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Can Africa achieve food sufficiency? Taking lessons from Indian agriculture in the face of 21st century agricultural challenges

[1]O.T. OWOLABI, [2]G.A. SHITU, [3]A.S. BALOGUN, [4]M.S. NAIN, [5]FREDERICK KOBBA, [6]T. PETER BIRTEEB, [7]M.V. SHITU, [8]J. ASUBIOJO, [9]M.A. ORABI, [10]A.O. OKO, [11]E.B. ASUBIOJO, [12]CELESTIN DEFO, [13]O.M. ALI E AND [14]S.O. OMOGBAI

[1]Department of Science Education, Ekiti State University, Nigeria
[2&4]Indian Agricultural Research Institute, New Delhi, India
[3]Department of Animal production technology, Oyo state college of Agriculture and Technology Igboora, Nigeria
[5]Sierra Leone Agricultural Research Institute, Freetown, Sierra Leone.
[6]Faculty of Agriculture, University for Development Studies, Tamale, Ghana
[7]Ekiti State University, Ado-Ekiti, Nigeria
[8]DCLM, Ado-Ekiti, NIgeria
[9]Department of Agric. Ext. and Rural Sociology, Sohag University, Egypt
[10] ICAR-NRRI, Cuttack, India & Department of Biotechnology, Ebonyi State University, Abakaliki Nigeria
[11] Department of Mechanical Engineering, Federal University of Oye, Nigeria.
[12] Faculty of Agronomy and Agricultural Science, S.W.W.N.R., University of Dschang, Ebolowa Campus, Cameroon
[13]Dept. of Pesticides and Toxicology, Faculty of Agricultural Science, University of Gezira, Sudan.
[14]Jv Agro Allied Industry Ltd, Yewa North, Ogun State Nigeria
Corresponding author's Email: topeshitu@gmail.com

There is no gainsaying the fact that Agriculture remains the backbone of developing nation's economy considering its importance for food security as well as major source of employment and rural livelihood. This is true in Africa as Agriculture remains the major source of income though this varies widely across countries. However, percentage share of agriculture in national GDP of many African countries in the recent time is declining. This coupled with increase in demand for food, population growth as well as changing in consumers' food patterns have led to increment in food importation bills of many African countries in other to meet their domestic food demand. This paper therefore reviewed the possibilities of African agriculture achieving food sufficiency in the face of 21st century agricultural challenges and opportunities. Effort was made to understudy the pathway to India Agriculture attaining food sufficiency keeping in mind the similarity of India Agriculture to African agricultural scenario with nearly same opportunities and challenges. We therefore conclude that a proactive and innovative pathway should be created in Africa using policy tools, adoption of proven adaptable agricultural technologies as well as promotion of climate smart agricultural technologies for transformation of Africa Agriculture from net importer of food to food sufficiency as well as becoming net exporter of food.

Keywords: African Agriculture, Farmer's First, Climate smart technologies, Food security, rural livelihoods.

