

Developing Mechanized Agriculture in Africa: The Export Destination

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ABSTRACT

Agriculture being the primary sector of India, has led to various innovations in the low-cost, energy efficient agricultural equipment. Being a developing nation, India is keen on building its agricultural infrastructure. In this process, Indian manufactures have developed several low-cost, energy efficient agricultural equipment as many Indian farmers cannot afford high cost equipment. The equipment includes solar based fertilizer pumps, tillers, weeders etc. This technology holds great export potential. The economies of many African nations are primarily dependent on agriculture. Several African nations such as South Sudan, Ghana, Tanzania, Mali, Mozambique, Senegal, Liberia, Malawi, Ethiopia, Zambia, Uganda, Kenya have the potential to become bread baskets of Africa but lack of basic infrastructure (electricity, water, storage etc.) and use of traditional agricultural practices have restricted agricultural growth. These nations could be export prospects for India. By tapping on their shortcoming, India can establish strong trade links with these African Nations and reduce its foreign reserve deficit. India can export low cost energy efficient equipment to these African nations and shape a new business biome.

Keywords: Energizing Indian Exports, Rural urban Connect, Global trade trends, Agricultural Sector growth prospects, Environment sustainability, Africa, Indian mechanized agriculture.

1. Introduction

India is among the largest producers of agricultural commodities such as cotton, rice, wheat etc. About 60% of India's population is depended on agriculture as their primary source of livelihood. India has also achieved self-sufficiency in production of various staple foods such as fruits, vegetables, grains. The success of achieving self-sufficiency should not be given to green revolution solely as many other factors have played a significant part. Indian farmers largely practiced traditional agriculture till late 1980s due to lack of education, resources and money. The focus was slowly started shifting to horticulture, multiple cropping, mechanized farming and organic ways to minimize the use of chemical fertilizers. The transition was difficult to execute due to poverty, changing government policies, and climatic uncertainties such as droughts which resulted in making farmers reluctant about getting loans. Machines and hybrid seeds were costly and farmers who could afford them, made good profits but the poor or small – scale farmers suffered losses as their crops were not at par with the standard

crops. The small- scale farmers were constantly trying to survive on break-even and were in huge debts. This adversity opened doors for an opportunity to produce innovative, low-cost agricultural machinery & equipment. Various scientists, entrepreneurs started taking interest in this field, and through government initiations & efforts such as subsidies, led to a wave of developing machinery and equipment which used less fuel or were based on solar power. The primary focus was to make these products as affordable as possible. The outcome led to positive results. Today, this innovate technology is not only limited to the Indian farmers but also accessible to farmers around the world as India exports agricultural machinery and equipment to 141 nations. As of 2019 (April-October), India exported agricultural machinery worth 41.23 million USD. Even USA, which is the largest exporter of agricultural machinery in the world is India's largest importer of the same commodity.

Here is the list of top importers of agricultural machinery from India

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Table 1

Country	Value (USD in millions)	Share % from total import of India
USA	13.7	33.23
Germany	4.35	10.55
Nepal	2.66	6.45
Kenya	1.53	3.71
Hungary	1.3	3.15
Denmark	1.13	2.74
Spain	1.04	2.52
Tanzania	0.92	2.23
Uganda	0.84	2.04
United Kingdom	0.83	2.01

On analyzing the table 1, we see that there are three African developing nations which have the potential to be the food basket of Africa. The current share% of these three countries sums up to 7.98% even when traditional agriculture is primarily practiced in these countries.

Other top two countries importing agro-machinery from India are Nigeria and Ethiopia. We will further analyze the current trade trends from last five years of the five selected countries. The selected countries in focus are Kenya, Tanzania, Uganda, Nigeria and Ethiopia. The countries are selected on the parameters of their trade relations with India, their impact on international trade, & contribution of agriculture in their economies.

Why African Nations (Under the savannah belt) should develop agriculture as their competency rather than industrializing to boost their economies?

Globally, the first world stepped into the industrialization age in mid 1900s. Today, in 2020 the African nations are way behind in the general development and it would take 50 more years for African nations in the Savannah belt, to develop infrastructure, needed for industrialization., given that the governments are stable and there are no ethnic tribal wars. By this time, other nations such as USA, China and India would be way ahead, and it would be impossible to build such a strong manufacturing and service sector. To put this in a logical framework, we need to look at the entire world together. Agricultural land in industrialized nations is shrinking. Pollution levels are getting high and deforestation increases the risk of rapid climate change. In this scenario, the African nations such as Nigeria, Kenya, Uganda, Tanzania and Ethiopia could enhance their agricultural practices and develop their potential to be the world food baskets.

As of now, natural resources such as oil, gold, diamonds

contribute to the economies of many African nations, but natural resources are depleting. It's crucial for African nations to consider the potential of their agricultural land and develop frameworks & strategies to utilize the agricultural potential.

