analysis (Biophysical factors, socio-economic factors/institutions).

6. COUNTRY / REGIONAL GREEN REVOLUTION DESIGNS

49. After completing the Design Principles the plenary broke out into the same subgroups to conduct a SWOT analysis of the current agricultural situation in selected African countries (Strength, Weaknesses, Opportunities and Threats). The results of this exercise are as follow:

A) SWOT analysis of maize commodity and action plan in West Africa

A1- SWOT

Strength

a) Farmers are used to maize production culture
b) Availability of available lands
c) Agro-ecological conditions suitable
d) Market (local and foreign)
e) Main staple food crops

Weakness

a) Research and Development
b) Poor infrastructure
c) Poor seed delivery system
d) Poor credit facilities and fertilizer availability
e) Lack of value addition

Opportunities

1) CG and NARS Network
2) Growing maize demand for the livestock sector
3) Favourable government policies

Threats

a) Narrow biodiversity: leading to genetic erosion
b) New pest and diseases
c) Smuggling of grains, across boarders will kill local industries

A2- ACTION PLAN

Technology

a) Use of already demonstrable technologies
b) Development of drought and low tolerant N using cutting-edging science e.g. Biotechnology
c) Development of high nutrient maize varieties to address nutrition and health issues
d) Improving R and D infrastructure and strengthening HR for R and D

Infrastructure

a) Development of irrigation by exploiting all water resources
b) Market infrastructure
c) Storage/processing
d) Rural roads

Institution
a) Decentralized institution for transparency technology
b) Input supply institution including credits
c) Developing partnership between public, NGO and private sectors

Policy
a) Price support i.e. state of intervention
b) Subsidiary
c) Adequate public support
d) Promote private sector partnership
e) Good governance

B) SWOT analysis of maize/wheat in East Africa

	S (Successes of GR lessons)	W (failure lessons)	Opportunities	Threats
Technology	- Availability of improved varieties - Availability of fertiliser - High adoption levels - Presence of Seed Co.	- Weak extension services - Weak input supply system - Lack of IK - Lack of regulation on seed Co.	- Available technologies - Private sector involvement - High levels of adoption - Biotech opportunities	- Other crops neglected - Loss of biodiversity - GMO - consumption - Trips Agreement PBR - Drought/monoculture
Institution	- NARS - IARC - Funding - Human Resource Capacity - Support by Farmer Communities.	- Low funding levels - Low Human Resource capacity - Low initiative/morale - Poor institutional coordination	- NARS - IARC	
Infrastructure	- Processing capacity - Roads/Railway - Market/Demand - Large base of commercial facts	- No Regional corporation (Trade) - No market support - Storage - Low Levels of mechanism	- Market infrastructure - Increased funding for roads - Regional integration	- Regional integration - Loss of market share
Policy	- Inputs subsidies - Price stabilization - S-Grain Reserve - Credit system - conducive laid policies - Government/Donor support	-Price stabilization - Inadequate subsidy - International policies/IMF - Low Donor/government support - Volatility of government	- Increased political commitment - Policy environment - Effective demand - Decentralization	- Liberalization - Globalization

C) SWOT analysis and action plans for Southern Africa

1. STRENGTHS

Technology: Technology for major commodities innovative methods of technology dissemination - i.e community based seed production and farmer field schools.
Infrastructure: Basic infrastructure already in place.
Institutions: Several CGs, NGOs in collaboration with national systems.
Policies: Favourable policy environment.

2. WEAKNESS

Technology: Some of the technology not suited to resource poor farmers - who are in the majority. (Some of the technologies have not reached farmers because of weak linkages between stakeholders) (institutions).
Infrastructure: Poor maintenance of infrastructure network.
Institution: Weak linkages among stakeholders.
Policies: Poor implementation - policies affected by external conditionalities.

3. OPPORTUNITIES

Technology: Potential for technology to spill over in the region. (SADC has great potential to harmonize inter-regional exchange of technology.
Infrastructure: Poor for expansion and inter-regional infrastructure expansion undergrowth corridors/triangles.
Institutions: SADC harmonizing inter-regional exchange of technology.
Policies: Domestication of policies designed by regional bodies.

4. THREATS

Technology: Narrowing of genetic resource base. Genetic resistance to pests and diseases, unpreparedness to take up new technological innovations.
Infrastructure: Adverse weather conditions, floods, civil investment.
Institutions: Lack of institutional capacities to address new challenges. Inadequate restructuring of regional institutions, i.e SACAR.
Policies: Lack of funding, impact of globalisation.

ACTION PLANS:

1. Technology:
- for major crops - improve technology transfer to farmers. Integrate genetic products of crops improvement with methods of natural resources management. Take a multidisciplinary approach from planning
- Participatory approaches to technology dissemination where farmers are given alternatives to increase income and profitability.
- Promote private-public linkages to promote technology dissemination and improve markets.

7. FIELD WORK: FARMERS PARTICIPATING IN BANANA ON-FARM TRIALS PROJECT

50. The Workshop participants made a working field visit to Bamunanika subcounty in Luwero District, one of NARO's Benchmark sites, where farmers are participating in testing and promoting agricultural technologies in order to modernise their agriculture to ensure food security and increased household income. In 1996, the Bamunanika Benchmark site was selected to represent Central and Eastern regions of Uganda, where banana production had severely declined due to losses in soil fertility and other factors. A number of farmers there have since been involved in evaluating and promoting banana technologies targeting the banana production constraints of:

- poor/exhausted soil fertility
- built up pests:- nematodes and banana weevils, and diseases:- black sigatoka and fusarium wilt
- prolonged dry spells
- local banana cultivars with low genetic potential and susceptible to pests and diseases and
- poor crop management.

51. The workshop participants devoted their day for field work. Their objectives were to:-

(a) check on how the principles of designing an African Green Revolution can practically be applied at grassroots among the farming communities.

(b) examine practical methods of transferring improved agricultural technologies from research to farming communities.

(c) assess the impact of farmers' adoption of improved agricultural technologies on modernising agriculture and rural transformation in case of Bamunanika subcounty.

52. The field work was divided into two parts:

- Part I involved moving from village to village assessing farmers' banana fields and
- Part II included besides other items, conducting a meeting of "farmers participatory evaluation of banana technologies" being adopted by the farming communities in the area.

53. The program for the field work was the following:

Part I. Visit Farmers Banana Plots

09:00 - 10:00 a.m.	Mpologoma Parish (Kiyunga, Kangulumira)
10:00 - 11:00 a.m.	Kyampisi Parish (Kakira, Maggogo)
11:00 – 12:00 a.m.	Kibanyi Parish (Kibanyi, Bugabo)

Part II. Bamunanika Community Centre

01:00 p.m.	Arrival of farmers and visitors
01:30 p.m.	LCIII Chairman Banmunanika subcounty welcomes visitors
01:40 p.m	Welcome song-Kasolo farmers group

01:45 p.m. Introducing visitors
01:50 p.m. Site coordinator welcome remarks
01:55 p.m. Sentebbe wa abalimi
02:00 p.m. Presentation of Bamunanika farmers report
02:30 p.m. General discussion
03:20 p.m. Songs
04:00 p.m. Closing

Topics for general discussion

- Methods of banana technology transfer from farmer to farmer
- Good attributes of banana technology adopted by farmers
- Farmers benefits obtained from growing improved bananas
- Extension of adoption of bananas
    - How many farmers adopted?
    - How many banana plants extended by trial

54. At each village farmers groups led by their chairman welcomed the visitors. Other farmers who have received suckers and adopted improved banana technologies were also present. At the meeting of farmers at Bamunanika Community Center, the farmers made the following report:

PROJECT BACKGROUND

The project, which is promoted and co-ordinated by NARO Kawanda, started in 1996 with fourteen participating farmers. In October 2000 and May 2001 the number of participating farmers was increased to a total of one hundred and ninety five. These farmers are divided into four On-farm Trial Groups. Currently, the number of farmers who opted for new methods and skills in banana management exceeds one thousand.

OBJECTIVES:

- To produce banana using their own hands and the surroundings.
- To improve on food security in the household.
- To alleviate poverty in the household.
- To improve the production of banana in Bamunanika sub-county and in the surrounding areas.
- To evaluate and disseminate exotic cultivars.

METHODOLOGY

- Most of the activities are performed by farmers using their own hands.
- The farmers utilise the surroundings for their own farm inputs i.e. cow-dung, grass, compost, household reside, coffee husks, etc.
- The farmers manufacture pesticides organically from: urine, pepper, tobacco, ash and other herbs.
- The farmers dig gullys and mulch their farms in order to preserve water in the soil and prevent soil erosion.
- The farmers have formed groups at village levels, parish level and at the sub-county level.

Through these organisations, more farmers have been trained and persuaded to grow bananas. This has been achieved by organising seminars, exhibitions, music and drama and field tours.

FINDINGS AND ACHIEVEMENTS:

- Exotic cultivars are not easily infected with disease and pests.
- Mulching is the best method of water management.
- Bananas can grow in any drained soil as long as you can improve on its fertility and water retainance.
- Bananas are one of the major income earners in the area which wasn't the case before the project.
- Food shortage has significantly decreased in the area.

BENEFITS:

- There is an improvement in the household income and economic development in the area at large.
- The standard of living has improved.
- Family relations have improved.
- The farmers have become popular in their sub-county, nationwide and internationally.

PROBLEMS AND HINDERANCES ENCOUNTERED:

- Some people thought that the exotic cultivars would have a negative effect on the indigenous cultivars.
- Black sigatoka in rampant in the area.
- Droughts: from December to February and June to July.
- Strong winds also destroy their plants.

SOLUTIONS:

- The farmers have taught farmers about exotic cultivars and currently the cultivars are on high demand.
- The farmers have been able to reduce the effects of black sigatoka by enhancing soil nutrition and practising better water management practices.
- The effects of drought have been reduced by mulching and digging gullys to trap water.
- The farmers have planted trees and persuaded other farmers to do so in order to lessen damage to their plants by strong winds.

ACKNOWLEDGEMENTS:

- The farmers thank the farmers who pioneered this project for their dedication and determination.
- The farmers thank NARO and other research institutions involved for promoting and co-ordinating the research activities in this project.
- The farmers thank the Financers for financing this project.
- Thanks go to the Government that has created a political environment, which has enabled this project to be a success.

ENDING REMARKS:
The farmers have grown bananas at a cost they can afford to maintain in the spirit of self-reliance. Hence their methods and technologies are socially acceptable. The farmers are now realising the beginning of a "Green Revolution" and they pray for the support of the local authorities and NARO in promoting and hastening this revolution.

8. LESSONS FROM THE FIELD WORK

55. The participants were impressed with the levels of farmers' active involvement in generation and transfer of banana technologies. Farmers' participation in research had greatly enhanced their capacities. Farmers showed a mastery of what they were doing. They articulated technological components very well during discussions. It was gratifying to see that farmers in Bamunanika had adopted improved banana technologies and revived banana growing within less than five years in an area where banana production had severely declined in the 1970s/80s. All participants commended Prof. Ngambeki, his team and the farmers for the good job done about the design/implementation of what looks like a typical success story of an African Green Revolution.

56. The participants agreed that the Bamunanika case is a good example of an African Green Revolution success story which should be replicated to other African countries. They wondered how the Bamunanika model could spill over to other African countries? If Ngambeki could be sent to other African countries and get his design skills replicated 1000 times to build capacity of other design teams in other African countries, then there would be a Green Revolution in Africa.

57. The participants noted that the entry point for Bamunanika success story was banana technologies among communities where banana is a major enterprise, thus suggesting the need for:

- prioritising the major farm enterprises that are most important to the specific local communities, then bringing in the other GR implementation components
- farmers' involvement at all stages of technology generation/research and transfer
- strong Research – Extension – NGOs and Farmers vertical linkages
- getting Government involvement
- ensuring sustainability through enhancing capacities of the basic institutions like forming farmer groups. However the participants could not see clearly whether or not the Bamunanika was a banana based cropping system. They wondered what could have happened to the crop combinations before and after. They asked about other related crops that are there in order for farmers to balance their diets.
- diversifying a system dominated by a single farm enterprise (namely bananas) which is amenable to the dangers of monocropping.

58. The Bamunanika case shows that the adoption of improved agricultural technologies has had a substantial impact on farmers' livelihoods and the villages/rural communities. Some of the signs showing progressive developments were:

- participating farmers have improved homesteads with houses covered with iron sheets and cemented floors and walls made out of bricks which are signs of improved farm income.
- a high presence of youths in the villages around Bamunanika as compared to other villages in other African countries. This suggests that there are a lot of development activities which are attracting the youth to stay in those rural areas.
- a good number of traders and/or hawkers were seen going round the villages and townships – which is another sign of attractive economic activities that must be going on among the communities.
- there are many schools in the area. That is another sign of development suggesting that the communities are getting some levels of income to enable them send their children to schools.

59. The fact that the Bamunanika experience used soil and water management technologies such:

- mulch
- manure
- mulch and manure
- elite banana varieties and
- exotic banana varieties to control both banana leaf diseases and exhausted soil fertility suggests that one can make significant steps towards modernising agriculture by using simple agro-cultural technologies which can easily balance the economic costs of technology generation and opportunity costs of labour.

60. The Bamunanika case is impressive in showing how farmer to farmer extension model is being used to transfer banana technologies from research to the farming communities. In this model first a set of farmers participating in research trial or promotion on-farm trials are trained and given the technologies. The trained farmers in turn train new (non-participating) farmers imparting them knowledge, skills, planting materials and other banana technologies. Then the cycle goes on.

61. This is a commendable extension model for disseminating agricultural technologies. It should be replicated in other African countries. However one wonders how the model really works and who pays for the costs involved? Also one wonders about the possible dangers associated with handing over banana planting materials from farmer to farmer whether farmers are not spreading diseased plants? What research can do to minimize or eliminate the dangers of farmers spreading diseased plants? Whether there are disease resistant banana varieties?

62. The Bamunanika case seems to be weak with respect to inbuilt sustainability issues. For instance:-

- strong public extension involvement seems to be missing
- also one wonders whether sustainability of the implementation activities is being ensured or whether the Bamunanika activities are not revolving around one personality.
- streamlining gender issues.

63. There are also questions about the possible adverse effects of HIV/AIDs. How the health of the people and whether or not health education issues were being addressed.

64. The Bamunanika implementation programmes seemed to be strong on the production and still weak on the following components.

- post-harvest technologies including processing and storage to help the farmers add value to their banana fresh produce and be economically sustainable.
- marketing information system so that they are not restricted to producing for home consumption.
- attracting local investments in agro-processing by private entrepreneurs.

65. Since banana is a major crop in Uganda, one wonders why research in bananas started only in the 1990s? Was it because research is donor driven or are there any other historical reasons?

66. The participants agreed that certain practical steps were necessary to make the African farmers move and to make the African Green Revolution a reality:

- they recommended to demonstrate the available proven technologies from success stories in pilot African countries.
- they recommended that National Governments realise the need for investments in irrigation using rivers and shallow wells.

RESPONSE FROM Mr NGAMBEKI TO PARTICIPANTS' COMMENTS / AND QUESTIONS

67. Comments were greatly encouraging. Indeed what was observed and pointed out is largely true, although due to limited time in the field some aspects of the Bamunanika implementation activities may have been missed. The Ugandan banana technology on-station and on-farm research teams work hand in hand. They use participatory technology development and transfer process. That is identifying target beneficiaries/farmers needs/priorities, then research for available solutions, then design and conduct research with farmers participation and other development partners including public and private technical service providers like public extension, National Advisory Agricultural Delivery Services (NAADS) and NGOs.

68. So at Bamunanika benchmark site, the programme was designed and is being implemented to modernise the agriculture and ensure food security and increase farm income of the communities. Then acceptable technologies are being scaled out to new communities living under similar conditions. There is collaboration with farmers and also with public extension officers and two NGOs.

69. In Bamunanika subcounty, there are three Agricultural Extension Officers and one NGO (VEDCO) who are collaborating on the provision of agricultural technical services. Then Ministry of Health officials and one NGO (Plan International) are collaborating in the area of providing health education and other related health services (including sensitisation on the HIV/AIDs scourge).

70. Among the participating farmers some have been trained as trainers in agricultural technical skills. Others have been trained as trainers in imparting health technical skills.