Introduction

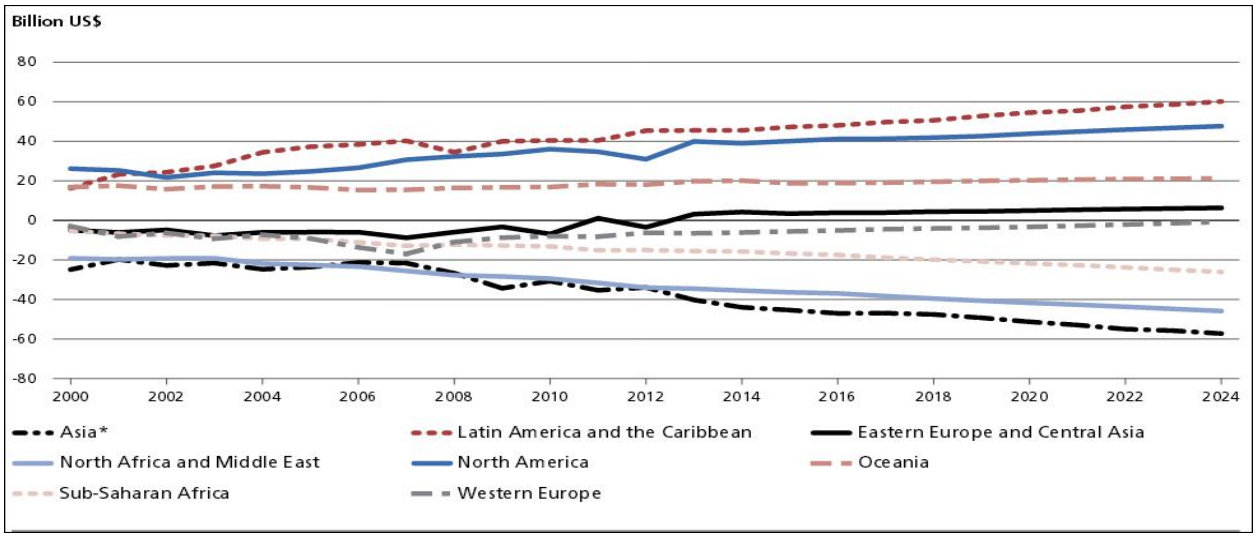
African cannot afford to continue to be food insecure considering the human and natural resource endowment which is enough to make her food sufficient. However, untapped agricultural potential in Africa has been the major reason for inability of the sector to meet the domestic food demand for the continent. This has contributed to Africa persistent poverty and deteriorating food security, resulting in a projected increase in the number of undernourished people from 240m in 2015 to 320m by 2025 (AFDB, 2016). Although agriculture remains major source of income and livelihood for Africans, over 60% of people in Africa lived in rural areas and relied on agriculture for their livelihoods, and women in Africa made up at least half of the agricultural labor force (FAO, 2011; World Bank, 2015). Ironically, the total food production output of the continent has not been able to keep pace with the food demand of the growing population. For instance, FAO report on the State of Agricultural Commodity Markets clearly sum it up that sub-Saharan Africa's net imports have been growing (about US$35bn in 2015 to over US$110bn by 2025), while the Near East and North Africa is rapidly becoming a net importing region as food production is unable to keep pace with growing demand. (Fig 1) (FAO, 2015). The challenge of keeping pace with food demand became demanding due to high import bill of these countries which relatively rich few countries hardly able to pay up with revenues from non-agricultural earnings while relatively low income countries find it difficult to meet up from the low export earnings (FAO, 2012).

However, it is of noteworthy that several developing countries like countries in Africa have been able to transform successfully from food import dependant to food sufficiency and net export of food. For instance, East Asia was able to lift 400m people out of poverty in ten years by investing heavily in agriculture and Brazil was able to go from a negligible agricultural producer to the world's second-largest producer of soy and beef, and largest producer of coffee beans, sugarcane, and oranges in the span of two decades, this was achieved by investing in research and development to boost food production (FAO, 2013; AFDB, 2015). In addition, South Asia and South East Asia counties especially India among others has been able to do the same. So, why not Africa at this time? India is a country in South Asia that can be compare with Africa continent virtually in everything.

Today, India has become a leader in 'World food bank' considering what they have been able to achieve in the last few decades transforming from once net importer of food grains to food sufficient nation. According to USDA, 2014, in its International Agricultural Trade Report, it was reported that India emerged as a major agricultural exporter, with exports climbing from just over $5 billion in 2003 to a record of more than $39 billion in 2013 (Fig. 3). India became the world's seventh-largest exporter of agricultural products in 2013, surpassing Australia (Fig. 3). There are several successful examples of transformation that India embarked from the time of Green revolution. These successful technology, practices, policies, national orientation etc can be

drawn and adapted to Africa Agricultural situation and policies towards Africa achieving her first Green revolution.