The countries in focus are

- B Nigeria (77.74% of land is agricultural land)
- B Ethiopia (65.33% of total employed are employed in agricultural)
- B Uganda (71.89% of land is agricultural land)
- B Kenya (57.03% of total employed are employed in agricultural)
- B Tanzania (65.75% of total employed are employed in agricultural)

Overview of selected nations

Nigeria

- " Nigeria is one of the fastest growing economies in Africa. With huge reserves on oil and natural gas (largest in Africa and 12th largest in the world), abundance of agricultural land, and growing telecommunication sector, Nigeria is hailed as the 'Giant of Africa'.
- " As of now, Agriculture in Nigeria only employs 36.38% of the total employed while 77.74% of its total land is agricultural land. Nigeria has the world's third largest youngest population after India and China.
- " As of 2015, Nigeria is world's 20th largest economy but despite this, Nigeria is unable to provide food to its entire population and relies heavily on import of staple grains. Nigeria is more focused towards cash crop products and its top exports are cocoa and rubber.
- " In August 2019, the country closed-down its border with Benin to stop rice smuggling and promote domestic production. Nigeria needs to focus on its agricultural productivity and use mechanized and modern techniques to provide for itself and the world.
- " Nigeria is already a leading export market for India. Indian exports to Nigeria during 2018 were worth US\$ 2.25 Billion, with vehicles, machines, pharmaceutical products, electrical equipment leading the list.

Ethiopia

- " Ethiopia has 14 major rivers, including Nile flowing through its highlands. Rich in water resources, it is the largest producer of coffee in the continent, providing livelihood to 16% of the population.

- " 65.33% of total employed are employed in agricultural while the agricultural land is reported at 36.26% only.
- " Agricultural products are its main export after gold (21% of total exports). Coffee make up for 19% of total exports. The other major exports are tea, spices, animal products, vegetables, oilseeds etc. Though contribution of agriculture to the GDP is comparatively less but in the long run, Ethiopia's hope relies on its agricultural and water resources.
- " Ethiopian imports from India in 2016 were 7.5% of the total imports, only behind USA and China. The major products imported were iron & steel, Cereals, pharmaceutical products, sugar and confectionary followed by machines including agricultural machines, equipment and tools.

Uganda

- " Uganda is a landlocked country, in the region of African Great lakes and share Lake Victoria with Kenya and Tanzania. With 71.89% of agricultural land, Uganda's agricultural potential is enormous.
- " Blessed with modified equatorial climate and Nil, the country's major crop is coffee which is also the largest exported commodity. Despite recent economic boom in the service sector, unemployment and poverty runs high in the streets of Uganda.
- " 70.38% of employed people are employed in agricultural, though many farmers still practice traditional agriculture. Practicing traditional agriculture in today's world is not good enough to produce good quality produce, keep the plants disease free and handle drought conditions. Uganda needs to revitalize its agriculture to using mechanized systems.
- " As of now, there are barely 2000 tractors and big machinery being used in agricultural process such as harvesting, rest everything is being done by traditional equipment such as sickle and plough or even sticks.
- " As of 2018, 12% of total Ugandan imports worth US \$816.95 million were from India, making India the largest exporter to Uganda only second to China whose exports to Uganda were worth US \$1.18 billion. The major commodities imported by Uganda from India are pharmaceutical products, mineral fuels, distillation products, machinery and vehicles.

Kenya

- " With 57.03% of people engaged in agriculture, Kenya is a leading producer and exporter of tea, coffee, cut flowers and legumes. Geographically,

Kenyan highlands are one of the most fertile and productive regions of Africa.

- " Despite being the most important sector by employment, agricultural sector is least developed and least efficient. Bad governance, corruption, child labour, poverty, lack of education or agricultural awareness and use of traditional practices are the major reasons for the poor performance of agricultural sector.
- " Tourism, telecommunication and financial activity compromising the service sector is the major contributor to the GDP, but it employs less than 30% of the population and the per capita income is still around 1 dollar.
- " Despite being poorly managed, Kenya's agricultural sector contribute more than 20% to the GDP and has employed most of the population. Kenya needs to realize its agricultural potential along with the impact it has on its masses. It's essential for Kenya to shift its focus towards agriculture as it can help raise the population above poverty and increase its exports.
- " Kenyan imports from India, for the year 2018 were estimated at US \$1.83 billion, second only to China. Major products imported from India include mineral fuels, pharmaceutical products, machinery and vehicles.

Tanzania

- " Home to the Africa's highest mountain, the topography of Tanzania varies from high mountainous to plateau regions to fertile plains. Three of the Africa's Great Lakes are partly located in Tanzania namely Lake Victoria, Lake Tanganyika and lake Nyasa.
- " Agriculture the primary pillar of Tanzanian economy, contributing for 85% of exports and employing 65.75% of the employed. Maize, cassava, sweet potatoes, beans, rice are some of the major crops. Largest cash crops are sugar, cashew nuts and tobacco followed by coffee.
- " As per the 2002 National Irrigation Master Plan, 29.4million hectares was suitable for irrigation farming but in 2011, it was found out that only 310,7245 hectares of farmland was irrigated. This proves the necessity for mechanized agricultural practices to boost economy.
- " India is Tanzania's largest trade partner, and Tanzania imported commodities worth US \$1.22 billion in 2018. The major products were mineral fuels, distillation products, machinery, articles of iron and steel, vehicles, and pharmaceutical products.