71. The entry point at Bamunanika four years ago was through improved banana production technologies, but in the last two years, post-harvest, agroprocessing, marketing and storage of bananas have been added. We now talk of banana production, commercialisation and utilization technologies. Also other complementary farm enterprises have been incorporated. For example coffee, which is also a perennial crop, is being promoted for intercropping with bananas. Then beans, maize and cassava are being intercropped with bananas during the establishment of a banana plot. Livestock especially cows and poultry are being incorporated to provide protein nutrition and animal manure as they feed on banana residues.

72. Both the research and promotion farmer groups have been trained to keep basic farm records of inputs, banana harvests and sales, and the suckers distributed to new farmers. Among the skills and technologies farmers have been taught, are corm paring and hot water treatment to clean suckers of nematodes and banana weevils before planting or giving the suckers to new farmers. As for the diseases - black sigatoka on local banana cultivars - it has been shown that it can be managed through enhanced plant nutrition. Fusarium wilt on bogoya and ndizi bananas can be managed through resistant cultivars. The exotic banana cultivars kabana 1, 2, 3, 4, and 5 have shown that they are resistant to diseases sigatoka and Fusarium wilt but only tolerant to pests (nematodes and weevils). However, recently, a highly dangerous banana disease – "Bacteria wilt"- erupted, which has affected all banana types and cultivars.

9. LESSONS FROM INDIA

73. After visiting the field, Mr. Aldas Janaiah, Visiting Fellow at the Indira Gandhi Institute of Development Research based in Mumbai, India, made a presentation on the lessons from the Green Revolution in India that may be relevant to Africa. A paper from Mr Janaiah on the lessons from India is given in annex 3. The highlights of his presentation are the following:

- Technology does not seem to be a serious constraint in Africa.
- Technology has to be brought closer to and acceptable to the farmers.
- A nation/region-wide large scale "Compact Block Frontline Demonstrations" of available and/or suitable technologies should be organized to demonstrate the economic superiority of improved technologies to the farmers. The multilateral agencies such as ECA, UNDP, WB, ADB, etc. should generously support national research & extension systems to initiate this kind of TOT programs on a large scale.
- National governments must create irrigation infrastructure by exploring all available sources/methods like construction of small/medium irrigation projects, digging community-based shallow tube-wells, water harvesting methods, watershed approach, etc.
- National governments must focus on strengthening BASIC infrastructure
    - Rural roads, Rural electrification, R&D, Markets, Institutional credit sources, Extension/TOT mechanism
- National governments must extend subsidies on key modern inputs such as fertilizer, seeds, credit, modern farm implements, etc. to make them affordable to the farmers at the initial stage of GR.
- Over and above, Asian experience clearly demonstrated the need for the political commitments for achieving national food security. Policymakers must be educated on

the basic concept of national food security, which involve three components; availability through domestic production, accessibility, and stability. ECA should take the lead in bringing awareness among the key policymakers on the need for the political commitment and a favorable policy environment to achieve national/regional food security through GR.

10. FINAL COMMUNIQUE AND RECOMMENDATIONS

74. The Workshop discussed and adopted the following Communique and Recommendations:

"From 8th to12th December 2003, an international workshop was held in Fairway Hotel, Kampala, Uganda, on the theme "Identification and Assessment of African Green Revolution Indicators and Design." Some 19 participants representing ten countries of Africa (Cameroon, Ethiopia, Ghana, Kenya, Lesotho, Nigeria, Swaziland, Tanzania, Uganda, Zambia and Zimbabwe), India and Japan, as well as regional and international organizations (The Common Market for Eastern and Southern Africa, and the United Nations Economic Commission for Africa (UNECA)) attended the workshop.

75. The following resolutions were drawn from the deliberations:

1. ECA should communicate with African governments to make a commitment to the creation of a congenial environment for fostering a Green Revolution;
2. African Governments should strongly make a commitment in the implementation of science and technology as established by the Lagos Plan of Action;
3. Governments should use internally generated revenue to subsidize agricultural inputs and make credits available;
4. African countries should be encouraged to develop rural infrastructure such as roads;
5. African countries should encourage strengthening and formation of NGOs and CBOs, and linkages between research, the private sector and extension;
6. On indicators, ECA should harmonize methods, revise the template on profiling countries, develop detailed guidelines and ensure further validation and testing of the information collected;
7. ECA should conduct a follow-up workshop to design and implement the programme, in which the plan of action will be designed in detail, ensure a monitoring and evaluation plan, identify the status of preparedness of Africa to a Green Revolution, and design a Green Revolution;
8. Organize subregional workshops for profiling of indicators, and design of Green Revolution for the subregion;
9. Ensure follow-up and implementation of recommendations of the Ad Hoc Expert Group Meeting on Science and Technology for Sustainable Development: Towards a Green Revolution in Africa, held in Addis Ababa, Ethiopia 10-12 June 2003;
10. Identify pilot case studies that are Green Revolution oriented, for enhancement, publicizing for replication and scaling out;
11. Ensure the involvement of key policy-makers – Ministers of Agriculture at African Union and other sub-regional summits (SADC, COMESA, CORAF, ECOWAS) – July 2004;
12. Ensure involvement of mainstream gender in assessment and design of a Green Revolution, and monitoring and evaluation of progress of gender mainstreaming in the Green Revolution process.

13. ECA should identify success cases and draw lessons, then replicate elsewhere by developing and harmonizing workable indicators;
14. Network and establish linkage with relevant institutions including Francophone countries;
15. Identify actors to carry the agenda forward and for fund mobilization;
16. Frontline demonstrations of available and suitable technologies should be organized to demonstrate the economic superiority of improved technologies to farmers;
17. National governments must create irrigation infrastructure by exploring all available sources – methods of construction of small and medium-scale irrigation projects, digging community-based shallow wells, developing water harvesting methods and promoting watershed management approaches;
18. Encourage government political commitment for achieving national food security, which involves domestic production, accessibility and stability.

Participants of the workshop resolved to form African Green Revolution design teams and networks for driving forward the African Green Revolution Initiative (AGRI).

The UNECA, as organizers of this workshop, wish to warmly thank the Government of the Republic of Uganda for the support given for the organization and hosting of this international workshop on "Identification and Assessment of African Green Revolution Indicators and Design".

Done in Kampala, this 12th day of December 2003."

11. CLOSING OF THE MEETING

76. Mr Tindimubona, the Coordinator of the Workshop, closed the meeting by thanking all participants and expressing his satisfaction at the results. He said that the Workshop had been an important step on the road map to a Green Revolution in Africa. He said that ECA was working closely with a number of partners, including the UN Science and Technology Cluster for the support of NEPAD.

77. Mr Tindimubona encouraged participants to form Green Revolution Design Teams (GRDT) in their respective countries and subregions. He also informed the Workshop that there would be a follow-up of this project soon, including possibly a symposium coinciding with a summit of AU Heads of State and Government on the African Green Revolution to be held in Addis Ababa in July 2004.

78. Participants also expressed their gratitude to the organizers of the Workshop and particularly to the resource person, Mr Ngambeki.

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Annex II
Profile of African Countries with Respect to Green Revolution Potential and Readiness

Zimbabwe (*Reviewer Gladys Mutangadura, November 2003)*

1. Basic Indicators Score /10

Population (2001),	12.9 million
Land Area,	38,685,000 hectares
Real GDP in Million US$ (Constant 1995 Prices) (2001)	7,447
GDP per capita US$ (Constant 1995 Prices) (2001),	570
Real GDP annual growth rate (2001),	-7%
Life Expectancy (2001)	39years
Adult Literacy (2001)	male 7.2, female 15.4

Source: World Bank, 2003, *World Development Indicators Database.*

2. Agricultural System (6) Score /10

- Agroecological zone(s); 5

The Natural Regions of Zimbabwe

Natural Region	Average Annual Rainfall (mm/ yr)	Area km^2	% of Total National Area	Recommended Farming
I	> 1,000	7,050	1.8	Specialized commercial farming: forestry, fruit, tea, coffee, macadamia nuts and intensive animal husbandry
II	750 - 1,000	58,750	15.0	Intensive Farming: flue-cured tobacco, cotton, soybeans, coffee, groundnuts, horticultural crops, winter wheat, beef, dairy, poultry, pigs, and ostrich.
III	650 - 800	72,900	18.6	Semi-intensive farming: Livestock breeding, and marginal production of maize, tobacco and cotton
IV	450 - 650	147,700	37.8	Semi-extensive farming: Livestock breeding and production of drought resistant crops (e.g. millets)
V	< 450	104,500	26.7	Extensive farming: Extensive cattle farming or game ranching.
Total	650	390,900	100	

Source: Central Statistics Office, Statistical Yearbook (1989).

Farming systems

There are four farmer categories in Zimbabwe: large-scale commercial, small-scale commercial, resettlement, and communal farming systems.

Category	Communal area farms	Resettlement area farms	Large scale commercial farms	Small scale commercial farms	Government
Average Area per farm (Ha/household)	18	38	2,500	125	7,644
Number of farms	1,000,000	56,794	4,500	8,500	55

Total area million ha's	16.4	7.3	10.3	1.3	0.4
Share of total agricultural land	50.8	10.2	33.4	4.3	1.3
Irrigated area (000 ha's)	7.2		126.0	3.6	13.5

Source: Chiremba and Masters, 2003.

Large-scale commercial farms produce on commercial basis maize, soybeans, cotton, groundnuts, barley, wheat, tobacco, coffee, tea, sugar-cane, dairy, beef, pigs, and poultry. In recent years, commercial farmers have diversified into horticultural production in particular flowers and wildlife farming, such as, ostrich, and crocodiles. The large-scale commercial farmers are substantially more capital intensive and technologically advanced than the majority of farms in other subsectors. Compared to smallholder farmers, production in the large-scale commercial sector is more diversified in the aggregate, although individual farms may be more specialized. Many smallholder producers produce on a subsistence scale only selling surplus production. Over 60% of farmers in communal areas are women and much of the agricultural work is done by women. Even when women are doing much of the day-to-day work, they may not have the power to take key decisions - this may detract from farm management if the man is absent or gives low priority to his wife's farming activities.

Major agricultural commodities

Major crops	Tobacco, maize, soya beans, cotton, groundnuts, sugar, tea Horticulture: flowers, citrus fruits, vegetables, herbs, spices for export
Major livestock	Beef, goats, poultry, dairy, pigs, sheep, farmed ostriches.
Fisheries	Inland or freshwater fish production

Other major resources/assets available

Water,	As a land locked country without natural lakes, Zimbabwe's water supply is based on water harvesting and use of groundwater resources. There are currently more than 800 large dams in Zimbabwe. 150 000 ha are under irrigation which is about 3.5% of total cropland.
Fertilizer deposits, minerals	The potential for development of the agro mineral resources of Zimbabwe is good. Zimbabwe has phosphate resources and limestone and dolomite deposits. Country however imports potash.
Energy etc	(1) Zimbabwe relies mainly on coal for thermal energy in industry and power generation, which provides the bulk of industrial energy and produces about 70% of total national electrical energy. Zimbabwe has 10.6 billion tonnes of coal in situ in 21 deposits. (2) Hydro-electricity is also produced from hydro resources of the Zambezi. (3) Biomass (mainly fuel wood) is the main source of energy for rural household who represent about 77% of total households in the country.

	(4) Liquid fuels are imported eg gasoline, diesel. Zimbabwe also imports electricity from Zambia, DRC and South Africa. Due to shortages of foreign currency that the country has been experiencing in recent years, shortages of diesel and electricity have interrupted agricultural activities.

Adequacy/inadequacy of system:

Value added in agriculture,	17.64% (2001) Agriculture value added (% of GDP). Value added is the net output of a sector after adding up all outputs and subtracting intermediate inputs. It is calculated without making deductions for depreciation of fabricated assets or depletion and degradation of natural resources. There is little value addition in most products that are exported. Products such as tobacco and cotton could raise additional money if more processing was done before exporting.
Food surplus/deficit, famine,	Zimbabwe is usually a major maize surplus producing country but in the years when it experiences a drought, it experiences deficits and has to rely on imports. Droughts were experienced in 1982, 1987, 1992, 1995 and 2002. The impact of the 2002 drought has been most severe because of the additional impact of the HIV/AIDS epidemic. Domestic cereal shortfall in 2002/03 was 2,355,000tons. The country has not yet recovered and it is estimated that for the 2003/04 the cereal requirements are 1,271,000tons. The system is not yet fully developed to withstand the impacts of a drought and HIV/AIDS.
Food imports/exports etc	Main food imports: wheat, maize, rice. Main exports: tobacco, cotton, flowers, sugar, beef, dairy, tea and coffee. Tobacco and cotton represented about 68% of all agricultural exports (in value) in 2000. Tobacco leaves alone covered 52% of all agricultural exports Normally major regional maize exporter.

3. Farming Communities (14) Score /20

- Demographic profile; economic profile; education/culture/awareness of modern methods

Nationally there are 3 major farmer organizations: (1) Zimbabwe Farmers Union (ZFU) representing the 1.6 million communal area and resettlement smallholder farmers, (2) Commercial Farmers Union (CFU) representing about 4,500 large scale, mainly white farmers, and (3) Indigenous Commercial Farmers Union (ICFU) representing about 8000 Black large and medium scale commercial farmers. Given the orientation of the other two unions ZFU is often seen as representing all CA and resettlement farmers, whether active member or not. In the farming communities themselves there are a range of organisations specifically linked into regional and national agricultural structures: Zimbabwe Farmers Union groups (ZFU), Agricultural Extension groups (Training and visit, Master farmer), Contract Grower groups (eg CottCo Cotton groups), Savings and Credit groups and Agricultural Project groups, often associated with specific NGOs or other programmes. Many of these groups have overlapping membership and in some the whole group might be linked into several apex structures. For instance an agricultural project group, perhaps producing vegetables, might have been formed with support of a specific NGO facilitating the vegetable

project, but also be linked to a savings and credit organization for their finances, be an extension group in the eyes of Agritex and also be a local ZFU group.

The Farmers unions provide a range of services to the farmers. For example, ZFU has an extraordinarily wide range of activities, many going beyond what are traditionally seen as union activities. Some of the more important are listed below: **Lobbying** - supported by the Economics and Planning Department, the ZFU does research and makes representations on a wide range of issues relating to agricultural policy and prices.

Research and Extension policy - this is a more specific form of lobbying in which ZFU has a place on the Agricultural Research Council and similar bodies. In addition ZFU has used donor funds to specifically support pieces of research by Department of Agricultural Research and Specialist Services (DR&SS). **Extension Access** - ZFU groups are active at a local level to ensure they and their members get access to Agritex advice and support. **Inputs** - the ZFU, particularly at District Office level, is involved in bulking up input orders and negotiating volume discounts from suppliers. **Marketing** - ZFU supports the development of farmer marketing collaboration at the local level, putting ZFU groups in contact with potential purchasers, supporting a marketing capacity building venture in the Midlands. Provision of market information through a weekly radio programme in vernacular languages, monthly magazine (mainly English with some vernacular) and an occasional marketing news sheet (currently in English). **Training** - both in organizational issues such as leadership training and gender awareness and technical training such as the production of technical manuals. **Commercial** - the ZFU has a transport fleet that it operates on a commercial basis, but with an emphasis on serving communal areas.

Level of modernization: subsistence/cash ratio, use of modern inputs/methods vs traditional

The large-scale commercial farmers are substantially more capital intensive and technologically advanced than the majority of farms in other sub sectors. Compared to smallholder farmers, production in the large-scale commercial sector is more diversified in the aggregate, although individual farms may be more specialized. Many of the large-scale commercial farms (32.8 percent) are located in natural region II. There is widespread use of irrigation, chemicals, tractors, and combine harvesters. "Yields are typically among the highest in the world, with high levels of input use" (Masters, 1994). Many smallholder producers depend on livestock (cattle or donkeys) to provide tillage with an ox-plough or transport with ox-cart. All other operations such as weeding, manuring, harvesting and threshing are done by hand. Small-scale commercial farmers and communal farmers own or hire tractors and other mechanical equipment. The table below shows the range of products grown by the different farming communities. The main inputs used by communal area farmers are fertilizer and hybrid maize seed. A range of implements are also bought - typically hoes and animal drawn ploughs and spares. Some farmers in various areas buy other seeds and agricultural chemicals; cotton farmers and vegetable growers tend to use a range of pesticides. Livestock vaccines and treatments tend to be supplied through the veterinary department and dip chemicals tend to be supplied through Government run dip tanks. The major constraints limiting smallholder farmers to using inputs are high prices of inputs in communal areas, particularly in the more remote areas with low retail competition and higher transport costs.