Fig 1. Evolution of net trade in agricultural products by region, 2000–24

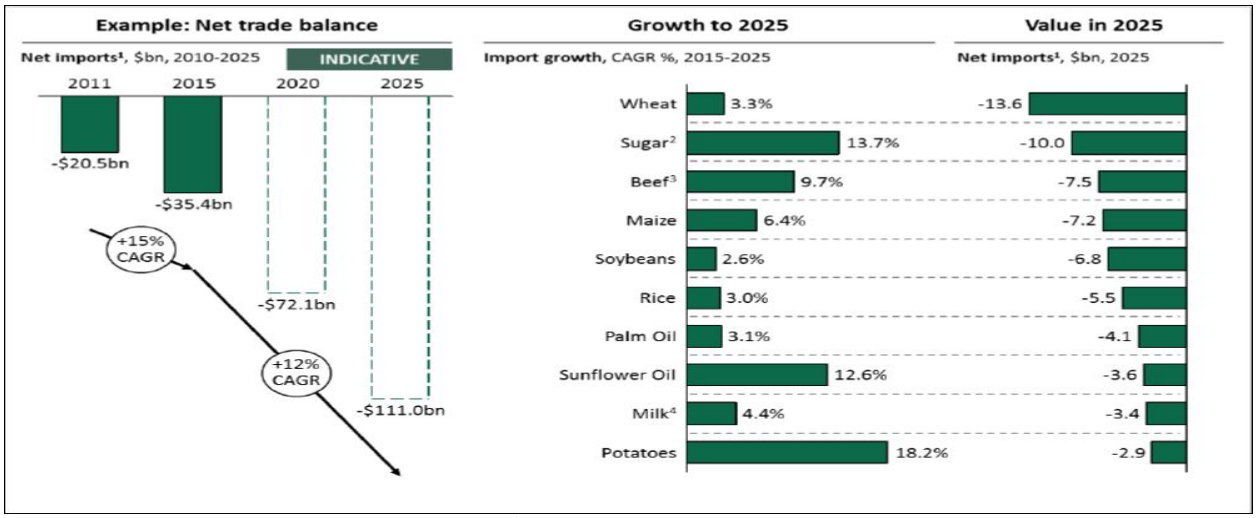


***Notes: Net exports of cereals, oilseeds, sugar crops, meats, fish and dairy products evaluated at 2004–06 constant international reference prices. Data from 2014 onward are projections.

*"Asia" covers all Asia except for Central Asia and includes Southeast Asia, South Asia, and East Asia (including China)

Source: FAO and OECD. 2015. OECD-FAO Agricultural Outlook 2015–2024

Fig. 2. Africa's negative net trade will increase significantly in the absence of transformation



Notes: Figures in Billions USD and exclude intra-African trade; (1) Imports represented as negative values; (2) sugar includes; sugar beet and sugar raw centrifugal; (3) beef includes; cattle and meat; (4) Milk includes; cow whole milk fresh, Dry whole cow milk and dry skim whole milk

Source: IFPRI; IITA, Dalberg analysis

This paper was therefore design with the objective to review such success stories and pathways and makes suggestions accordingly for Africa continental Agricultural development.

Methodology

We understudy the pathway to India Agriculture attaining food sufficiency keeping in mind the similarity of India Agriculture to African agricultural scenario with nearly same opportunities and challenges. We identified the critical factors in Indian Agriculture which could possibly transform Africa Agriculture to food sufficiency. The data for the study was sourced from FOASTAT, World Bank websites relevant published Government data literatures and other official websites.