2. Literature Review

The World Bank has been extensively working on building the economies of the third world developing countries with the aid of developing and developed countries. In this research, we have researched extensively on various database sources of institutions such as World Bank. In this process, we have found out that World Bank database source site – Trading Economics has maintained reliability of facts and the database covers the entire world. On deep diving further, we came across various documents published by the World Bank, focusing on developing agricultural competencies across various African poor nations. This instigated the thought of finding more about the trade potential these African Nations hold and how the trade potential could be beneficial for India.

On searching various platforms such as journals and websites, it was easy to understand that, even though the role of India in the agricultural sectors of many different African countries has been discussed, the possible trade potential of mechanized tools was barely discussed. A report published by FICCI shed light into the commerce and trade orientation and partnership of India with African Nations. Developed by PwC, “India- Africa Partnership in Agricultural – Current and future prospects” report analyzed the agricultural sub- sectors in detail to explore the partnership opportunities between India and Africa Nations, and how they can help each other to develop their capacities and contribute to the global food security. The paper promotes investment partnerships which is the case with many other reports that we came across. Very less attention is given to the possibilities of strengthening the existing trade ties or introducing more innovative products in the African Nations. thus, in this paper, we have discussed the trade potential of agricultural machineries and types of innovative machineries that could be promoted to develop the trade and agricultural sector simultaneously.

Objectives

- " To analyze the relationship between agricultural machinery imports from India and agricultural GDP of selected five African countries.
- " To suggest suitable framework and strategies for the development of mechanized agriculture in Africa
- " To provide feasible policy recommendations to increase trade between India and the five countries.

3. Research Methodology

We have followed a quantitative approach to reach our first objective. To analyze the relationship between agricultural machinery imports from India and agricultural GDP of selected five African countries, we have used statistical tool of regression analysis, by assuming if we

want to double the imports, how much should agriculture contribute to the GDP of the respective nation.

To achieve the other two objectives, result of the regression analysis are taken into consideration as the deciding factor. Secondary research is done extensively to provide best suited framework to develop mechanized agriculture in selected African countries and how can India use this opportunity to increase its exports and reduce its trade deficit.

4. Analysis & Observations

To double the exports, we need to see increase the share of agriculture in the GDP of the selected nations. We are using regression technique to find out the relationship between imports of agricultural machinery and agricultural GDP of the selected African nations. If we want to increase the imports, how much market should be existing to achieve the targeted imports. We have taken value of imported agricultural machinery from India as X and value of agricultural GDP as Y. here, X depends on Y and equation is $X - X \text{ mean} = bXY (Y - Y \text{ mean})$ i.e. imports could be doubled only if a certain value of agricultural GDP is reached. All the analysis, calculations and graphical presentation is done by the author respectively.

Nigeria

Table 2: Data of Nigeria

Year	Agro-machinery Import from India (value in million USD)(X)	Total share of agriculture in national GDP (million USD)(Y)
2014	16.25	114
2015	17	102
2016	14.5	85
2017	10	78
2018	27.2	84

$$\text{Sum of } X = 84.95$$

$$\text{Sum of } Y = 463$$

$$\text{Mean } X = 16.99$$

$$\text{Mean } Y = 92.6$$

$$\text{Sum of squares } (SS_X) = 159.852$$

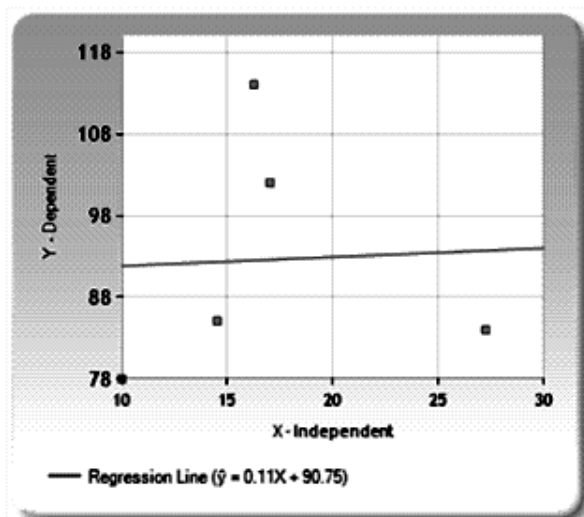
$$\text{Sum of products } (SP) = 17.43$$

$$\text{Regression Equation} = \hat{y} = bX + a$$

$$b = SP/SS_X = 17.43/159.85 = 0.10904$$

$$a = M_Y - bM_X = 92.6 - (0.11*16.99) = 90.74744$$

$$\hat{y} = 0.10904X + 90.74744$$



Result-To double the imports from India (from 27.2 to 54.4), the GDP share of agriculture in Nigeria should be 96.6 million USD.

