PROJECT ADAS

DEFYING LIMITS, SURPASSING STANDARDS

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The ADAS project aims in creating Agriculture and Technology Development system that would be used in Arid and Semi-Arid areas in Kenya and other Sub-Saharan countries in Africa. ADAS will be characterized by intensive research and development of innovative systems, rooted in the need to overcome local scarcities of water and arable land. The industry's growth will arise from the close cooperation among researchers, governments, extension agents, farmers and agriculture-related industries, cooperative efforts. These in turn will fostered a market-oriented agribusiness that will exports its agro technology solutions worldwide. The result will be a modern agricultural methods, systems and products in a county (ies) where more than half the area is desert. The project aims to optimize and use dry areas in production of agricultural products.

This project is not only beneficial in terms of increased food production but also production of water to the community (ies) and renewable energy(ies) (i.e. solar system energy that uses an energy source (the sun)) that is consistently available especially in arid and semi-arid areas. It will be a clean source of energy and will not do any damage to the environment and to the nature. Furthermore it will last forever since it uses renewable energy.

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CHAPTER ONE: INTRODUCTION

1.1 OVERVIEW

ADAS agriculture is characterized by high technological level, pressure irrigation systems, automatic and controlled mechanization and high quality seeds and plants. ADAS will be able to meets most of our food requirements through domestic production to produce over 5 million tons of field crops, 1.15 billion liters of milk, 1.6

billion eggs and 1.2 billion flowers for export. The total area of arable land is 99,050 km^2 with 78% under cultivation (FAO). Water scarcity is the main limiting factor in Kenya agriculture; the total area under irrigation in Kenya is estimated at 476,000 acres about 0.033 % of the land is irrigated (Ministry of water and irrigation, 2017). Of the 1,129 million cubic meters (MCM) of water used by agriculture per year (FAO). The Ministry of Agriculture, County governments and Rural Developments are key driver of plans supporting sustainable development and reducing environmental hazards stemming from agriculture.

Along with other government bodies, the Ministry of Agriculture is dedicated to increasing the efficient use of water. However, continued research is required to ensure the success of recycled water in agricultural production. The Ministry is also dedicated to upgrading existing branches of agriculture, such as dairy and poultry farms to make to them more sustainable and less polluting. Biological pest control is being encouraged to reduce pesticide use. Despite the fact that Kenya strengthened its efforts to address sustainable development processes, the risk of soil degradation and desertification is persistent here is a continuous and there is a need to promote soil conservation through programs. At the heart of the agricultural sector is the ability to wisely balance financial incentives, government regulation and free-market forces to improve the agricultural sector and make it more sustainable. In addition the unique climate of Kenya will necessitate close collaboration between government institutions, scientists, farmers, and localized agricultural concerns in order to maximize the growth and sustainability of agricultural output in an area with limited natural resources.

1.2 BACKGROUND INFORMATION

Agriculture is a fundamental human activity, providing human societies with food, clothing, medicine and other useful products as well as a number of vital ecosystem services including biodiversity, soil formation, water regulation, carbon sequestration and more. Since our world population is expected to reach 9.1 billion people by 2050 (UNDP), agricultural production needs to grow accordingly to meet this growing demand; climate change presents a challenge to this, since it has and will continue to seriously affect agriculture. The International Food Policy Research Institute (IFPRI) estimates that climate change could reduce irrigated wheat and rice yields by 30 and 15 percent, respectively (Nelson et al., 2009). The agriculture, forestry and the fisheries sectors are essential to the livelihoods of around 75 percent of the people living in rural areas. Thus, the threat presented by climate change is very significant for the livelihoods of a large share of the worlds' population.

Agriculture and the other land-based sectors are not only impacted by climate change, but are themselves major emitters of greenhouse gases (GHG). About one third of the global emissions can be attributed to the agriculture, forestry and other land use sectors. Agriculture accounts for 13.5 percent and land use change and forestry represent 17.4 percent of all GHG emissions (IPCC, 2007). However, the land-based sectors are also part of the solution for climate change, because they have a high potential for reducing emissions and enhancing carbon sinks. This potential provided through the agriculture, forestry and other land use sectors can make an important contribution to reach the necessary targets for reducing the threat of climate change.

At the beginning of 2010, Mitigation of Climate Change in Agriculture (MICCA) was established at the Food and Agriculture Organization of the United Nations (FAO) to support efforts to mitigate climate change through agriculture in developing countries and to move towards carbon friendly agricultural practices. As one of the first activities under this project, the participation of agricultural activities to mitigate GHGs will be supported.

Kenya has the largest, most diversified economy in East Africa with agriculture being the backbone of the economy and also central to the country's development strategy. More than 75% of Kenyans make some part of their living in agriculture, and the sector accounts for more than a fourth of Kenya's gross domestic product (GDP).

However, agricultural productivity has gradually deteriorated in recent years due to change of preference (society is focused in investment towards Real estate industry and Oil which was recent discovered), despite continuous population growth. Moreover, only about 17 % of Kenyan land is suitable for farming (Ministry of Agriculture, 2017), and in these areas maximum yields have not been achieved, leaving considerable potential for increases in productivity. Since independence, Kenya has made significant investments for the mobilization of water resources, but slightly has marginalized the expansion and modernization of agricultural sector in the context of a harmonious political and integrated agricultural resources management.

In view of the utilized agricultural area which is approximately 9.9 million hectares, distributed in different agro-climatic regions of the country, it is inadequate availability water resources that limit the potential of agricultural production. Dryland areas (or ASALs – arid and semi-arid lands) make up more than 83% of the country, and Northern Kenya constitutes most of this area (NKIF, 2012), other regions include the Rift Valley, Eastern and Coast provinces. They are home to approximately 6 million pastoralists who constitute more than 10% of Kenya's population plus other rangeland users (Kirbride & Grahn 2008:8). NKIF estimates that ASALs are home to almost 30% of Kenya's population. Livestock raised by pastoralists is worth US$800 million per year (AU-IBAR in IIED and SOS Sahel 2010). Pastoralists occupy most of the border areas of Kenya, with pastoral groups straddling borders with Somalia, Ethiopia, Sudan, Uganda and Tanzania. Pastoralists are divided into various ethnic and linguistic groups, ranging from the large and famous groups like the Maasai and the Somali, who number in excess of half a million people each, to small and so far obscure groups numbering a few thousand1 (Umar, 1997).

Kenya's livestock production accounts for 24% of total agricultural output. Over 70% of the country's livestock and 75% of the wildlife are found in the ASALs (Government of Kenya 2005b cited in Orindi et al. 2007). Despite this, pastoralist areas have the highest incidences of poverty and the least access to basic services of any in the country. The highest poverty levels remain in the northern pastoralist districts (Kirbride and Grahn, 2008). Droughts are common in the ASALs, and it has been suggested that they have increased in frequency. The prolonged drought of 2008-9 has been attributed (at least in part) to climate change (Campbell et al., 2009).

1.3 PROBLEM STATEMENT

Kenya's agriculture continues to diminish, and supplies most of the country's food needs, though profitability in export sectors has declined sharply in recent years. Among the numerous problems the crop-growing sectors have contended with since the State was founded, water scarcity remains the principal and growing threat. Nevertheless the ongoing introduction of new water sources, coupled with altered irrigation methods and more water efficient crops, promises long-term security.

By the year 2030 Kenya's population is expected to grow by about a half, over 65.4 million and 85 million by 2050 (United Nations and Euro-monitor International). This will cause huge increases in demand for agricultural produce and products; but urban use of land and water will also increase enormously. The amount of fresh water allocated for agriculture will be reduced radically, by 50%, in 2040. By 2020 it is unlikely to exceed this amount, and may well be considerably less. At the same time, the amount of suitable land available for farming (58,264,600 hectares) will also be some 34% less than at present.

Part of the higher demand notably for field crops (such as cereals, vegetables and sugar) and for milk products, fish and beef will have to be met by increased imports. Nevertheless a substantial part of the additional requirements will have to come from increased domestic production. Sweeping changes like a 28 % increase in the labor force and a reduction in irrigated field crops, such as rice will be required to make water available for growing fruit and vegetables for the local market.

The above is based (with minor updates) on a study by the Government of Kenya ministries ("Agricultural Production Forecast for the year 2030”).

1.4 OBJECTIVES

Considering agriculture and water as a fundamental element of rural development and food security, it is time to make wise choices in use of the unused Arid and Semi-Arid areas through irrigation to maximize food production whereas at the same time minimize water losses, resources that are becoming increasingly rare for increasingly strong demand. The ADAS project regurgitates the need to realize sustainable development by indorsing economic development, environmental sustainability, social annexation and upright governance including peace and safety. The main aim and milestones of ADAS project are as follows:-

1.5 MAIN OBJECTIVES

1.5.1 OBJECTIVE 1: TERMINATION OF THRILLING POVERTY THROUGH AGRICULTURE

Termination of thrilling poverty in all its forms. This includes:-

Child stunting, malnourishment, starvation, and food diffidence.

Goal 1.0. End aggregate income poverty ($1.25 or less per day) and hunger, including accomplishing food security and apt nutrition, and culminating child stunting.

Goal 1.1. Deliver enhanced support for exceedingly vulnerable and Least Developed Counties, to address the structural challenges facing those counties, including violence and conflict.

1.5.2 OBJECTIVE 2: ACCOMPLISH AGRICULTURAL GROWTH WITHIN PLANETARY BORDERS

All countries have sovereignty to development that respects planetary borders, this guarantees sustainable invention and consumption structure, and aids in stabilizing the global population by mid-century.

Goal 2.0. Kenya as a country reaches at least the next income level as defined by the World Bank. E.g. Low Income Countries become at least lower-middle income countries through agricultural production.

Goal 2.1. Kenya reports on its contribution to planetary borders and incorporates her agricultural produce, together with supplementary environmental and social indicators, into extended GDP measures and nationwide accounts.

1.5.3 OBJECTIVE 3: DEVELOP AGRICULTURAL SYSTEMS AND ELEVATE RURAL PROSPERITY (ARID AND SEMI-ARID AREAS)

Develop farming practices, rural infrastructure, and access to resources for food production to upsurge the efficiency of agriculture, livestock, and fisheries, elevate smallholder incomes, reduce environmental effects, stimulate rural opulence, and guarantee resilience to climate change.

Goal 3.0. Guarantee sustainable food production systems with high yields and high efficiency of water, soil nutrients, and energy, supporting nutritious diets with low food losses and waste.

Goal 3.1. Halt forest and wetland conversion to agriculture, protect soil land resources, and ensure that farming systems are resilient to climate change and disasters.

Goal 3.2. Ensure complete access in rural regions to rudimentary resources and infrastructure services (land, water, sanitation, modern energy, transport, mobile and broadband communication, agricultural inputs, and advisory services).

1.6 OTHER OBJECTIVES

1.6.1 OBJECTIVE 4: GUARANTEE EFFECTIVE EDUCATION FOR ALL OFFSPRING AND YOUTH FOR LIFE AND LIVELIHOOD THROUGH AGRICULTURE

All girls and boys complete affordable and high quality early childhood development programs, and primary and secondary education to prepare them for the challenges of modern life and decent livelihoods. All youth and adults have access to continuous lifelong learning to acquire functional literacy, numeracy, and skills to earn a living through decent employment or self-employment (Through Modern Agricultural farming).

Goal 4.0. All girls and boys have equal access to quality education development programs.

Goal 4.1. All girls and boys receive quality primary and secondary education that focuses on learning outcomes and on reducing the dropout rate to zero.

Goal 4.2. Youth unemployment rate is below 10%.

1.6.2 OBJECTIVE 5: REALIZE GENDER EQUALITY, SOCIAL ENCLOSURE, AND HUMAN RIGHTS FOR ALL THROUGH AGRICULTURE

Guarantee gender egalitarianism, human rights, rule of law, and complete access to public services. Diminish relative poverty and other inequalities that cause social omission. Inhibit and eradicate violence and exploitation, especially for women and children.

Goal 5.0. Decrease by half the fraction of households with incomes less than half of the national median income (relative poverty).

Goal 5.1. Avert and eradicate violence against individuals, especially women and Children (women and child labor).

1.6.3 OBJECTIVE 6: EMPOWER COMPREHENSIVE, PRODUCTIVE, AND RESILIENT COUNTIES THROUGH AGRICULTURE

Make all counties socially comprehensive, economically dynamic, environmentally sustainable, secure, and robust to climate change and other risks through agriculture. Develop partaking, accountable, and effective county governance to support rapid and equitable metropolitan transformation.

Goal 6.0. Terminates extreme urban poverty, enlarge employment and productivity, and elevate living standards.

Goal 6.1. Guarantee complete access to a secure and affordable built environment and basic urban services including water, sanitation and waste management and low carbon energy.

Goal 6.2. Safeguard safe air and water quality for all, and integrate reductions in greenhouse gas emissions, efficient land and resource use, and climate and disaster resilience into investments and standards.

1.6.4 OBJECTIVE 7: CURB HUMAN INDUCED CLIMATE CHANGE AND SAFEGUARD SUSTAINABLE ENERGY THROUGH AGRICULTURE

Curb greenhouse gas emissions from energy, industry, agriculture, the built environment, and land use change to ensure a peak of global CO_2 emissions by 2020 and to head off the rapidly growing dangers of climate change. Promote sustainable energy for all.

Goal 7.0. Decarbonize the energy system, ensure clean energy for all, and improve energy efficiency, with targets for 2020, 2030, and 2050.

Goal 7.1. Cut off non energy associated emissions of greenhouse gases through enriched practices in forestry, agriculture, industry and waste management.

Goal 7.2. Adopt incentives, as well as pricing greenhouse gas emissions, to curb climate change and promote technology in Kenya.

1.6.5 OBJECTIVE 8: SAFEGUARD ECOSYSTEM SERVICES AND BIODIVERSITY, AND GUARANTEE NOBLE MANAGEMENT OF WATER AND OTHER NATURAL RESOURCES THROUGH AGRICULTURE

Biodiversity, marine and terrestrial ecosystems of local, regional, and global significance are inventoried, coped, and observed to ensure the prolongation of resilient and adaptive life support systems and to maintain sustainable development. Water and other natural resources are managed sustainably and transparently to sustain inclusive economic and human development.

Goal 8.0. Guarantee resilient and prolific ecosystems by adopting policies and legislation that address drivers of ecosystem deprivation.

Goal 8.1. Partake in and support regional and global engagements to inventory, observe, and protect biomes and environmental commons of regional and global significance and curb trans-boundary environmental destructions, with strong systems in place no later than 2020.

1.6.6 OBJECTIVE 9: TRANSFORM GOVERNANCE FOR SUSTAINABLE AGRICULTURAL GROWTH

The financing of poverty reduction and global public goods including efforts to head off climate change are strengthened and based on a graduated set of global rights and responsibilities

Goal 9.0. Satisfactory domestic and international public finance for ending thrilling poverty, providing global public goods, capacity building, and transferring technologies.

1.6.7 OBJECTIVE 10: ATTAIN HEALTH AND WELLBEING AT ALL AGES THROUGH AGRICULTURE

Realize universal health exposure at every phase of life, with particular prominence on crucial health services, together with reproductive health, to guarantee that all individuals obtain quality health services without distress of financial hardship. All counties in Kenya promote strategies to help people make healthy and sustainable choices concerning physical, activity diet, and other individual or social scopes of health.

Goal 10.0 Guarantee complete access to crucial healthcare through healthy diets.