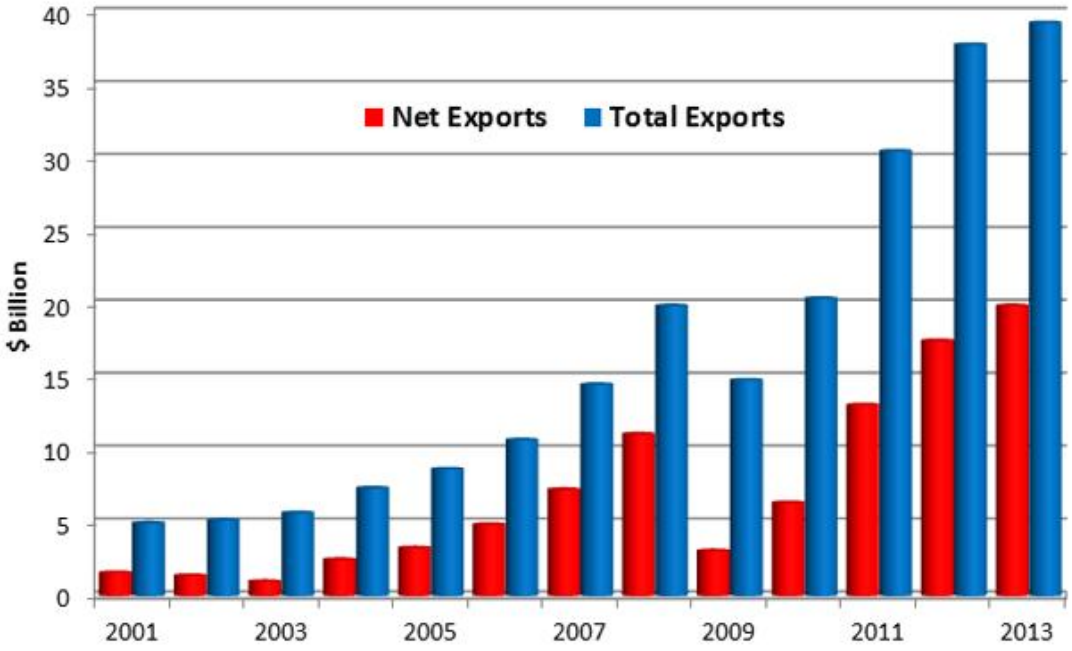
Discussions

"Farmer's First" attitude of Government and policy makers in Agriculture in India

Attitude they say is everything. According to Thurstone (1946), Attitude is the degree of positive or negative affect associated with some psychological object. Farmer's first attitude has been the salient underline secret behind India Agricultural transformation from food dependant to sufficient nation. Although many literatures from both outside and inside Africa have proposed motivation for Agriculture becoming a business oriented adventure in Africa.

They focus on private investments, Agricultural trade and food balances, export oriented panacea, changing demographics factors such as population and consumer preference, low productivity etc (Mosley, P., 1996: Delgado et al. 1999: FAO, 2012: Chauvin et al, 2012: AFDB, 2016). But these authors have unable to acknowledge that for Agriculture to become self reliant, welfare and support for primary stakeholder must be at the fore front of transformation agenda.

Fig.3. India Emerges As a Large Net Exporter of Agricultural Products



Until then panacea to other things affecting African agriculture can be effective as well as become sustainable. For instance, Due to overall passion for welfare of farmers in India, the Government of India (GOI) created a department named as Ministry of Agriculture and Farmers welfare. They are saddled with responsibilities to oversee welfare of farmers. As much as food is important to life, farmers are much more important.

Defilement of Comparative advantage theory in production of the grains/staple food

Economic theory of comparative advantage in Agriculture is a foundation by which Agricultural trade thrives all over the world. But it is unbelievable worthy of note that India defiles the law of comparative advantage on their way to become food sufficient. Despite the low productivity and high cost of production of staple grains like wheat, India took the dogged initiative to develop their own production and productivity instead of continuing dependence on the developed world like USA and Australia for supply. India determined and doggedly worked towards developing their varieties and produce maximum support for the farmers to produce their food locally. And today, we can all see it that that sole decision to defile law of comparative advantage has been a plus to their food security mission.

For Africa countries to achieve food sufficiency, it is high time we work to defile the economic theory of comparative advantage and focus on producing locally what we eat no matter what it will cost us. Over time improvement will pay off and offset the initial cost of production like what is happening in India today.

Fig 4. Status of African and Indian Agriculture

Indicator	Africa	India
Population 2015	1.1 billion	1.25 billion
Land Area	11.7 M sqmi	1.3 M sq mi
% of Agricultural area/land area	42.89%	60.47
% Arable land/Agric. area	19.36%	87.51%
% total area equipped for irrigation/Agric. area	1.19%	37.12%
Permanent meadows and pastures/cover/Agric. Area	77.92%	5.64%
Agricultural machinery, tractors per 100 sq. km of arable land	63.4	102.2
Rural population (% of total population)	66.5	67.25
Fertilizer consumption (kilograms per hectare of arable land)	17.5	157.5 (2013)
Total Cereals production	188MT	294MT

Source: Authors compilation from FAOSTAT, World Bank websites.