Ethiopia

Table 3: Data of Ethiopia

Year	Agro-machinery Import from India (value in million USD)(X)	Total share of agriculture in national GDP (million USD)(Y)
2014	1.28	21
2015	1.75	23
2016	.86	26
2017	2.6	28
2018	3.5	26

Source- (World Bank, 2020)

Calculation Summary

Sum of $X = 9.99$
 Sum of $Y = 124$
 Mean $X = 1.998$
 Mean $Y = 24.8$
 Sum of squares (SS_X) = 4.4905
 Sum of products (SP) = 5.538

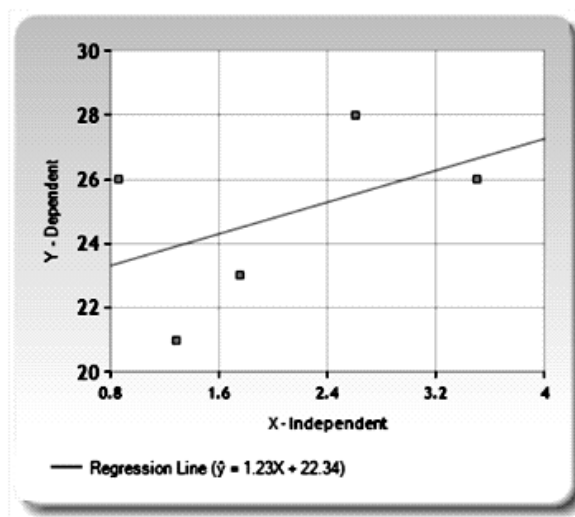
Regression Equation = $\hat{y} = bX + a$

$$b = SP/SS_X = 5.54/4.49 = 1.23328$$

$$a = M_Y - bM_X = 24.8 - (1.23 \times 2) = 22.33592$$

$$\hat{y} = 1.23328X + 22.33592$$

Result- To double the import to 7 million USD, the GDP share should be 30.98 million USD.



Uganda

Table 4: Data of Uganda

Year	Agro-machinery Import from India (value in million USD)(X)	Total share of agriculture in national GDP (million USD)(Y)
2014	2	7
2015	2.1	6
2016	1.4	5.7
2017	1	6
2018	1.4	7

Source- (World Bank, 2020)

Calculation Summary

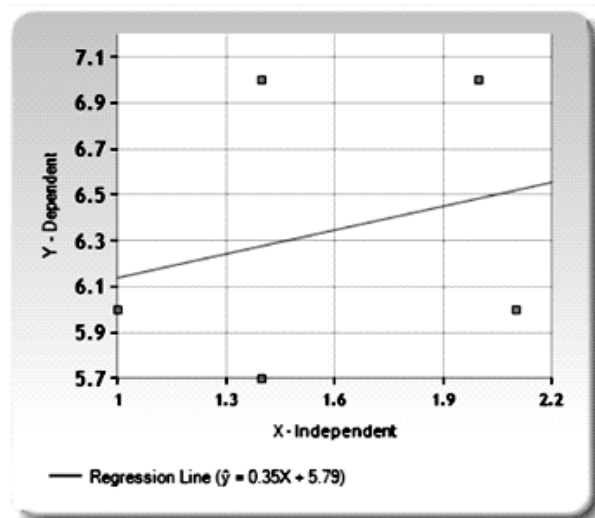
Sum of $X = 7.9$
 Sum of $Y = 31.7$
 Mean $X = 1.58$
 Mean $Y = 6.34$
 Sum of squares (SS_X) = 0.848
 Sum of products (SP) = 0.294

Regression Equation = $\hat{y} = bX + a$

$$b = SP/SS_X = 0.29/0.85 = 0.3467$$

$$a = M_Y - bM_X = 6.34 - (0.35 \times 1.58) = 5.79222$$

$$\hat{y} = 0.3467X + 5.79222$$



Result- To double the imports from India, which is 2.8 million USD, the agricultural share in GDP should be 6.7 million USD. In this case, the possibility of increasing the imports from India are very high.

Kenya

Table 5: Data of Kenya

Year	Agro-machinery Import from India (value in million USD)(X)	Total share of agriculture in national GDP (million USD)(Y)
2014	3.9	17
2015	5.9	19
2016	6.2	21
2017	4.3	27
2018	34.8	30

Source- (World Bank, 2020)

Calculation Summary

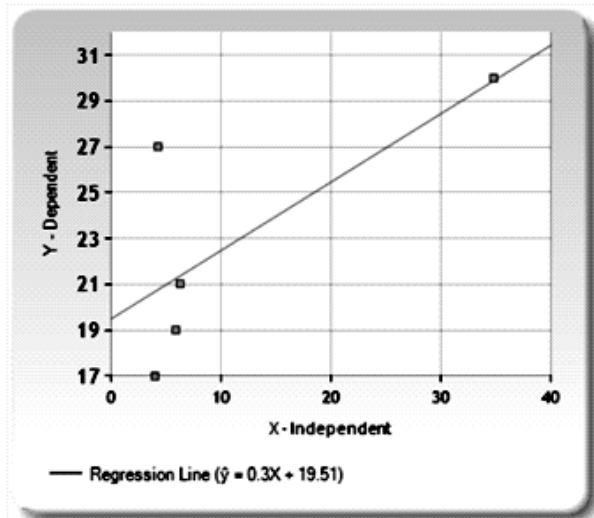
Sum of X = 55.1
 Sum of Y = 114
 Mean X = 11.02
 Mean Y = 22.8
 Sum of squares (SS_X) = 710.788
 Sum of products (SP) = 212.42