Goal 10.1 End preventable deaths by reducing child mortality to 20 or fewer deaths /1000 births, maternal mortality to 40 or fewer deaths /100,000 live births, and mortality under 70 years of age from non-communicable diseases by at least 30%.

The project will address the following sub-objectives questions:

i. How can ADAS make Kenyan farming more lucrative and more viable in our generation?
ii. How can consumer characteristics be transformed towards healthier diets and wasting less food?
iii. Will aspiring consumers in Kenya follow the same food consumption model as in the West?
iv. Will Kenya import more food and thus also water, nutrients and energy from other countries?
v. How can Kenya transform her own agriculture to produce enough food in a sustainable and safe manner?
vi. How can Kenya direct more of her economic growth towards rural development and eradicating widespread poverty and malnutrition?
vii. How can Kenya utilize its land and water resources better?
viii. What will be the role of Kenya large scale commercial agriculture development in comparative to smallholder production?

ix. What will be the future role of Kenya counties that still have arable land and water resources that could be tapped? What should be produced there? How?

x. How can the Kenya's double poverty trap of small farms with poor soils be overcome?

xi. Will Kenya rural development and job creation require more consolidation of farms into greater sizes or business entities that could be more productive and sustainable?

xii. How can Kenya's agriculture become an attractive entrepreneurial undertaking, reducing drudgery, reducing unemployment, and getting people women and youth in particular decent and fulfilling work?

xiii. How can biotechnology best contribute to future food and nutritional security and serve the needs of the poor both in Kenya and worldwide?

xiv. To what extent can agro ecological principles be harnessed in soil, plant and pest management, to substitute for and/or improve the efficiency of external inputs?

xv. How much can Kenya's organic agriculture contribute to feeding the world? Where and at what cost?

xvi. How much can Kenya urban farming contribute to feeding the world? Where and at what cost?

xvii. How can ADAS capitalize on the revolutions in genomics, IT, physics, biology, chemistry, and material sciences to take agriculture to a new level in Kenya?

xviii. How can ADAS make the best choices for a sustainable agriculture development path and what should be the role foreign aid in it?

xix. How can ADAS ensure that Kenya agricultural investments are motivated by facts and priority needs rather than political interests?

xx. How can ADAS improve the business climate to encourage more investment and small business development in Kenya? What new mechanisms and incentives can be provided for public, civil society and private sector actors to work more effectively together?

xxi. What could be new, more effective models for agricultural extension?

xxii. What should be the future investment models for agricultural research and development? Do current agreements and laws on plant genetic resources and other intellectual property serve future needs? How can ADAS ensure that intellectual property is honored but also accessible to poorer communities as well as small and medium sized businesses?

All the above sub-objectives can be attained through empowerment of affect counties through support of their county governments.

1.7 SIGNIFICANCE OF THE PROJECT

ADAS offers workable options to improving the environmental performance of agriculture while eradicating poverty and hunger, but demands transformative, simultaneous interpolations along the entire food chain, from production to consumption. It also entails unprecedented, large scale behavior transformation by consumers as well as producers of food. Key elements of a sustainable development pathway for agriculture and food systems are:

1. Shifting in route for healthier diets.
2. Guaranteeing the supply of safe, nutritious food to all through increasing agricultural productivity on existing crop and pasture land and making it more resilient to climatic extremes.
3. Preserving the environment through systems management principles that increase resource efficiency, reduce net carbon emissions and other pollutants associated with agriculture, and improve soils and conserve natural resources.
4. Reducing food losses and waste.
5. New visions and business models for smallholder agriculture and rural development that create economic and job opportunities and make rural areas more attractive places to live.
6. Empowering women along the value chain.
7. Coherent policies at all levels that stimulate behavior change, align all actors, provide secure rights to land and other resources, and incentivize

solutions for sustainable intensification of agriculture and food systems that take advantage of rapid advances in science and technology.

8. Clear goals, targets and indicators that address critical areas of food production and consumption, motivate people and provide a structured approach to guide countries in designing their own development paths for agriculture.
9. Monitoring agriculture and food systems at unprecedented level of detail.
10. Long term vision and investments in capacity building and research.

1.8 Limitations to the Project

Agricultural planning from an environmental perspective must take account of the sustainable use of non-renewable production factors which are in short supply in Kenya water and soil. Land availability in affected counties in the country will be dependent on how much agricultural land is converted to residential, commercial and industrial development. Agriculture contributes to open space by protecting rural landscapes and containing sub/urban sprawl, particularly in the center of the country.

Fresh water is already in short supply today both in terms of quality and quantity. Since Kenya's freshwater potential will be allocated to the growing urban sector in the future, development of marginal water sources and treated wastewater will be essential to supply agricultural needs in the long term. While wastewater can and should be used in agriculture throughout the country, its quality must be upgraded and adapted to each specific use.

CHAPTER TWO: PROJECT DESIGN AND METHODOLOGY

2 Overview

This chapter contains the materials on the project design and the methods of the project implementation, validity of the project, data analysis and reliability of the project design.

The main scope of work in ADAS are:-

1. Research (MB.1)
2. Irrigation(MB.2)
3. Technology(MB.3)

Each scope of work is supported by a major pillar that is ***education.***

ADAS project has four dimensions:

- **Supply**: availability of enough food from diverse sources to meet the consumption needs of a healthy and nutritious diets, by either feeding oneself directly from productive land or other natural resources, or well-functioning distribution, processing and market systems(Farmers don't have to struggle for

  market as ADAS finds market farmers produce and sells there produce on behalf of the farmers).

- **Access**: all members of society must have economic and physical access to sufficient food for a healthy and nutritious diet, through their incomes or special programs (ADAS distributes the agricultural produce).
- **Utilization**: people must be able to absorb the food's nutrients. This involves sufficient intake, diverse diets, good food preparation, intra-household distribution of food, access to clean water and sanitation, and freedom from diseases and toxins that affect food utilization.
- **Stability**: year round and year-to-year stability of the food supply, as well as access and utilization of safe and nutritious food provides the foundation of food and nutritional security.

2.1 Project design

2.1.1 Strategic Plans for the Project

ADAS is in the process of defining a tactical plan and comprehensive structure for agricultural and rural sustainable development, while preserving the rural landscape and maintaining environmental values. The following strategies are incorporated for the plan:-

a) Efficient use of resources and materials in agricultural activity (GB-1).
b) Reduction of both degradable and non-degradable waste (GB-2).
c) Reduction of agriculture related hazards and damage to the environment (GB-3).

d) Preservation of agricultural land and open space, and maintaining the culture and landscape values of agriculture (GB-4).

e) Preservation of the nature/agriculture balance (GB-5).

f) Efficient use of land and resources for rural development (GB-6).

g) Preservation of the unique rural character of agricultural communities (GB-7).

h) Maintaining rural open space as "green lungs" for the benefit of urban communities (GB-8).

i) Promotion of sustainable development in accordance with national concepts and international agreements (GB-9).

j) Incorporating sustainable development principles into purchasing contracts among farmers and by the Ministry (GB-10).

k) Ensure that all investment and economic development protects the environment and delivers maximum benefits to communities in these region and to the country. This includes developing an investment framework and appropriate mechanisms channel a fixed percentage of the proceeds from resources directly to local communities (GB-11).

Sustainable development for agriculture refers to the wise use of irreversible resources (land, water, energy) and minimizing the adverse environmental impact of manmade resources used in agricultural production (fertilizers, pesticides, non-degradable materials). It includes reducing the use, replacing, and improving these resources as well as treatment for additional agricultural byproducts.

2.1.2 Concrete Actions and Specific Progress

The following sections highlight new effective policies and programs to promote sustainable agriculture in Kenya.

Strategic Policy to Prevent Land Degradation and Promote Soil Conservation Techniques ***(C2-2-1.2.1).***

The implementation of the mechanism will be carried out in stages and includes the following elements:-

- Creating a long term agreement (5-10 years) with farmers who are obligated to cultivate an area defined by drainage basins.
- Creating a leading organizational system (as part of an already existing organized body) that will act as an inter-ministerial steering committee.
- Creating a strong, professional system for instruction, learning and application. Building a mechanism for incentives, fines and compensation.
- Specific financial support for the following:

• Infrastructure (irrigation systems, strategic landscape planting, surface drainage planning, Etc.).

• Soil conservation strategies especially in hilly areas ***(C2-2-1.2.2).***

• Land enrichment ***(C2-2-1.2.2).***

• Budget support for professional agronomic assistance.

• Subsidized purchase of specialized agro-technical farm machinery.

From its inception, ADAS will connect farmers directly with specialist and make a strong societal commitment to supporting science and technology. This will be manifested in several activities relevant to agricultural boost. For example, the flourishing of agriculture in the country's semi-arid and hyper-arid regions, concentrated investment in research related to salt and drought-resistant plant species, animal husbandry for extreme climates as well as green/hot house technologies and aquaculture.

Access to New Technology and New Farming Techniques ***(C2-2-1.2.3).***

2.1.3 Research on Wastewater Reuse

Impact Assessment of Reuse of Reclaimed Wastewater ***(C2-2-1.3.1).***

In order to properly appraise the long term effects of the use of reclaimed water, the Soil and Water ADAS will run a survey, which examines the effects of reclaimed waters on soil. This follow-up includes tests on water, soil and plant in fruits throughout the counties. The survey is part of the ADAS extensive effort to promote the use of high quality reclaimed water while examining its impact on agricultural activity. The survey is incorporated into research on reclaimed water that is part of a wider research effort sponsored by the chief scientist of the project. In addition, the interim findings are utilized in agricultural extension training for farmers.

Plan to Treat Discharged Fish Farm Waters ***(C2-2-1.3.2).***

2.1.4 Agricultural Waste

While agricultural wastes are known as sources of water, air and land pollution, much of the organic waste can be converted into environmentally and economically profitable products. The following sections describe successful efforts in treating agricultural waste.

Regional Solutions to Agricultural Wastes ***(C2-2-1.4.1).***

Dairy Farm Reform ***(C2-2-1.4.2).***

2.1.5 Reducing Agriculture Waste

Ban on Burning Plant Waste ***(C2-2-1.5.1).***

Expanding the Use of Organic Waste in Agriculture ***(C2-2-1.5.2).***

2.1.6 Integrated Pest Management

A gradual transition from traditional chemical pest control to integrated methods is the growing professional trend in plant protection. Pesticide use can be minimized, thereby minimizing adverse health effects, environmental damage and the development of pest resistance. In principle, this is done in the field by promoting three levels of pest control:

i. Supervised
ii. Integrated
iii. Biological

The main goals may be summed up as follows:

Strategic use of pesticides as well as other means of pest control while striving to reduce the use of pesticides in agricultural areas.

Expand areas that implement an integrated pest management policy.

Emphasize growing of produce that complies with international export market standards.

Biological Pest Control in Agriculture ***(C2-2-1.6.1).***

Nationwide Raptor Program for Biological Pest Control ***(C2-2-1.6.2).***

2.1.7 Subsidies to Promote Sustainable Agriculture

Regulation, Subsidies and Economics ***(C2-2-1.7.1).***

With regards to "regulatory strategy", despite the enforcement authority it holds, ADAS with the help of Ministry of Agriculture's will try as much as possible to avoid controls and regulatory dynamics with farmers and prefers to engage them in "voluntary" control efforts through subsidies and economic incentives.

Regulatory Agrarian Reform for Agricultural Cooperatives ***(C2-2-1.7.2).***

- Zoning Map Defining Priority Areas for Agricultural Assistance ***(C2-2-1.7.3).***
- Grants for Sustainable Practices ***(C2-2-1.7.4).***
- Farmer Subsidy Baskets ***(C2-2-1.7.5).***

A plan has been formulated to encourage the cultivation of open agricultural land that contributes to the conservation of environmental and landscape values. ADAS will provide direct budgetary support to encourage the maintenance of these open spaces by creating a permanent safety net against sharp fluctuations in farm income that typify certain agronomic activities. Financial Support will be made available per farming size unit in three areas:

- Cattle and herd breeding throughout the country.
- Non-irrigated crops, especially in the Northern part of the country and desert areas and in drought affected areas.

2.1.8 Advanced (Subsurface) Drip Irrigation for Arid and Semi-Arid Soils (MB.2)

Water is undoubtedly the key to much of Kenya's success in agriculture. The most conspicuous technology in this regard is the ubiquitous surface drip irrigation developed in Israel, will be used to enabled farmers to increase crop yield and quality while using less water and fertilizers in semiarid and dry sub-humid zones. The new generation of irrigation technology involves subsurface drip irrigation (SDI), where the irrigation can be applied below the soil surface. This result in even higher levels of water use efficiency through reduced runoff, evaporation and other parameters, and provides nutrients to plants while maintaining a dry soil surface.

3 Solutions available for action

3.1 More nutritious staple food crops

A few staple food crops dominate the food intake of 2 billion people suffering from undernourishment caused by iron, zinc, vitamin A and other deficiencies. Achieving better nutritional balance involves a wide range of measures, diversification of agricultural systems (crops, livestock and fish products), external mineral and vitamin supply, optimal feeding and caring practices, breeding of more nutritious crops, agronomic bio fortification, and other measures.

3.2 Nutrient management and stewardship through science and local solutions

Improving nutrient management is a central element in meeting the challenge to increase food production, increase farm incomes, improve soil quality, reduce nutrient losses to the environment and protect natural ecosystems.

ADAS seeks to invest in solutions initiatives that seek to systematically improve nutrient management for increased crop production, sustainability and associated benefits, such as the 4R Nutrient Stewardship and civic education programs.

- 4R Nutrient Stewardship ***(C2-3-2.1)*** and (NS-B)**.**

- Civic Education ***(C2-3-2.2)*** and (CE-B).

3.3 Investing in livestock

3.3.1 Livestock markets

Livestock account for 40% of agricultural GDP in Kenya and four of the five highest traded agricultural commodities are livestock products, but the sector underperforms in terms of its contribution to food security, poverty reduction and livelihoods of smallholder producers. By investing in promotion of livestock enterprises and value chain development, national governments and the donor community will pave the way for the emergence of a livestock industry that will sustainably respond to national food security needs while staying inclusive of small livestock keepers. ADAS strategies in promoting enterprise and value chain development will address four main constraints:

1) Strengthening the institutions governing livestock product value chains

2) Consolidating the enabling environment for livestock businesses.

3) Implementing targeted public incentives to encourage investment in livestock enterprises.

4) Developing the business management capacities of livestock value chain stakeholders.

Doubling livestock productivity with better use of crop residues ***(C2-3-3.2).***

3.3.2 Livestock vaccines

Medical and veterinary vaccine inventions are among the most cost effective disease control interventions ever deployed. They have enabled the global eradication of two lethal diseases, e.g., smallpox in humans (1979) and rinder pest in cattle and wild ungulates (2011). Vaccines against livestock diseases have the power to reduce livestock mortality, sustainably increase productivity, increase food and nutritional security, enhance the livelihoods of the poor and will help county governments and Kenya economy to grow.

3.4 New models for agricultural extension

Many unexploited income, productivity and resource efficiency gaps will be closed through accelerating the transfer of new knowledge and technologies, enhancing access by farmers to markets and formation, facilitating better interaction among farmers and knowledge providers, and assisting farmers and small businesses to develop their own technical, organizational and management skills and practices. ADAS will be in full command of soft facilitation skills, modern decision tools, and information technologies (mobile, smart phones, internet, social media, participatory video, remote sensing, soil and weather data, etc.).

