Middle-East Journal of Scientific Research 21 (7): 1083-1096, 2014
ISSN 1990-9233

DOI: 10.5829/idosi.mejsr.2014.21.07.21564

A New Theory of Change in African Agriculture

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Abstract: The low productivity of Africa agriculture has received considerable attention of researchers, policy makers and development agencies in recent past. The different problems confronting the growth and productivity of agriculture is rooted in the way agricultural research and development activities are conducted. The conventional linear method solely embraces the generation of technologies by researchers and its transfer to farmers through the extension agent. This method is limited in its stakeholder's engagement and often leads to generation of technologies that may not easily translate to meaningful socio-economic benefits due to limitations by institutional issues. Apparently, a model that could harmonizes technological, institutional and infrastructural issues in agriculture would generate useful socio-economic benefits and impact. The development of the Integrated Agricultural Research for Development Concept (IAR4D) following the innovation systems approach has been proven to lead to higher adoption of technologies, increased farm productivity, increased income for farmers and other stakeholders, reduction in farming household poverty and rapid development of the medium scale enterprise along the commodities value chain. The theory of change behind the IAR4D concept revolves around the "Innovation Platform" (IP) which is its operational frame. The IP engages all the stakeholders along and outside the value chain of the commodity or system of production to interact to identify problem, prioritize the problem and jointly develop solutions. This continues in circles until an innovation situation is generated. The stakeholders are the domain of change, while the central portion of the pathway of change is the IP. The IAR4D concept admits a handful of assumptions viz., assurance of effective communication on the IP; the public sector willingness to change its approach to a more business-like mode; the policy makers will be amenable to policy issues raised on the IP and be apt to develop the required infrastructure.Activities on the IAR4D innovation platform often lead to technological, institutional and associated social change which is reflected largely when the IP stakeholders acquire the capacity to innovate.

Key words: IAR4D · Innovation Platform · Theory of change · Agricultural productivity and impact

INTRODUTION

African agriculture has witnessed series of positive changes in the last four decades. Some of the changes come from attempts to position the sector to respond more effectively to changes in population, industrial needs and livelihood support to people engaged in it. Thesechanges, as positive as they may look are still far from the target expected tofully deliver the desired impact on the populace and the economies of African countries. As such, African agriculture still remainsthe lowest in productivity in the world [1]. The yield of crop is generally low due to a number of factors that are best appraised on a case by case basis; notable among these factors are lack of high yielding, disease resistant and hardy varieties; lack of access to the required external inputs viz., fertilizer, pesticides, herbicides, agricultural lending, machineries etc. and outputs markets; poor knowledge of appropriate agronomic practices and incidence of pest and diseases. While some of these problems are directly related to yield of commodities, several other constraints hinder the productivity of the entire system. An attempt to

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characterize these problems shows that some of them are technological in nature, while others are institutional and some others infrastructural in nature. The interplay of these factors hastraditionally given us a harvest of problems related to rural poverty, food and nutrition insecurity and environmental degradation. Today, these problems have been further heightened by unstable commodity prices, globalization, increasing protectionism of the West, rising energy costs, challenges of new waves of technology, climate change, traceability [2]. To these, we can add the insidious problem of ageing and an ever dwindling farming populace.

Frantic efforts have been made by different agencies to provide solutions to these problems. At best, these efforts havegiven what has been generally regarded as "island of success"in African agriculture [3]. Although interventions which constitute the "islands" have been brilliant both contextually and procedurally, the potentials of the different knowledge, technologies and inventions are not maximised, because many of them are not scalable beyond the test areas. The poorer of these remain on the shelves in laboratories and research institutes because they have not been demanded while others have suffered low adoption by the end users leading to a lower than expected returns on investment in agricultural research and development [4]. The obvious lack of patronage of research products and the failure in translating knowledge to development could be attributed to the theory of change and impact pathway that had been embraced by research and development players. This theory of change which fundamentally emerged from the reductionist school perceives a linear configuration and pathway for knowledge development and sees knowledge always initiated by research activities from the researchers and ending with end users after passing through a number of intermediary agencies including the extension agencies. This model has obvious assumptions, which limit its ability to deliver adequate socio-economic benefits expected from its generated knowledge, technologies and inventions. As it has failed to meet the challenges in the past, it is most unlikely that it would be helpful in meeting neither the challenges of today nor those of tomorrow with the complexity that we have seen in the manifestations of these problems. The theory of change behind the model thus requires obvious review to address the changing face of the agricultural research and development continuum [5]. The review must enable African agriculture use its enormous potentials to meet the challenges that we face today which are equally enormous. This paper aims at explicating the theory of change in the linear approach to agricultural research and development; identify the needed modification and propose a new model for rapid delivery of impact from the agricultural sector.