Regression Equation = $\hat{y} = bX + a$

$$b = SP/SS_X = 212.42/710.79 = 0.29885$$

$$a = M_Y - bM_X = 22.8 - (0.3 \cdot 11.02) = 19.50666$$

$$\hat{y} = 0.29885X + 19.50666$$



Result- To achieve double the imports to 69.6 million USD, the GDP of Kenya should have minimum contribution of 40.3 million USD from the agricultural sector. In this case the import value of 2018 is greater than the GDP contribution of agriculture which is a strong indicator that Kenya may be exporting the machinery further to other inland African nations.

Tanzania

Table 6: Data of Tanzania

Year	Agro-machinery Import from India (value in million USD)(X)	Total share of agriculture in national GDP (million USD)(Y)
2014	2.7	13
2015	5.3	13
2016	4.2	14
2017	3.1	15
2018	5.8	17

Source- (World Bank, 2020)

Calculation Summary

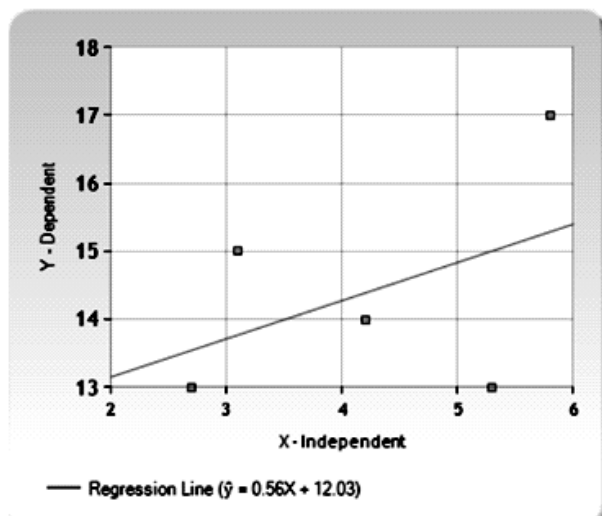
Sum of X = 21.1
 Sum of Y = 72
 Mean X = 4.22
 Mean Y = 14.4
 Sum of squares (SS_X) = 7.228
 Sum of products (SP) = 4.06

Regression Equation = $\hat{y} = bX + a$

$$b = SP/SS_X = 4.06/7.23 = 0.5617$$

$$a = M_Y - bM_X = 14.4 - (0.56 \cdot 4.22) = 12.02961$$

$$\hat{y} = 0.5617X + 12.02961$$



Result- To create the possibility of increasing imports by double, the contribution of agricultural sector to the GDP of Tanzania should be 18.54 million USD. In this case, a slight improvement in the agricultural GDP can positively impact the imports from India.

Frameworks to development mechanized agriculture in Africa

Strategy India could put on the front foot in aim to create awareness about its low-cost innovative machinery.

Collaborate with international NGO and humanitarian organizations such as FAO, UN and supply them with locally manufactured low cost energy efficient agricultural machinery at subsidized price or simply sponsor the agro-machinery to create awareness about mechanized agricultural and promote made in India agro-machinery & equipment in African continent.

India can utilize the 'first impression' technique. By supplying machinery of Indian companies, a certain trust factor will work in favor of Indian companies. Indian companies will be able to create a brand name in the African nations and African suppliers & buyers will demand the machinery from specific trusted brands.

Various low-cost innovative and energy efficient machines are listed below, which are widely used in India. These machines can be made available to masses in the rural Africa where agricultural is primarily practiced, through various frameworks such as FREG and FFS models.

Why low-cost innovative and energy efficient machinery?

" Only a minor fraction of population living in sub-Saharan Africa have access to grid-electricity and live on more than a dollar a day. Current available machines are only diesel-powered machines which are expensive to maintain due to high fuel prices.

" Solar powered machines could address the challenges of electricity and poverty, which will ultimately increase the adoption of farm machinery, thus, increase agricultural production by bringing more area under cultivation.

" Solar farming is not only environmentally friendly, but also reliable and cost effective. Maintenance cost is low, since there will be fewer moving parts and lesser impact of oil corrosion.

Solar-powered tractors

Solar-powered tractors can easily handle non-energy intensive operations like planting and harvesting and tilling. Their operating costs is a fraction of those of conventional tractors. However, the technology is relatively new in India and used in a few places along with conventional tractors. They can also be programmed to be remotely operated. It is beneficial for African countries as diesel run tractors are very difficult to maintain in the rural areas and cost of fuel is also very high.