3.4.1 Context specific way out that transcend farming and food systems

Farming systems are complex and highly heterogeneous at all scales, from regional and national. For ADAS to meet farming objectives, solutions and adjustments, strategies are must. ADAS provide practical options for farms that can produce extensive surpluses as wells as for those small farms that support the livelihood of millions in rural areas. Different solutions are requisite for large farms with good market access and high input use (4), small farms with good market access and high input use (3), small farms with weak market access and low input use (2) or larger farms with poor market access (1).

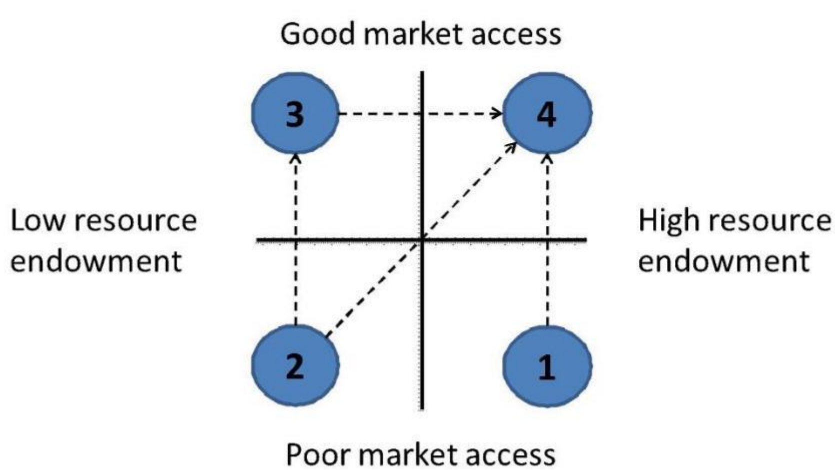

Figure 1. **Resource endowment and access to markets are key determinants for tailoring different solutions to the local context to overcome current constraint sand establish better business models for agriculture.**

ADAS will characterize and segment the market in order to target technologies and policies, and then market better technologies efficiently through modern delivery systems. ADAS will initiate movement away from subjective mapping of factors of theorized importance to a rigorous definition of development and business domains based on quantitative data for resource endowment and market access, to solutions which are flexible in terms of offering a suite of technologies and support systems provided by different sectors in a complementary mode, with a particular prominence on business driven models.

All farmers need to be moved towards good access to inputs, markets, information and other supporting services (Fig. 1). Strategies that provide the needed support base as well as timely market information would lower the barriers for participating in domestic and export markets. Such mechanisms include:

(i) Formation of cooperatives or growers' associations to increase their collective ability for effective negotiation, sharing of the cost of inputs, more efficient dissemination of new ideas and market information to farmers, and reduction of cost of certification.

(ii) Participation in 'out grower' schemes organized by centralized agribusinesses where the smallholder provides land and labor in exchange for technical assistance, credit, inputs, infrastructural support and market knowledge.

(iii) Access to high value crop options, niche markets and the necessary information and technologies for successful production.

(iv) Regional initiatives which help to disseminate technologies, increase smallholders' market leverage and coordinate reliable supplies.

ADAS will work with Governments, civil society, the private sector and international agencies with local extension services and farmers to support the tailoring of ADAS solutions to farmers' needs by improving:

Diagnosis: Understand the context in which an effort or an intervention will be implemented and its links to the best available scientific and local knowledge. *Contextualized principles:* Identify the right economic, social and ecological principles of relevance to farmers' needs.

Getting it right locally: Empower local communities to improve the performance of the farming system or value chain based on scientific principles and local preferences.

Scaling and support: Expand the scope of the effort or intervention (in terms of numbers of people involved and the size of the territory) and create the necessary value chains, services, support systems and self-sustained business models.

Evidence: Monitor and document the performance, and learn to enrich the local, national and global knowledge base to influence policies that will support further implementation.

3.4.2 Solutions for early action

Practical solutions for transforming Kenya agriculture need to address innovation, markets, people, and political leadership. ADAS solutions enables concrete action for change, towards meeting one or more of the goals defined in Chapter 1. ADAS will strive to change the behavior of everyone, from the food producer to the consumer, including politicians and business executives. On the other hand, ADAS will provide new opportunities for people women and youth in particular become part of a new sustainable development movement through attractive job opportunities. That requires equipping people with the knowledge, skills, new tools and information needed to enact change.

ADAS offers an important approach to solving problems through practical initiatives involving new technologies, business models, institutional mechanisms, and policies that are promising for early action, can take place in any county, and can also generate learning elsewhere. During early action ADAS solutions will be integrated initiatives designed and implemented in a specific development or landscape context, in response to the most relevant national and local (regional) challenge domains for agriculture. Nevertheless, ADAS will also recognize those few interventions or innovations that could indeed trigger transformative changes in farming or a whole food chain over a relatively short period.

3.4.3 Key actions for improving nutrient use productivity in food systems

Improving the full - chain Nutrient Use Efficiency (NUE) of nitrogen and phosphorus, defined as the ratio of nutrients in final products to new nutrient inputs, is a central element in meeting the challenge to produce more food and energy with less pollution and better use of available nutrient resources. Nutrient flow is a cycle from resources through stages of use (blue arrows) and recycling (green arrows). The system is driven by the ‘motors’ of human consumption (red), which are thus also a key part of the solutions needed for achieving future nutrient targets. The poorest need to be allowed to increase their food and other nutrient consumption, while the richest must realize that it is not in their own interest to over consume. Possible actions include:

1) Improve NUE in crop production
2) Improve NUE in animal production
3) Increase the fertilizer equivalence value of animal manure
4) Low emission combustion and energy efficient systems

5) Develop NO_x capture and utilization technology

6) Improve efficiency in the fertilizer and food supply and reduce food waste

7) Recycle N and P from waste water systems

8) Energy and transport saving

9) Lower personal consumption of animal protein

10) Spatial and temporal optimization of nutrient flows.

Of the 10 solutions proposed, the first three are directly related to agricultural systems management.

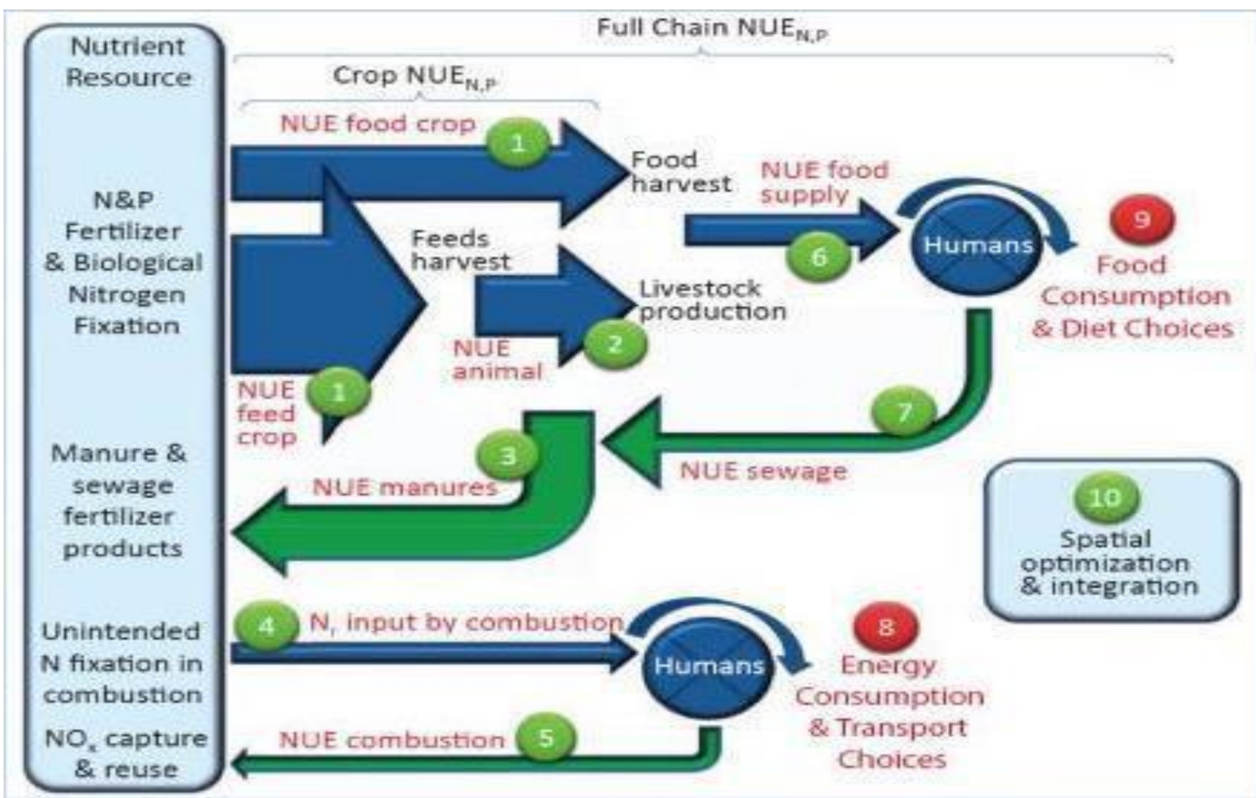

Figure 2. **Sutton, M.A.** ***et al. Our nutrient world: the challenge to produce more food and energy with less pollution*****.**

(Center for Ecology and Hydrology, Global Partnership on Nutrient Management, INI, Edinburgh, 2012).

3.5 New, productive crop varieties for the poor

Crop yield growth rates in many smallholder farms remain too low and farmers often experience periods of food or income insecurity due to yield losses caused by abiotic and biotic stresses. Every farmer should have access to affordable, quality seed from a

wide range of well adapted crop varieties or hybrids, from its 4^{th} year henceforth ADAS will provide free seeds and seedlings to the farmers of ADAS recommended crops.

ADAS through seed laws and policies will enable and support a vibrant public and private seed system, including many small and medium size companies and seed producer groups. ADAS through a well-coordinated global crop improvement networks can further accelerate progress in genetic gain by increasing the resolution and precision of environmental information, working across key domains and hotspots for a range of biotic, abiotic, and socioeconomic constraints, and sharing knowledge, genetic and other resources in 'open source' breeding platforms. Thus enabling farmers countrywide to increase yields and reduce the risk of yield losses due to drought, high temperatures, flooding, salinity, diseases and insect pests.

3.6 Micro irrigation for smallholder farmers

Many smallholder farms in Kenya are trapped in poverty and experience periods of food insecurity due to low cropping intensity and productivity caused by water stress. ADAS irrigation project section will be key entry point for doubling or tripling crop yields and enabling diversification of cropping systems. Large scale irrigation systems are capital intensive and restricted to lowland areas with suitable conditions in Kenya but with ADAS we will be able to extend to arid and semi-arid areas, ADAS will offer free water drilling services to communities. Micro irrigation technologies, on the other hand, will be customized to meet the needs of small farmers operating in diverse environments with limited capital. Micro irrigation systems that precisely deliver water, nutrients and other inputs directly to the root zone, resulting in high yields and high efficiency of these inputs. These systems can also supply clean drinking water. Utility models used will provide the electricity needed for irrigation pumps, as well as local households, schools, and small village enterprises, including processing or storing of food. Demonstrated impacts include improved food security and nutrition, increased incomes, reduced poverty, and new local business opportunities and jobs.

3.7 Climate smart-Tech agriculture

Climate Smart-Tech Agriculture is not a single, specific agricultural technology or practice that will be universally applied. It is an approach that will require site specific assessments to identify suitable agricultural technologies and practices that aim to increase productivity in an environmentally and socially sustainable way, strengthen farmers' resilience to climate change, and reduce agriculture's contribution to climate change by reducing GHG emissions and sequestering more carbon. Typical ADAS investment areas include

a) Implementation of sustainable land management practices,

b) Climate risk management and

c) Transformation of whole production systems.

Innovative policy instruments and financing mechanisms that link investments from the public and private sectors are key components for implementation. ADAS includes activities that communities, villages, districts and higher government levels will take, for example to provide a backup in case of crop or animal production failures. Implementing ADAS approaches will involve climate smart interventions that are highly location specific and knowledge intensive. Considerable efforts will be channeled to develop the knowledge and capacities of a wide range of farmers.

3.8 Increasing resilience to pests and diseases

As cropping systems intensify, the potential for losses due to insects, diseases and weeds (together termed "pests" hereafter) will increase if it is not actively managed. This may be exacerbated by the increased climate variability that is predicted over the next four decades, which could favor the rapid buildup of pests and disease populations. Pest risk will be compounded by increased movement of humans, food and natural products among counties. Over the past four decades, integrated pest management (IPM) has emerged as a widely accepted approach to manage pests using host plant resistance combined with cultural, biological and chemical control methods. Most importantly, input suppliers, extension professionals and farmers will be trained well in all aspects of modern pest management, including pesticide stewardship through crop protection stewardship to minimize environmental or health risks.

3.9 Innovative smallholder technologies to increase crop value, reduce postharvest losses, and improve food safety ***(C2-3-9).***

3.10 New business models for smallholder farming and marketing

Where structural transformation processes in urban and rural areas proceed rapidly, traditional smallholder farming will more and more be supplemented or replaced with outsourcing of farming operations, the formation of small and medium size farmer cooperatives or agribusiness enterprises, and contract farming. Value chains for major agricultural commodities will become more tightly integrated because processors and consumers demand more information and control over how food is being produced. For farmers this will be a chance to connect with rapidly growing domestic and export markets and thus become more direct beneficiaries of competitive food systems. ADAS food industry in particular will increase investments in direct sourcing of agricultural produce from small farmers countrywide, a trend that is expected to continue due to increasing industry and consumer demands for tracing food and meeting certified as well as non-certified production standards (e.g., Good Agricultural Practice and the SAI Platform).

ADAS will link farmers to super- markets and food processing chains and that will lead to substantial income gains for the participating farmers as well as better access to inputs, services and new technologies.

Structural and value chain transformations of this nature will become key vehicles for improving the income of small farmers, creating attractive jobs in rural areas, and providing affordable, safe, nutritious food to urban consumers. They will also provide entry points for reducing food waste, particularly food which perishes between farm and market in the developing world. They are opportunities for solutions that combine food industry and agribusiness development and market competitiveness with the food security and poverty alleviation agenda. More and larger scale pilots will be developed to develop inclusive and sustainable business models for such a transformation of smallholder farming, including good compliance mechanisms.

3.11 Digital agriculture

Digital technologies will be a key enabler to grapple with the complexity of ADAS and taking it to scale. Digitally enabled technologies will drive transparency that in turn supports accountability and ultimately leads to good governance an essential ingredient for development. ADAS governance will embrace the era of digitally enabled exchange of information and learning to accelerate the pace of development, democratize information, and empower farmers, consumers and investors to make informed choices.

3.12 Promoting integrated landscape management

To address the challenges of food insecurity, persistent poverty, climate change, ecosystem degradation and biodiversity loss successfully, it is critical to move beyond zero sum strategies that solve one problem but exacerbate others. "Integrated landscape management" objectives are to realize synergies and reduce trade-offs among these multiple objectives. ADAS will reaching out across traditional sectoral boundaries to forge partnerships with conservation organizations, local governments, businesses and others to solve problems that are inter-connected. However, current institution still sectorally soloed provide weak support for these efforts. In Lari---Kijabe in Kenya, smallholder farmer organizations are partnering with local governments, banks and conservation groups to expand agricultural markets and protect high conservation value forests and watersheds. In the Maasai Steppeland of Tanzania, commercial avocado producers, pastoralists and conservation organizations are partnering to raise incomes and food security, while protecting wildlife. With ADAS integrated landscape management will be more intensify through a global coalition of more than 50 agriculture, environment and development organizations that came together to implement the Landscapes for People, Food and Nature Initiative. The Initiative will advance viable pathways for sustainable development in places where food production, ecosystem health and human wellbeing must be achieved simultaneously. The top priority will be to strengthen the capacity of existing landscape initiatives and mobilize cross-site learning, coordinated investment and documentation. To accelerate the scaling up of integrated landscape approaches, the Initiative will assisting Kenya to put in place supportive policy frameworks, encouraging businesses to pursue sustainable sourcing through landscape partnerships, expanding financing for integrated landscape investments and promoting science and knowledge systems for landscape solutions.