Developing Improved and Climate resilient varieties

India Green revolution was powered by the development of high yielding varieties (HYV) of wheat. The introduction of high-yielding varieties of seeds and the increased use of chemical fertilizers and irrigation led to the increase in production needed to make India self-sufficient in food grains. (Fujita, 2006: Erenstein et al, 2007). However, local farmers in Africa have always depended on imported hybrid rice varieties, particularly from Asia, which sometimes do not adapt well to conditions in sub-Saharan Africa (Eipisu, 2016). It is high time we develop our capacity to produce our own resilient and improved varieties. These improved and climate resilient varieties are the need of the hour. The WARDA's breakthrough in developing the New Rice for Africa (NERICA) and the ground breaking news of first hybrid rice varieties developed in sub-Saharan Africa yielding up to four times more than other improved varieties are believed to be setting the stage for Africa's Green Revolution ((Eklou et al, 2008: Eipisu, 2016). The 15 hybrid varieties, bred in Kenya and Tanzania, are tolerant to diseases as well as the high temperatures experienced in Kenya's western Lake Region and coastal areas. Scientists hope new varieties can spark Africa rice revolution. However, new and improved rice varieties do not suffice to bring about the needed green revolution, but supporting systems such as increasing area under irrigation and irrigated crop schemes in addition to the rain fed have to be sought. In Africa, only about 17% of the rice area is irrigated, whereas in Asia, about 57% of the rice area is under irrigation. Chandhary and Dat Van Tran (1999) have reported that there are millions of hectares of land appropriate for rice growing which lie idle in Africa as well as water and other resources can be turn to Agricultural productive land by supporting the farmers with needed improved mechanization and agronomic practices.

Establishment of Agricultural Education higher institutions in core and emerging areas of crop improvement and farm mechanization

There is no gainsaying the fact that education is mother of all development. Agricultural education in Africa in the core area of crop improvement and Agricultural Mechanization is not up to the mark compare to what is obtainable in other developing nations where Agriculture is thriving well. Investment in this field of study and research will go a long way in changing the face of Agriculture and food security in Africa. There is need for a clarion call for specialization in this area of Agricultural Education. These areas include Genetics, Seed science and technology, Agricultural Biotechnology, Agricultural Statistics, Fruit and Horticultural technology, Agricultural Engineering (Farm mechanization option), and Environmental Sciences (Climate Resilient Agriculture). There should be establishment of departments from existing Agricultural faculties and colleges in African universities so as to build our capacity in this core area. Also, there should be establishment of Agricultural based Universities in African countries, with full fledge faculties and colleges only in core areas of Agriculture. We need to recruit experts from developing nations to help us build our capacity in these areas.

Adoption of Climate Smart Agricultural Practices: A must initiative

With the present trend of changes in climatic conditions and their effect on agriculture, there is likelihood of drastic reduction in food production in near future as well as impending

food crises if efforts are not taken. This is expected to aggravate the current food insecurity scenario of many African countries. Literature reveals that the vulnerability of developing countries to impact of climate change is high especially those with high population and largely dependence on Agriculture for livelihood. Like any other developing country, Africa and India with more than 58% of the population engaged in agriculture and allied fields are highly vulnerable to climate change impact (Anonymous, 2013, AFDB, 2016). Therefore adoption of Climate Smart Agricultural practices (CSAPs) is not an option for us in Africa but a must. However, India foresees this impending challenge and the Government of India (GOI) is at the forefront of implementing series of Climate resilient Agriculture project. Many of these noteworthy initiatives must be emulated in Africa so as to face the challenge.