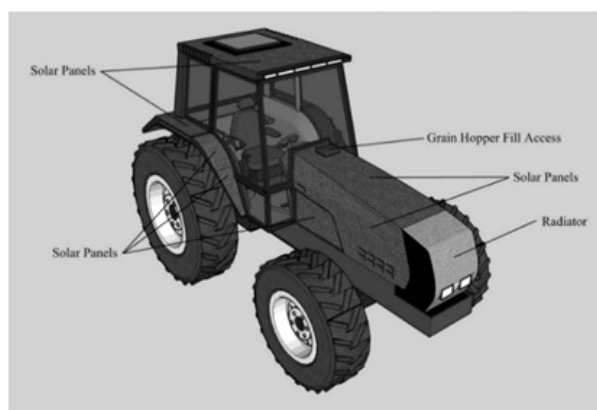


Fig 1: Solar Tractor

Solar electric mowers

Solar electric mowers are available with cordless and rechargeable battery options. These lawn mowers do not emit toxic fumes and do not require frequent refueling to run. Only a few hours of recharging from a solar-powered battery charger are required. It is also possible to convert an existing fuel or electric lawn mower into a solar mower.

Solar Milking machines

Solar Milking machines for cows instead of diesel or electric power is another innovative product. A SPV module connected to batteries powers the machine. A mobile milking machine along with solar panels and battery backup is available for US\$ 900. Some states like Karnataka provide subsidies of up to 50% for these machines. There are manual milking machines that can be either hand operated or connected to solar power as well. Ethiopia is a pastoralist nation, such innovations can make them commercially utilize their cattle.



Fig 2: Solar Milling Machines

Solar Powered Agro-Processing Mills (for maize)

Solar powered mills are easy to operate which can produce flour from the raw agricultural produce. The Corn Huller cum Flour Mill produces more than 200kg of corn flour per day from dried corn cobs. The multi-feedstock flour mill can produce fine to coarse grained flour and process a range of other grains including soybean, sorghum, other cereals and dried root vegetables such as cassava. The standard system can be upgraded with 30A control unit to accommodate up to eight solar panels to produce more than 400kg of corn flour per day. It comes with 4 x LED tube lights, 12V lighter socket outlet and mobile phone charging kit. The prices are around US\$ 900.



Fig 3: Corn huller

The power generated by the solar PV system can also be used to provide household power. The village lamp lighting can extend the working hours until night-time and thus provide an opportunity of additional income for African people.

The advantages of solar powered mills are

- " Zero fuel costs, which is very beneficial for energy starved country like Ethiopia and Kenya
- " Very low maintenance as rural areas are difficult to access
- " Long machine life
- " Ease of operation
- " Affordable under "pay as you go model" (rental)
- " Competitively priced against traditional diesel equipment

FPOs and cooperatives can come together and invest in agro-processing units and set up solar mills in their areas, which would not only generate good income by adding value to their raw produce but also make them sustainable. The challenge of higher initial capital can be addressed by group funding and the increased processing capacity of the central processing units could fetch good profits due to economies of scale.

Solar Winnower cum Dryer

Solar Winnower cum dryer is a convenient machine for winnowing threshed agricultural produce, especially during the period of lull in natural winds and for dehydrating fruits and vegetables with forced circulation of air. The system comprises a PV module, a compatible winnower, a pre-air heating tunnel, a specially designed solar drying cabinet with proper interconnections to use the fan of the winnower for enhanced air circulation while dehydrating the produce. When used as winnower, raw produce can be processed in one hour to obtain 35-50 kg of cleaned grains/seeds from this machine.



Fig 4: Solar winnower

Self-Propelling Solar mobile units

The self-propelling solar mobile unit is a moveable self-propelling power system that can be used to accomplish domestic, agricultural and rural oriented tasks such as - operating a churner to extract butter, a blower, a winnower, etc. Since the inception of the solar unit modules, the self-propelling solar mobile unit have made progressive development. It is particularly useful in isolated cluster of houses in rural areas where grid electricity is not accessible. Many pastoralist rural households can benefit from this mobile portable unit as they keep moving from place to place in search of new pasturelands for their cattle.



Fig 5: Self Propelling Solar Units

Frameworks which can help in developing mechanized agriculture in Africa and increase the presence of Indian machinery.

Given below are frameworks, which can be applied to selected African nations, to make them aware about low-cost innovative solutions. These models can also be the platform through which farmers could utilize the benefits of mechanized agricultural, even partially.

Digital Green

Digital Green (DG) mobilizes rural communities and educates them about agriculture, healthcare and livelihoods using videos and other multimedia. It works closely with grassroots organizations for outreach, engagement and customizes media content for local language and context. Since its inception in 2008, the initiative has reached many villages and improved the lives of community members (70 percent women) in South Asia and Sub-Saharan Africa. DG uses existing large-scale government programs and agencies such as National Rural Livelihood Mission (NRLM), to disseminate information to wider groups of small and marginal farmers.

In 2010, DG registered its not-for-profit arm in the U.S. to

undertake projects in other countries - Mozambique, Ghana, Ethiopia, and Tanzania.