What Is the Theory of Change?: Theory of Change is the process of describing all the building blocks required to bring about a long-term goal. It describes the process of social change by making explicit the perception of the current situation; its underlying causes, the long term changedesired and the things that need adjustment for the change to happen.Clear expression of the theory of change for agricultural research and development concepts and initiatives is important because it reveals the thinking that guides the intervention and action as well as the trajectory of change within the system. A well-articulated theory of change also helps to:

- Build a common understanding and foster collective thinking with regards to the process needed to achieve the desired change;
- Identify potential weaknesses or gaps in our collective thinking, such as certain hypotheses or assumptions that need to be tested, refined or discarded;
- Develop more coherent program strategies that are constructed from logically robust theories of change;
- Engage in a better learning that brings together theory and action.

These suggest that having the theory in place creates an environment for more adaptive, iterative and non-linear approach to the way we think so that actions can be more coherent, nimble and effective. When required, evidence may be gathered to reframe the thinking and actions. The theory of change is often depicted with the pathway of change diagram which demonstrates how each outcome is tied to an intervention and how the presence of multiple outcome-intervention situations give a complex web-like diagram that represents what happen in real life situation. The underlying assumptions and riskswhich are considered help to express the plausibility of the theory.

Theory of Change in Linear Model for Africa Agricultural Research and Development: The linear method for Africa agricultural research and development was developed based on the single notion that agricultural growth relies solely on increased production of food and fibre. The model thus concentrated attention