3.13 Monitoring the world's agricultural systems

Effective monitoring networks will be essential to track, anticipate and manage changes in the biophysical, economic, and social aspects of different farming systems around the world. An agricultural monitoring system will be established as a well-designed and well directed network of partners engaged in collecting high quality data required by ADAS and a wide range of farmers in the counties. It would provide up to date information on the status of agriculture and progress towards meeting the agreed future Sustainable Development Goals (SDG) targets, including environmental targets affected by agriculture. An integrated monitoring system will allow scientists, land managers and other decision makers alike to find solutions to the most pressing problems facing Kenya and global food security. It will help direct public and private investments, and would allow for quantification of the multifunctional aspects of agriculture and food systems in a comparable manner across scales.

It will utilize adaptive monitoring and hierarchical design strategies to address specific and new questions or hypotheses, including those that will be subject to much public debate, such as the impacts of genetically modified (GM) crops or tradeoffs of organic agriculture. Universities and International Agricultural Research Centers (Ramat Negev Desert Research Center, SAJOREC, the CGIAR and others), will play a major role in such an effort because they have thousands of experts in various disciplines and thousands of partners on the ground. An interdisciplinary monitoring network will also provide unique, exciting opportunities for students and others to learn about the science and practice of sustainable agriculture. The monitoring work would have to tie in with national statistical agencies, UN agencies and others who collect and analyze data on agriculture and associated and natural ecosystems, to overcome many of the current weaknesses in data coverage and quality.

3.14 ADAS research that will lead to future transformative changes in agriculture and food systems

- Massive discovery of genes' functions by sequencing and phenol-typing the world's collections of wild and domesticated crop and animal species, and using that know how in conventional and biotechnology applications for accelerating next generation crop and animal breeding. The revolutions in biological sciences and information technology have put this exciting opportunity at our fingertips. Potential returns on such investments are huge and broad, including for small farms worldwide.

- Re-engineering crop photosynthesis to increase yields and make crops more resource efficient. Introducing C4 photosynthesis into a C3 crop such as rice could produce 30---50% more yield for the same amount of sunshine, water and nitrogen. The metabolic components already exist in C3 rice plants. However, the anatomical and biochemical features of C4 plants must be understood and transferred to rice plants. This is currently being pursued by a group of scientists from the International Rice Research Institute (IRRI) and advanced institutions around the world in the international C4 Rice Consortium, who hope to construct a functioning C4 rice plant within the next 20 years.

- Genetic improvements to increase the nitrogen use efficiency in non-leguminous crops, including engineering a mechanism for fixing atmospheric N_2 into such crop species. The three major cereals (rice, wheat, maize) account for about 50% of global nitrogen fertilizer consumption. A breakthrough in nitrogen use efficiency of such staple crops would help decouple rising food production from rising fertilizer consumption, and make farming more profitable.

- Cost effective small scale production of ammonia integrated with renewable energy generation to meet local fertilizer supply needs and “store” energy in fertilizer to buffer intermittent supplies of electrical energy..

- Smart fertilizer technologies and genetic improvements that could double the crop recovery efficiency of applied phosphorus fertilizer. Typically, only 20 - 25% of the P applied with fertilizer is recovered by the crop in the first growing season. Although it can be increased through better nutrient management and stewardship programs in low performing areas (arid and semi-arid areas), new technology could enable increasing short or long term phosphorus efficiency. This will be more profitable for farmers, and also reduce the risk of P losses.

- Next generation biofuels and other bioenergy solutions that are more energy efficient, use crop residues and biomass waste, and don’t consume more

  agricultural land or natural ecosystems.

- Environment independent, self-sustained sky farming or other forms of vertical urban agriculture and horticulture, as part of local food chains.

- Semi-autonomous farm robots for precision farming at different scales, including for performing tasks that are difficult, laborious or dangerous to humans.

- Edible, commercially viable 'synthetic' meat grown under controlled, energy efficient conditions to replace livestock products.

- New products made from agricultural by-products and waste, including recycling of chemical elements for other uses.

- Innovative payment and (digital) monitoring schemes for environmental services that incentivize the implementation of high ecological and social standards at

  landscape scale.

- Food market system innovations that can incentivize species and landscape diversity in agriculture, e.g., whole new storage facilities and computerized

  delivery systems for diverse products.

3.15 PROJECT MANAGEMENT

This is a subset of tasks, processes, tools and templates used in combination by the

management team to get insight into the major structural elements of the project in order to initiate, plan, execute, control, monitor, and terminate the project activities throughout the management life-cycle. It involves five main stages; Initiation stage, Planning stage, Execution stage, Control stage and Closure stage.

3.15.1 Initiation stage

At this stage, management of all types of activities going on and need to keep the "whole" thing moving collectively integrating all of the dynamics that takes place. This includes:

Project charter(st-1-01)

Statement of work(st-1-02)

3.15.2 Planning stage

At this stage what takes place is management of

1. Scope of work(st-1.2-00)

    scope management plan(st-1.22-01)

    work breakdown structure or WBS(st-1.2-02/st-1.2-03)

ADAS managing scope is about planning, definition, WBS creation, verification, and control. Defined parameter or scope, and has be broken down and managed through a work breakdown structure or WBS.

2. Time/schedule control

Beginning and a definite ending date(Phase 1, Phase 2, Phase 3)

Phase 1(a)

Set up offices and equipment

Establishment of Research center

Identify and recruit counterpart staff

Agree with partners' priority areas for planning studies

Establishment of land

Convene project steering committee

Hold regular meetings for partners

Undertake planning studies research studies

Convene working groups to undertake studies

Agree with partners priority areas for research studies

Undertake planning studies jointly with the partners

Provision of strategic plans

Development of framework and policy formulation

Phase 1(a)

Identify and recruit farmers

Identify farmers to undertake agricultural studies

Liaison with relevant government departments

Undertake planning studies jointly with the farmers

- Convene farmers to undertake studies
- Make recommendations
- Recommend Changes and Corrective Actions

Phase2

- Project tracking at country level
- Measure According to the Plan
- Project monitoring missions
- Integrated Change Control
- Risk Audits

Joint reviews Donors/Partners

- Report on Performance
- Course review workshops
- Confirm Work Meets Requirements
- External evaluations

Gain Formal Acceptance

Phase3

Lessons Learned

Team Celebration

Final Performance Reporting

Index & Archive Records

Product hand Off from Project to Operational

ADAS project has a definite beginning and a definite ending date. Therefore, there is a need to manage the budgeted time according to a project schedule. Managing time/schedule is about definition, sequencing, resource and duration estimating, schedule development, and schedule control.

3. Costs

Cost Benefits Analysis(st-1.3-01)

cost estimate

budgeting, and control(st-1.3-02)

ADAS project will consume resources, and therefore, there is a need to manage the investment with the realization of creating value (i.e., the benefits derived exceed the amount spent). Managing costs is about resource planning, cost estimating, budgeting, and control.

4. Human resources (project team(s) during the life cycle of the project. hiring, and developing and managing a project team),

ADAS project will consist of teams and there will be need to manage project team(s) during the life cycle of the project. Finding the right people, managing their outputs, and keeping them on schedule is a big part of managing a project. Managing human resources is about human resources planning, hiring, and developing and managing a project team.

5. Communication

Communication plan and conference planning(st-1.5-01/st-1.5-02) ADAS project invariably touch lots of people, not just the end users (customers) who benefit directly from the project outcomes. This can include project participants, managers who oversee the project, and external stakeholders who have an interest in the success of the project. Managing communication is about communications planning, information distribution, performance reporting, and stakeholder management.

6. Risk

risk matrix (st-1.6-01)

Risk Management Plan(st-1.6-02)

Risk management Process(st-1.6-03)

Identify all foreseeable risks. Common risks include unrealistic time and cost estimates, customer review cycle, budget cuts, changing requirements, and lack of committed resources.

MODEL

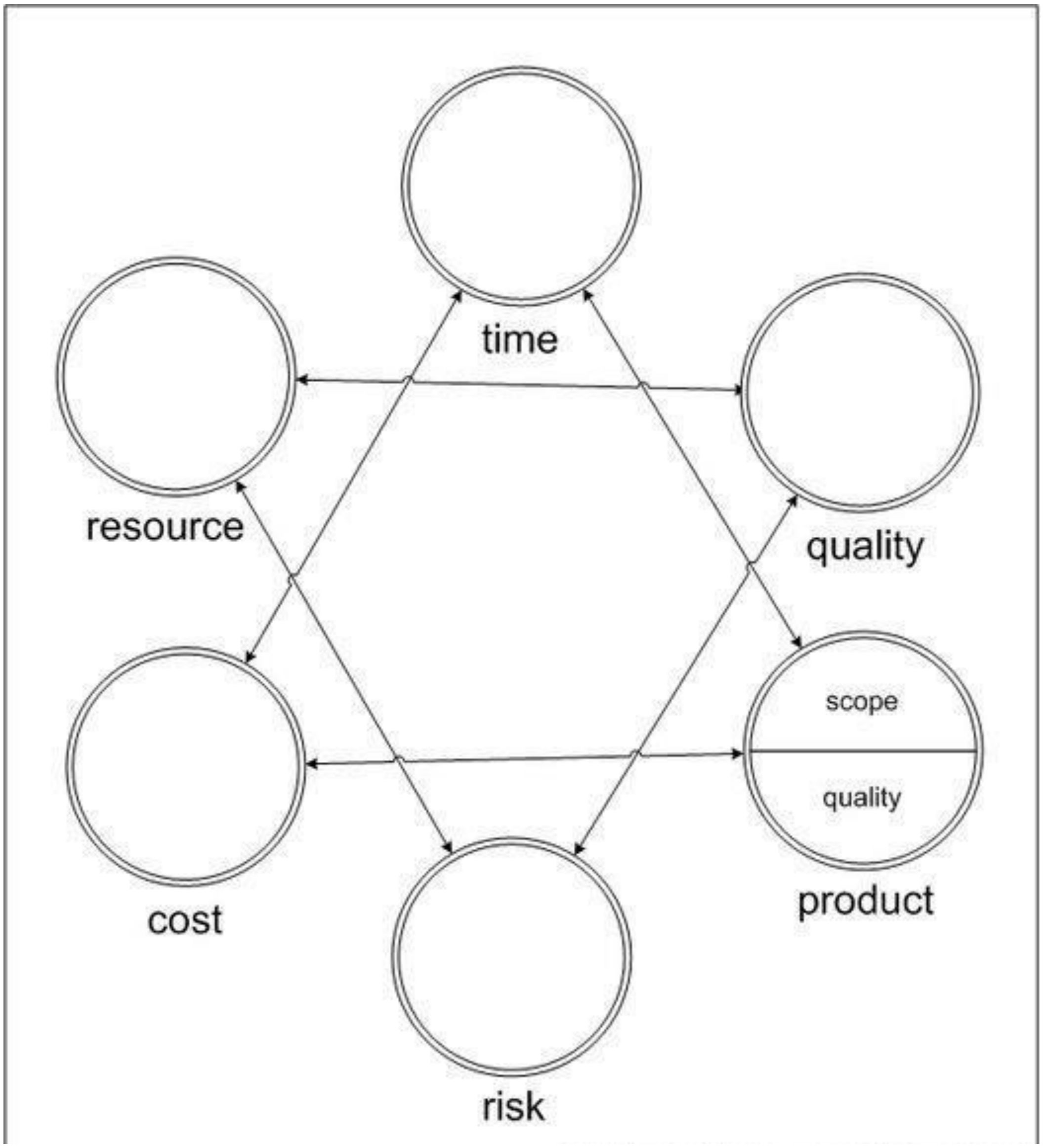

Fig 10.0 model representation of planning stage.

3.15.3 Execution and Control

Tasks completed during the Execution and Control Phase include:

Develop team

Assign resources

Execute project management plans

Procurement management if needed

Set up tracking systems

Task assignments are executed

Status meetings

Update project schedule

Modify project plans as needed

PM directs and manages project execution

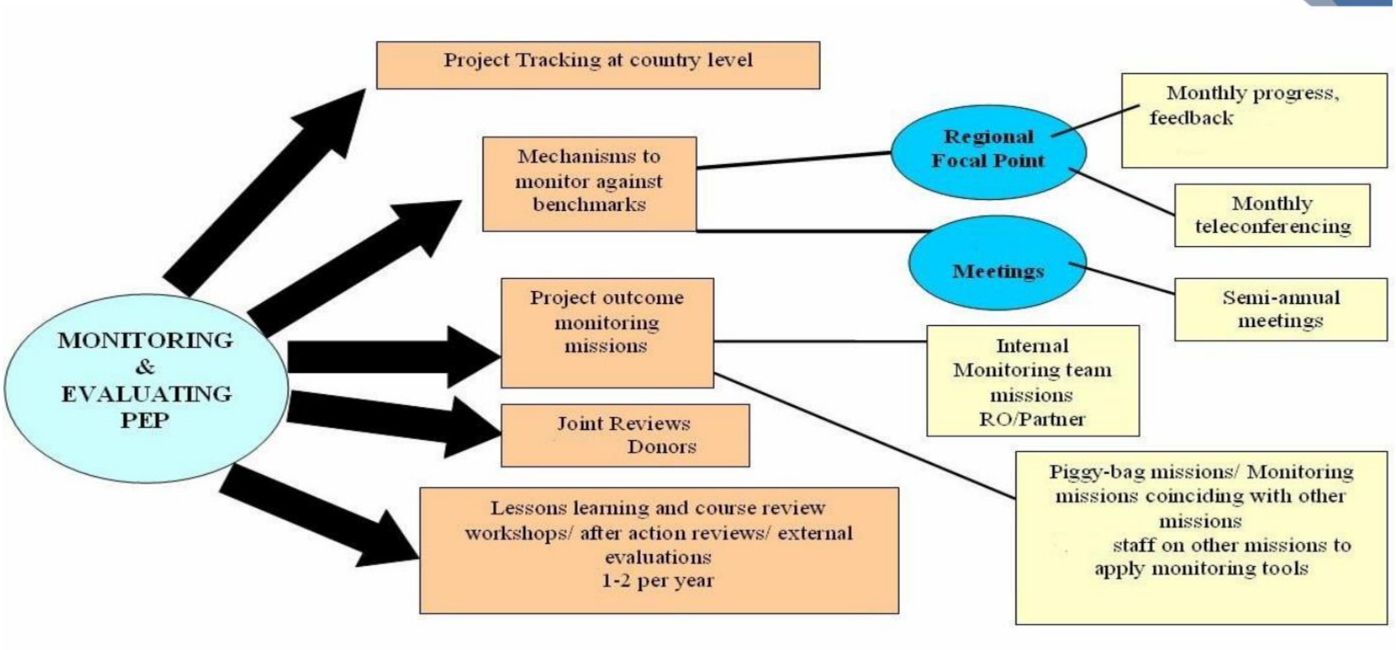

Fig 11.0 diagram showing monitoring and evaluating during execution and control stage