Cropping Patterns By Farming Sector (in % of Cropped Land Under Indicated Crops)

Commodity	Communal Areas (1987-89)	Resettlement areas (1991)	Large Scale Commercial (1993)	Small Scale Commercial (1991)	Zimbabwe Total[1]
Maize	51	54	39	55	49
Millets	15	6	*	4	12
Cotton	8	11	7	11	8
Groundnuts	9	11	*	12	8
Sorghum	8	3	2	1	7
Sunflower	5	10	1	9	5
Tobacco	*	1	18	*	3
Wheat	*	*	9	*	2
Soybeans	*	*	8	*	1
Others	4	5	14	8	6
Total	100	100	100	100	100

[1] Weighted average of the sub-sector figures.
* Less than 1% when rounded.
Source: Masters, 1994.

Fertilizer Use/Arable Land kgs/ha	51.9 kgs/ha average for 1996-2000. Figure has declined from 56.8kgs/ha average from 1980-1989.
Other inputs: agricultural chemicals	Agricultural chemicals (pesticides, insecticides, herbicides, fungicides, bactericides, nematicides and plant growth regulators) are produced under a high degree of competitive pressure. The industry blends and packages imported materials, with a local value added generally under 20 percent. Virtually all sales (over 98%) are to the large-scale commercial sector.
Mechanization tractors/arable land	24 000 tractors in use, 7.5 per 1000 hectares. However a lot of the mechanization is done on commercial farms. In communal areas, about 90 percent of draft power is from cattle or donkeys, with the remainder from tractors hired from District Development Fund.
Irrigation/ soil/water management	3.5% of total cropland is under irrigation (about 150 000ha). Opportunities for irrigation are strongly skewed to the large-scale commercial sector. Only about 7% of the total irrigated land is in the smallholder sector, most of them are irrigation schemes. Research studies show that most smallholder irrigation is both financially and economically viable and can help meet the food security needs of households during the droughts. However a major constraint for many schemes is the availability of markets, especially for vegetables. Within the large-scale sector, the proportion of land irrigated varies widely by crop with wheat, cotton, groundnuts, soybeans, sugar, coffee, maize and tobacco the major irrigated crops. The bulk of irrigation facilities in the large-scale commercial sector has been privately developed and is privately owned by individual large-scale commercial farmers or a partnership of neighbors.
Seeds/genetic materials	There are 5 seed companies: the Seed Company of Zimbabwe (Seed Co), Cargill Hybrid seeds, Pioneer Hi-Bred International, Pannar Seeds and African Pacific Seeds National Tested seeds. Zimbabwe is usually self-sufficient in the production of the seeds of the main crops grown in the country. However, this coming season, the country will experience a deficit in maize seeds, as well as in groundnut, sorghum and millet seeds.

- Community Organization and Management, empowerment and demand response for modernization

This is well developed in the commercial sector, in the smallholder sector it is not fully developed to optimal levels, although ZFU farmer groups and NGOs are helping build the capacity of rural farm communities.

4. Agricultural Science and Technology Institutions (15) Score /20

- Capacity of agricultural research, extension and education institutions;

There is a range of different institutions involved in research:

1. Department of Research and Specialist Services (DR&SS) - a division of the ministry, it has a staff role of over 2000 including 150 technical and 270 technical staff, and a network of 11 research stations.
2. Department of Veterinary Services - a division of the ministry responsible for research into animal diseases
3. Forest Commission -research into forest products
4. Commodity research boards - Tobacco Research Board (parastatal), Pig Industry Board (parastatal), Central Africa Tea Foundation (industry funded, regionally based in Malawi), Sugar Cane Growers Association (private).
5. Agricultural Research Trust Farm - set up by commercial farmers, used by commodity organizations, fertilizer and seed companies.
6. Commercial seed companies - including multinationals and locals like SeedCo, commercial fertilizer chemical and implement manufacturers.
7. University of Zimbabwe, faculties of Agriculture and Veterinary services.
8. International Agricultural Research Centres - ICRISAT, CIMMYT and with Southern African Centre for Co-operation in Agricultural Research ICRAF and ACRDC.
9. African Center for Fertilizer Development, Zimbabwe.
10. Biotechnology research institute

Decline in public investments in agricultural research and extension over the 1990s has been offset by expanded private sector. High breed maize breeding is now dominated 5 research-based agri-business seed companies: the Seed Company of Zimbabwe (Seed Co), Cargill Hybrid seeds, Pioneer Hi-Bred International, Pannar Seeds and African Pacific Seeds National Tested seeds.

Agricultural extension is done by Agritex the main government department responsible for extension, NGOs, input suppliers and commodity processors (e.g. in outgrower type schemes for cotton). The commercial farmers union, a farmer organization for the commercial farmers, provides highly specialized advice to commercial farmers. Agritex uses 4 main extension methods: master farmers, training and visit system, special interest groups such as irrigation schemes and demonstration plots and farmer field days. Extension officer to farmer ratio is 1 extension worker to 600-1200 farmers. A number of NGOs are involved in agricultural extension; and are using a number of different approaches: provision of 'alternative/additional' extension at a local level (e.g. COOPIBO, ACHRM, and Silveira House), attempts to try to work with and improve Agritex at a local level (ITDG in Chivi), promotion of alternative extension messages and methodologies through running training courses, radio etc. (Fambidzanayi, PELUM, Silveira House).

Capacity of public research and extension has been severely constrained by reduced government spending which has affected both retentions of skilled experts and funds

necessary to carry out the research. Private sector research activity has grown rapidly, with estimates of its contribution to total agricultural research ranging between 15 and 50%. Commercial companies are particularly focused on development of hybrid seeds, fertilizers and agrochemicals.

The agricultural colleges do have capacity to produce diploma level, higher diploma and degree level agricultural experts.

Existence and development of improved technologies and methods, especially with respect to the major crops, animals and assets;

Although there has been a considerable quantity of high quality research done in Zimbabwe during the last half a century, only a small proportion of this is useful for resource poor smallholders in regions IV and V (Whiteside, 1998). Nearly all breeding and extension has concentrated on hybrid maize. However in the 1990s DR&SS have been less successful in meeting smallholder needs, in particular research has failed to generate appropriate technologies for smallholder farmers in regions IV and V, where rainfall is low and unreliable and soils tend to be poor, there are a number of reasons given for this: A less favourable external environment for smallholders - drought, lower prices, higher costs etc. and Lack of sufficient government budget, donor support or cost recovery for research.

A variety of traditional and nontraditional crops have potential for increasing smallholder returns or spreading risk; examples are sunflower, cotton, tobacco, cowpea, pigeon pea, groundnut, castor bean, cashews and paprika. There has been limited research into the comparative advantages of the different crops and the different ways these can fit into their farming system. Many argue that a radical change of research and promotion emphasis is needed to focus on resource conserving technologies that can meet the needs of resource poor smallholder farmers in the marginal agro-ecological zones. Such research to include technologies that optimize water use, conserve soil, soil fertility management, technologies suited to AIDS affected households such as high yielding varieties that are drought resistant and require less inputs, new technologies of animal weeding.

Effectiveness and utilization of these technologies in agriculture;

The rate and extent of adoption depends on many factors which include agro-ecological factors such as rainfall, topography, soils, and temperature, and socio-economic factors such as land tenure, farmer education, quantity and quality of extension, religion, transport infrastructure, availability of credit and communications (Alston *et. al*., 1995). Adoption rates are usually higher for the commercial sectors because they have more access to information and resources to adopt the new technologies. Technology adoption is lower among the smallholder farmers because of limited access to the new information and limited resources to purchase the required inputs. Among the different technologies, adoption rates are higher for new varieties than for agronomic and soil management techniques. An interview of 98 research scientists and extension officers, where the following questions were asked: What percentage of the farmers are expected to adopt the new maize breeding technology (variety, practice, etc.) once it is released? (b). How many years after it is released do you expect to see maximum adoption? Results showed high adoption rates averaging 80% to 90% within 2 to five years for commercial farmers while communal farmers the averages ranged from 20% to 70% within 4 to 7 years (Mutangadura, 1997). In 1988 a remarkable 90% of smallholders purchased hybrid seed (Rohrbach 1988), although this proportion has probably since fallen due to rises in prices and reduced income among smallholders.

Adaptive/on-farm research
There is good potential for adaptive on-farm research. The DR&SS has a farming systems research unit which aims to adapt research to farm conditions. The major obstacle is limited funding to carry out the activities.

- Links with farmers, private sector, NGOs and CBOs, and with regional and international communities
Generally the linkage between private sector and commercial farmers is good because of the good infrastructure and the services of the Commercial Farmers Union. In the smallholder sector communication tends to be through the radio, extension officers and the ZFU farmer groups. The main constraints experienced include poor infrastructure resulting in delayed information, lack of a radio, and lack of funding to facilitate extension workers visiting all areas regularly.

5. Infrastructure for Agriculture and Rural Development (15) Score /20

Feeder/rural road coverage;	Zimbabwe has an extensive rail and road transport network linking it to principal ports in Mozambique and South Africa, and to all neighbouring countries. The road network is well developed for the large-scale commercial farms, and while the major roads leading to most rural areas are well developed and well maintained, the road network connecting points or feeder roads within the communal areas are not well developed - A large proportion are earth tracks and are not easily accessible particularly during the wet season. Paved roads as % of total (1998 World Bank) 47.4. There are 8,435 km of designated state roads, of which 8,710 are surfaced and 9,725 graveled. Another 61,630 km in rural areas are maintained by local and district authorities.
Market infrastructure and information;	The marketing boards for major agricultural crops were commercialized in the 1990s following the adoption of the structural adjustment programme. Under ESAP involvement of small traders, transporters and entrepreneurs was recommended. While some studies indicate that the private marketing channels which emerged have provided farmers with alternative channels that has lower transaction costs and timely payment some outstanding constraints still exist namely the loss of important and timely information previously provided by the marketing boards and inaccessibility of some emerging marketing channels to some smallholder farmers. The marketing and input supply channels for the smallholder have lengthened as the middlemen have moved in to provide the inputs (Makamure et al, 2001).
International market access/integration	Trade liberalization has resulted in some significant response in the commercial sector, who have shifted from non-tradables to tradables. Smallholder farmers however, have failed to make the switch because they are limited by access to resources required to produce tradables such as irrigation, agricultural inputs, access to information and financing. The rules of international trade are high-pitched and smallholder farmers certainly have an uphill struggle to be fully participating members of the club. The following list of problems they face is not exhaustive: (1)The traceability of export products calls for labeling to show the farm origin of the produce. Implementation of this requirement is not easy for smallholder livestock producers, as most faremers do not have registered brands and most crops are packaged by bulk from a number of farms, due to the small volumes produced at each farm. (2) The inefficient use of chemicals for pest and disease control results in poor quality produce and low commodity prices, as the natural disease control methods are not yet well understood nor practiced by smallholder farmers. (3) Although the use of the Internet

	for communication and marketing is on the increase, smallholder farmers do not have access to such facilities yet. Their participation in the international trade market is hampered by the technology gap.
Storage, agro processing opportunities/linkages;	Zimbabwe has good storage capacity available for grain storage through the Grain Marketing Board. However because of commercialization some rural areas do not have storage facilities – indicating the need. Agro-processing opportunities are well developed in urban centers, there has been a drive to introduce agro-processing industries at rural growth points, and this has not been very successful in all areas because of resource constraints.
Credit and finance;	Zimbabwe's banking sector consists of the Reserve Bank of Zimbabwe, seven commercial banks, eight merchant banks, six finance houses, five building societies, seven discount houses and a Post Office Savings Bank. The commercial farms have access to all the formal banks for credit because they have collateral. In communal areas financial services are from informal and semi-formal institutions (such as savings and funeral clubs, credit unions, rural village banks) and limited formal lending from Agri-Bank.
Communication,	Zimbabwe has a well-developed communication infrastructure. It has an average of 42.7 telephone lines per 1000 people. The system was once one of the best in Africa, but now suffers from poor maintenance (World Bank, 2001). Zimbabwe has a well-developed electronic and print media, which is highly state-owned. 4 Radio broadcast stations, 1 television station, 1 daily paper and 4 national weekly papers. There are also some local newspapers in some of the towns. There are 17.9 daily newspapers per 1000 people, 22.9 mobile phones per 1000people, 362 radios per 1000 people and 30 television sets per 100 people (World Bank, 2003, World Development Indicators Database). Zimbabwe also has a good tertiary education system and boasts of producing highly skilled manpower.
Education	Total adult illiteracy is 13.2, which is low compared to other countries in the sub-region. School enrollment primary was 95% and school enrollment secondary 44% and primary to teacher to pupil ration is 1:37 (World Bank, 2000). The country has the capacity; the major problem is cuts in budget spending on education, which affects the rate of students who proceed to secondary because of lack of fees (following introduction of cost recovery). HIV/AIDS has also impacted the education sector personnel.
Energy, Water	Main source of energy in commercial farming areas is electricity and liquid fuel, whereas in the communal areas its wood.
Health services	Health services in Zimbabwe are provided by (1) Government through: 57 rural health centers, 34 District Hospitals, 7 Provincial hospitals, and 5 Central hospitals, (2) Municipalities and rural district councils (through more than 600 clinics, (3) 128 Church mission hospitals and clinics, (4) 209 private sector hospitals and clinics. The ESAP adopted in the 1990s resulted in cut backs in the health budget, cost recovery measures, and declines in real incomes of the potential health users, which have resulted in poor performance of the health sector with some health indicators deteriorating to below 1980 levels. The HIV/AIDS epidemic has placed additional stress on the health sector and has compounded the problem. Real government allocations to the Ministry of Health and Child Welfare have decreased from 6% of total government expenditure in the 1980s to about 4% in the 1990s. The country because of the HIV/AIDS epidemic (estimated adult HIV/AIDS prevalence now stands at 33.7, UNAIDS, 2002) and economic problems is experiencing stress in its health delivery for example: insufficient numbers of appropriately trained medical health personnel such as anesthetists, difficulties and delays in referral especially from rural areas due to poorly maintained or inadequate number of ambulances, rural hospitals and clinics without drugs or gloves (in 1995, drug availability for rural health sector was 70%) and central hospitals without trained staff to manage the country's referral system.

6. Policies for Sustainable Modernization of Agriculture and Rural Transformation (SMART) (12) Score /20

Existence/implementation of agricultural modernization vision, stance, policies, strategies, and plans	Yes Zimbabwe has always developed an agricultural policy spanning 5 year periods. Three land review commissions; 1980, 1994 and 2003. The Ministry produced a Policy Framework 1995-2020, which signaled a change of vision from one of control and dominant supplier of market and technical services to one of facilitating technical and institutional change in response to and collaboration with a variety of stakeholders. The framework also identified smallholder agriculture as the most effective way to transform rural areas in the short and medium term "raising productivity and incomes of smallholder agriculture is the most direct route towards eradicating poverty, hunger, malnutrition and unemployment. Increases in rural productivity and incomes will provide the economic incentive for rural agro-industry and broader participation of the rural-based private sector".
Major agricultural and rural development programs/projects/modernized farming systems	With the advent of majority rule in 1980, the government of Zimbabwe (GoZ) adopted the goal of 'growth with equity'. New policies included bringing underutilized land into full production and reducing the inequality in land holdings. The first phase of the Land Reform and Resettlement Program (LRRP1) began in 1980, which by 1997 had redistributed 3.5 million hectares to 71,000 families from communal areas—well below the initial target of 8.3 million hectares and 162,000 families. A second phase of resettlement (LRRP2) was begun in 1998, followed by an accelerated fast-track resettlement phase in June 2000, and then the announcement of an end to land redistribution in August 2002. The implementation of LRRP has been marred by disruptive and controversial land occupations or invasions. The total area in resettlement areas has increased from 3.3million ha in 1994 to an estimated 7.3million ha in 2002. The government is now trying to provide services to meet the agricultural production needs of resettled farmers. Efforts are being limited by financial resource constraints.
Integration with industry, markets and inputs	There is still room to assist in the establishment of joint ventures in the processing or value-added activities along the marketing chain for farmers and for promoting market linkages with established agro-processing and export companies.
Investments/budgets for agriculture (local, foreign)	Government budget on agriculture as a percent of total government spending averaged 7.2% over the 1980s, but has been experiencing a steady decline over the 1990s due to the budget cuts necessitated by ESAP. In 1998 government spending on agriculture as a percent of total government spending was 1.9%.
Investments in research, extension, education for agriculture and natural resource management	Government spending on research and extension services is roughly 10% and 30% of the total government spending on agriculture respectively. The government supports the main government departments of research (DR&SS), extension (Agritex) and Department of Veterinary Services and the three main 'levels' of formal training: (1) farmer training centres - both for smallholders and foremen, assistant managers etc. on commercial farms. (2) Agricultural colleges - award diplomas and higher diplomas and (3) Faculties of Agriculture and Veterinary Science at the University of Zimbabwe awarding degrees.
Empowerment of farmer communities - e.g. via land tenure, democratization,	This is an area, which requires development. Local farmer communities are not fully empowered to deal with land tenure issues and democratization is limited. There are few cases such as the CAMPFIRE

liberalization, decentralization, participation, communication, voice/articulation of needs and constraints, prospects, plans and accountability etc.	programme where empowerment of farmer communities has resulted in success. The Communal Areas Management Programme for Indigenous Resources (CAMPFIRE) is a Community Based Natural Resources Management (CBNRM) programme which started in the 1980s; it is probably the best known and most established CBNRM programme in the Southern Africa Region. Until recently it focused almost entirely on wildlife, although now some other natural resources are being incorporated into the programme. The Campfire programme involves the devolution to Rural District Councils, and through them to local communities, some responsibility for the management of natural resources, especially wildlife, and in return their right to a proportion of the wildlife derived income for their area. It involves active conservation and management of wildlife in the area with a parallel participation in some of the revenue from wildlife which might be a share in tourist hunting fees, employment as guides, opportunity to sell crafts, employment/ participation in tourist facilities etc.