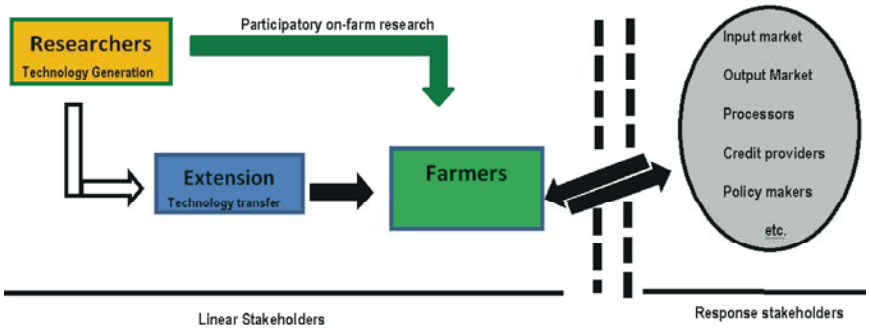

Fig. 1: Pictorial representation of ARD in linear model

on the research system, specifically to develop improvedvarieties to meet the needs of the farmers [6]. The linear model has experienced further development toinclude research from other discipline in agricultural production such as agronomy, pathology and entomology. Intrinsic in the linear model is the notion that technologies generatedare transferred to the farmers through the extension agent. The inadequacy of this approach to meet the challenges faced by Africa, which had been apparent from the beginning especially as those problems stubbornly persisted and became more apparent with the systemic institutional collapse of one of the pivotal institutions like the extension services. A review of the system [7] opined that this model produced some appreciably good results in Africa till the agricultural extension system became weak due to lack of governmental support and other institutional neglect. Following this realization, attempts were made to refine this theory of change which led to the introduction of the Farming Systems Research to look at the development of the system rather than the development of individual components within the system. This later got improved by the introduction of Farmer Participatory Research approaches which aimed at improving the level of participation of the farmers in the process of knowledge generation as a way of improving subsequent adoption of developed technologies. The introduction of on-farm trials was based on the assumption that non adoption was predicated on the fact that technologies were developed in a controlled environment and non-adaptable to farmers real environment. This introduction also created a shunt that linked researchers directly with the farmers in an effort to mask the relative under-performance of the natural link derived through the activities of extension services. Variants of this includedthe Farmers-managed, Researcher-managed and Farmers/Researcher-managed on farm trials [8]. The linear model in its full form (Figure 1) only engages three main partners viz. the farmers, researchers and the extension agents; with the assumption that if these primary stakeholders are influenced to perform at optimal level, the other stakeholderswhich are secondary in nature will respond in a corresponding manner to yield the desired development in the sector.

The pathway of change for the linear model (Figure 2) recognises the prevailing problem of agriculture as the declining productivity of smallholderfarming system, as amplified bythe poor economic state of the farmers which limits the farmers to the use of crude implements, traditional cultivars and cropping methods etc. The problem is further complicated by shortage of land to continue the conventional land extensification practices, lack of the required external inputs, poor market prices for commodities, unorganized market, poor policy system etc. The attempt to provide solution using the linear model identified research, extension and the farmers system as the three most important domains of change. The theory suggests that the research system which was solely public sector driven should be empowered to develop technologies especially varieties and good agronomic practices. These practices should be communicated through the extension agents to the farmers; the farmers in turn are expected to produce, sell their produce and make good profit.

The five prime assumptionsin this theory include:

- If the research system is active and forthcoming with improved varieties and improved practices, then technologies will be available for use.
- If the extension system is functional; technologies will be made available to the farmers.
- If the institutional collaboration between the research and the extension system is very good, farmers will have access to improved technologies and be able to use them.