3.15.4 Closure

Tasks completed during the closure Phase include

Administrative Closure vs. Contract Closure

Confirm Work Meets Requirements

Gain Formal Acceptance

Lessons Learned

Team Celebration

Final Performance Reporting

Index & Archive Records

3.16 List of Agricultural produces

1. VEGETABLES (AP-1)

1) KALES (AP-1.1)
2) BROCCOFLOWER (ROMANESCO)
3) LETTUCE
4) RED CABBAGE
5) SPROUTING BROCCOLI (OR CALABRESE)
6) ASPARAGUS
7) SPINACH
8) SPRING ONION
9) CAPSICUMS (BELL PEPPERS OR SWEET PEPPERS)
10) CUCUMBER
11) EGGPLANT (AUBERGINE
12))GARLIC
13) BUTTON MUSHROOMS
14) ONIONS
15) TOMATOES
16) BEANS (AP-1.16)

2. CEREALS (AP-2)

1) BARLEY
2) MILLET
3) SORGHUM
4) WHEAT

3. FRUITS (AP-3)

1) APPLES
2) PEARS
3) AVOCADOS
4) GRAPES
5) ORANGES
6) GRAPE-FRUITS
7) MANDARIN
8) LIME
9) NECTARINE
10) APRICOT
11) PEACHES
12) PLUMS

13) STRAWBERRIES
14) RASPBERRY
15) BLUEBERRY
16) KIWI
17) PASSION
18) GALIA MELON
19) DATES

4. OIL PLANTS (AP-4)

1) ARGANIA SPINOSA
2) HELIANTHUS ANNUUS / SUNFLOWER
3) ALMOND NUT
4) OLIVE OIL
5) SAFFLOWER (CARTHAMUS TINCTORIUS)

5. PLUSES (AP-5)

1) KIDNEY BEANS
2) MUNG BEAN
3) CHICKPEAS
4) YELLOW PEAS
5) LENTILS

6 LIVESTOCK

1) POULTRY
2) BEEF FARMING
3) BEE KEEPING
4) FISH FARMING
5) DAIRY FARMING

3.17 Location of the project.

Code	County	Area (km^2)	Population Census (2009)	Capital
2	Kwale	8,270.30	649,931	Kwale
3	Kilifi	12,245.90	1,109,735	Kilifi
4	Tana River	35,375.80	240,075	Hola
5	Lamu	6,497.70	191,539	Lamu
6	Taita–Taveta	17,083.90	284,657	Mwatate
7	Garissa	45,720.20	623,060	Garissa
8	Wajir	55,840.60	661,941	Wajir
9	Mandera	25,797.70	1,025,756	Mandera
10	Marsabit	66,923.10	291,166	Marsabit
11	Isiolo	25,336.10	143,294	Isiolo
14	Embu	2,555.90	516,212	Embu
15	Kitui	24,385.10	1,012,709	Kitui
16	Machakos	5,952.90	1,098,584	Machakos
17	Makueni	8,008.90	884,527	Wote
23	Turkana	71,597.80	855,399	Lodwar
24	West Pokot	8,418.20	512,690	Kapenguria
25	Samburu	20,182.50	223,947	Maralal
28	Elgeyo-Marakwet	3,049.70	369,998	Iten
30	Baringo	11,075.30	555,561	Kabarnet
32	Nakuru	7,509.50	1,603,325	Nakuru
33	Narok	17,921.20	850,920	Narok
34	Kajiado	21,292.70	687,312	Kajiado
36	Bomet	1,997.90	730,129	Bomet
		503,038.90	**15,122,467**	

In the above counties there are county booklets explaining what and type produces and industries are going to be incorporated when and where.

CHAPTER THREE: FINDINGS, INTERPRETATION AND PRESENTATION

4 Introduction

This chapter consists of the findings of the study and the interpretation of the results.

The chapter also consists of presentations of the findings in tabulation.

4.1 Challenge domains for agriculture and food

Agriculture is the supplier of that basic human need, nutrition is the world's largest user of land, occupying more than one third of Earth's terrestrial surface and also using vast amounts of water. It affects our daily life in many ways, both directly and indirectly. Humans expect agriculture to supply sufficient nutrients, economically and culturally valued foods, fibers and other products. Agriculture must also provide desirable employment and optimized land use and productivity in relation to limiting resources. It must coexist with the needs of urban and natural environments, landscapes and a wide range of other ecosystem services. Agriculture is essential for inclusive development because it produces food as well as economic wealth for many of the world's poorest people wealth that allows for improved livelihoods through better health care, education, infrastructure improvements and greater investment in environmentally sound practices. For Kenya, growth generated by agriculture is eleven times more effective in reducing poverty than GDP growth in any other sectors.

Crop and animal production systems are hugely diverse. A good framework is needed to identify entry points that can lead to the desired outcomes of reducing poverty, improving food security from household to global scale, enhancing population nutritional and health status, and reducing agriculture's environmental footprint. Such a framework must consider the trade-offs and outcomes explicitly, across different scales.

To identify entry points for action, three challenge domains are identified as:

(1) Sustainable intensification of agricultural systems for food security with high resource use efficiency and environmental protection,

(2) Poverty alleviation, economic and social rural development, and

(3) Food systems for nutritional security and better health.

4.2 Sustainable intensification of agricultural systems for food security and environmental protection

High food prices slow down economic growth. After decades of decline, food prices began to rise slowly in the early 2000s and more sharply after 2005 (Fig.3). Since a spike in 2008, commodity prices have fluctuated, reflecting a different market context for agricultural products than prevailed for the previous half century. It should also be noted that the commonly used food price indices have shortcomings because they measure prices against the earning power of populations which have experienced substantial economic and income growth, and thus do not represent the conditions of the poorest and most food insecure members of global society(United Nations).

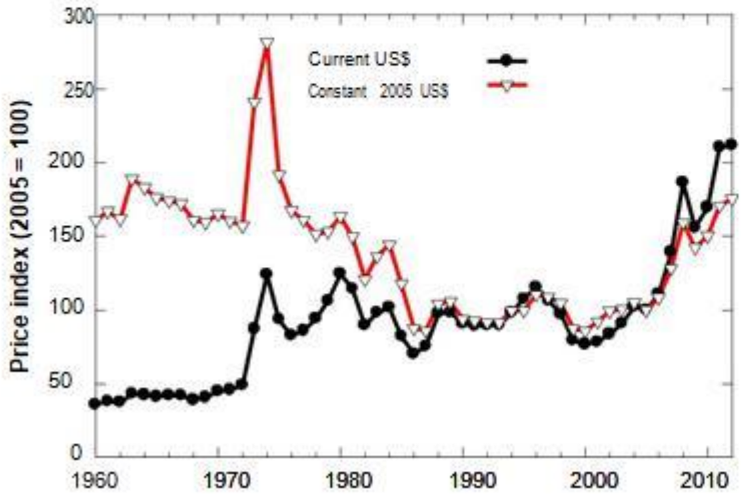

Figure 3. **Global food price index, current and constant US dollars, 1960---2012.**

Source: World Bank Commodity Price Data (Pink Sheet).

Supply and demand balances for agricultural products have become tighter. Global food demand will continue to increase for at least another 50 years due to increasing population and changes of diet. A rapidly expanding middle class in transition countries is expected to further increase the demand for fruits, vegetables, livestock products (milk, meat and eggs) and fish, but generally also for more processed, packaged and branded food. While economic growth will generally lead to an improvement in nutrition in low and middle income countries (Kenya), both rural and urban food and nutrition insecurity remain challenges because of rising numbers of people with low and unstable incomes living in settlements with inadequate infrastructure, including inadequate access to food. In Kenya, urban and rural households that are net buyers of food often spend half of their income on food, have limited means to store it, are exposed to natural disasters and disease epidemics, and are also the most vulnerable to shocks.

It is difficult to make accurate predictions of future demand for food and other agricultural products because consumption depends on demographic trends, economic growth, behavioral choices and policy decisions, i.e., to what extent Kenya as a country and its citizens commit to a sustainable development path. If recent trends in population and per capita wealth continue, feeding Kenya population of about 64.5million people in 2030 would require raising aggregate local food production by at least 60-70% (United Nation). Kenya may have to even double her food production to nourish her rapidly growing populations. It is likely that the demand growth for cereals will be less than demand growth for food in the aggregate, but one can also imagine a scenario in which both cereal and livestock production may have to double within that period if meat consumption and bioenergy use of crops accelerate. Under such a scenario, it will be difficult to meet simultaneously the goals on eradicating poverty and hunger while also safeguarding the environment.

On the positive side, annual growth in global agricultural output has remained fairly steady at 2.1 to 2.5% over the past five decades (Fig. 3.). The contribution of technological change to agricultural productivity, measured as total factor productivity (TFP), has shown a remarkable increase, from less than 0.5% annual growth in the 1960s to greater than 1.8% annual growth in the 2001-2009 decade. In other words, TFP growth accounted for 3-4 of the total growth in global agricultural production during the past decade, outpacing area expansion and input intensification as the primary source of growth in world agriculture. However, TFP growth has been uneven worldwide. Countries with strong investments in agriculture, including strong research and development (R&D) capacity (e.g., China and Brazil), have demonstrated high productivity growth. By contrast, growth has slowed elsewhere and remains slow in many food insecure countries in Sub-Saharan Africa (e.g., Kenya, South Sudan).

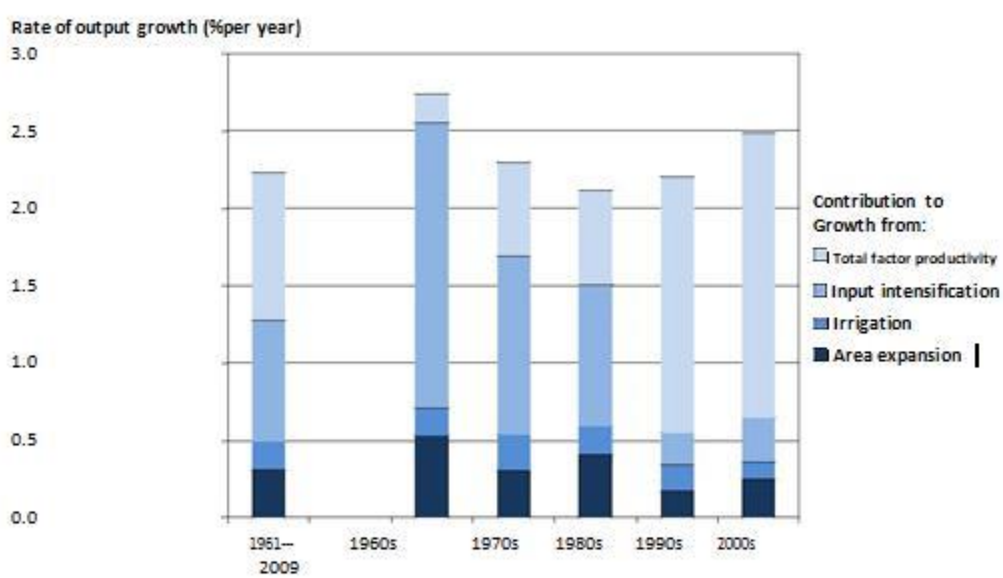

***Figure 4*. Agricultural total factor productivity (TFP) has replaced resource expansion and input intensification as the primary source of growth in world agriculture. The**

total height of the bar is the average annual gross rate in gross agricultural output over the period, which is partitioned into the four components shown.

Source: Fuglie et al.

Indicators such as crop yield or partial factor productivities of land, water, fertilizer, and labor show a less encouraging global picture. Declining freshwater resources, rising energy prices, or low efficiency of nitrogen fertilizer affect many former Green Revolution regions. Recognizing that each country has different staple crops that form the basis for food and nutritional security, a major global concern is the slowing yield growth in cereal crops, particularly rice and wheat that are the basis of food security in many parts of the world. During the 1989---2008 period global yield growth rates have averaged 1.6% for maize, 1.0% for rice, 0.9% for wheat and 1.3% for soybean, which is insufficient for meeting future food demand without having to convert a lot more land into agriculture. For comparison, doubling yields over the next 40 years would require annual yield growth rates of more than 1.7% (FAO).

Farm yields are approaching their economic upper limits in highly productive areas. In major irrigated wheat, rice, and maize systems, yields appear to be near 80% of the yield potential, with little evidence for having exceeded this threshold to date. Further genetic improvement of crop yield potential is difficult and will take decades rather than years to be achieved. On the other hand, many improved agronomic practices can still lead to higher yields and higher efficiencies and greater sustainability in many farming systems. Rain fed farmers, for example, appear to have relatively large yield gaps (50% or more) that persist largely for agronomic, economic and social reasons. There is also strong evidence for decreasing crop yield growth due to rising temperatures and uncertainty in growing season weather. More broadly, climate change will affect agriculture in many ways, requiring substantial investments in designing and implementing climate smart food system.

In Kenya land and water are becoming scarce resources in agriculture. How much more fertile agricultural land will be lost to urbanization and industrialization in rural areas is difficult to predict. It is safe to assume that those trends will continue, thus increasing the pressure to produce more from the remaining land. Various forms of land degradation already affect about 60% of all cultivated land and the hundreds of millions of people living there, often coinciding with areas of extreme poverty. Soil erosion, drought, salinization, waterlogging, desertification and other forms of land degradation have spread widely in the past 30 years, particularly threatening ecosystems and agriculture in arid and semi-arid environments. Economic losses associated with land degradation have recently been estimated at US$ 490 billion per year, or 5% of total agricultural gross domestic product (GDP) [WFP].

Current predictions indicate that less water may be available and more droughts may occur in the coming decades. Kenya is currently using tons of cubic kilometers of fresh water per year, 73% of which goes to agriculture, and the world is currently using some 6000 cubic kilometers of fresh water per year, 70% of which goes to agriculture (Fig. 4.0). It is unlikely that Sub-Saharan Africa (Kenya) can achieve a much higher level of food security and sovereignty without more irrigated agriculture. For example, consuming less water can also be achieved through wasting less food, consuming less water intensive food, and improving water use efficiency in crop and livestock systems as a whole, from forage production to meat consumption.