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Ethiopia *(Reviewer: Dejene Aredo, November 26, 2003)*

1. Basic Indicators

1.1. Population: nearly 70 million, the second largest in sub-Saharan Africa, growing at a rate of about 2.9 % per annum and population density of 66/ km^2 in 2001.
1.2. Land area: 1,104.000 square kilometres
1.3. GDP: 7.966 billion US dollars (at constant 1995 prices) in 2001.
1.4. GNP per capita: national income per capita amounted to 100 US dollars in 2001.
1.5. GNP growth rate: According to World Bank (2003), the average annual growth rate of GDP was 4.9 percent over the period 1990-2001.
1.6. Life expectancy at birth: 43 years for males and 44 years for females (in 2001).
1.7. Adult literacy: For (% age 15 and above), UNDP (2003) reports 40.3 for both sexes.
1.8. (additional information) *School enrolment ratio (gross*): total enrolment was 21 in 1975, 33 in 1990, and 43 in 1996. The female-male ration was 0.49 in 1975; o.67 in 1990; and down to 0.55 in 1996 (UNDP 2003).

2. Agricultural System

2.1. ***Agroecological zone***: Ethiopia is a land of contrast and of great diversity. There are as many as 18 agroecological zones and 62 sub-zones having their own physical biological potentials. The highlands with altitude 1500 meters above sea level constitute 36.3% of the total land area. It supports about 88% of the human and 70% of the livestock population, and contributes over 90% of the cropland as well. However, it suffers soil erosion (1 billion ton per year) caused by high pressure on land. The lowlands, which constitute about 63.7% of the total land area of the country, supports 30% of the livestock and 12% of the human population. However, it is infested with malaria, tsetse flies and other vectors, which rendered the area unfavorable for human settlement and cattle rising.

2.2. ***Farming systems***: there are diverse and contrasting farming systems in Ethiopia. The different systems vary in terms of resource endowments, techniques pf production, cropping patterns, extent of integration of livestock production with crop cultivation, cultural backgrounds, community level economic interactions, production and marketing constraints, etc.

2.3. ***Major Crops***: Agricultural land use patterns in Ethiopia are as follows; land under temporary crops account for 75.47 % of the total. The rest are as follows: land under permanent crops (5.7%), grazing land (6.82 %), fallow land (7.45 %), wood land (0.26%), other land uses (4.3 %) (Dejene 1999). The ten major crops, in order of importance are: 1) maize, 2) teff, 3) sorghum, 4) wheat, 5) barley, 6) millet, 7) horse beans, 8) chick peas, 9) haricot beans, and 10) field peas Cereals account for as much as 76 % of the total crop production, followed by oilseeds (16.7 %) and pulses (7.3 %) (CSA 2002). However, CSA surveys do not cover inset, a tuber which sustains the lives of more than 10 million people in Ethiopia. Similarly, we do not have reliable data on other important food items like vegetables and fruits.

2.4. ***Livestock***: Ethiopia has enormous potential in terms of livestock population and diversity. Ethiopia ranks first in Africa and tenth in the world in terms of livestock population. Livestock production in Ethiopia can be classified into: a) mixed farming in the highlands and b) pastoralism in the lowlands. The latter system has been

marginalized economically, socially, and politically. The livestock sub-sector suffers from three main categories of problems, i.e. a) feed problems, b) animal diseases, and c) lack of improved breeds. In addition, there are marketing problems (and other problems).

2.5. ***Fisheries***: Ethiopia has huge reserve of fresh water fish. Of the total capacity of 30,000-40,000 tones per year, only 15 % is produced. But, the potential of this sector has remained untapped in part due to: a) inadequacy of infrastructure, b) marketing problems, and c) cultural factors

2.6. ***Trade in food***: up until mid-1950s Ethiopia used to be a net exporter of food. Today, Ethiopia heavily depends on non-commercial food imports (food aid). Ethiopia's cash crops (for exports) include coffee, chat, and vegetables (to Djibouti). Half of Ethiopia's major export crop, coffee, is used for domestic consumption.

2.7. ***Water***: Ethiopia is known as the "Water Tower" of north-eastern Africa. The nine major rivers of Ethiopia have a total length of 5785 kms inside Ethiopia and 1536 kms outside the country. The twelve major lakes of the country cover a total area of 7023 square kms (CSA 2002). However, the country's enormous water resources have remained untapped. Irrigated land accounts for less than 4 percent of the total cultivated area. Currently the Government has taken water-harvesting technique as a way out of the prevailing food crisis.

2.8. ***Fertilizer deposit, minerals, energy***: Ethiopia has enormous reserve of unexploited mineral resources including Bikilal phosphate amounting to 100 million tons (at 4 % $P_2 O_5$), Dallol potash (160 million tons), Adola nickel (17 million tons), Delbi-Moye coal (20 million tons), Lege -Dembi primary gold (200 tons), the platinum deposits of Yubdo, natural gas deposits of Ogaden (Calub), and the columbo-tantalite deposits in Adola (MEDAC 1999).

2.9. ***Value-added in agriculture (including fishing and forestry):*** value - added per agricultural worker, during 1998 - 2000, was only 138 US dollars (1995 prices) as compared to $ 362 for sub- Saharan Africa and $3,661 for upper middle income countries. In 2001, the ratio of agricultural value-added to GDP was 52 % as against 11 % for industry and 37 % for services (World Bank 2003).

2.10. ***Food availability***: It is well-known that Ethiopia has been suffering from chronic substantial food deficit for decades. Currently, about 14 million people in different parts of the country need food aid amounting to more than 1.6 million tons. As a result of the failure and /or delays in rains, the food security situation has deteriorated considerably in 2002/03 and is the worst since the 1984/85 droughts. Agricultural production in 2002/03 is estimated to have declined by 12 % from the previous year. Cereal production alone declined by 26 %, while coffee and livestock production fell by 8 and 6%, respectively. The Government has taken certain measures to deal with the crisis. In the short - term, it has allocated budget totaling Birr 1.2 billion for a water harvesting scheme, local food purchase (100,000 MT), and resettlement program. In the water harvesting scheme, approximately 200,000 households are expected to benefit from water catchments and storage facilities supplied by the government (IMF 2003).

3. Farming Communities

3.1. ***Demographic profile***: According to official statistics (CSA 1998), 86.3 % of the population in Ethiopia lived in rural areas in 1994. The 1994 census showed that there were an average of 4.8 persons per households in rural areas. The proportion of children under the age of 15 is about 45 percent for rural areas. Disguised unemployment is a feature of rural areas, where only 0.7 % reported to be unemployed (against 22 % for urban areas). The fertility rate was 7.2 for rural areas (against 4.5 for urban areas). About 44.7% of the total urban and 9.2 % of the total rural population of the country are migrants.

3.2. Economic profile: rural poverty has remained deep and pervasive. Landlessness is on the increase. Land and labour are the major farm input. Capital is little used. Off-farm activities are limited. Rural labour market is narrow and fragmented. The farm-gate price account for is a small share of the final price. The peasant household is self-sufficient in the provision most services. The rural environment is very risk.

3.3. ***Modernization and Technology***: Ethiopian farmers are well endowed with indigenous knowledge systems. Through centuries of trial and error peasants (and pastoralists) have accumulated technical knowledge about animal husbandry and crop cultivation techniques. However, policy makers and researchers have paid little attention to the indigenous knowledge systems of the rural people. On the other hand, most farmers are making little use of modern techniques of farming. They produce mainly to meet their consumption requirements. The marketed surplus is not more 30% of total crop production.

3.4. ***Community Organization and Management***: In rural Ethiopia, community level solidarity and cooperation are strong. There are important economic activities taking place at the community level. The community is responsible for labour exchange arrangements, the management of common property resources, conflict resolution, information exchange, financial intermediation (like *iqqub* and *iddir*), and for mutual support networks. However, the community of has remained neglected by policy makers and researchers. Only NGOs have made modest attempt to mobilize the resources of the community.

4. Agricultural Science and Technology Institutions

4.1. ***Capacity of Agricultural Research:*** The Ethiopian Agricultural Research organization (AERO) is responsible for agricultural research in the country. In addition, agricultural colleges and universities undertake agricultural research. The research system has given priority to certain food crops like wheat and teff. Other important crops, such as enset, have received limited attention in terms of investment in research. Moreover, the livestock sub-sector (which accounts for 33% of the agricultural GDP) has received limited attention from policy makers. The research system has over-emphasized the technical aspect of crop and livestock production, thus neglecting the social sciences. Agricultural research in Ethiopia suffers from both supply-side, demand-side problems. On the supply and R&D are constrained by shortages of scientists. It has been estimated that the country meets only 10 percent of the total scientists required for the agricultural sector. This is largely due to the massive brain the country has been suffering from since late 1970s. Perhaps, there more Ethiopia-born agricultural scientists in USA than in Ethiopia. Available funds are often underutilized in part due to shortages of human resources and lack of

incentive structures. On the demand side, the adoption of new technologies has constrained in part due to limited capacity of farmers.

4.2. ***Extension:*** The Government has put in place a policy of boosting the number of extension workers. Training schools are opened in different parts of the country. But, research and extension activities are little coordinated. In many places, farmers report that extension workers rarely visit them. Extension workers are underpaid and they lack facilities required to improve their performances. The Government plans to cover six million farmers through its Extension Package Program.

4.3. ***Education institutions***: In recent years, education institutions have significantly expanded in different regions of Ethiopia. However, the quality of education has been deterioration over years. Educated unemployment is on the increase and graduates have high propensity to migrate to the West. Few graduates are attracted to low-paying jobs in rural areas. There are few training schools for farmers.

4.4. ***New agricultural technologies***: Agricultural technologies in Ethiopia can be characterized as follows; a) heavy reliance on chemical technologies (specially fertilizers) b) neglect of indigenous technical knowledge of farmers; c) largely top-bottom approach to the generation and dissemination of new technologies; d) concentration of R&D on few crops; e) underutization of already available technologies; and f) increased environmental problems associated with intensive agriculture.

4.5. ***Participation of the private sector, NGOs, and of CBOs***: The private sector is little involved in the generation of new technologies there are indication that the private sector has been withdrawing from the marketing of fertilizers. NGOs have made some efforts to introduce new methods of farming and resource conservation techniques in rural areas. They have made some progress in empowering the poor and in advocating pro-poor policies. But, their interventions are little coordinated with national and regional plans. Their contributions to rural development in Ethiopia have never been assessed. Community-based organizations do have enormous potentials for reducing poverty in rural in rural areas. But they have received little attention from policy makers. The Society for the Promotion of Self-help Organizations was recently established to address this problem.

5. Infrastructure for Agricultural and Rual Development

Infrastructure has remained inadequate and unevenly distributed in rural areas. A typical rural household lives 3.4 kms away from the nearest primary school, 19.2 kms away from the nearest secondary school, and about 8 kms away from the nearest health center. Feeder roads are lacking in many areas. There are shortages of storage facilities, market information systems, agroprocessing facilities, credit institutions, schools, and of health institutions. Electricity is unknown in rural areas.

6. Policies for Sustainable Modernization of Agriculture and Rural Transformation (SMART).

6.1. ***Integration with industry and effective demand***: Currently, agriculture is little integrated with the industrial sector. Farmers have very limited effective demand for

industrial products. Own agricultural enterprise is the single major source of rural incomes (72.5%). Of the other sources, household enterprise (other than agriculture) account for 5.5 % of total household income and gift and remittance for 3.5 %. Agriculture depends heavily on foreign aid for its capital investment. Since 1996, a number of microfinance institutions have been set-up to meet the credit needs of the poor. But, we doubt whether microfinance instituting have any positive impacts on the lives of the poor.

6.2. ***Investment in natural resources***: Investment in natural resource management is limited. Food-For-work projects are extensively used to rehabilitate the environment. But, the conservation structures have been subjected to a cycle of dubious destruction and reconstruction been subjected to a cycle of. Also, food aid has created dependency syndromes.

6.3. ***Land tenure***: there is a long way to go to empower farmers. Farmers have *usufruct* rights to land. The Law prohibits the transfer of land through sales. In some regional states, farmers can lease out their land for a short period. Insecurity is said to be the main problem emanating from the current tenure arrangements. The holding size (which averages about 1 hectare) has been declining over years because of deepening population pressure over land. Informal (unofficial) land market has been thriving since the land nationalization Act of 1975.

6.4. **Liberalization, decentralization, and participation**: official documents declare that the decision-making process has been decentralized, democratized, and that farmer participation has increased over years. And yet, the voice of the rural poor is little heard at the policy-making level. Farmers are still suspicious of urban-based elites.

6.5. ***Agricultural policies and food security***. The Government has put in place policies and programs for rural and agricultural development. At the center of the government's development policies, there lies Agricultural Development Led Industrialization (ADLI). But this policy stance has been criticized by certain groups on the grounds that it does not pay sufficient attention to the role of industry in enhancing agricultural growth. The Government has proposed the following specific policy measures:

- Introduce menu-based extension packages to enhance farmers choice of technologies;
- Expand borrowers' coverage of micro-financing institutions;
- Establish an institute for diploma-level training of extension agents and expand agricultural Technical Vocational education Training (TVET);
- Measures for the improved functioning of markets for agricultural inputs (fertilizer, seed) and outputs;
- Organize, strengthen and diversify autonomous cooperatives to provide better marketing services and serve as bridges between small farmers (peasants) and the non-peasant private sector;
- The possibility of establishing an agricultural products exchange market will be studied, and if found feasible, implemented; and
- Agricultural research, water harvesting, and small-scale irrigation.
- The strategy adopted rests on three pillars: increasing the availability of food through domestic (own) production; ensuring access to food for food deficit

household; and strengthening emergency response capabilities. Regarding pastoral areas:

- Sedentarisation of mobile pastoralists on voluntary basis;
- Consolidate and stabilize those who are already settled or semi-settled through improved water supply, pasture and social services;
- Carefully select viable and reliable river courses for future sedentatisation based on irrigation and link these places through roads and other communication lines; and
- Provide mobile social services including health and education holistically for those that continue to be mobile.

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Rating of Ethiopia's Profile.