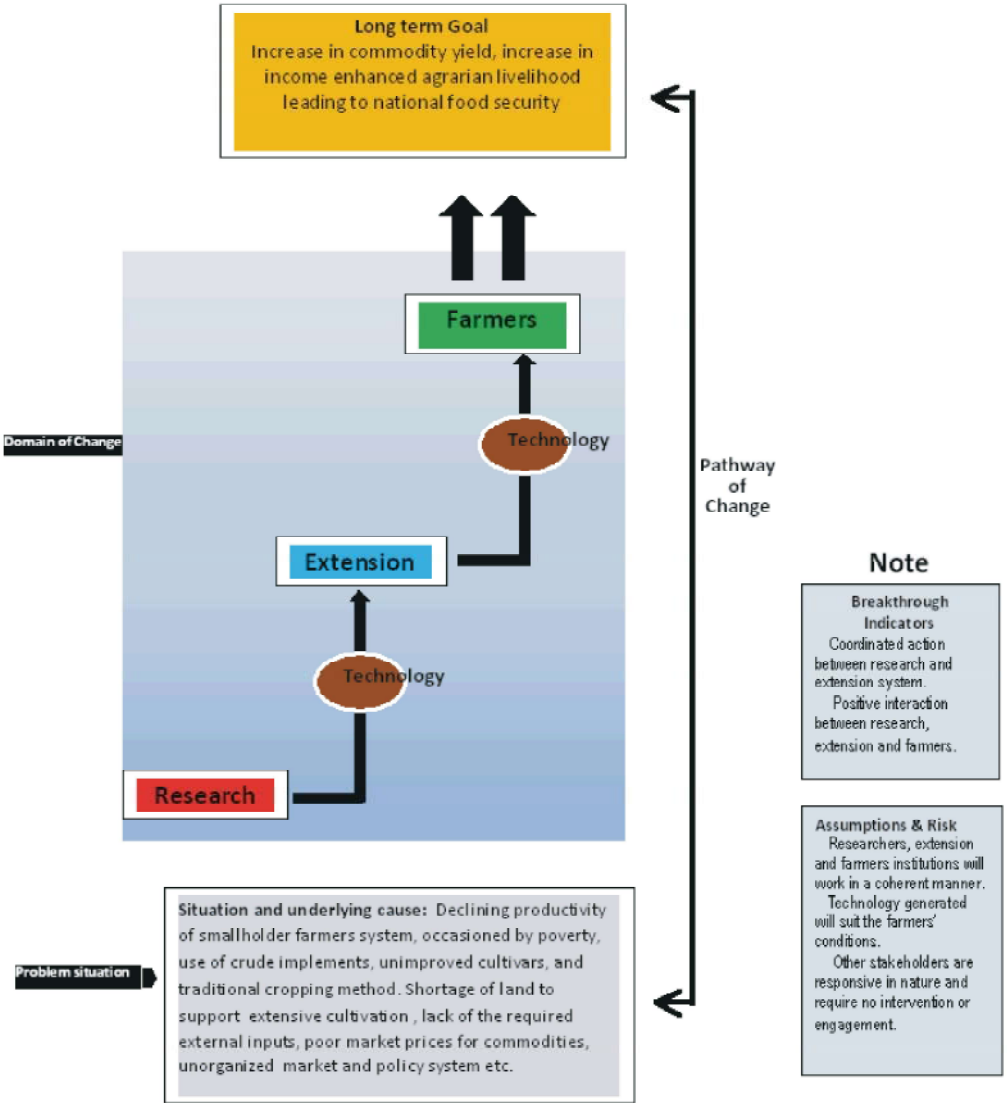

Fig. 2: Pathway of change diagram for the linear system for ARD

- The technologies generated by the research institutes through their on-station work will be acceptable to the farmers and meet their development need.
- Other stakeholders outside the farmers, extension and researchers are secondary stakeholders who normally should respond to good output from the farmers field.

Thus, the projected indicators of success from this theory of change is related to good working relationship between the research and the extension system on one hand and the tripartite linkages of the farmers- researchers – extension (Figure 2).

Shortcomings of the Theory of Change Guiding Thelinear Model: The adduced theory of change for the linear model for ARD has generated a number of outcomes that benefited the smallholder farmers in terms of increase in yield of crop and livestock commodities. An example is the introduction of hybrid varieties which gave a boost to the yield of the commodities at the farmers' level, but the success was short lived as farmers cannot continue their cultivation due to high requirement of external inputs and intensive agronomic practices [9]. Obviously the smallholders' cannot afford the required external inputs for these technologies; as such many of them reverted back to their old practices to sustain their livelihood. The obvious shortcoming from this scenario is

the way agricultural research issues are conceptualized and developed; often the researchers come up with perceived subject without consideration or adequate consultation with the farmers as the end user of the product. Technologies generated from this type of approach often lack relevance to farmers circumstances because they have in many cases not been backed by effective demand. It has been reported that African smallholders have a huge wealth of knowledge of their production system and such knowledge needs to be tapped along the process of developing adaptable technologies that will yield good outcomes [10].In addition to this, we also know that other stakeholders also have abundant experiences that should make them key players in the knowledge system.

The assumption that gives prime importance to the farmers, extension agents and researchers over other stakeholders in the linear model is a major shortcoming, which eventually limits the realization of the goal of the model. In few instances where the model works, the success was short lived, apparently limited by institutional constraints such as non-availability of fertilizers and agrochemicals during the growing season when and where it is needed and also lack of financial wherewithal for the farmers to procure them [11]. Under a different scenario where the inputs are made available either as a loan or subsidies from government, the farmers are still faced with market related constraints that limit their returns from investments [12]. For this reason, the role of the other private sector practitioners such as input dealers, transporters, processors, equipment hiring outfits, etc. has been observed to be very vital. All these also need to be supported by the prime role of the policy makers in developing supportive policies and developing needed infrastructure for the development of the sector [13]. The realization that the development of the agricultural sector should be all encompassing especially as it relates to stakeholders engagement is factual. Observations in agricultural development science have shown that the issues around the deliverables from the stakeholder that is not effectively engaged along the development pathway will limit the output of the whole system [14, 15]. In essence, the development of agriculture needs to embrace the engagement of all necessary stakeholders drawn along the commodities and systems "innovation sphere". The Innovation Sphere refers to all stakeholders on the value chain and others that influence the chain from outside.