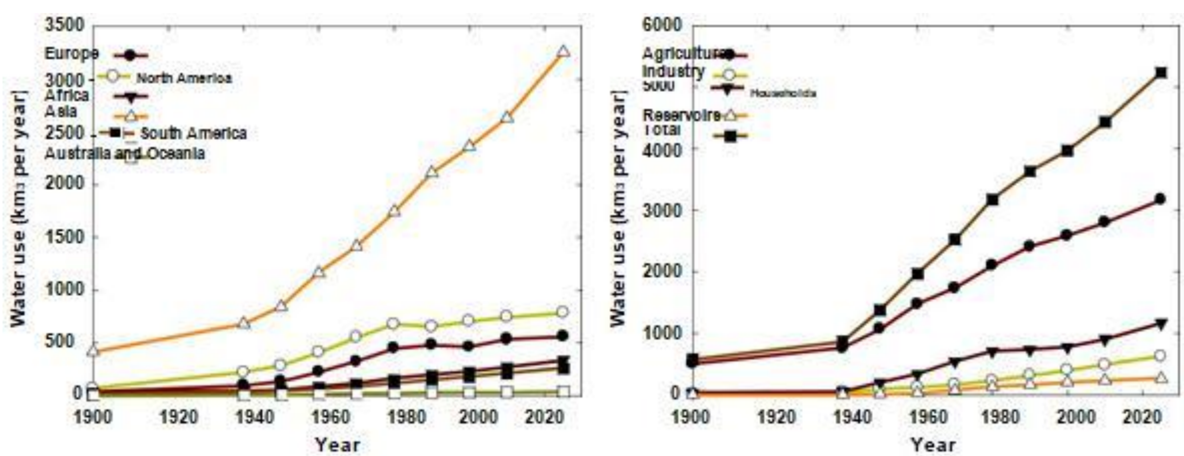

***Figure 5*. Global freshwater use by regions and sectors.**

Source: [UNESCO, I. Shiklomanov]

Modern food production depends on fossil fuels and fertilizers, but the planet's nitrogen and phosphorus cycles are out of balance: excessive or otherwise inappropriate nutrient use is causing environmental problems in some regions, while nutrient deficiencies and insufficient fertilizer availability prevent productivity increases in other regions. In Kenya in particular, continuous cultivation without such fertilizer leads to widespread soil nutrient mining and traps people in poverty. Such regional imbalances and different contexts need to be addressed in defining successful strategies for better nutrient management. Increasing sustainability will demand a push towards both accesses to fertilizers and greater efficiency in nutrient use. Significant opportunities exist to increase nutrient use efficiency and thus also reduce GHG emissions through full life cycle approaches in the contexts of integrated use of both organic and inorganic fertilizers. Globalization of the food system has also created massive nutrient and virtual water flows of traded agricultural commodities across regions, which also need to be considered when developing new solutions for sustainable use of nutrients and water resources. The nutrients imported are commonly concentrated in cities, creating waste disposal problems rather than alleviating deficiencies in rural soils.

Some 17 billion animals in the world utilize substantial amounts of natural resources, mostly in the developing world (Kenya), where most of the growths of the sector will occur. Common global concerns about intensive livestock production include overgrazing, costs and environmental consequences of global trade of feed and meat, pollution due to livestock waste, transmission of diseases, animal welfare and large emissions of greenhouse gases, particularly methane. The productivity and nutritional services of extensive livestock systems will need to be boosted substantially in many regions, including crop livestock systems that enable better utilization of the available resources. Grasslands occupy 40% of the world's land surface (excluding Antarctica and Greenland) and support extensive nomadic as well as intensified livestock production systems. Nearly 1 billion people living on less than 2 dollars a day in Sub-Saharan Africa keep livestock (UNDP). For many, these animals are their most valuable asset and income source. Many grazing lands are in a degraded state, particularly in marginal areas of Kenya, affecting productivity, household incomes and environmental services such as hydrology, biodiversity, and carbon cycles. Grassland management practices can be optimized to result in positive outcomes for grasslands, the environment, and households. Pastoral communities are among the most marginalized, living in remote areas with poor infrastructure and communication. They often lack access to markets and input supplies and are dependent on their animals to support them. The development challenge for these communities is how to reduce their vulnerability and increase their resilience in the face of external shocks such as drought, which can devastate their herds and livelihoods. Both short and longer term interventions are required for these areas, including rangeland and herd management, early warning systems, social safety nets, livestock insurance programs, timely disaster responses, better education and ensuring political stability.

Fish are a rich and often cheap source of protein and nutrients for the poor. Aquaculture's contribution to fish supply for human consumption will soon exceed that of wild capture fisheries. Aquaculture has grown at record pace in recent years and it has been a major factor in annual fish consumption reaching an average of 18.6 kg per person in 2011. Growth is driven by increasing demand from a growing urban middle class as well as by technological changes that have increased productivity and lowered prices and volatility.

4.3 Poverty alleviation, economic and social rural development

The first MDG of eradicating extreme poverty and hunger was in many ways the most ambitious and the most difficult to define in terms of implementation strategies. The goal of halving the proportion of people whose income is less than $1.25 a day will met five years ahead of schedule, primarily due to the extraordinary economic growth rates in Kenya and the associated structural transformation of Kenya economy. Reducing rural poverty still remains one of the more difficult development challenges because it requires sustained, socially inclusive economic growth, particularly in the agricultural sector. Farm sizes are shrinking due to population increase as well as current land tenure systems in densely populated areas, while there is continued reliance on area expansion where populations are sparse. Reliance on market mechanisms only may contribute to inequality in rural income distribution, as efforts to increase farm productivity, improve access to markets, and subsidize inputs may favor farmers with sufficient land and capital resources. Other policies can contribute to inequality by favoring those with legal tenure over those without, male farmers over female, ethnic majorities over minorities or nomadic peoples, and farmers living closer to population centers and markets over those living in the most rural areas.

4.4 Food systems for nutritional security and better health

Achieving food and nutritional security requires every member of society to have access to nutritious food and the information and freedom to make appropriate choices concerning good nutrition. Progress has been made in reducing undernourishment, underweight, child stunting, child mortality, and micronutrient deficiencies. But progress has varied among countries and setbacks are common due to volatile food prices, conflicts and natural disasters. Currently, about 870 million people (12.5%) are chronically undernourished in terms of energy intake and about 2 billion people suffer from vitamin and mineral deficiencies. Malnutrition resulting in fetal growth restriction, underweight, stunting, wasting, and deficiencies of vitamin A and zinc and suboptimum breastfeeding causes more than 3 million child deaths annually (or 45% of all child deaths in 2011). Stunting has surpassed underweight as the most prevalent nutritional challenge, affecting 165 million children worldwide, or one in 4 children under the age of five. Overcoming malnutrition during the first 1000 days of life, from conception until age 2, is among the most critical interventions needed, for which SATADAS agricultural strategies provide solutions.

4.5 Risks under a Business-As-Usual scenario

In the absence of change towards a new, shared global framework for sustainable development of agriculture and food systems, a Business-As-Usual (BAU) trajectory would have severe implications for food and nutritional security, economic and social development, public health as well as environmental sustainability. In a scenario of continuing current trends world cereal production would increase by 52% from 2010 to 2030, whereas meat production rises by 64%.

4.5.1 Food and nutritional security

- High food prices will put a drag on economic growth.
- Agricultural productivity growth and access to food will be insufficient to eradicate extreme hunger and nutritional deficiencies in a growing population by 2030 or even 2050.
- Volatile food markets and prices, and little ability to absorb supply shocks caused by climatic extremes, natural disasters, economic constraints, political unrest, and competition with biofuels.

- Kenya will continue to have unexploited yield and efficiency gaps and rely heavily on food aid and imports.
- Continued large food losses and waste; eroding public trust due to frequent food quality scandals and diseases caused by unsafe processing and handling of food.
- An excessive focus on staple productivity exacerbates the problem of micronutrient deficiency. Persisting malnutrition in mothers results in the next generation not being able to fulfill its human potential.
- Increasing obesity problems due to unhealthy diets and emergence of numerous associated health problems.

4.5.2 Economic and social development

- Agricultural productivity growth will not be sufficient to eradicate rural and urban poverty. Due to volatile food prices, tens of millions of people will swing between being lifted out of poverty and being thrown back into it.
- Social, economic, and political stability is at risk due to large regional, national, and within the country nutritional and food distribution gaps as well as competition for natural resources.
- People will fight over land, water, and some mineral nutrient resources, particularly counties that do not own such resources.

- Smallholder farmers and local agricultural businesses will continue to lack access to markets and financial resources, and thus are not able to overcome the poverty traps associated with small holdings and poor soils. They will be unable to benefit from new technology. Farming families will be left behind in the economic and social development taking place in urban areas.
- Gender asymmetry in access to assets and economic services continues.
- Farmland prices will rise, making it difficult for young people to enter farming.
- Lack of roads, clean water and electricity will continue to make it impossible to significantly improve the lives of the rural poor.
- Youth unemployment in rural areas will further rise. More young people will leave the countryside and move to the city, accelerating urbanization (Slums).
- A less mobile, aging workforce will be left behind in the villages.

4.5.3 Environmental sustainability

- Global fertilizer production will increase by another 40-50% by 2030 to feed the growing population and its dietary lifestyle. If not managed correctly, the increase in fertilizer production may have unwanted environmental impacts.
- Faster depletion of water resources used by agriculture may lead to reduced access and higher prices.

- More forest, wetlands and other land could be converted to agriculture, further increasing greenhouse gas emissions.
- Degradation of existing agricultural land may increase further. Soils will become even more depleted of carbon and nutrients.
- Excessive or otherwise inappropriate use of agrochemicals in agricultural systems will cause more water pollution and loss of species diversity, particularly of insects and their food webs.
- Unsustainable depletion of many fish stocks will continue.
- Declining diversity and species habitat quality in agricultural landscapes could reduce ecological resilience and increase the vulnerability of agriculture, particularly in fragile environments.
- Progress in sustainability reporting and stewardship system development by a variety of stakeholders will continue, but at a relatively slow pace.

BAU scenario would also mean a continuation of dependence on foreign aid investments in agriculture as opposed to governments and private sector making their own investments and policy reforms that create an enabling environment for broad based economic development. Lack of long term strategy, commitment and coordination would continue to dominate investments in agricultural research and development, slowing progress in much needed innovations.

4.6 Sustainable development pathway for agriculture and food systems

Population and income growth are the major drivers for agriculture. A sustainable development path will require decisive and ultimately transformative changes of the global agriculture and food system to increase food availability and utilization, improve the environment, make human beings healthier, and create more prosperous rural communities.

These trends have huge implications for agricultural policies, rural development, and research. Kenya needs to concentrate its efforts on science based, actionable solutions that are tailored to local situations and support structural transformations of the whole food system. ADAS will provide new business models for farming and new approaches for providing access to modern agricultural technology to all farms at different scales are needed to ensure a sustainable development path. Good governance and support mechanisms must ensure fair access to resources, new markets and innovative technologies. Policy makers, scientists, agricultural professionals from all sectors and farmers need to be equipped with the right knowledge and information. Basic education and vocational training will play an important role. It is only through education that we can provide every child the chance to escape poverty in rural areas, and that we can change the behavior of food consumers towards healthier diets, less food waste and a greater understanding and acceptance of agriculture and new technologies.

4.7 Reducing food losses and waste and shifting to healthier diets

Healthier diets and less food loss and waste must be integral components of future sustainable food systems. Given the diversity of causes involved, solutions for that need to be flexible, targeted, and applied in a local context, with strong government leadership at all levels as well as participation by all key actors along the food chain, including the food industry. Greater coordination among agriculture and health extension workers would be beneficial.

Many successful interventions would require substantial investments in infrastructure and improved technology. Reductions of postharvest losses often require significant capital investment to improve storage and transportation systems. However, many less costly technologies can also help reduce losses at different stages of the food chain, including packaging for portion control at pre-consumer stage; breeding crops with longer shelf life; using micronutrient-enriched fertilizers with boron, known to prolong the shelf life of fruits and vegetables; improving harvest practices; and low-cost drying and hermetic storage solutions.

4.8 Producing more food through sustainable agricultural intensification

A consensus is emerging that addressing the new challenges requires a **Sustainable Agricultural Intensification (SAI)** in small and large farms throughout the Kenya. A simple operational definition of the objective of SAI is to provide sufficient, accessible, nutritious food, while enabling economic and social development in rural areas and treating people, animals and the environment with respect.

Depending on the context, improved performance may mean any or all of the following: increased profitability and productivity (agricultural outputs such as food, feed, fiber, and biofuels), high efficiency and returns from external inputs, improved crop and livestock yield stability, reduced greenhouse gas emissions, enhanced ecological resilience, better animal welfare, and environmental service provision (e.g., clean water, flood protection, recreational and cultural landscape values).

Not all of these outcomes can be achieved at once or simultaneously everywhere. Trade-offs among different outcomes is often required to achieve SAI. High priority must be given to helping farmers in affected counties to adapt to climate change and weather extremes by building more resilient agricultural systems. Otherwise, Kenya food security will be at tremendous risk and other development goals cannot be achieved. Agricultural labor productivity is of fundamental importance to economic growth, poverty reduction and food security and must receive sufficient attention when setting the goals and strategies for future, sustainable agriculture. Simply speaking, SAI aims to reduce the environmental footprint of agriculture while meeting all of its other goals. That requires making farming more precise by implementing genetic, agro-ecological, as well as socioeconomic intensification measures, and having the necessary support systems in place for maximum impact (Fig. 6).

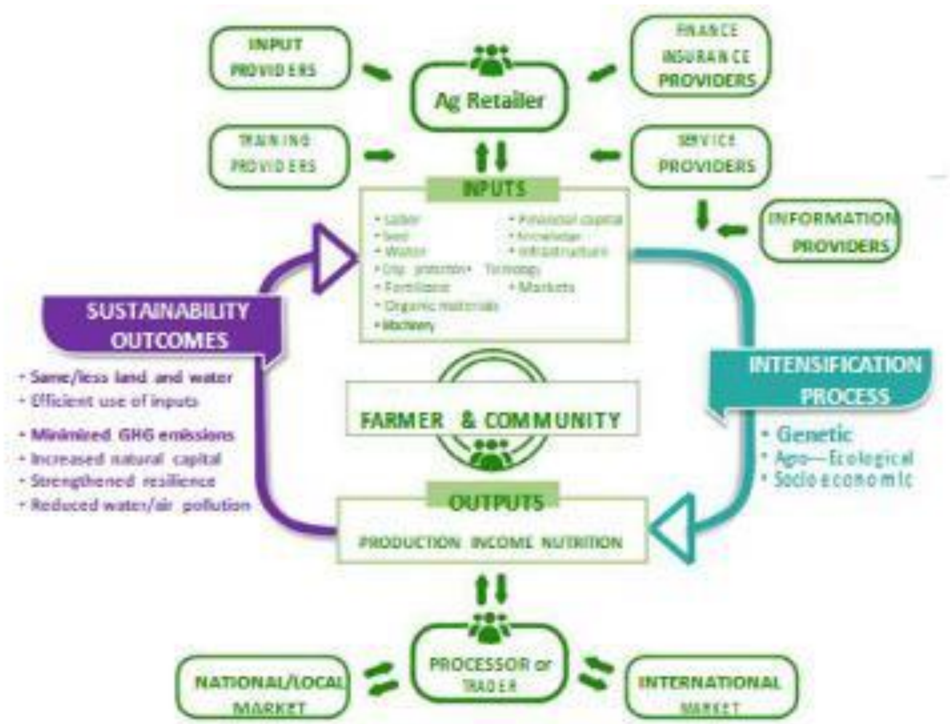

Figure 6. **Sustainable Agricultural Intensification and its enabling environment.**

Source: Modified from The Montpellier Panel.

In practice, workable options actionable "solutions" must focus on raising the diversity, productivity, efficiency, resilience, value and therefore also the overall profitability of farming. This is the entry point for moving from the vicious circles trapping rural people in poverty or creating environmental problems towards virtuous circles of agriculture for sustainable development (Fig. 7.0). It requires flexibility to adapt to new information and the recognition that the information upon which one takes initial action may, in retrospect, be misinformation. Sustainability will necessarily require trial and error, i.e., adaptive approaches on a grand scale. One of the chief hurdles will be to deal with resistance to change.