Table 7: Success of Digital Green

Success Criteria	Ethiopia	India
Farmers reached	222,195	454,094
Practices improved	85,721	185,988

DG adopts a participatory approach to make videos on Good Agricultural Practice (GAP) in crop husbandry, from pre-sowing to production, and post-harvest phases. The DG team partners with local public, private, and civil society organizations to disseminate these videos among small farmers to encourage GAP adoption.

Videos on Pico Projectors: The videos are simple and locally relevant. DG facilitates information dissemination by featuring progressive farmers from the same or neighboring villages. Video screening is synchronized with cropping schedules in that area so that the information is timely and is used within a few days of dissemination. Videos are screened to farmer groups through Pico projectors in the presence of community mediators, who address farmer queries and participate in dialog during the screenings and feedback sessions. The videos are an efficient, cost-effective, and resource-light method to increase adoption rates.

Through Digital green's pico projectors, application of solar based agro-machinery can also be taught, and this model can generate interest and trust of traditional farmers to shift towards mechanized agriculture.

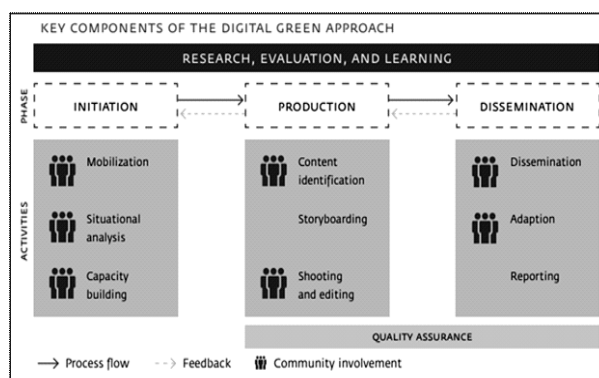


Fig 6: Key Components of Digital Green Model

Till date, Digital Green has produced more than 3000 videos in more than 20 languages and reached more than 650,000 farmers, which have resulted in more than 370,000 adoptions in South Asia and Sub-Saharan Africa

Farmer Research Extension Group (FREG)

The concept of Farmer Research Extension Group (FREG)

as an extension methodology was first introduced in Latin America by local agricultural research community as a focal point for participatory technology development and verification. With time, the concept of FREG has spread to Asia and then to Africa.

FREG is a group of farmers, who could be used as a tool for adopting and transferring improved technologies (initially developed in the research centers) to their fellow farmers in their locality. The approach has been designed to facilitate the transfer of knowledge and technology from the model farmers who have successfully adopted improved technologies and techniques, to the local farmers. Farmer to farmer extension has been effective as one of the participatory extensions approaches because it gives the opportunity to share knowledge and experience at the field between fellow farmers.

This is already being practiced in Ethiopia and its time that this approach is applied to other African countries as well. FREG makes it possible to focus on application of tools, equipment and machinery as farmers teach fellow farmers in real-time.

Farmer Field School

Nearly 25 year ago, the 'Farmer Field School' (FFS) approach was developed by FAO & its partners in Southeast Asia to solve situations where more complex and counter-intuitive problems existed such as pesticide-induced pest outbreak. The FFS approach was developed as an option when the prevailing 'top-down extension' method of the 'Green Revolution' failed to work. African nations are challenged with frequent complex situations and FFS approach has the potential that may led to significant improvement in good agricultural practices.

In FFS approach, a group of 20-25 farmers meets once a week, in a local field setting, under the guidance of a trained facilitator. The groups further divided into smaller groups, each having 5 farmers. The small groups observe and compare two plots over the course of an entire cropping season. Local conventional methods are applied on one plot while the other plot is used to experiment with good agricultural practices which may be considered potential "best practices". The small groups experiment on both plots and observe key elements of the agro-ecosystem by measuring plant development; taking samples of insects, weeds and diseased plants; and constructing simple cage experiments to compare characteristics of different soils. At the end of the weekly meeting all the farmers present their findings in a plenary session, followed by discussion and planning for the coming weeks. Agricultural tools are also introduced to farmers.

In a field-based setting, farmers can investigate a wide range of topics such as soil fertility, water management,

local varietal selection method, seed quality assessment etc. The farmers can inquire about the topics which deal with risks associated with toxicity of pesticide and its hazards, low-toxicity options & their implementation. Topics associated with development of marketing skills; and diversification of farming systems with new crops for food, fodder & profit are also included.

When one crop season ends, the FFS group (all 20-25 members) holds a field day to demonstrate what they are doing to local politicians, government agriculture workers, and other farmers. Exchange visits with other FFS groups are also encouraged. The season-long approach helps build stronger social ties that carry on after the initial FFS season.

Policy Recommendations

There are various ways in which the development of markets can be accelerated, which will boost trade.

The government should help farmers by providing subsidies and loans to acquire solar powered agricultural tools. Agricultural experts are being encouraged to guide farmers in operating them.

Connecting markets: Maintain and strengthen the market and price monitoring system in order to inform on the product availability and price situation in different markets across countries and allow timely intervention.