In essence the linear model lacks sustainability, where it has worked; it did not have a structure that encouraged the working together of all the required stakeholders. It also limits the development of the sectors to outputs at the farm gate, suggesting that value addition and other activities along the value chain are not necessarily agricultural but agro-industrial in nature. This notion continues to limit the share of returns that accrue to the farmers as primary producers and indirectly limits their capacity for expansion and use of modern technology due to poverty [15].

Understanding the ARD System in Africa: The first step in getting a theory of change codified is to have a thorough understanding of the ARD system that the theory would describe. Efforts at developing the Africa ARD in the last decade have identified the following issues as point of limitation to the development of the sector.

- Access of farmers to appropriate technologies; this include well adapted varieties to farmers production conditions with sufficient hardiness to thrive under condition of marginal soil fertility, low moisture regime, tolerance to pest and diseases and abiotic stress. There is the recognition that the research institutions have generated a lot of knowledge, technologies and inventions that have largely suffered low adoption[16] This often occur when the technologies are not demanded and or not well targeted to align with socioeconomic and cultural circumstances of the farmers, for instance, a high yielding, hardy and dwarf variety of sorghum will not be suitable for a farming community where sorghum stalk is required for fencing and for feeding livestock. Technologies also suffer lack of adoption when it demands much external input from the farming communities or demands extra management services. The drudgery in small holder agriculture is sufficiently high to discourage extra activities like multiple spraying to apply agrochemicals and or some labour intensive cultural practices. Often, technologies that are embedded in the seeds are more acceptable at the smallholders' level. In some other instances, there is zero awareness of some technologies by farmers due to the failure of the extension system, howbeit, the extension system is public sector driven and in countries where the public sector lacks the required incentives for performance, the extension system is largely inefficient.