Indicators	**Maximum Score**	**B. Ethiopia Score**	**Main Reason**
1. Basic Indicators	10	4	Very low per capita in come
2. Agricultural System	10	5 for potentials 2 for food security	Difficult to rate because the country has high potentials but is characterized by chronic famine

3. Farming Communities	20	11	Has promising tradition of hard work and strong community level organization. But, weak in other areas
4. Agricultural Science and Technology Institutions	20	10	Low level of technology but the rate of adoption has in creased recently
5. Infrastructure for Agriculture and Rural Development	20	8	Weak infrastructure, but recently heavy investment inroads.
6. Policies for Sustainable Modernization of Agriculture and Rural Transformation (SMART)	20	12	Policies are there, but there are problems of implementation. Certain policies are lacking.
C. Total	**100**	**52**	

Kenya (*Reviewer: Dr. John Omiti, November, 2003*)

1. Basic Indicators Score 8/10

Population,	30.8 Million
Area, (square Miles)	58 Million Hectares
GDP, (At market prices, (2001)	US$ 11,231 Million
(Current prices, (2001)	US$ 318 Milion
GNI, PPP Per Capita 2001	US$970
GDP growth rate, (Constant Prices, 2001)	1.2%
Life Expectancy,(Male)	46 years(declining)
Life Expectancy,(Female)	46 years(declining)
Population growth rate (2001)	2.1%
Adult Literacy (male) (2000)	89%
Adult Literacy (female) (2000)	76%

2. Agricultural System Score 6/10

Agro ecological zone(s); farming system(s); major crops- /livestock/fisheries with large consumption/market - local or export (list up to 10)

Agricultural crops include tea, coffee, horticultural products, pyrethrum, pineapples, sisal, tobacco and cotton. Food crops for domestic consumption include maize, beans, cane sugar, wheat, rice, bananas, cassava, potatoes, sorghum, millet, etc.

Livestock farming:- Daily animals, Meat animals, poultry and Honey.Other major resources/assets available: Water Fertilizer deposits Minerals -:Titanium -Kwale District; Soda Ash –Magadi; Flourspar - Kerio valley

Energy -:Hydro –Electric, Biomas, solar, Geothermal, wind etc (Petroleum is imported)

Adequacy/inadequacy of system:

value added in agriculture:- 18.97% (2001)

Food surplus/deficit, famine, food imports/exports etc: Diverse situations-largely dependent on weather conditions

Main Industries: Food and beverages processing, manufacture of petroleum products, textiles and fibres, garments, tobacco, processed fruits, cement, paper, pyrethrum products, engineering products, wood products, pharmaceuticals, basic chemicals, sugar, rubber, plastics, etc.

Exports: Tea, coffee, horticultural products, hides and skins, pyrethrum, pineapples, beer, among others.

Imports : Industrial machinery, crude and refined petroleum, motor vehicles and transport equipment, minerals, iron and steel, chemicals, food and manufactured goods

3. Farming Communities Score 12/20

Demographic profile;-	Average household size 5 persons
economic profile; -	Agricultural contribution to GDP =24%
education/culture/-	Rural literature rate is less than the national average of 82.3%
awareness of modern methods	Modest (40 – 50%)
Level of modernization:	Modest (Energy distribution is limited and expensive)
subsistence/cash ratio,-	N/A
use of modern inputs/methods vs traditional (seeds/genetic materials, fertilizers, mechanization, irrigation, soil/water management etc.)	Modest (35% adoption rates)

- Community Organization and Management, empowerment and demand response for modernization

Has emerged in the last ten years with political pluralism

4. Agricultural Science and Technology Institutions Score 15/20

- Capacity of agricultural research, extension and education institutions; existence and development of improved technologies and methods, especially with respect to the major crops, animals and assets; effectiveness and utilization of these technologies in agriculture; adaptive/on-farm research- (good)
- Links with farmers, private sector, NGOs and CBOs, and with regional and international communities-(Reasonable)

5. Infrastructure for Agriculture and Rural Development Score 10/20

- Feeder/rural road coverage; market infrastructure and information; storage, agro processing opportunities/linkages; credit and finance; international market access/integration-(Weak)
- Water, energy, communication, education and health services- (costly and largely inaccessible)

6. Policies for Sustainable Modernization of Agriculture and Rural Transformation (SMART) Score 14/20

- Existence/implementation of agricultural modernization vision, stance, policies, strategies, and plans-(Good)
- Major agricultural and rural development programs/projects/modernized farming systems-(Good)
- Integration with industry, markets and inputs-(stagnant - modest)
- Investments/budgets for agriculture (local, foreign); investments in research, extension, education for agriculture and natural resource management (Reasonable)
- Empowerment of farmer communities - e.g. via land tenure, democratization, liberalization, decentralization, participation, communication, voice/articulation of needs and constraints, prospects, plans and accountability etc. (Though evolving, has largely remained politicized)

7. Other Comments/References TOTAL 65/100

Lesotho *(Reviewer: J. Mohammed, 15/11/2003)*

1. **Basic Indicators**

Population=	2,207,954 (2002 est.)
Area =	30,350 sq km
GDP=	$570 per capita (20010
GNP per capita=	$ 1,340 (1994 est.)
GNP growth rate=	3.8% (2002 est.)
Life Expectancy=	*total population:* 47 years *female:* 47.8 y (2002 est.) *male:* 46.3 years
Adult Literacy=	83% (male= 72%, female=93%) (2002 est.)

2. Agricultural System

Climate= temperate; cool to cold, dry winters; hot, wet summers
Agro-ecological zone(s)= four, Lowland, Foothills, Highland and Seque Vally (irrigation)
Farming system(s)= subsistence farming and livestock
Major crops= Maize, sorghum, wheat, pulses,
Livestock, sheep, goats, horses
Fisheries= none
Large consumption/market - local or export = feeding the population will be priority
Local market, South African market, European market, American market, Middle East market
Other major resources/assets available – Exporting water to South Africa and generating electricity, Very limited diamond mining underway

- Adequacy/inadequacy of system: some processing and manufacturing going on, very low level of value adding, most eroded, low yield, importing large percentage of all food items, food deficit, prone to famine.

3. Farming Communities

Demographic profile: 0-14 years =41%, 15-64 years=54%, 65 years and above=5%
Economic profile: Mainly subsistent farmers and not self sufficient in food
Most can read and write and receptive to modern technology
Level of modernization: subsistence mainly, willing to use modern inputs, production predominantly traditional, seeds/genetic materials local or imported, fertilizers used by some but less than recommended rate, mechanization is limited, irrigation not practiced, soil/water management is very poor

- Community Organization and Management, empowerment and demand response for modernization: Weak and top dawn. There is goodwill of government to empower through local government.

4. Agricultural Science and Technology Institutions

Agricultural research division in MOA is to generate technology. It has about 20 researchers with B. Sc. or above. The school of Agriculture in NUL trains manpower at B. Sc. and M. Sc. levels. Lesotho Agric. College offers Diploma and certificate in Agriculture.
Existence and development of improved technologies and methods: in general research out put is very poor. Most researchers are too young. The University does not have research budget. Linkages between institutions are extremely poor. Technology for major crops is not

adequately available and where it is available, there is no good follow up to take it to the farmers. Extension is weak. Some adaptive/ on-farm research underway
- Links with farmers: Linkages between institutions are extremely poor. Private sector is not developed. Some NGOs and CBOs are coming up. Linkage with regional and international communities is high through participation in different activities.

5. Infrastructure for Agriculture and Rural Development

Feeder/rural road coverage: 7215 km (1988 data)
Market infrastructure and information: High potential but not yet developed
Storage, agro-processing opportunities/linkages: Fairly good
Credit and finance: There was agric. Development bank. It is no more functional.
International market access/integration: Lesotho enjoys access to most international markets.
Water, energy: Improvement of a major hydropower facility is generating power for Lesotho and water is sold to South Africa.
Communication: 5920 phones and presently increased use of cell-phones
Education and health services: Strong education support system. Good education policy. Hospitals and health center in major towns.

6. Policies for Sustainable Modernization of Agriculture and Rural Transformation (SMART)

- Existence/implementation of agricultural modernization vision, stance, policies, strategies, and plans: Recently formulated and put in place through wide participation of stakeholders.
- Major agricultural and rural development programs/projects/modernized farming systems: Attempts in different areas, however, most past attempts left very little behind. There is need to rethink and plan differently.

- Integration with industry, markets and inputs: attempts being made
- Investments/budgets for agriculture (local, foreign): Attempts made by government but implementation is poor.
- Investments in research, extension, education for agriculture and natural resource management: Mainly through training of professionals
- Empowerment of farmer communities: modernization of land tenure system under way, democratization, liberalization, decentralization, participation, communication, voice/articulation of needs and constraints, prospects, plans and accountability are all on the government agenda. These are processes, which will become clearer through time. Some are already clear case of democratic transparent election system in Lesotho in the near past.

7. Other Comments/References

Progress made in human development and poverty alleviation over the past decades is being rapidly reversed by HIV/AIDS. With national prevalence rate of 31% (2002 est.) and drought, the country is heavily dependant on foreign aid. The pandemic is threatening the productive sectors of the economy, delivery of social services and the entire social fabric. There is urgent need to look into small irrigation projects, intensive high value crop production

Nigeria, Niger (Reviewer: Taiwo Alimi, November 2003)

Profile of African Countries with Respect to Green Revolution Potential and Readiness		
ITEMS	COUNTRIES	
1.Basic Indicators		
Country Name	Nigeria	Niger
Population	133,881,703	11,058,590
Area	923,768 sq km	1,267,000sq km
GDP	₦113.5b	$8.8billion
GNP per capita	₦875	$830
GNP growth rate	3%	3%
Life Expectancy at birth	51.01years	42.21
Adult Literacy (15+ years): Male Female	 66.8% 59.4%	 74.2 90.3
SCORE	6/10	5/10
2.Agricultural System		
Agro ecological Zones	Humid Forest zone Moist Savannah Drier Savannah	Semi- Arid Arid
Farming System	Shifting cultivation Monocropping Mixed cropping Bush fallow Mixed fallow	Dry land agriculture Urban agriculture
Major Crops/Livestock/Fisheries with large consumption/market:local export	Cocoa, peanuts, palm oil, corn, rice, sorghum, millet, cassava (tapioca), yam, rubber, timber, cattle, sheep, goats, pigs, fish cocoa, rubber	Cowpeas, cotton, peanuts, millet, sorghum, cassava (tapioca), rice, cattle, sheep, goats, camels, donkeys, horses, poultry Livestock, cowpeas, onions
Other major resources/assets available	Rivers, ocean, lakes, crude oil, natural gas, columbite, coal, tin, lead, bitumen	Uranium ore
Adequacy/inadequacy of system: Value added in agriculture %of GDP Food surplus/deficit Famine Food import/export	 34.6 deficit not frequent import	 Deficit Frequent Import
SCORE	5/10	3/10
3. Farming Communities (Rural Area)		
Demographic profile	More of old people	High in old people
Economic profile	Poor	Very poor

Education	High illiteracy	Very high
Culture	Traditional	Traditional
Awareness of modern practice	Low	Low
Level of modernisation	Low	Low
Subsistence/cash ratio	High	High
Use of modern inputs/ methods vs traditional	Low	Low
Community organisation and management	Low	Low
Empowerment and demand response for modernisation	Low	Low
SCORE	2/10	2/10
4. Agricultural Science and Technology Institution		
Capacity of agricultural research, extension and education institutions	Poor locally as a result of inadequate funding	Poor
Existence and development of improved technologies and methods	Fair because of existence of international agric institutes such as IITA	Poor
Effectiveness and utilization of these technologies in agriculture	Fair	Poor
Adaptive/on-farm research	Poor	Poor
Links with farmers, private sector, NGOs and CBOS etc	Poor	Poor
SCORE	4/10	3/10
5.Infrastructure for Agriculture and Rural Development		
Feeder/rural road coverage	Poor	Poor
Market infrastructure and information	Poor	Poor
Storage, agro-processing opportunities/linkages	Poor	Poor
International market access/integration	Poor	Poor
Water, energy, communication, education and health	Poor	Poor
SCORE	2/10	2/10
6. Policies for sustainable modernization of agriculture and rural transformation	Fair	Poor
1Existence/ implementation of agric modernization vision, stance, policies, strategies and plans	Very poor implementation	Very poor

2.Major agricultural and rural development programs/projects/	Fair	Poor
3. Integration with industry, markets and inputs	Poor	Poor
4. Investments/budgets for agriculture (local, foreign); investments in research, extension. Education for agriculture and natural resource management.	Poor	Poor
5. Empowerment of farmer communities e.g. via land tenure, democratization, liberalization … accountability	Very Poor	Very poor
SCORE	3/10	2/10
Other comments/references	Corruptions, lack of accountability, mismanagement and bad leadership are the key constraints to Nigeria's greatness in general and in agriculture in particular, as necessary natural resources are available.	Poor resource base level and bad governance are responsible for poor performance of the economy.

Sources of Data: I) The Little Green Data Book 2001, from the World Development Indicators.
ii) The World Bank Group, Country Profile Table.
iii) Annual Report and Statement of Accounts, Central Bank of Nigeria. 2001
iv) World FactBook

Swaziland (*Reviewer: Musa M. A. Dube, November 2003)*

The purpose of this paper is to identify Swaziland=s agricultural profile on selected technological innovations or interventions and activities. The paper builds on the assumption that Swaziland like many developing countries has adopted and implemented several technologies and innovations in order to improve food production. In this paper, a holistic view is proposed in order to describe the profile of Swaziland=s agricultural sector in terms of selected technological innovations and interventions that are likely to accelerate agricultural development. It is recommended that Swaziland should consider with urgency the challenges and prospects in order to join Africa=s campaign on the field project on strengthening Africa=s capacity in Science and Technology for sustainable development and renewal of the Green Revolution campaign.

D. Introduction

The Kingdom of Swaziland is located in Southern Africa. It is a landlocked country; bordered by Mozambique to the East and the Republic of South Africa on all the other sides. It has a total area of 17,364 km2. The country is mountainous and hilly, with undulating sloping plans. The 1997 Census reported that the population at was about 1 million people. The population growth rate is estimated to be between 2.7-2.9 percent. It is estimated that over 77 percent of the Swazi people reside in rural areas. This figure is likely going to increase due to the current trends where some people are leaving the urban areas to settle in the rural areas.

Two major systems of land tenure are found in Swaziland. First, the Swazi National Land (SNL). This land is covers about 54 percent of the total land area and is held by the King in trust of the Swazi people. The average farm holdings for cultivated land stands at 1.5 ha per household with an average yield for maize of 1.5 tonnes per hectare. Second, the Title Deed Land (TDL). This type is privately owned and is used mainly for growing commercial crops such as sugar cane, citrus fruits, pineapples and forestry. In addition, ranching is practiced under the TDL. For administrative purposes, the country is divided into four administrative districts. These are : Hhohho in the North, Manzini in the centre, Shiselweni in the South, and Lubombo in the East.

Generally speaking, the country has good soils. The rainfall distribution stands as follows: Highveld receives about 950 mm; Middleveld 700 mm; Lowveld 475, and Lubombo 700mm. However, the continued drought spell and changing patterns of rainfall, is becoming a serious concern. The amounts reported are likely going to decline as the drought continues to be a serious threat in Swaziland.

E. The Agricultural Sector

Since 1968, Swaziland has realized that the agricultural sector is the mainstay of the national economy. The agriculture sector employs over 80 percent of the Swazi population. Also, the agricultural sector has made significant contributions to gross domestic product (GDP). Details on the contributions of the agriculture sector are presented in Table 1. As a result of the importance of the agricultural sector, the
Government of Swaziland (GOS) has accepted that progress in the agricultural sector requires a massive effort in the field of research, staff development, and agricultural extension (Dube, 1992). In addition to these accelerators, many more are gradually being added and adopted. Despite these efforts, food shortage and poverty continues to be a critical and perhaps second to the HIV/AIDS pandemic. Many people continue to ask why should Swazi survive by

means of a Ahandout@, this is, donated food. Answers to this question are not easy as many people may think but are more demanding and complex.

Table 1 : Contributions of Agriculture to GDP in Swaziland

Year	Percentage Contributed
1968	23
1990's	10
2002	8

Source: Nomsa Tibane (2003). Poverty situation with special reference to Swaziland, Mbabane, Swaziland.

F. Statement of Problem

Swaziland is confronted with more complex problems. Examples of the problems include i. the alarming shortage of food, ii. escalating poverty, and the iii. HIV/AIDS pandemic. Food in particular, continues to be inadequate and is aggravated by among other things low production, erratic distribution even when procured, poor storage practices, changing and declining rainfall pattern. In addition, efforts that have been expended by the Ministry of Agriculture and Cooperatives (MoAC) have not changed the food situation. Instead, food continues to be elusive and inadequate. Given this status of affairs, Swaziland is compelled to look for alternative strategies to address the food shortage crisis. One such a strategy is for Swaziland to take the initiative to participate in the call for strengthening capacity in science and technology (S &T). It is hoped that this initiative could lead to sustainable development in Africa. Also, to employ a more "holistic" approach so that technological innovations and interventions are adapted to the Swaziland environment.