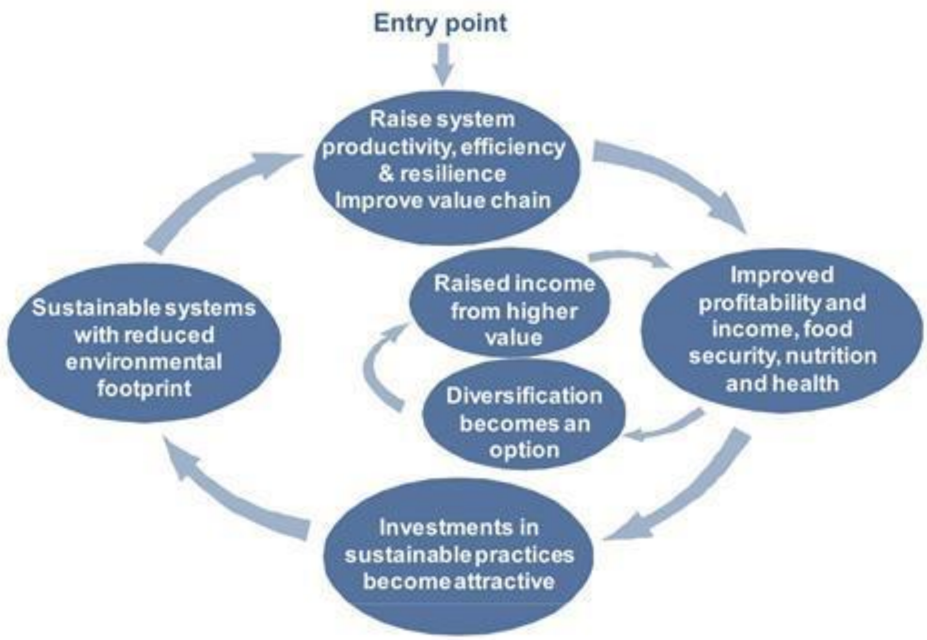

Figure 7. **Enhancing system productivity and value is the entry point for enabling farmers to enter a virtuous circle of sustainable agricultural production and livelihood.**

Source: Modified from IRRI.

Among the greatest challenges for agriculture is to boost crop yield growth rates to levels that would allow feeding the growing Kenya population a healthy diet primarily through increased production growth on existing agricultural land. In Kenya diversification of cropping systems and conserving more land can only happen if yield growth in cereals and other food staples can be accelerated.

To define the right SAI strategy in a country, a precise understanding of yield, efficiency and product quality and value gaps, i.e., how large they are, where they occur, and what their biophysical and socioeconomic causes are, is needed at sub-national and local levels. Progress has recently been made in establishing better methodologies for yield gap analysis, mapping the yield gaps of major crops at global and regional scales, and understanding their different contexts. Although this is encouraging, a lot more remains to be done to obtain a deep understanding of yield and efficiency gaps in Kenya's major agricultural systems, at a scale that enables people to use this knowledge for concrete action in farmers' fields. Similar methodologies need to be applied to quantify livestock productivity gaps.

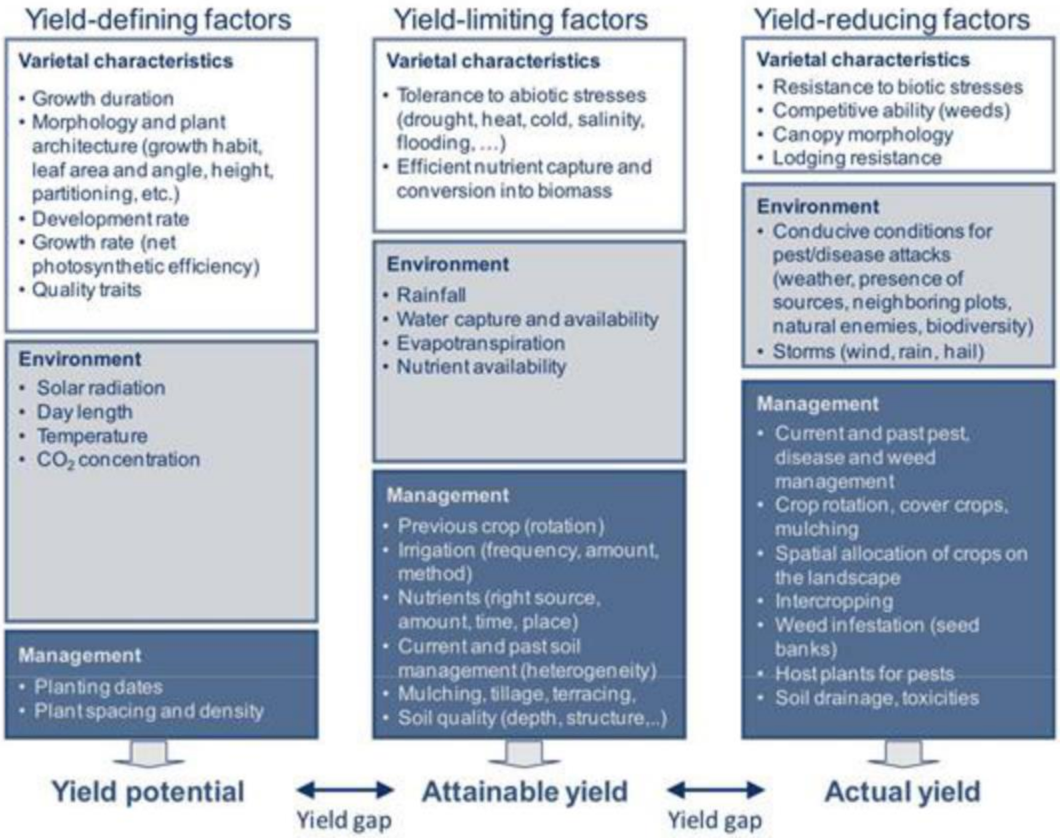

Figure 8. **Yield defining, yield limiting and yield reducing factors determine the exploitable yield gaps in crop production.**

Source: Modified from Tittonell and Giller.

Varieties with high yield potential, enhanced tolerance to abiotic and biotic stresses, and high nutrition and product value are a prerequisite for successful agriculture. The addition of high nutritional value would contribute significantly to food and nutritional security. Recent advances in gene discovery, biotechnology and genomics based precision breeding methods have opened up new opportunities for genetic improvement that must be fully exploited, particularly those that can benefit smallholder farmers most. The full potential of modern biotechnology for genetic improvement of plants and animals has to be harnessed faster because it is one of the key technologies that will be required for meeting multiple goals of SAI, including increasing productivity and protecting the environment. Implementing SAI in crop production implies taking full advantage of genetic potential by implementing good agronomic principles tailored to the local context, including:

- Profitable and sustainable crop rotations and other forms of using functional diversity in time and space, including intercropping where appropriate (Agronomic p-1).
- Tillage, cover crop and crop residue management that conserves and improves soil productivity (Agronomic p-2).
- Access to quality seed of well-adapted varieties that meet local preferences or market demands (Agronomic p-3).
- Planting at the right time to maximize the attainable yield (Agronomic p-4).
- Maximizing the capture and efficient utilization of available water for high water productivity (Agronomic p-5).
- Precise, integrated use of mineral fertilizers and available organic nutrient sources to meet crop nutrient requirements with high efficiency and sustained soil quality (Agronomic p-5).

- Integrated pest management strategies that include host plant resistance, functional biodiversity, biological control and the judicious use of pesticides (Agronomic p-6).
- Harvesting at the right time (Agronomic p-7).
- Optimizing recycling and use of biomass and agricultural by products, including better use of crop residues for livestock feeding or other purposes (Agronomic p-8).

With the right approach and support mechanisms, agronomic interventions can lead to fast, large and sustainable productivity and efficiency gains.

4.9 Potential for urban food production

There are complex and often well integrated systems and processes that bring food to urban areas and ensure it can be reached by the urban populations through a range of traders, retail markets, shops and supermarkets, or direct purchasing from producers or middlemen by consumers through electronic and other means for door-to-door delivery. The need for packaging and transportation increases the carbon footprint of agricultural products and there are potential losses from poor postharvest management of perishable products. Where in place, inflexible regulatory systems between retailers and consumers minimize risk to the consumer while creating a large amount of wastage.

There are many uncertainties, competing demands and other factors that often require making compromises in land use and landscape management. Achieving multiple objectives is an ongoing process subject to negotiation, learning, adaptation, and improvement. Ten principles have recently been proposed to guide the process of decision making in landscape contexts:

1. Continual learning and adaptive management,
2. Common concern entry point,
3. Multiple scales,
4. Multi-functionality,
5. Multiple farmers,
6. Negotiated and transparent change logic,
7. Clarification of rights and responsibilities,
8. Participatory and user friendly monitoring,
9. Resilience and
10. Strengthened farmers' capacity.

CHAPTER FOUR: CONCLUSION AND RECOMMEDNATIONS

5 OVERVIEW

ADAS is guided with three important sections, the objectives part and the goals part.

Objective It expresses an ambitious, specific commitment. Lays out a single challenge with great impact.

Goal Specific, measurable, attainable, time bound sub-component that contributes in a major way to achievement of the goal, i.e., an outcome variable that is easy to understand, representing one major direction of change.

Milestone A significant stage of development with specific sub-goals at a specific time.

5.1 INTRODUCTION

In every village there is a huge diversity of households, from relatively better off to abjectly poor. For each counties and each locality there will be a chosen agricultural transformation paths, and prioritize concrete solutions. These solutions will be achieved through implementation of SADAS objectives and goals that follow some principles. These principles are;

- SADAS will makes sustainable development of agriculture a priority and support it through larger and sustained investments.
- SADAS will weigh the costs, benefits and potential tradeoffs of specific steps to take, but within a generic framework that aims to achieve transformative changes.
- SADAS will constantly adjust its own policies to remove barriers, take advantage of new technologies and create incentives for farmers, technology developers and the investment community to develop workable options for deploying into agricultural systems.
- SADAS agricultural productivity growth in cereals and other staple food crops will be compromised because it is essential for eradicating poverty and hunger.
- SADAS improvement of agriculture and food systems is a continuous, iterative process involving many public, civil society and private sector stakeholders. Many small steps will be taken, involving learning as well as requiring behavior change by all actors involved. Multi-faceted approaches are to be used to respond to the diversity of farmers' environments, objectives, constraints and incentives and to ensure proper targeting.

- SADAS will pay specific attention to increasing the resilience of crop and livestock systems, adapting agriculture to climate change and climatic extremes, reducing the water intensity of crop production, better nutrient management, improved animal health, and halting the expansion of agriculture into natural ecosystems of ecological high value.

- SADAS will ensure equity in terms of access to inputs and markets throughout the country (Kenya) to help smallholders escape from poverty and resource depletion traps.

- SADAS will ensure farming, and the broader rural agribusiness sector, must provide attractive social and economic development opportunities for people living in rural areas, particularly women and the hundreds of millions of young people who will soon be looking for jobs. Women are key drivers of change in agriculture. They will be empowered along the whole value chain, from equal access to land to opportunities for small business development in the agriculture and food sector.

- SADAS will ensure provision of better support systems on the ground to accelerate progress, including more professional extension systems, mobile phone technology, soil data, real time weather data, reference research information, crop information, etc.

- Implementing SADAS will include efforts to integrate agriculture with other sectors to have greater impact, particularly on health, natural resource management, disaster risk reduction, gender, education and energy.

- Multiple stakeholders will be encouraged to participate in the SADAS project. The engagement of farmers, communities and consumers will increase. Biophysical, economic, social and environmental metrics will be collected in a comprehensive, reliable manner to assess different policy and technology options, make the right choices, and evaluate the performance of agriculture over time. SADAS will adopt open data policies.

Planning for success has an implementation plan that provides a roadmap to realize strategic goals (chapter 1). With the high level ADAS goals for the post 2017 era will galvanize the global community to work towards shared development goals; county-by-county as well as local implementation plans will be required to achieve the goals. National and county governments will need to take the lead in developing and implementing their own sustainable development strategies and action plans at different levels, based on the proposed ADAS principles and the four dimensions of sustainable development. Improved measurement of development outputs and outcomes will be an integral part of this. A structured assessment and back casting approach typically includes five steps:

- ✓ Background analysis: data collection, past trends and future projections, possible scenarios
- ✓ Analyze data on problem relevance: define and characterize key problems/opportunities
- ✓ Assess different technology/policy solutions (assumptions, timeframes, effectiveness, cost, etc.)
- ✓ Estimate outcomes and effects at scale (direct and indirect effects)
- ✓ Modeling of large scale impact on development goals: direct and indirect sectoral and cross sectoral benefits; cost vs. benefits

Political will, will be needed to implement a more coordinated and business approach to development, including behavior change on the part of all participants. One of the major challenges is the alignment of many actors who play different roles in development to ensure strategies are translated into tangible outputs and outcomes to improve food security and nutrition for the rural and urban poor. One initiative which has shown some success is the development of 'Innovation Platforms' to foster linkages between the many players in a specific value chain. These 'Innovation Platforms' or 'Innovation Hubs' bring together the public and private sectors, research and development, and actors at different places in the value chain to contribute to local innovation and strengthened chains. Local and national governments are often overwhelmed by disparate programs operating within their borders, but such platforms will give a solid base from which to drive action which will be well coordinated.

5.2 Framework for action and recommendations

Directly and indirectly agriculture will contribute to achieving interrelated development outcomes such as poverty, food and nutritional security, economic and social development, gender equality, energy, water, climate, biodiversity, peace and security, and disaster prevention or mitigation. A framework is needed for understanding and realizing these contributions, with clear objectives and goals, with effective solutions for concrete action. The project framework comprises of project management and scope.

5.3 Milestones of the project

5.3.1.1 TERMINATION OF THRILLING POVERTY, ACCOMPLISH GROWTH WITHIN PLANETARY BORDERS, GUARANTEE EFFECTIVE EDUCATION FOR ALL OFFSPRING AND YOUTH FOR LIFE AND LIVELIHOOD AND REALIZE GENDER EQUALITY, SOCIAL ENCLOSURE, AND HUMAN RIGHTS FOR ALL

Milestone 1

The number of people living on less than $1.25 a day is effectively reduced by 80% by 2030 in Kenya.

Milestone 2

The share of people living below Kenya's 2015 national poverty threshold by 2030 is less than 45.2 %.

Milestone 3

The share of the population not able to meet minimum calorie requirements is effectively zero by 2030 in Kenya.

Milestone 4

The share of calories from non-staple foods has increased by 20% by 2030 (relative to a 2010 baseline). The share of animal derived protein in the diet of women and young children has increased by 20% in Kenya with high prevalence of malnutrition and low meat and dairy diets.

Milestone 5

The number of children under [five / two] who are stunted (as a result of malnutrition) has been reduced by 70% in 2030 relative to the 2010 baseline. By

2050, the country has no any child stunting beyond levels occurring in normal populations.

Milestone 6

Anemia in non-pregnant women of reproductive age has been reduced by 50% in 2025 (relative to a baseline set in the 1993 - 2005 period).

Nutritional interventions will focus on overcoming malnutrition in women of reproductive age (particularly before and during pregnancy), and in children in the first 2 years of life. For Goals 1 and 5, we recommend adopting and extrapolating the six targets and indicators for maternal, infant and under the age of 5 nutrition that have recently been endorsed by the World Health Assembly. They can be translated into realistic national targets based on the county specific context i.e.:-

- 40% reduction of the global number of children under five who are stunted by 2025
- 50% reduction of anemia in non-pregnant women of reproductive age by 2025
- 30% reduction of low birth weight by2025
- No increase in the prevalence of overweight in children under five by 2025

- Increase the rate of exclusive breastfeeding without supplementary feedings in the first six months to reach at least 50% by 2025

- Reduce childhood wasting to less than 5% by2025 and maintain it below that level

5.3.1.2 DEVELOP AGRICULTURE SYSTEMS AND ELEVATE RURAL PROSPERITY AND EMPOWER COMPREHENSIVE, PRODUCTIVE, AND RESILIENT CITIES

Milestone 1

Annual yield growth rate of major food crops approaches or exceeds 1.5% by 2021.