Strengthen monitoring systems: Closely monitor food stocks and trade behaviors in the main markets to facilitate the distribution of commodities from surplus to deficit areas, taking into consideration local market dynamics and commodity usage (commercial or humanitarian). Government should also regulate imports and maintain records of foreign traders, their commodities and profits.

Economic stimulus: Expand the use of Cash Based Transfers (CBTs) in areas where markets are functioning to encourage supply and greater market stability through demand stimulation. Utilizing an appropriate mix of mechanisms to stimulate core markets, including easy cash transfers to consumers, smart subsidies to traders, and capitalization of key businesses can be beneficial in accelerating the development of markets.

Regulate currency: Foreign dealers exchange local currencies they earn in profits into USD or Ugandan Shillings or other currency through NGOs, Government exchange agencies, and black markets. This further reduces the availability of foreign reserve for local traders as all foreign transactions are done in USD.

Subsidize transportation costs: The transport infrastructure should be developed to ensure well-connected distribution system and market linkage for farmers and traders. Strong and reliable infrastructure would also ensure the farmers that their produce can reach

the markets at right time with minimum post-harvest losses as they would be able to afford the transportation cost.

Proper channeling of subsidies: Adjusting levels of support in relation to market functionality but ensuring that subsidies are carefully targeted and are channeled through market mechanisms. The major focus should be supporting and not undermining local traders, formal & informal financial service providers and safety nets.

Creating small-holder farmer groups: The models identified as the most likely to succeed are those that are formed based on local cultural contexts and the marketing needs of members.

Government interventions: To rehabilitate and renovate the markets, the government should come up with innovative development projects such as Public-Private Partnership (PPP) Model. Market-based approaches require parallel, long-term livelihoods interventions that help support income-generating or livelihoods activities, allowing people to raise their own income and protect their purchasing power.

Targeted interventions: Targeting weakened but recovering markets where interventions will have maximum impact and focusing on strategic locations that can have maximum redistributive influence on the most vulnerable households.

Strong frameworks for collaboration and mutual accountability: Strong frameworks for collaboration and mutual accountability between the government, private sector, development partners and other CAADP actors: Several proven models for public-private sector collaboration have emerged at national and continental level and we need to build on and scale these initiatives. One example is Grow Africa, a partnership co-founded in 2011 by the African Union Commission, the NEPAD Agency and the World Economic Forum as an African-owned, country-led, market-based platform for cross-sector collaboration to increase inclusive and responsible investment in African agriculture. Now hosted by the NEPAD Agency following an initial incubation at the World Economic Forum, Grow Africa has helped generate a private-sector investment commitment to agriculture of over \$10 billion. Of that committed investment, \$2.5 billion has been implemented between 2013 and 2015, benefiting more than 10 million smallholder farmers and creating over 88,000 jobs.

Real-time adjusted interventions: Adopting an adaptive management implementation approach involving market and conflict analysis with ongoing monitoring to allow for real-time adjustments and tailored interventions and investments based on said analysis, working closely with local communities and stakeholders.

Maintaining an atmosphere of peace: Supporting components of the market that could have a positive stimulating effect within a wider network of inter-connected markets, mainstreaming protection program and supporting locally led conflict mitigation or peace building structures wherever needed and possible. Programs should aim both to jumpstart the local economy and to raise the incentives for peace by showing that there is a tangible socioeconomic benefit to cooperation and by cooperating with each other.

Identify beneficiaries: Humanitarians need to analyze more closely what kind of market or private sector actors they are supporting in war environments, and for what purpose. Few agencies have taken a systemic, conflict-sensitive approach to supporting markets in conflict areas such as small-scale indigenous initiatives that are aimed at reviving local trade relationships and peaceful coexistence.

By capitalizing on competitive advantage: small holders can compete better with other larger suppliers by offering a differentiated product to the market. The offered product can be characterized by a higher quality grade; a lower price; or a niche market product destined for fair trade, organic or boutique premium markets.

5. Conclusion

From the above results we can draw a conclusion that, to energize the global trade with focusing on increasing India's export with African nations, the agricultural sector should be improved as rise in agricultural GDP will give rise to imports. Manufacturing sector in Africa is at very nascent stage and it would require huge capital investments. The demand of Africa can be fulfilled by existing manufacturing giants such as China and India. India has good trade ties with African nations, and it should strengthen the trade relations and use the competitive advantage of being geographical closer to the African continent.

Kenya and Uganda have the most positive results from the regression analysis, so India should focus more on strengthening its ties with Kenya and Uganda. Kenya's Mombasa port is a very competitive port and strengthening ties Kenya can give India a huge trade advantage. India is geographically closer to these nations and control the parts the Indian ocean. Kenya and Uganda are trade gateways for the entire African continent. India should prioritize Kenya, followed by Uganda.

India should focus on creating awareness about its solar powered innovative low-cost machinery as Africa is a huge market which is underexploited as of now. By emphasizing on improvising agriculture in the selected African nations, we are also creating a new market for innovative agricultural machinery.

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