Biotechnology option in Agriculture (A Perfect Tool)

A recognition of the enormous level of food sufficiency attained in some countries of the world (both developed and developing) owing to their giant advances in biotechnology. In the recent years, assessment of the level of biotechnology development in Africa presents a wide gap between aspiration and possible attainment of food sufficiency in the African continent within the nearest future. Even though some African countries like Nigeria, acknowledge the great benefits associated with biotechnology and several effort towards maximizing the potentials, the level of biotechnology development in Africa is still very low. However, a wide range of biotechnologies in Agriculture are available and have already been used in developing countries like India. Such biotechnologies have contributed immensely to increasing productivity, particularly in developed countries and could be employed to achieve the African need for Agricultural biotechnologies, including the use of molecular markers, cryopreservation and reproductive technologies, Artificial insemination, Recombinant DNA as well as Fermentation technologies, precision disease diagnosis and Bioremediation can all play important roles in the characterization and conservation of crop, livestock, forestry, aquatic and microbial genetic resources for food and agriculture as they are currently applied in developing countries for this same purpose (FAO, 2011b). The discovery of the new genome editing techniques (CRISPRS-CAS 9) in recent time is helping to produce genetically modified organisms (GMOs) without transgenesis thereby allaying the criticisms form antagonists of biotechnology products. Therefore, African countries have no reason whatsoever to be politically independent while directly or indirectly depending on other countries for their food supply.

Agricultural Extension intervention towards Africa Green Revolution

African Agricultural Extension systems could play a leading role in ushering in the green revolution, by introducing improved technologies from developing countries that thrives successfully in Agriculture. Conducting on-farm testing of those technologies to identify location specificity agricultural technologies under various farming systems is of paramount need in Africa. We need to organize frontline demonstrations to establish production potential of various crops and enterprises on the farmer’s fields, technology assessment, creating awareness about improved technologies to larger masses through appropriate extension programmes. There

should be production and supply of good quality seeds and planting materials, livestock, poultry and fisheries breed by both private and Government organizations to support the farmers.

Also, there should be more emphasis on value chain approaches to technology development and transfer. This is already been adopted and practiced in some African countries but more should be diffused to the other countries. The chain should be critically analyzed identifying entering points, strengths, weaknesses, opportunities, threats as well as other issues like equity, effectiveness and comparatively of the various value chains. An appropriate technology is sought that could be beneficial at each stage of the value chain, that is, from producers to processors, marketers, agro-dealers and other service providers too could be used to improve the agricultural sub-sector. Furthermore, farm mechanization, Integrated Pest Management (IPM) practices as well as precision conservation Agriculture should be promoted. Also, credit facilities should be provided through rural financial institutions to increase farmer's access to finance for their farming activities.

Adaptable intervention in livestock production

Currently, livestock is one of the fastest growing agricultural subsectors in developing countries. Its share of agricultural GDP is already 33 per cent and is quickly increasing (Thornton, 2010). This growth is driven by the rapidly increasing demand for livestock products, this demand being driven by population growth, urbanization and increasing incomes in developing countries (Delgado 2005). The multipurpose functions of livestock and complex relationships between the biological, technical and social components require a systems approach, whereby nutrition, animal health, breeding, biotechnology knowhow, inputs and technologies are used to optimize resource use (Kaasschieter, 1992: Wanapat et al., 2015). Many developing countries like India, Kenya and brazil etc has made use of gain from livestock sectors to boost their economic. For example it is of noteworthy that despite the extreme harsh weather conditions experience in India, Indians were able to stabilize Holstein freizian crosses breed of cattle and acquire maximum desirable output from it. Among the countries in the world, India is the first in production of milk and equally had largest buffalo population size, they also in 20th position in egg production though these may have resulted in them losing their entire good germplasm which are locally adaptable to their climate and can survive on roughages with moderate management and care.

However Nigeria stand a better chance to reduce climate degradation, since majority of the livestock farming system are still in the hands of herdsman's and rural people, except for poultry sector which has been commercialized to a moderate extent. But the fact remain non of our potential germplasm has been exploited or utilized, has the poultry industries solely depend on importation of strains or stock from developing countries like ours. As result of these it is advisable that when Nigeria will be laying down her breeding strategies and plans for improvement of indigenous locally adapted breeds either through selection and cross breeding or as the case may be, selection against unenviromental climate friendly animal should be put into consideration. This way Nigeria will be able to achieve food sufficiency and simultaneously

avert or reduce environmental degradation which may be constituted through pollution which is emitted from the excreta of our various livestock species.