Technological innovations and interventions adopted

Since independence, Swaziland has adopted many technological innovations and interventions to boost the agricultural sector. Some initiatives have yielded positive results, while others have not. However, a close analysis of the initiative reveals the food shortage crisis have not been eradicated. This kind of affairs, therefore, warrant urgent analysis of what technological innovations and interventions has Swaziland instituted since independence. Following below are some examples of the many interventions and are discussed very briefly. They are not listed in any priority order.

Formal inception of Agricultural Extension Service : Agricultural extension (AE) was incepted in the 1930's (Trail, 1985). However, for a long time, AE was operated more as a regulating unit by colonialists rule over Swaziland. As unit, AE is expected to be educative in order to develop capacity among farmers. Recently, AE has assumed a more educative function in livestock, land use planning, marketing, farm mechanization, irrigation, and forestry.

Responsibility of the Agriculture Sector : The Government of Swaziland entrusted the MoAC to be the custodian of the agriculture sector. Against this initial plan, other key stakeholders and actors in agriculture have emerged. These include NGOs, industry, the University of Swaziland, Faculty of Agriculture, and the Agricultural Research Division.

a. Agricultural Policy: The MoAC has for over a decade operated with no clear agricultural policy. Yet, a policy sets a framework upon which other relevant interventions can be engineered, monitored and evaluated. Currently, the MoAC through the assistance by FAO is engaged second phase of formulating the policy.

b. Establishment of Rural Development Areas (RDAs): RDAs were established in the 1970s for the purpose of bringing field extension officers and some agricultural inputs closer the farmers. This initiative has however, not made the anticipated impact. Feedback from farmers reveals that there is a need for improvement in terms of how the RDAs are used.

c. Human Resource Development : The Swaziland Agricultural College and University Centre (SACUC) along with the Malkerns Agricultural Research Centre were built to provide training of extension officers and conduct research, respectively. SACUC has been upgraded to full fledged University and provides training up to a masters degree in agriculture and agricultural education. The research division continues to conduct research and assists in analyzing soils.

d. Collaboration between the MoAC and Other Stakeholders: Due to the Increasing stakeholders and key actors in agricultural development, informal collaborative arrangements among the field officers have been observed. However, collaboration has not been formalized and thus not sustainable.

e. Agricultural Research : A research division with minor sub-stations has been established in Swaziland. Recently, efforts have been made to review the Agricultural Research Division. Whether or not, the recommendations have been implemented is not known. The review of the division revealed that the research division needed adequate funding to conduct basic and applied research and to train more personnel (Dube, 2000)

Summary and Recommendations

Given that food shortage continues to be topical in Swaziland, the country needs to consider a holistic approach to tackling the food crisis. A holistic approach is needed in order to ensure that all the key necessary factors in agricultural development are considered. There is no argument that the challenges and opportunities to increase food production cannot be overemphasized. The selected technological innovations and interventions need to be further analyzed in order to get their maximum influence on the agricultural sector. Studies by Dlamini and Dube (1993) on tractor hire service have revealed that this unit if properly managed could impact agricultural production. Burt and Styles (1999) stated that proper irrigation practices could make a significant difference on food production. Finally, Africa's call for drawing lessons from the successes and failures of the Green Revolution could make a difference in food production.

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Tanzania *(Reviewer: Omari Mponda, November 2003)*

1. Basic Indicators

Population:	35.2 millon
Area:	945 087 km^2
Mainland;	942 626 km^2
Zanzibar	2 461 km^2
GDP:	9.4 billion $
GNP per capita:	$ 277
GNP growth rate:	0.3
Life expectancy:	44
Adult Literacy:Male:	84%
Female:	67%

2. AGRICULTURAL SYTEMS:

Currently our country has been divided into 7 Agro-ecological zones with major crops: Tobacco Cashew Coffee Cotton Tea Maize Rice Cassava Sorghum
Beans

Water resource: Tanzanian renewable water resources amount to about 80 km^3/year, of which 30 km^3 is groundwater. Tanzania has three major lakes (Victoria, Tanganyika and Nyasa). Major rivers include Rufiji, and Ruvuma

Total land potential for irrigation is 2% (828 000 ha) of cultivatable land.
Fertiliser deposit: Minjingu Phosphates and Panda in Arusha and Mbeya respectively.

Mineral deposit: Mchuchuma Iron ore in Iringa, Kahama and Geita Gold mines, Mererani Tanzanite mines, Songosongo and Mnazi-Bay Natural gas

Value added in Agriculture (% of GDP) 45
Food surplus/deficity – 10% decline and 77, 489 tonnes deficity, 1.94 million people needs food assistance.

Demographic profile: Total population 35.1%, population growth 3.1%, urban population 32.3%, population under age of 15 45%, population over age of 65 2.4%, Total fertility rate per woman 5.5, Physician per 100,000 people 4 (1990-99)
Economic profile: GDP 9 US$ billions, GDP (PPP US$ billions 17.6, GDP per capita (PPP US$) 523

4. Agricultural Science and Technology Institutions
The country divided into 7 Agricultural Research Zones, Total 25 Research and Extension (Agriculture, marine, animal), Agricultural Research Institutes conducting adaptive research and On-farm research. Various NGOs and CBOs participate in Agricultural Research and extension. Farmers Linked through District Councils. International communities- FAO, ICRISAT, SIDA, CYMMIT and others.

5. Infrastructure for agriculture and rural development

Development assistance –as % of GDP	11.6%
Public health expenditure as % of GDP	1.3%

6. Policies for Sustainable Modernization of Agriculture and Rural Transformation

Long term "Tanzania Development Vision 2025" (TDV) and mid-term Poverty Reduction Strategy Paper (PRSP) identify agriculture as a priority sector critical to poverty reduction. In phase with TDV and PRSP, in 2001, the Government approved the Agricultural Sector Development Strategy (ASDS) which was developed through a broad stakeholders' consultation process. The overall objective of ASDS is to create an enabling environment to improve agricultural productivity and profitability, improve farm incomes, reduce rural poverty and ensure household food security. To achieve its ambitious poverty reduction and food security targets, Tanzania will need a dynamic agriculture with sustained growth rates of about 5% a year.

The ASDS provides an opportunity for the public sector to operate more efficiently. In terms of organizations, the ASDS advocates private/public sector partnerships. It supports the growth of small-scale farmers' associations and professional institutions, and calls for improving the dialogue between the private and public sectors on ways to increase efficiency and to expand the sector. Good leadership, governance, and effective partnership are needed with the private and public sectors, and with development partners, both within the sector and with other sectors. The Government is about to launch the Agricultural Sector Development Programme (ASDP) to implement the strategy. The ASDP will provide a flexible mechanism for overall coordination and prioritization, and a forum for sharing experience and resolving implementation issues. Overall, the primary function of the ASDP is to bring public and private stakeholders together to implement, in a coordinated manner, the ASDS.

Zambia *(Reviewer: Wilson Mazimba, November 2003)*

1. Basic Indicators

The Republic of Zambia is a land-locked state occupying elevated plateau country in south-central Africa. Zambia has an area of 752,614sq km(290,586) sq miles). The country is irregularly shaped, and shares a boundary with no fewer than eight other countries. For many years the line of rail' extending south from the Copperbelt, through Lusaka, to the Victoria Falls has been the major focus of economic activity.

Zambia's population density of 10.7 inhabitants per sq km is low, by African standards, for the state, which contains no truly arid area. However, this average figure is misleading, for Zambia is the third most urbanized country in mainland black Africa, with 41% of its population. GDP (US $): $8.5 billion (2001 est.) Principal exports and value (US $): $876 million f.o.b. (2001 est.): copper 55%, cobalt, electricity, tobacco, flowers, cotton. Value of imports (US **$):** $12.05 billion f.o.b. (2001 est.): machinery, transportation equipment, petroleum products, electricity, fertilizer; foodstuffs, clothing. Value of exports to COMESA countries (Million US $): 87.59 (2001). Value of imports from COMESA countries (Million US $**):** 139.49 (2001. The life expectancy is estimated at 59, adult literacy for both male and female

Scor/10

2. Agricultural System

Zambia's topography, with its variations in elevation, enables a variety of crops to be grown, although only about 10% of the surface area is cultivable. The principal crops are maize, sugar cane, sunflower, cassava, millet, beans, sorghum, groundnuts, cotton, tobacco, rice, wheat, arabica coffee and horticultural products. A number of lakes and rivers, particularly those in the Northern Province and at Lake Kariba on the southern border, offer considerable potential for fishing. Zambia has 295,000 sq. km of forest land, of which 265,000 sq km are open to exploitation. Commercial forestry is important on the Copperbelt, where there are numerous soft wood tree plantations, and in the hardwood areas of the southwest.
Zambia has a few hundred large commercial farms, situated mostly near the rail lines, which account for about 45% of the country agricultural output. The number of smallholders who cultivate cash crops is increasing, while most subsidence farmers in all parts of the country use traditional methods, without adequate inputs or infrastructural support Agriculture accounted for 11% of gross domestic product(GDP) in 1970 and 16% of GDP in 1991. Food production per capita remained static throughout the 1980s, even registering a decline of 0.7%. The agricultural sector is frequently affected by drought, but increased by an annual average of 2.1% in 1970-80 and by an annual average of 3.3% in 1980-91.
Production of maize(the staple food of most Zambians) exhibited a remarkable recovery after a particularly severe drought in 1991/92. Output in 1992/93(year ending 30 April) amounted to record level of 12 m bags(compared with just 1 m in 1993/04. National consumption is about 13 million bags per year.

Wheat is grown almost exclusively on large commercial farms, usually under irrigation. Production increased from 37,000 metric tons in 1988 to 47,000 tons in 1989, and to 54,500 tons in 1990. The country's flour mills, however, require 200,000 tons per annum to keep the nation supplied with bread. Zambia has the potential to meet much more of its wheat requirements from local production.

The livestock sector suffered as a result of the drought in 1991/92, when a higher number of animals were slaughtered than in most years; in 1992/3, however, herds began to reach normal levels. A small amount of beef is generally exported. Food and mouth disease constitutes a problem in some areas of the country.

The table 1 provides the population of livestock (FAO estimates,'000 head, year ending September

	1990	1991
Cattle	2,800	3,045
Sheep	55	65
Goata	520	540
Pigs	220	230

Table 2 below shows the principal crops('000 metric tons)

Crop	1990	91
Wheat	52	68
Rice(paddy)	9	14
Maize	1,845	1,350
Sorghum	20	40
Millet	32	37
Sugar cane	1,340	1,350
Sweet potatoes	27	28
Cassava(Manioc)	260	270
Pulses	14	17
Onions(dry)	29	30
Tomatoes	29	30
Soy beans	27	61
Sunflower seed	20	23
Groundnut in shell	25	45
Cotton seeds	20	44
Cotton lint	10	25
Tobacco(leaves)	4	5

With regard to the agro-ecological zones, Zambia has three agro-ecological zones based on the amount of rainfall. The zones are classified as High rainfall, Medium rainfalls and low rainfall. The country has huge deposit of fertilizers (Phosphate) in the Copperbelt. Currently the country is involved in the manufacturing of fertilizers NPK for the small-scale industry. Zambia become self- sufficient in hydro-electric power in 1974 and began exporting power to Zimbabwe and CongoDr. In that year a major expansion of output from Kafue Gorge resulted in an increase of 82% in domestic energy production. Long delays occurred in the construction of the Kariba North power station, but 150 MW of capacity were operational by 1977, with a further 150 MW for later completion. New 150 MW generators came into service at Kafue Gorge in 1976 and 1977, bringing the facility's total installed capacity to 900 MW. The construction of an additional dam at Itezhi -Tezhi provided a more reliable flow of water to the Kafue Gorge power plant. In addition, Zambia has 45% of the total hydrology of the SADC region. The food surplus for the country this year amounted to 230,000 metric tons, the farming system of the country is well organised and has the necessary technological transfer to improve the food surplus situation. Zambia in the recent years experienced famine due to the drought which affected the southern African region. the country has the potential to export in the horticultural sector, amount to the US$ 350 million per year.

Score /10

3. Farming Communities Score /20

The farming communities are divided into three main categories: small-scale farmers, larger commercial farmers and medium farmers. The first category represents 60% of the entire farming community, while, 20% represents the larger commercial farming communities. Currently most of the farmers are rural based farmers, and constitute almost 60 % of the entire farming communities. Country has tremendous potential to improve its economic base, the macro economic indicators such as exchange rate, rate of inflation and so on are stabilizing over the last year, economic climate is now improving and there is scope for improvement. Education level is also improving with the implication of various NGOs in this sector. The government has embarked on a major program " Education sector reform", the rate of people who are not educated is estimated 50% particularly the rural community. The girl child education program has been implemented and this has encouraged a number of girls to go to school. Adult education has also been introduced with community school programmes to help adult individuals to acquire additional skills to improve their lives. With regard to the level of modernization, most of the agriculture products produced are meant for household consumption, most of farmers have limited knowledge on the utilization of the modern agriculture inputs such as fertilizers, pesticides, use of farm equipment's etc. But the traditional agriculture sector is well known by most of the rural dwellers of the country, they know how to conserve seed and other genetic materials for future use. Irrigation is not well developed, most of the farmers require additional capacity building in this area to improve production. Zambia has established agricultural science and technology institutions which might offer scope for technology transfer in the agricultural sector. They have done a lot of research in the agricultural sector. One of the major constraints is the lack of equipment to improve the technical know-how of the skilled manpower, in addition, there is need to improve the training capacity of these institutions if technology is to be transferred to the grass root level. Currently, with the support of donors, research in the agricultural sector is well coordinated with the assistance of the NGOs and CBOs involvement. This offer great scope for technology dissemination to the communities.

45. Infrastructure for Agriculture and Rural Development

Score

Concerning the infrastructure, the country is lacking behind in this area, but with the coming with the new government, efforts are being made to improve the feeders and rural roads for agriculture and rural development. Most of the rural communities have developed their storage capacity but efforts are needed to 6. Policies for Sustainable Modernization of Agriculture and Rural Transformation (SMART) Currently the country is developing an agricultural policy which will address issues of market access, credit and finance for farmers, investment policy, extension etc.

Score /20

Uganda *(Reviewer: Dr Fina Opio, November 2003)*

1. Basic Indicators

Total population	24.7 million
Females:	12.6 million
Males:	12.1 million
Total area:	236,040 Sq Km
Land area:	199,710 Sq Km
Water area:	36,330 Sq. Km
GDP (2002):	Shs. 8.7 trillion
GDP per capita (2002):	UShs. 0.38 million
GDP growth rate: (2002/03):	4.9%
Life expectancy (2002):	44 years
▪ Male:	43 years
▪ Female:	45 years
Adult literacy	
▪ Males:	78%
▪ Females:	57%

2. Agricultural System

Major Cash Crops	*Food Crops*	*Livestock*	*Fish*
Coffee	Beans	Cattle	Capture
Cotton	Banana	Goats	Fisheries
Tea	Cassava		
	Maize		
	Sweet potato		
	Finger millet		
	Sorghum		

Other major resources: Lakes, rivers and streams (Covering 36,000 sq. km)

- Super phosphate deposits
- Gold
- Copper
- Cobalt
- Diamond
- Oil deposits
- Water energy
- Forests
- Game parks and game reserves
- Tourism

Adequacy: Food supply (domestic consumption)
Inadequacy: Food exports
Manufactured goods
Value addition of agro-products
Infrastructure for distribution/marketing

3. Farming communities

- Limited awareness of modern methods
- Low level of education
- Attachment to culture
- Disease prevalence (HIV/AIDS, Malaria)
- Agrarian economy predominates (Subsistence/cash ratio is high)
- Limited use of modern inputs and methods (local varieties, limited use of fertilizer, low levels of mechanization, irrigation and soil management)
- Individual small-scale mode of operation predominates
- Low levels of empowerment (knowledge and material) resulting in poor demand response for mechanization

4. Agricultural Science and Technology

- Strong public research institutions
- Weak and fragmented private research sector
- Weak and ever changing extension education systems
- Wide range of technologies for major crops, natural resources, livestock and fisheries available
- Effective but low utilization of the technologies
- Deliberate and wide application of adaptive/on-on farm research exists
- Strong linkage and partnerships with farmers, NGOs, CBOs and regional and international communities prevail
- Less interaction with private sector.