Milestone 2

The majority of farms achieve 80% of the attainable water limited yield potential by 2030.

Milestone 3

Post-harvest losses and food waste have been reduced by 30% in 2030 and by 50% in 2050 relative to current levels.

Milestone 4

Water productivity of crop production has increased by 30% in counties with high water use for irrigation.

Milestone 5

Livestock and aquaculture productivity in counties has doubled by 2030, especially in Arid and Semi-Arid Areas.

Milestone 6

The share of irrigated agricultural land has increased by 30% by 2030 with unexploited water resources.

Milestone 7

Full chain efficiency of nitrogen and phosphorus has increased by 30% relative to current levels in each county with sub-optimal efficiency (e.g., high nutrient consumption relative to actual yield). For counties with low full-chain efficiency an aspirational target could be to reach, by 2030, a 30% increase relative to current levels.

Milestone 8

Crop nitrogen efficiency increased by 30% relative to current levels with low efficiency. Unsustainable soil nutrient depletion halted and reversed with insufficient nutrient use, resulting in increased crop production and economic return.

Milestone 9

50% change in fertility arid and semi-arid area by 2030.

Milestone 10

30% net land degradation by 2030, i.e., achieve a land degradation neutral world (Kenya).

Milestone 10

At least 50% of all households in rural areas have access to good quality water sources by 2030.

Milestone 11

At least 50% of all households in rural areas have access to affordable local drying, storage and processing facilities by 2030.

Milestone 12

All farmers have access to quality agricultural advisory services that provide locally relevant knowledge, information and other services.

5.3.1.3 CURB HUMAN INDUCED CLIMATE CHANGE AND SAFEGUARD SUSTAINABLE ENERGY

Milestone 1

Adoption of GHG saving management practices has increased to 40 % of the agricultural area by 2030.

Milestone 2

GHG emissions from agriculture reduced by 30% relative to current levels (per unit food equivalent).

5.3.1.4 SAFEGUARD ECOSYSTEM SERVICES AND BIODIVERSITY, AND GUARANTEE NOBLE MANAGEMENT OF WATER AND OTHER NATURAL RESOURCES

Milestone 1

The genetic diversity of cultivated crops farmed has been effectively conserved and is widely utilized in crop improvement programs.

Milestone 2

All fish stocks are managed and legally harvested sustainably within their biological limits, applying ecosystem-based approaches, so that overfishing is avoided.

Milestone 3

Deposition of non-indigenous nutrients on natural ecosystems (terrestrial and aquatic) has been reduced by at least 30% relative to current levels.

Milestone 4

The adopting of cross breeds with improved genetics has increased by 43 % and the genetic diversity of domesticated animals farmed has increased by 25 % relative to current levels by 2026.

5.3.1.5 TRANSFORM GOVERNANCE FOR SUSTAINABLE GROWTH

Milestone

During the entire 2019-2025 period, Kenya spend at least 10% increase of its current national budgets on supporting the agricultural sector in the country.

5.3.1.6 ACHIEVE HEALTH AND WELLBEING AT ALL AGES

Milestone 1

38 % increase in the prevalence of overweight in children under [five], girls and/or adolescent girls and women of child bearing age by 2025.

Milestone 2

40% decrease in per capita [red] meat consumption by 2025 relative to a 2017 baseline in Kenya with currently high per capita [red] meat consumption.

Milestone 3

The share of calories from non-staple foods has increased by 20% by 2030 relative to a 2017 baseline.

Milestone 4

30% decrease in the fraction of calories from added saturated fats and sugars by 2025 relative to a 2017 baseline.

CONCLUSION

Agricultural development is a complex process of interaction between the physical input - output relations of the agricultural system and the social and economic milieu of the national economy in a dynamic equilibrium. Land use planning and irrigation are strategic planning exercise to assess the future potential of the agricultural sector and achieve accelerated growth through judicious management of land and water resources. Kenya today is facing a critical situation in relation to land use planning. Since past 50 decades, Kenya has been recording shortage of food, shortages of pasturelands and fast depletion of the forest wealth are assuming serious proportions. As a consequence of various development endeavors ecological imbalances e.g. soil erosion and water pollution, are growing adversely affecting the agricultural productivity. Unless special efforts are made towards preservation of the land, water and vegetative resources of the country and its long term sustainable use, the food grains and other basic needs of the country's population cannot be met, food security and self-reliance cannot be assured and enhanced livelihood security to the millions in Kenya cannot be ensured.

The efficient use of land, water and other natural resources are major thrust areas to be established for accelerated as well as sustainable economic development of agriculture. For this, ADAS is an important parameter in order to optimize the agricultural activities. It will help to decide about the basic course of action of the farming business. In the context of the recent technological breakthrough, management today should be viewed as a process within a rapidly moving frame of reference. *"It is now more scientific, less artistic; more dynamic, less static; more versatile and less rigid".*

Long lasting solutions will require rethinking of rural development and smallholder agriculture towards structural transformations that include and benefit the poor. Improved farming systems and new technologies and business models that can create decent jobs, allow the overcoming of resource constraints, enable greater market participation, and also lessen physical hardships in agriculture, particularly for women and youth. Agriculture in Kenya will also need to change, including changes in policies that affect many low and medium income individuals. High income individuals will have to embark on a pathway that addresses urgent issues such as unhealthy diets, food waste, the right balance of food vs. biofuels production, and fair agricultural policies. This will provide important lessons for development of Kenya as a country in terms of technologies and policies to consider.

ADAS leads in demonstrating how higher standards of productivity, resource efficiency, food safety and traceability, and environmental impact can be met hence achieve all of the above.

New technologies will make it possible for sustainable agriculture to become the new global standard, not the exception; the main factors resisting change are political will, lack of policy coherence at many levels, financing, governance and human behavior. Many of the solutions needed are known and with wise investments, they will become available in the next 6-8 years. Early action is important, but above all more support and better mechanisms are what are needed for long term thinking and action, including strengthening public research and development (R&D), human resources development, and institutional change through ADAS project. We propose evidence based indicators that could be applied to track progress towards meeting the Sustainable Development Goals (SDGs) and their goals, at local, national, regional and global scales.

Their effective use will require investing more in monitoring agriculture and food systems, taking advantage of rapid advances in digital information technologies.

The transformation of agriculture will also require rethinking of international and national structures. The Kenyan food system should morph into a true global partnership that widely shares information, experiences and new technology, following open access principles and practices that honor intellectual property but enable wide

access and use. Otherwise progress in implementing Strategic Agricultural Initiative (SAI) will be slow, and consequently goals and targets for sustainable development will not be met. New models for implementation are needed that unlock the real potential of farmers, public and private sectors in solving complex problems. The ADAS will be a key player in sustainable agriculture and food systems. Good governance will be essential, including supporting farmer groups, managing risks, and deploying tools and accountability measures that foster greater private sector investment in agriculture, but also put clear constraints on unsustainable or inequitable exploitation of land, water, forests and fisheries.

Sustainable development will require that the goals be pursued in combination, rather than individually or one at a time. Support highly vulnerable and marginalized communities, to support inclusive economic development and the achievement of all SDGs By defining ADAS objectives more clearly, we can help all people to see it, to draw hope from it, and to move irresistibly towards it.

Agriculture was the first occupation of man, and as it embraces the whole earth, it is the foundation of all other industries. It is impossible to have a healthy, wealthy and sound society without a proper respect for agriculture. Agriculture is the great art of directing and aiding nature in the performance of those functions which were designed by Providence for the comfort and subsistence of man.

"Agriculture is our wisest pursuit, because it will in the end contribute most to real wealth, good morals, and happiness."

APPENDIX

MB **– Method Booklet**

GB **– Guide Booklet**

CX-Y.x **– Chapter X, Section Y, subsection x**

S-B **– Stewardship Booklet**

CE-B **– Civic Education Booklet**

St **– structural project Break down**

AP – **Agricultural Produce Booklet**

Agronomic p **- Agronomic Principles Booklet**

ANNEX I

Perceived benefits from the project

Through ADAS following will be achieved from county level to national level:-

1) *ADAS will strengthen cohesion and integration of Arid and Semi-Arid Areas with the rest of the country and address inequality including gender, youth and vulnerable groups*

Promote Information Technology Enabled Services (ITES) and Business Process Outsourcing (BPO) industries to diversify investments for job and wealth creation.

Implementation of affirmative action programmes for the above categories of vulnerable groups

Initiate programs that promote social and moral responsibility among the youth. Encourage youth to be proactive and innovative as a source of their livelihood

Development of an investment framework and appropriate mechanisms that channel a fixed percentage of the proceeds from resources, directly to local communities.

Development of programmes to enhance social integration and cohesion.

Involve youth and Integrate youth issues in Arid and Semi-Arid areas planning and development including implementation of programs and projects.

2) *ADAS will provide an enabling environment for sustainable development in the Arid and Semi-Arid Areas by establishing the necessary foundations and bridging the development gaps.*

Development of modalities of utilization of inter-boundary water resources, water supply and irrigation infrastructure.

Harnessing and development renewable energy especially green energy, such as wind and solar energy, including installation of distribution infrastructure for the benefit of these counties and the nation.

Promote efficient adaptation measures for productive and sustainable resource management in the Arid and Semi-Arid areas and involve and empower communities in the management of ASAL ecosystems.

Develop and improve appropriate infrastructure for education, training and health care at all levels, including tertiary and higher education.

Establishment of comprehensive measures to end cattle rustling and inter-communal conflict, including incentives for individuals, communities. Also establishment of bolus technology as way of dealing with cattle rustling (with the help of Government of Kenya).

Enhancement community policing through the House holds Initiative.
Strengthen market linkages between low and high production areas.

Appropriate technologies in irrigated agriculture and agricultural conservation for sustainability and profitability.

Increase the acreage of irrigated land in the Arid and Semi-Arid areas with irrigation potential and mitigate the negative aspects of irrigation.

Development integrated pest management systems to cope with increased threats from insects, pathogens and weeds, and promote improved practices in post-harvest storage and management

Establishment of mechanization in high value crop farming.

Establishment of strengthened research and extension systems which are relevant to the livelihoods of Arid and Semi-Arid Areas livestock keepers, including women.

Promote diversification into other economic activities to help mitigate challenges emanating from climate change.

Enhancement of extension services and institutional development to support activities in Arid and Semi-Arid Areas

3) Develop alternative approaches to service delivery in Arid and Semi-Arid areas.

Promote sharing of resources across administrative boundaries to accommodate mobility and build on the knowledge and experience of customary institutions.

Incorporate knowledge management as a resource for sharing information among the Arid and Semi-Arid communities.

4) *ADAS will promote sustainable utilization of existing land and land based resources to facilitate national economic development.*

Protect and promote indigenous knowledge and practices, promote environmental education and awareness, and intensify environmental conservation efforts.

Promote low-maintenance water technologies; with an emphasis on water harvesting Address interests of pastoralists, particularly pastoralist women, are in new land legislation and institutions, in line with the National Land Policy.

Register all land either as public, community or private in order to facilitate investments and minimize land use conflicts and insecurity.

Target beneficiaries.

Women

Youths

Children

Communities in arid and Semi-arid areas. Kenyan counties and as a Country.

ANNEX II

PARTNERSHIP AREAS WITH THE GOVERNMENT OF KENYA AT COUNTY LEVELS AND NATIONAL LEVEL.

1) National government and county governments to work together with local extension services and farmers to support the tailoring of ADAS solutions to farmers' needs by improving:

   Diagnosis: Understand the context in which an effort or an intervention will be implemented and its links to the best available scientific and local knowledge.

   Contextualized principles: Identify the right economic, social and ecological principles of relevance to farmers' needs.

   Getting it right locally: Empower local communities to improve the performance of the farming system or value chain based on scientific principles and local preferences.

   Scaling and support: Expand the scope of the effort or intervention (in terms of numbers of people involved and the size of the territory) and create the necessary value chains, services, support systems and self-sustained business models.

   Evidence: Monitor and document the performance, and learn to enrich the local, national and global knowledge base to influence policies that will support further implementation.

2) Creating a leading organizational system (as part of an already existing organized body) that will act as an inter-ministerial steering committee. Which will lead us to

take people from the community where we will be handling the projects (Coordination with the national government and county government in selection of potential farmers) and facilitate movement and accommodation of our researchers within the specified counties for soil research.

3) Creating a strong, professional system for instruction, learning and application. Building a mechanism for incentives, fines and compensation.
4) Governmental permits to run irrigation systems, strategic landscape planting, surface drainage planning.
5) Ensure that livestock-based food products are categorized as part of the national food reserves.
6) Establish the Kenya Livestock Marketing Board (to facilitate international trading of livestock products).
7) Land availability from the government will be vital at this point, which will help us in development of ADAS.
8) Civic Education to the community (farmers). As it's important for local farmers to have the knowledge of what is expected and how they can achieve them
9) Provision of security by the government as it is a major concern, considering the project is taking place in some war prone areas (e.g. Protection of research and Development Hub, Protection of international Workers within this areas, Protection of Market place).

10) Tax relief by Government of Kenya in some commodities for purely community development related infrastructures (e.g. Water drilling Machines).

11) Liaison with relevant Government of Kenya Authorities from the national level to county level (Ministry of Agriculture, Irrigation Board, NEMA, Ministry of Trade etc.)

12) Endorsement of ADAS project by the Government of Kenya (i.e. through official launch to create public awareness of the project).

13) Promotion of ADAS Integrated Pest Management which uses a variety of pheromones, natural predators and biological materials to control unwanted insects and weeds.

14) Government of Kenya through the Ministry of Agriculture and Environmental Protection as well as nature and bird protection NGO's to join in ADAS project to establish and monitor nesting boxes for these species in the agricultural sector. The program includes nationwide establishment and monitoring of raptor nesting boxes, educational efforts and promotional programs to farmers as active participants in the effort.

15) Government of Kenya to promote value addition in trade for crustaceans, fish, livestock and agricultural products.

16) The government to at least set aside land for the establishment of enterprise development centres.

17) Improve the water and sanitation infrastructure in line with a strategic assessment of the most appropriate locations and maximize use of trans-boundary water resources in coordination between counties.

18) Implement the National Action Programme (NAP) to combat desertification and revitalize the Desertification Trust Fund.

19) Enhance the presence and capacity of the security and justice systems (Due to development justice cases may arise).

20) Improve roads to improve the accessibility and enhance the volume of trade.

21) Put in place measures to minimize human-wildlife conflict.

22) Develop an innovative insurance scheme (to mitigate crop failure).

23) Provide e-government and m-government services.

24) In partnership with the national government and county governments, identify and map out all natural resource areas.

25) Register all land either as public, community or private in order to facilitate investments and minimize land use conflicts and insecurity.

26) Provision offices space where we can work at county level (Easier access of ADAS services), relevant studies materials/documents, counter-part staff and facilitate movement (i.e. provision of ADAS vehicle) and accommodation of ADAS team within the county as they will be monitoring on farmers from the initiation stage of the project to operational stage of the project (self-sustaining stage where the

farmers have best knowledge about the crops in case a problem arises they can comfortably solve it without external assistance) and county survey in depth.

Agriculture was the first occupation of man, and as it embraces the whole earth, it is the foundation of all other industries. It is impossible to have a healthy, wealthy and sound society without a proper respect for agriculture. Agriculture is the great art of directing and aiding nature in the performance of those functions which were designed by Providence for the comfort and subsistence of man.

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