Adaptable Statistical Intervention

Utilization of data for monitoring and evaluation of development programmes plays a vital role in sustaining whatever has been invested to the programme. Adequate evaluation of the contribution of agricultural sector to developing economies requires proper collection, compilation and maintenance of agricultural statistics at all levels of a nation. Statistics is very important in agriculture because it provides bases of evaluation of trends of production to assess evolution of agricultural sector over time (Southern Delaware, 2011). To ensure sustainable development, African countries require efficient Agricultural Statistics Systems that will collect comprehensive data on several agricultural components including land ownership and size, land use, farming systems, crop area, crop production, livestock production, marketing and pricing of agricultural products, fisheries, forestry, etc. Comparatively, India has a well-established and internationally acknowledged Agricultural Statistics System which plays a major role in the collection, compilation and publication of annual Agricultural Statistics. Over the years, those publications have become a trusted source of reference for a wide range of data on economic indicators, which is of immense use to academicians, researchers and policy makers alike (Agricultural Statistics, 2015).

Although in most African countries, governments have agencies especially Ministries of Agriculture which are responsible and engaged in gathering of agricultural data, those agencies are deficient in statistical expertise. Also, lack of specialization and focus on purely on Agricultural statistics has been a major setback on the development of Agricultural sector. Consequently, the data collected are often deficient and their applications limited. The need to produce efficient agricultural statistics require that African governments consider establishment of working Directorate of Economics and Statistics as well as engaging statistics experts who will be involved in the planning, collection, processing, maintenance and analyses such data. Educational institutions engaged in training agricultural scientist should consider incorporating agricultural statistics as a core component in their training modules.

Adaptable Fisheries option

Fish is an important food for over 400 million Africans, contributing essential proteins, minerals and micronutrients to their diets. Paradoxically, despite the high dependence on fish as a source of animal protein, fish consumption in Africa is the world's lowest (WorldFish Center (2009). Fisheries in the African economy show that there is already a demand/supply deficit of over 60%. There is in addition, steady decline in capture fisheries sources, due to normal global trends which are aggravated by specific local disturbances in African coastal and offshore waters (FAO, 2014). This scenario has led to a shift in focus to inland water resources especially aquaculture, which efforts have yielded encouraging results in the past few years (FDF, 2008). This upward trend is expected to continue and there is a subsisting Government directive on the fisheries administration to among other things. There is no dough learning from Indian achievements to "Review the existing Policy and formulate strategies and plans for sustainable

fisheries management and development in the Africa." It is of noteworthy to conclude that many of these strategies are underway in some African countries. In Egypt, for example, aquaculture production has grown 10 fold since the 1990s. In Uganda production grew at an average of around 142% annually between 2004 and 2006. In Mozambique, Malawi and Nigeria over the same period, annual growth rates were 62%, 43% and 39%, respectively (WorldFish Center, July 2009). These success stories need to be learnt from and replicate in different part of Africa for sustainable fish production and food security.