5. Infrastructure for agricultural and rural development

- Adequate network of feeder roads but poorly maintained and
- Inadequate, fragmented and disorganized market structure information
- Enormous opportunities/potential for storage and agro-processing exist
- Underdeveloped credit/micro finance opportunities
- Very poor access to international markets and weak market intelligence
- Inadequate water, energy and health services
- Good opportunities for primary education but limited and expensive post-primary education

6. **Policies for sustainable modernization of agriculture and rural transformation (SMART**)

- Deliberate and comprehensive policies, strategies and plans for modernization of agriculture available, but with limited implementation
- Few, uncoordinated programmes for agriculture and rural development through agricultural farming systems
- Poor integration with industry, market and inputs
- Budget constraints in agricultural sector predominates
- Farmer communities empowerment by National Agricultural Advisory Services (NAADS) exists

7. Other Comments

- All 7 components (pillars) for Plan for Modernisation of Agriculture (PMA) should be integrated and simultaneously implemented to cause impact on the livelihoods of peasants
- Strong market research should be instituted and implemented
- Value addition should be at the center of agricultural development policy
- A deliberate policy on exports diversification to include reduction of over-reliance on agricultural products should be set up and operationalized.

Kenya, Uganda, Ethiopia *(Reviewer: Takashi Yamano (FASID), November 2003)*

1. Basic Indicators Score /10

Population, Area, GDP, GNP per capita, GNP growth rate, Life Expectancy, Adult Literacy (male, female)

	Kenya	Uganda	Ethiopia
Population	30	22	64
Area (1,000 km^2)	569	200	1,000
Arable Land (1,000 ha)	4,600	5,100	10,712
GDP	10,410	6,248	6,304
GNI per capita	360	310	100
Life Expectancy (1999)	48	42	42
Adult literacy (male & female)	81	66	37
Score 1/10	9	8	6

2. Agricultural System Score /10

- Agroecological zone(s); farming system(s); major crops/livestock/fisheries with large consumption/market - local or export (list up to 10)
- Other major resources/assets available - water, fertilizer deposits, minerals, energy etc
- Adequacy/inadequacy of system: value added in agriculture, food surplus/deficit, famine, food imports/exports etc

Agroecological Zones (Area in ha)

	Kenya	Uganda	Ethiopia
Lowland Tropics	41 (3.3%)		
Dry Mid-altitude	166 (13.3%)		
Dry Transitional	66 (5.3%)		
Moist Transitional	466 (37.5 %)		
Highlands	316 (25.4%)		
Moist Mid Altitude	173 (13.9%)		
	1,244 ha		
Score on zones	7	8	5

Major Crops/Livestock/Fisheries

	Kenya	Uganda	Ethiopia
Cereals	Maize, Wheat, Sorghum	Maize, Banana,	Teff, Maize, Wheat
Cash crops	Coffee, Tea, Sugarcane	Coffee, Tea,	Coffee, Chat,
Vegetables	Skumawiki,		
Root crops	Potatoes, Pulses,		
Livestock	Milk,		Beef,
Fisheries			
Score on crops	8	6	5

Major Resources

	Kenya	Uganda	Ethiopia
Irrigation (% of arable land)	1.87 %	0.18 %	1.77 %
Fertilizer Use (2001) (metric tons)	144,642	5,800	134,913
Fertilizer Use /Arable Land (MT/1,000 HA)	31.4	1.1	12.6

Incidents of droughts Between 1986-98	4 times	1 times	6 time
Score on resources	8	5 (potentially high)	6

Total in this category

	Kenya	Uganda	Ethiopia
Score in 1/10	7.7	6.3	5.3

3. Farming Communities Score /20

- Demographic profile; economic profile; education/culture/awareness of modern methods
- Level of modernization: subsistence/cash ratio, use of modern inputs/methods vs traditional (seeds/genetic materials, fertilizers, mechanization, irrigation, soil/water management etc.)
- Community Organization and Management, empowerment and demand response for modernization

Farming Communities

	Kenya	Uganda	Ethiopia
Demographic profile	High (farmers are educated and eager to adopt new technologies)	Mid (Educated but not aware of new technologies)	Mid (Low education level)
Level of modernization	High –Mid (Hspecially in highlands)	Mid-High (High in western regions, but low in Eastern & North regions)	Low (Depend on traditional production system- Teff does not have HYV)
Community Organization and management	High (Dynamic farmers organizations are emerging)	Mid (Some developments)	Low (Seems confused between old PA systems and new developments)
	16	14	12

4. Agricultural Science and Technology Institutions Score /20

- Capacity of agricultural research, extension and education institutions; existence and development of improved technologies and methods, especially with respect to the major crops, animals and assets; effectiveness and utilization of these technologies in agriculture; adaptive/on-farm research
- Links with farmers, private sector, NGOs and CBOs, and with regional and international communities

Agricultural Research

	Kenya	Uganda	Ethiopia
National Agricultural Research Organizations /Extension	KARI (Strong on Maize)	NARO (?)	EARO (Under funded, divided and poor coordination across regional research organizations)
International Research Organizations	ICRAF (Conducting some research on soil conservation practices) ILRI		IRLI
Links with farmers, NGOs, CBOs			
	16	14	10

5. Infrastructure for Agriculture and Rural Development Score /20

- Feeder/rural road coverage; market infrastructure and information; storage, agro-processing opportunities/linkages; credit and finance; international market access/integration
- Water, energy, communication, education and health services

Infrastructure for Agriculture and Rural Development

	Kenya	Uganda	Ethiopia
Credit from Banks	?	?	?
Credit from Non-banks	Available from Out-grower schemes	No	No
Access to domestic markets	Good (Nairobi and some major cities)	Average (Kampala and a few cities)	Poor (Rural roads are in poor conditions and cities are far away)
Access to International markets	Good (Mombasa)	Poor	Poor
Water	Good in highlands and Western areas, Poor in Eastern & Northern areas	Good	Poor
Energy	Good	Good	Poor (depends on wood)
Communication	Good (Mobile phone connections available)	Good (Mobile phone connections available)	Poor
Education	Good	Good	Poor
Health	Good in general	Good in general	Poor Poor child nutrition
Health (HIV/AIDS)	HIV prevalence 14% (stable)	HIV prevalence 9% (declining)	HIV Prevalence 13% (Potentially Rising)
Score 1/10	17	15	12

6. Policies for Sustainable Modernization of Agriculture and Rural Transformation (SMART)

Score /20

- Existence/implementation of agricultural modernization vision, stance, policies, strategies, and plans
- Major agricultural and rural development programs/projects/modernized farming systems
- Integration with industry, markets and inputs
- Investments/budgets for agriculture (local, foreign); investments in research, extension, education for agriculture and natural resource management
- Empowerment of farmer communities - e.g. via land tenure, democratization, liberalization, decentralization, participation, communication, voice/articulation of needs and constraints, prospects, plans and accountability etc.

Infrastructure for Agriculture and Rural Development

	Kenya	Uganda	Ethiopia
Modernization Strategies	Positive since January 2003	Positive	
Integration with Industry	Good with Coffee, Tea, sugarcane, and vegetable industries	No strong industry	No strong industry
Investments			
Empowerment	Good	Good	Poor (Very much top-down)
	14	13	10

7. Other Comments/References TOTAL /100

Over-all Total

	Kenya	Uganda	Ethiopia
Section 1	9	8	6
Section 2	7.7	6.3	5.3
Section 3	16	14	12
Section 4	16	14	10
Section 5	17	15	12
Section 6	14	13	10
Total in 1/100	79.7	70.3	55.3

India (*Reviewer: Aldas Janaiah, IGIDR, November 2003)*

1. Basic Indicators Score /10

- *Population:* 1.02 Billion (48.4 female; 71.6% rural)
- *Area*: Geographical: 328 million ha (Arable land: 168 million ha)
- *GDP*: US $ 460 Billion (at constant prices of 1995)
- *GNP per capita*: US $ 440
- *GNP growth rate*: 4%
- *Life Expectancy*: 66 years
- *Adult Literacy* (male—20.2%, female—35.1%)

2. Agricultural System Score /10

- *Agro ecological zone(s)*: There are 15 major agro climatic zones with diversified production environments such as arid, semi-arid, humid tropics, semi-humid tropics, coastal lands, semi-temperate, hill areas, etc. However, there are three broad production systems viz., irrigated (40% of total cropped area); rainfed lowlands (18%); and rainfed uplands (52%).
- *Farming system(s)*: Crop-dairying system; crop livestock (goat/sheep raring); crop-poultry system; and rice-fish system
- *Major crops/livestock/fisheries with large consumption/market - local or export (list up to 10)*: Rice, wheat, maize, jowar (sorghum); potato, sunflower, ground nut, gram, mangoes, grapes, banana, coffee, tea, milk & milk products, poultry (both chicken & eggs); and meat of goat and sheep
- *Other major resources/assets available - water, fertilizer deposits, minerals, energy etc:*
  - About 45% of cropped area is irrigated.
  - Average fertilizer use is 101 kg of NPK plant nutrients/ha.
  - Per capita energy use: 4400 KWH per annum (from all sources for all uses)
  - *Electricity use for agriculture*: 500 KWH/ha
  - About 30% of total electricity consumption is for agriculture
- *Adequacy/inadequacy of system: value added in agriculture, food surplus/deficit, famine, and food imports/exports etc* India attained self-sufficiency in food sector in the mid 1980s. At present, it is surplus by 30-40 million tons. India exports about 5-6 million tons of cereals every year. Per capita consumption of food grains: 188 kg/year

3. Farming Communities Score /20

- *Demographic profile*

Population, total	1.02E+09
% Cultivators	31.7
% Agricultural laborers	26.7
Population, female (% of total)	48.389
Rural population	7.27E+08
Rural population (% of total population)	71.6
Life expectancy at birth, female (years)	63.44
Life expectancy at birth, male (years)	62.2

Life expectancy at birth, total (years)	62.80488
Mortality rate, adult, female (per 1,000 female adults)	209
Mortality rate, adult, male (per 1,000 male adults)	222
Mortality rate, infant (per 1,000 live births)	69.2
Mortality rate, under-5 (per 1,000 live births)	87.74
Illiteracy rate, adult female (% of females ages 15 and above)	54.608
Illiteracy rate, adult male (% of males ages 15 and above)	31.643
Illiteracy rate, adult total (% of people ages 15 and above)	42.764
Illiteracy rate, youth female (% of females ages 15-24)	35.179
Illiteracy rate, youth male (% of males ages 15-24)	20.276
Illiteracy rate, youth total (% of people ages 15-24)	27.419
Birth rate, crude (per 1,000 people)	25.33333
Fertility rate, total (births per woman)	3.06

- *Economic profile:*
  - Agriculture's share in GDP is 25%
  - Total food grain production: 200 million tons
  - Total exports: US $ 44
  - Total imports: US $ 50
  - External debt: US $ 101
- *Education/culture/awareness of modern methods*
  - Literacy-adults: 60%
  - Awareness of modern methods: Moderate in Rainfed areas; very good in irrigated areas
- *Level of modernization*
  - Subsistence/cash ratio: About 36% of cropped area is under subsistence farming; and rest 64% is under commercial farming
  - Use of modern inputs/methods vs traditional:
    - About 50% (nearly 90 million ha) of all cropped area is under HYVs;
    - Fertilizer use—101 kg of NPK per ha of plant nutrients;
    - Quantity of certified seeds distributed—1.1 million tons;
    - Number tractors—2.5 million
    - Number of irrigation pump sets—16.5 million;
    - Pesticide use (technical grade)—44, 000 tons (about 240 grams/ha)
    - Cropped area under soil conservation measures: 40 million ha
    - Credit from government sources to the farmers—average—Indian Rs. 3700 / ha.
    - Number of farmers received *kisan* (farmer) credit cards –22 million

- *Community Organization and Management, empowerment and demand response for modernization:*
  - At every block level (for every 30-35 villages) one agricultural extension officer.
  - There are input supply shops at every block level within radius of 8-10 KM—approachable by fairly good roads.
  - One Farm Science Center in each district

4. Agricultural Science and Technology Institutions Score /20

- *Capacity of agricultural research, extension and education institutions;*
  - `Total number of agricultural scientists in public sector are 32,000
  - Number of national agricultural research institutions: 88
  - Number of state agricultural universities is 32 (at least one in every state)
  - Number of PhD degree holders produced in agriculture science every year—1600
  - Number of Post-graduates (M.S.) degree holders produced in agriculture science every year--5000
- *Existence and development of improved technologies and methods, especially with respect to the major crops, animals and assets; effectiveness and utilization of these technologies in agriculture; adaptive/on-farm research*
  - Total 2300 high yielding varieties/hybrids of various crops were released (650 for rice' 300 for wheat)
  - Large number of hybrid cows and buffaloes were developed.
  - Nearly 100% cropped area under irrigated systems are planted to HYVs

- *Links with farmers, private sector, NGOs and CBOs, and with regional and international communities*
  - One farm science center in every district to train farmers.
  - Every agricultural university in each state will spend 20-25% of its budget for farmer-scientist linkage activities (first hand extension)
  - Research stations in the farmers' fields conduct on-farm demonstrations of improved technologies.
  - NGOs get support from R&D system to participate in adaptive research
  - Private-public sector partnership is gaining momentum in exchange of knowledge and materials in agricultural R&D system.

5. Infrastructure for Agriculture and Rural Development Score /20

- *Feeder/rural road coverage:* About 3.0 million kilometers
- *Market infrastructure and information:* There are 7200 regulated markets for providing marketing services on agricultural produce, which were spread all over India.
- *Storage, agro processing opportunities/linkages;* Food Corporation of India, and Central Warehousing Corporation are the public sector agencies that provide storage facilities for keeping agricultural produce during off-season. At state level, state warehousing corporations provide storage facilities to the farmers. They also provide storage facilities to the agro-based processing units to keep raw/finished produce. A large number of private storage facilities are now coming up to meet growing demand for storage needs of farmers as well as processing units.
- *Credit and finance;* There are about 120, 000 branches of various institutional credit agencies are working in India, of which 45% are located in rural areas, meeting credit requirements of farmers. At present, on an average, credit provided by public institutions for agriculture is Rs 3700 per ha.
- *International market access/integration:* India offers a good market for imports, and also provides an opportunity to exports. Indian agriculture market is moderately integrated to the world market –especially after India's entry into WTO.

- *Water, energy, communication, education and health services:*
  - 32% of irrigated area is under canals
  - 30% of irrigated area is under
  - Per capita energy consumption from all sources for all uses: 4400 KWH per annum
  - Number of telephones (land lines) per 1000 persons: 32
  - Number of Cellular phones per 1000 persons: 5
  - Number of personal computers per 1000 persons: 5
  - Number of television sets per 1000 persons: 78
  - Number of universities: 400
  - Number of all hospitals/health centers/dispensaries: 150,000
  - Number of total doctors 520, 000

6. Policies for Sustainable Modernization of Agriculture and Rural Transformation (SMART) Score /20

- *Existence/implementation of agricultural modernization vision, stance, policies, strategies, and plans: Basic components of agricultural policy vision in India are.*
  - Providing price support to make agriculture remunerative
  - Providing market support by procuring food grains at support price.
  - Providing support for agricultural R&D system.
  - Providing production support (subsidies). At present on an average, agriculture subsidy in India is about US $ 53 per ha (or US $ 66 per farmer), as against US $ 129 per ha in USA, US $ 117912 per ha in Japan, and US $ 831 per ha in EU.
  - Providing food grains at reasonable price to the consumer by various state invention measures
- *Major agricultural and rural development programs/projects/modernized farming systems*
  - Frontline Demonstrations Program to popularize modern technologies
  - Watershed projects
  - Soil conservation projects
  - Food for Work Program
  - Self-employment program for rural youth
  - Self-employment program for educated youth

- *Integration with industry, markets and inputs*
  - Seed industry was fairly developed.
  - Sugar, and textile industries are well linked to their crop production.
  - Forward contract in case of sugar
  - Fertilizer industry was well developed to meet domestic requirements.

- *Investments in agriculture:*
  - Budgets for agriculture (local, foreign); Rs. 83 Billion-excluding irrigation & agricultural R&D budget (4% of total budget)
  - Investments in research, extension, education for agriculture and natural resource management: Rs 28 Billion (about 0.30% of agricultural GDP)

- *Empowerment of farmer communities - e.g. via land tenure, democratization, liberalization, decentralization, participation, communication, voice/articulation of needs and constraints, prospects, plans and accountability etc.:*
    - A large number of landless got land after implementation of land reforms since 70s. At present, about 60% of total farmers are so small with less than one ha of farm size, occupying only 15% of total arable land. Most of these small farmers were empowered by land reforms initiated in the 70s.