Table 1: Comparison of Fertilizer Procurement, Distribution and Marketing cost

	United States			Nigeria			Malawi			Zambia			Angola		
	US$/MT	£	%	US$/MT	£	%	US$/MT	£	%	US$/MT	£	%	US$/MT	£	%
Cost Item & Margin															
FOB Cost	135	135	59.57	135	135	40.16	143	143	44.5	145	145	43.5	226	226	27.29
Ocean freight	25	160	11.03	30	165	8.92	25	170	7.78	25	170	7.5	95	321	11.47
Insurance	0.08	160.08	0.04	0.1	165.1	0.03	0.1	170.1	0.03	0.1	170.1	0.03	2	323	0.24
CIF Cost	**160.08**	**160.08**	**70.64**	**165.1**	**165.1**	**49.11**	**170.1**	**170.1**	**52.94**	**170.1**	**170.1**	**51.03**	**323**	**323**	**39**
LC Cost	0.8	160.88	0.35	1.65	166.75	0.49	1.7	171.8	0.53	1.7	171.8	0.51	3.23	326.23	0.39
Port cost, transfer inland	4	164.88	1.77	21.7	188.45	6.46	7.82	179.62	2.43	17.5	189.3	5.25	98	424.23	11.83
Duties	0	164.88	0	12.04	200.49	3.58	1.63	181.25	0.51	1.63	190.93	0.49	48	472.23	5.8
Losses	1.65	166.53	0.73	3.77	204.26	1.12	1.8	183.05	0.56	1.89	192.83	0.57	0	472.23	0
Bag and Bagging	0	166.53	0	15.69	219.95	4.67	0	183.05	0	0	192.83	0	0	472.23	0
Free on barge/truck	**166.53**	**166.53**	**73.49**	**219.95**	**219.95**	**65.43**	**183.05**	**183.05**	**56.97**	**192.83**	**192.83**	**57.84**	**472.23**	**472.23**	**57.01**
Barge/truck transport	10	176.53	4.41	50	269.95	14.87	60	243.05	18.67	72	264.88	21.6	5	477.23	0.6
Barge/truck unloading	4	180.53	1.77	0.5	270.45	0.15	0.5	243.55	0.16	0.5	265.33	0.15	0.5	477.73	0.06
Storage and loading	10	190.53	4.41	1	271.45	0.3	7.29	250.84	2.27	1.5	266.83	0.45	3	480.73	0.36
Interest	2.22	192.75	0.98	16.97	288.41	5.05	12.54	263.38	3.9	13	279.83	3.9	30.05	510.78	3.63
Wholesale cost	**192.75**	**192.75**	**85.06**	**288.41**	**288.41**	**85.8**	**263.38**	**263.38**	**81.97**	**279.83**	**279.83**	**83.94**	**510.78**	**510.78**	**61.67**
Importer margin	3.8	196.61	1.68	31.73	320.14	9.44	39.51	3.2.89	12.3	28.84	308.67	8.65	97.5	608.28	11.77
Wholesale price	**196.61**	**196.61**	**86.76**	**320.14**	**336.15**	**95.24**	**302.89**	**302.89**	**94.26**	**308.67**	**308.67**	**92.59**	**608.28**	**608.28**	**73.44**
Dealers Cost and margin	30	226.61	13.24	16.01	336.15	4.76	321.33	321.33	5.74	24.69	333.36	7.41	220	828.28	26.56
Farmers price	**226.61**	**226.61**	**100**	**336.15**	**336.15**	**100**	**321.33**	**321.33**	**100.NA**	**333.36**	**333.36**	**100**	**828.28**	**828.28**	**100**
Wholesale: CIF ratio	na	1.2	Na	1.75	1.75	na	1.55	1.55	na	Na	1.65	na	na	1.58	na
Retail: CIF ratio	na	1.42	na	2.02	2.02	na	1.89	1.89	na	na	1.96	na	na	1.58	na

- Access to inputs especially fertilizers, agrochemicals (herbicides, insecticides etc.) and machineries is a major limitation to the growth and development of Africa agriculture. Advanced agricultural systems in the other parts of the world have thrived on adequate supply of inputs, with concomitant increase in productivity of the farming business leading to increased competitiveness of the commodities produced. The situation is the direct opposite in most Africa countries where the use of inputs is far less than 10% of what is used in the West and ASIA [16-17]. Adequate supply to ensure availability as at when needed and the affordability of this commodity has been a major constraint. The price regimes of most inputs aremuch higher in Africa than in several other parts of the world thereby constituting a major factor limiting their use. Efforts at managing this situation have been the use of several models of subsidies on these commodities at the governmental level, but such have suffered much manipulation by the political class leading to failure in most cases. (Table1).
- Access to affordable financing has also been identified as a limitation to the productivity of the agricultural system. Agriculture in Africa will require a different financing scheme different from the available finance with the public banking sector that requirescollateral and with high interest rate charges. The nature of agricultural production and its associated small scale industries require a different loan gestation period, such should givesufficient time for a complete business cycle before repayment can commence. Knowledge from the more stable agricultural advanced countries showed that interest on agricultural loan stand within single digit margin (Table 2).
- Access to output market constitutes a major limitation to production at the farmer's level, it also limits socio-economic benefits from best bet technologies that are effectively transferred and used. Farmers are not able to access market due to a number of institutional issues ranging from unorganized commodity market system, non-competitiveness of commodity produced locally in terms of price and quality compared to the same commodity imported from ASIA and the West. Efforts at opening up market for commodities will be all encompassing, requiring active contribution of policy makers to make supportive policies to create more space for locally produced commodities. The policy makers may also need to provide the needed infrastructures that will facilitate the production of high quality produce at reasonable costs. The contributions of the researchers to develop new products that will generate additional value chains that will take up the commodities that are produced locally are important. The organization of farmers into commodity groups is also vital for them to negotiate good prices for their produce.