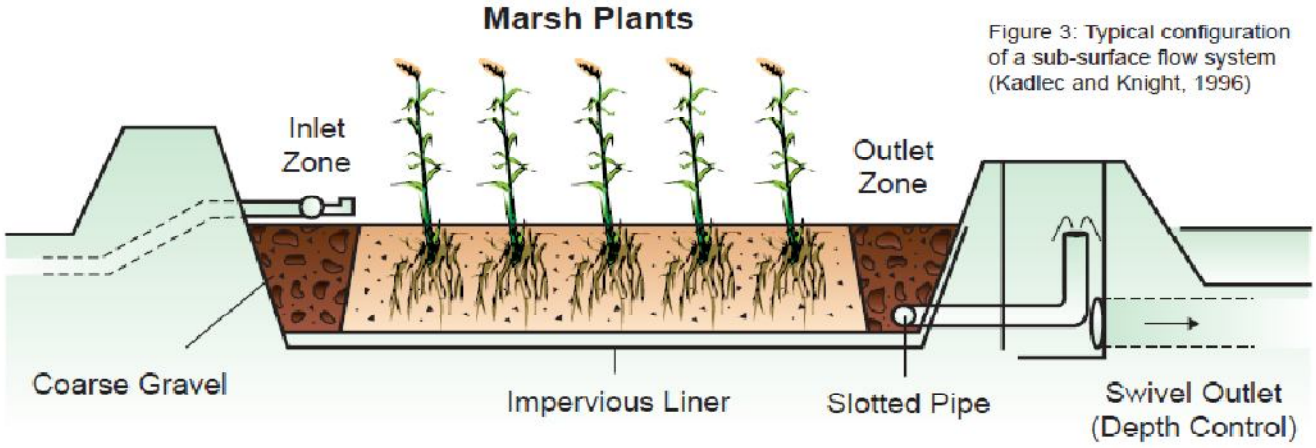
Sustainable Water Management Intervention in Africa

Africa situation of water scarcity is still alarming. In Africa, an average of 64% of the population has access to improved water supplies. Then, Africa has the bottommost coverage in water supply of any region of the world. In the rural areas where coverage is averagely 50%, compared to 86% in urban areas. It was projected that by 2025, at least 48 countries are expected to be facing water shortages.

Among which at least 22 are in Sub-Saharan Africa, representing about 2.8 billion people (35% of the projected world population) will be living either in water-scarce areas (less than 1,000 cubic metres/cap/yr) or in water-stressed areas (between 1,000-1,700 cm/cap/yr). Constructed wetlands appear today to be sustainable systems for wastewater treatment, as one of their main components are macrophytes (Marchand et al., 2010; Garcia et al., 2010; Mirhet et al., 2014). Many types of macrophytes (aquatic plants) are found in the nature and are commonly selected for wastewater treatment: free-floated plants, floated plants, submergent plants and emergent plants (Vymazal, 2008). Several processes are involved in the use of macrophytes for wastewater treatment such as physical (adsorption, sedimentation, filtration) chemical (precipitation, co-precipitation, oxidation/reduction, volatilization etc.), biological (biodegradation, physical decay, plant uptake…) (Crites and Tchobanoglous, 1998).

There are different types of constructed wetlands. This includes constructed wetlands based on water surface flow regime, Subsurface flow systems, Surface flow systems. This have been successfully adapted in India and can also work for us in Africa for sustainable food security.

Fig. 5. Constructed wetlands based on water surface flow regime



Source (CSE, 2016)

Leveraging youth for agriculture

The categories of human beings in any nation based on age include: infants, children, the youth, the middle-aged, and the old. However, it is not all the human being in all the above mentioned categories that can in the strict sense work to produce needed goods and services, especially in the field of agriculture of a nation. Africa has yet untapped potential in this area that can be easily leverage for Agricultural development and food security. As it is happening in India, Agriculture need to be less drudgery and exciting for youth to be attracted to farming. This information age can benefit Agriculture in a long way if youth can be attracted. The emerging improved Agricultural practices are knowledge intensive and need the youth age for its actualization in Africa content. Therefore Governments of Africa countries need to develop strategy to leverage youth for Agriculture for sustainable food production.

Conclusion

With the rapid population growth, declining budget for Agriculture, global warming, it is becoming increasingly aware that the conventional system of Agriculture cannot feed the growing African population. In Africa, two-third of the population largely depends on farming for their livelihoods, which implies that improving Agriculture could not only lead to improvement in livelihoods but will at the same time create employment opportunities (Kofi Annan (2014). New and improved ways have to be sought in order bring about a drastic change or revolution throughout Africa. The challenges that Africa is confronted with are not too different from those faced by India prior to the first and second waves of the green revolution. That means there is hope if Africa could learn from the India situation keeping in view the challenges and shortcomings of their green revolution.

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