7. Other Comments/References TOTAL /100

Ghana *(Reviewer: Emmanuel Owusu-Bennoah, November 2003)*

Introduction
The objective of this paper is to give a short country profile on Ghanaian agriculture and its contribution to the economy. The paper concentrates mainly on three themes: Agricultural performance of Ghana, President's Special Initiative and Agricultural research.

Agricultural performance
In most developing countries, including Ghana, agriculture is considered as an engine of growth and research as the spokes, which make the engine to turn. Agriculture constitutes the backbone of the Ghanaian economy. It is considered, as the force behind wealth creation in the country. It dominates with about 36% contribution to Gross Domestic Product (GDP) followed by services with almost 30% and industry about 25%. Cocoa, timber and gold and a few other minerals are the major export commodities. The non-traditional exports which, fetched $401 million in 2000 rose further to a little above $500 in 2002. Agriculture remains the largest employer in Ghana with about 70% of the work force making a livelihood from it. In addition, it is an important source of raw materials for manufacturing; and agriculturally dependent rural households (72% of the population in 1995) form the largest potential domestic market for textiles and other manufactured products from agro-industries.

In Ghana, the agricultural sector is made up of 15 sub-sectors, namely: crops other than cocoa (61% of agricultural GDP), cocoa (14%), livestock (7%), fisheries (5%) and forestry (11%). The non cocoa sub-sector includes: cereals (maize, rice, sorghum and millet); roots and tubers (cassava, yams and coco-yams); industrial crops (tobacco, cotton, kola nuts, oil palm, rubber, groundnuts, copra and sugar cane); horticultural crops (pineapple, mangoes, chili peppers, ginger, lime and oranges) and other crops (plantain, banana, beans, tomatoes, etc). The fisheries sub-sector includes marine and fresh water products. The forestry sub-sector includes well-known tropical timber species such as Odum and Mahogany and hundreds of other well known and lesser-known secondary species.

Smallholder farmers on family-operated farms using rudimentary technology produce about 80% of total agricultural production. Only some of the industrial crops, such as oil palm, rubber, citrus and pineapple are produced on large corporate-managed estates, although smallholders also produce significant shares of these crops, especially oil palm.
In general increases in production have been achieved primarily by farmers using more extensive farming methods (especially more land and labour), and only secondarily by increases in productivity through the application of improved technology (seed and fertilizers).

About 57% of the total land area of Ghana is suitable for agriculture. However, there are indications of land scarcity because of degradation, access and cumbersome land tenure practices.
The need to rapidly transform agriculture in Ghana is underscored by the fact that Ghana's population is expected to increase from 18.6 in 2000 to about 36 million by 2020 and thus reduce agricultural land availability per capita from 0.73 hectares to 0.38 hectares in 2020. However, resource problems such as deforestation, nutrient mining, soil erosion, pest and disease infestation etc can be directly related to increased pressure on land and to intensification of agricultural practices. As these problems continue to increase a balance has to be found between agricultural growth and a sustainable environment. This will make the

traditional shifting cultivation and the limited use of improved technology undesirable from both economic and environmental points of view.

Ghana is also striving to transform its agriculture from virtual subsistence into a highly productive, efficient and responsive sector of the economy. Steps have been taken to significantly change the relative contributions of roots and tubers (40% to 55%) cereals (5% to 10%), industrial crops (1% to 5%), fruits and vegetables (2% to 5%), cocoa (10% to 14%), livestock (7% to 9%) and forestry (no change at 11%) between the period of 1997 and the year 2020. If Ghana succeeds in this effort, the agricultural sector will shift from dependency on roots, tubers, plantains and cocoa to more balanced situation with cereals, fish, livestock, fruits and vegetables making more significant contributions.

Despite a gradually reduced importance of agriculture in the economy, agricultural activities have on the average remained the main source of income and, even more so, employment. Agricultural income amounted to almost 50% in the early stages of economic reforms. Agriculture is predominantly in the poorest segments of the population. For example, the poorest 40% derive almost thee-quarters of their income from farming. Improvement in agriculture will therefore have a positive impact on poverty reduction and enhance the livelihood of a large number of the Ghanaian people. When this happens farmers would be able to save to improve upon the low savings rate of 7-8% of GDP for the whole economy.

The Ghanaian agriculture is mainly rain-fed (less than 10% of the land under cultivation is irrigated). Since subsidies from fertilizer and other agricultural inputs were removed, fertilizer use dipped and Ghana became one of the lowest fertilizer consuming countries in Africa. In 1990 Ghanaian farmers used less than 5 kg of plant nutrient per hectare of arable land as compares with 12 kg in Nigeria, 53 kg in Indonesia and 366kg in Egypt. In per capita terms, a typical farmer used 0.9kg as compared with 6.5kg in Malawi, and a global average of 28.5kg. The low fertilizer use has resulted in nutrient depletion and reduction in productive capacity.

Post-production management has been a major bottleneck in agricultural development in Ghana. Many agricultural commodities tend to be competitive at the farm level but this competitiveness is lost at the wholesale level because of post-production losses and high transportation costs due to underdeveloped infrastructure.

In terms of transportation, head loading is the most popular mode of transport for agricultural produce because of inadequacy of roads and absence of other modes of transport for agricultural commodities. Where it is possible to use vehicles the nature of the road leads to high transport charges. When marketing costs are high they tend to raise prices and lower farm prices.

Apart from underdeveloped infrastructure, market information is scanty to the extent that the existing markets are not integrated and so large disparities in prices exist between major producing centers and major consuming centers for food commodities. This phenomenon has been aggravated by the abolishment of the support price (guaranteed minimum price) for selected commodities that used to be implemented by Ghana Food Distribution Corporation.

Despite its constraints the agriculture sector makes substantial contribution to the economy of Ghana. From 2001 to 2002 agriculture’s contribution to foreign exchange earnings increased

by 15 8%to US$732 million which was 35.5% of the total foreign exchange earner of Ghana for that year. Apart from cocoa, which is a major foreign exchange earner for Ghana, agricultural non-traditional exports have also featured well in the foreign exchange earnings of Ghana. In 2002, agricultural non-traditional exports comprised about 17% of the total of US$504.3 million earned from all non-traditional exports. Horticultural products and fish and sea products dominated the agricultural no-traditional exports.

Presidential Special Initiatives
The recently announced President's Special Initiatives (PSI) are attempts to simulate private enterprises, improve productivity and create jobs in agricultural production and processing. The various initiatives announced are the cassava starch, salt, textiles and garments, oil palm and handicrafts.

The cassava initiative
Ghana has the capacity to transform her cassava industry into a major economic growth pole, on account of the potential of cassavas an industrial raw material. Cassava starch, in either native or modified form, has varied uses in the paper, textile, pharmaceutical, oil-drilling and petrochemical industries. It is also used extensively in food industry. The bye-products are pulp and juice. The pulp is a valued cattle fodder, while the juice can be used as fertilizer. The volume of cassava production in Ghana is estimated at 7million tones per annum, but there is a huge potential to double that. The critical implementation tasks under the PSI on cassava are three-folds:

- enhancing production capacity and efficiency of the cassava crop;
- adding value to the crop by processing into starch, and
- sourcing external markets for cassava starch

The expected outcomes of the Initiative are:

- increased employment
- reduction in poverty and increased wealth in rural areas
- increased foreign exchanges earnings and improvements in the balance of trade

The proposed mechanism for the project is through an innovative farmer-ownership programme called the Corporate Village Enterprise (COVE) scheme. The COVE model is based on the concept of establishing large-scale, export-oriented enterprises, collectively owned by farmers in rural communities, which utilize competitiveness production and processing technologies and are managed by high-calibre professionals with proven managerial and technical expertise.
These enterprises also use labour provided by farmers from within the communities.

Oil Palm initiative
Oil palm has a great potential in Ghana. It has been grown as plantation crop for oil mills and by out-growers who sell their produce to the mill for processing. So far about 250,000 hectares of land are under cultivation, which will be planted under the PSI for oil palm. The Oil Palm Research Institute of the Council for Scientific and Industrial Research has been commissioned to produce high quality oil palm seedlings for sale to farmers. So far an amount of 530 million cedis has been released to the Institutes to support the establishment of 12 oil palm nurseries.

Agricultural research

It has been recognized that without Science and Technology Ghana's agricultural development will be stagnant and the country cannot be competitive in the world market. It is important to increase productivity and reduce cost of production per unit of output to make agriculture competitive and help to reduce poverty and create wealth for the rural people.

To enable application of S&T to agriculture in order to harness the natural resources, a number of agricultural research institutes were established under the auspices of the Council for Scientific and Industrial Research (CSIR).

Over the years the CSIR, the Universities and the Cocoa Research Institute have conducted research and released improved varieties of several agricultural commodities for distribution to farmers and developed improved practices to increase yield on farmers fields. For instance, recently the National Varietal Release Committee released three new varieties and a new rice variety after years of testing and adaptation to climatic and environmental conditions. The cassava varieties have high fresh root yields and are suitable for human consumption with adequate starch content for industrial use. The rice variety can be grown across the country and it is readily acceptable by consumers.

Currently under the Agricultural Services Sub-sector Investment Project (AgSSIP) priority research programs are being funded under the National Agricultural Research System (NARS). The research programmes cover the following: agro-processing, coconut, cotton, fruit crops, leguminous crops, ruminants, non-ruminants, maize, natural resource management, oil palm, ornamental crops, rice, root and tuber crops, sorghum and millet, and vegetable crops.

It is envisaged that the application of technologies such as biotechnology (tissue culture and molecular biology) will be involved in both upstream and downstream research.

It is important to point out that following the restructuring of the Ghanaian research institutes there has been a shift from research solution to innovation outcome. The outcome-oriented research being adopted by institutes involves:

- research as one input into innovation system
- researcher's responsibility extended to encompass outcome
- appreciation of role of end-users and others in innovation system
- starting at the end-point, leading to a demand-driven agenda.

The shift from isolated, self-contained research body with supply-driven focus on generating solutions to increasingly networked, demand-driven research body trying out a number of institutional innovations (own structure, partnerships, etc) and targeting outcomes, not just solutions will, hopefully, contribute to the growth of the Ghanaian agriculture and hence the economy by 2020.

Conclusion

Given the dominance of the agricultural sector in the economy, the strong link between agriculture and rural poverty, it is generally accepted that without significant improvement in the sector's performance, it will be inconceivable that Ghana can achieve its planned

accelerated economic growth with a sustainable growth of 8 % from 2000-2020. The government is however optimistic that with the country's immense agricultural resources and the action being taken to more local and foreign private investment into the agricultural sector in response to demands in the domestic, ECOWAS and international markets, the agricultural growth rate can be increased from the present average of 4% to 6% in the medium term.

Uganda *(Reviewer: Dezi Ngambeki, November 2003)*

1. Basic Indicators **6/10**

2. Agricultural System **7/10**

Exports have fallen; there is corruption; cotton almost on track; some small exports have come up; most things in place; a Green Revolution could easily take off.

3. Farming Communities **12/20**

Farming communities not well equipped, apart from improved seeds where NARO is doing very well for most crops, and a little animal traction. But fertilizer not there, very little irrigation e.g. in Kasese as a scheme, improved methods of weed control is good; very high empowerment and demand for modernization.

4. Agricultural S & T institutions **15/20**

Education very good; agricultural research not bad - was actually very good but is now under review; its current leadership doing well. NGOs very active, good links with farmers; private sector still weak; extension in place - down to subcounties, but not secure in their jobs, so not effective. Neighbouring countries are depending on NARO research - Sudan, Tanzania, Rwanda, Democratic Republic of Congo.

5. Infrastructure **15/20**

Rural road network leading in East Africa; market infrastructure ok; information ok but not reaching farming communities - needs more research on uptake pathways; farmers know information of last season, can still be conned by middlemen who say "things have changed". Market infrastructure for coffee, Irish potatoes and bananas very good. Credit and international market limited.

6. Policies for SMART **9/20**

Plan for Modernization of Agriculture (PMA) exists, but not yet clear to people, both technical and non-technical. Could be a bad policy - should be broken down and simplified, so that people can see how to slot in - This is beginning at some sectoral levels. But when it is sold wholesale like a bible, it loses its power for guidance. Currently no 2 departments can agree. Ministries have different policies, which are not publicized. There is a technical information gap - few documents, paper, electronic, practical, popular. Too much emphasis on Local Councils (LCs) and slogans like "poverty eradication" which is not quite a policy. Ministers, when they officiate at meetings do not have a policy statement to articulate, and some even refuse to talk. These are lost opportunities for policy-making and leadership, because when a minister articulates a policy, people are guided and fall in and know what to do.

TOTAL 64/100

Annex III

Lessons from the Asia's Green Revolution: The Indian Experience

Aldas Janaiah, IGIDR, Mumbai-65 (India)

1. *During first Five Year Plan (1951-55)*: Top priority was given to irrigation projects; and for strengthening S&T (about 50% of budget allocation)
2. Same approach was continued in Second & Third Five Year Plans(1955-65) with more emphasis on large scale industries (Five large fertilizer units were set up)
3. *1961-66*: Serious droughts/famines. Agricultural R&D was given a top priority. About 20 agricultural universities were set up within four years. Many national level institutions were set up.
4. Potential new varieties were developed, but not released due to hue and cry from opponents of GR.
5. Change of political leadership in 1966.
6. Mrs. Indira Gandhi became PM in PM.
7. Mr. C Subramanian was new Agriculture minister
8. Dr M.S. Swaminathan was DG of ICAR-an apex body for agricultural R&D.
9. A major policy decision was taken to go ahead releasing new MVs, and also importing small quantities of new seeds of MVs of Mexican wheat from CIMMYT.
10. Large-scale adoption of MVs of wheat and rice in 1967-68.
11. Yields were doubled. Bumper harvest in 1968.

Key Drivers of GR

- **Technology**
  - *Strong R&D*: About 100 national institutions, and 32 state agricultural universities.
  - Nearly 32,000 scientists are now working in public sector R&D system
  - *MVs:* About 2300 MVs/hybrids of various crops were released.
  - *Improved crop & resource management technologies*
  - *Improved plant protection technologies.*
- **Infrastructure development**
  - Irrigation
  - Rural roads
  - Markets
  - Credit institutions
- **Policy support**
  - Agricultural Price Commission was set up in 1966 to fix MSP for the farmers
  - Food Corporation of India (FCI) was set up in 1966 to purchase farm produce from the farmers at MSP. FCI also distribute food grains from surplus region to deficit region for public distribution system at issues (for consumers). It maintains buffer-stocks to meet any unforeseen situations such as floods, droughts, and any other natural calamities
  - Central Warehousing Corporation was set up to provide storage facilities.
  - Thus, price policy brought in incentives to the farmers and price stabilization to protect the interests of consumers.
  - Nationalization of 14 major scheduled banks in 1966-brought under public sector.
  - 40% of banks' lending is meant for agriculture at subsided interest rates
  - Many rural bank branches were opened—about 160,000 branches

- Subsidized supply of key inputs—fertilizers, farm implants, credit, electricity, irrigation, etc.
- Implementation of various agrarian reforms-1970s
- Initiation of many TOT PROGRAMS

Major Milestones in Indian Agriculture

- *Milestone A: 1966-1985*Green revolution---Cereals
- *Milestone B: 1980-1990*
  - Horticulture development---Fruits & Vegetables
- *Milestone C: 1985-1995*
    - White revolution—Dairy sector
    - Yellow revolution---Oilseed sector
    - Blue revolution---Fisheries sector*Milestone D: The 1990s*

  Period of new advances in agricultural science Some Achievements

(A) Increases in food grain production
(Area: Million ha; Production: Million tons)

	Area		Production	
Crop	1966	2002	1966	2002
Rice	36	44	46	136
Wheat	13	26	10	74
Maize	5	7	5	13
Sorghum	18	10	10	9
Pearl-millet	12	9	4	7
All food grains	115	122	90	260

(B) Increases in oilseeds, fruits, vegetables, milk, egg, and fish production (million tons)

Commodity	1981	2002
Oilseeds	9	23
Fruits	6	16
Vegetables	12	28
Milk	30	83
Eggs (Billion Nos)	13	33
Fish	2.4	58

Major concerns for attaining evergreen revolution in Asia

- Exhaustion of GR tech in the irrigated ecosystem
- Increased pest & disease problem
- Increased pesticide uses—posing health and environmental consequences
- Declining productive capacity of resource-baseNon-availability of drought tolerance MVs-that were developed from the conventional crop improvement methods-for rainfed areas