Table 2: Agricultural Lending Rate in Selected Countries in Africa and Three Western Countries as Checks

	Agriculture Lending Rate (%)			
Countries	2008	2009	2010	2011
Angola	12.5	15.7	22.5	18.8
DRC	43.2	65.4	56.5	43.8
Gambia	27.0	27.0	27.0	28.0
Liberia	14.4	14.2	14.2	13.8
Madagascar	45.0	45.0	49.0	52.5
Malawi	25.3	25.3	24.6	23.8
Mozambique	18.3	15.7	16.3	19.1
Nigeria	15.5	18.4	17.6	16.0
Rwanda	16.5	16.1	16.7	-
Sierra Leone	24.5	22.2	21.3	21.0
Tanzania	15.0	15.0	14.5	15.0
Uganda	20.5	21.0	20.2	21.8
Zambia	19.1	22.1	20.9	18.8
South Africa	15.1	11.7	9.8	9.0
Thailand	7.0	6.0	5.9	6.9
United Kingdom	4.6	0.6	0.5	0.5
United States	5.1	3.3	3.3	3.3

Adapted from World Bank World Development indicators (2013).

- Lack of infrastructures has also placed a huge limitation on the development of the agricultural sector. The non-availability of rural roads, poor electricity supply, irrigation facilities and storagefacilities have grossly limited the scope and scale of production and productivity of the system. The limitation ranges from inability to utilize advance production methods, which rely on intensive use of machineries and electricity to the absence of good roads to transport commodities to local markets. For instance, the production of broiler birds under intensive technologies require control of light, temperature and humidity, this is only feasible using the public supplied electricity.
- Suboptimal institutional support has also short-changed the development of African agriculture. The main institutional support are from the research and the extension systems, which s in most Africa countries, are poorly organized to deliver their outputs in terms of technologies and effective extension and advisory services to the farmers and other stakeholders in the system. The known limitations range from insufficient staffing, low capacity of the staffs to deliver the required outputs and lack of funding to actually carry out the research endeavour. The proportion of the farmer per extension staff is Africa is abysmally high with no possibility of performance even with adequate facility, yet the extension system is poorly funded and the output is poor. Additional institutional support that is lacking is the provision of reliable meteorological, weather forecast and early warning services.. This should also be a public function, but it is lacking and where there are traces they are anchored by non-governmental organizations that depend on unsustainable donor funding to carry on their activities.

The summary of the characterisation process of the African ARD shows that it is bedevilled by problems besides technological problems that have caught the attention of players for several years and which require the attention of other non-research stakeholders. We can classify these additional problems as Institutional and Infrastructural, the resolution of which will enable technologicalsolutions blossom and meet their potentials thereby taking African agriculture beyond the “Island of Success” syndrome.

Developing a New Theory of Change for African Agricultural Research and Development: The state of Africa agriculture requires the development of a new model for implementing agricultural research and development initiative, such that its outputs will be commensurate with the amount of investment. Such a system needs to address the shortcomings of the old linear model andshould possess the ability to provide sustainable solution to emerging issues.

Table 3: Evolution of ARD Systems Scenarios

ARD System Scenario	Partners engagement						Market consideration	Value chain consideration	Research demanded by Users
	Research	Extension	Farmer	Policy	Private	End user			
•Traditional linear model for research and extension	yes	Yes	No	No	No	No	No	No	No
•Farming systems perspective (OFR/FSP	Yes	No	Yes	No	No	No	No	No	No
•Participation/participatory research methods	Yes	Yes	Yes	No	No	No	No	No	Yes
•Action research	Yes	Yes	Yes	No	No	No	No	No	No
•Rural livelihoods									
•Agri-food systems/value chain	Yes	No	Yes	No	No	No	yes	yes	No
•Positive deviance	yes	No	yes	No	No	No	No	No	No
•Knowledge development, dissemination and use	Yes	No	yes	No	No	No	Yes	No	No
•Doubly green revolution	Yes	No	Yes	No	No	No	No	No	No
•Rainbow revolution	Yes	yes	Yes	Yes	No	No	yes	No	No
•IAR4D	Yes	yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes

Quite a number of concepts have been introduced to improve the delivery of impact in the African ARD. Anandajayasekeram [5] listed some of the emerged concepts to include;Farming systems perspective (OFR/FSP); Participation/participatory research methods; Action research; Rural livelihoods approach; Agri-food systems/value chain; Positive deviance and Integrated agricultural research for Development (IAR4D). Most prominent among the issuesthat have been tackled by some of these models include; (a). Effective and all-encompassing engagement of stakeholder's in ARD activities viz., [researchers, farmers, extension, private sector, policy makers and end users](b). Consideration for market access and development, (c).Consideration for value chain development, (d).Creation of platformsthat ensure that research subjects aredemanded by the end users. Table 3 below shows a comparative analysis of different concepts with respect to different parameters including engagement of partners, market access, value chain consideration and demand for the research efforts by partners.

Integrated Agricultural Research for Development which was developed by FARA capitalizes on all inclusive engagement of stakeholders and which is combined with market orientation, value chain consideration and end user demand for research. It builds on the strength of previous concepts and obtains it success through the process of integration.

Integration is the main and unique feature of IAR4D. Hawkins [19] defines four components that make up the integrated agricultural research for development. These are: integration of the perspectives, knowledge and actions of different stakeholders around a common theme; integration of the learning that stakeholders achieve through working together; integration of analysis, action and change across the different dimensions (environmental, social and economic) of development; and integration of analysis, action and change at different levels of spatial, economic and social organization. To these should be added the integration of policy, markets, institutions, NRM and knowledge management into innovations processes. There are other dimensions of integration in IAR4D. Research in integrated with development and players on both sides become co-players in the promotion of innovation. Technological solutions are integrated with institutional and infrastructural solutions for the removal of all obstacles that limit the achievement of impacts. Even the domains of research are linked. Practically, productivity research is linked with markets, policy, NRM, product development, gender and nutrition for an enhancement of impact from collective activities. The integration and interaction of the components and the overall outcomes (successful innovations resulting from the interaction are the most important and not the individual components of the approach.

Although many mechanisms could be used to implement integration, FARA proposes the use of Innovation Platform which is a virtual or physical platform for interaction by players in the ARD with a focus on a commodity or system and a compelling agenda of operation leading to derivation of impact on a win-win basis.

How Innovation Platform and IAR4D Address Change: The success of a theory of change depends on the extent to which the proposed theory addresses areas that require change which cumulatively leads to an overall change of the system.

The overall changes required in the agricultural landscape are connected with the improvement of food and nutrition security, reduction of poverty and

improvement of the integrity of the environmental. These call for a number of smaller changes in the areas of productivity; interaction of stakeholders; access to inputs like seed and fertilizers, agrochemicals and finance; access to insurance; access to processing and value addition and access to end markets. But changes are also required in policies, natural resource management, institutional arrangements guiding and influencing operations in ARD as well as the area of infrastructural development. All these little areas of changes have to take place in the general platform of interaction and gender sensitivity guided by the principles of sustainability. An effective theory of change must address each of these areas in order to have a cumulatively positive change in the overall areas of desired changes.

The concept of innovation platform has emerged following the different efforts at transforming Africa agriculture from its precarious state. The innovation platform has it root in the innovation systems approach; this has been used effectively in the industrial development in the West [20]. This approach embraces a multi-stakeholder orientation and gathers perspective of every stakeholder that is associated with a product line to identify important problems and jointly generates solutions. It was evident in the industrial revolution that products developed within such systems do receive better public appeal; it enjoys broader market and regular improvement [21].

Platform Membership: One mechanism through which the Innovation Platform promotes effective change is related to the assemblage of partners in what is called innovative partnerships. Although ARD players have realized that partnerships engender progress have moved in the direction of engaging partners of various types for ages, it is not until lately that we have had an amplification of the usefulness of partners. Partnerships became more prominently featured with the current reforms of the Consultative Group for Agricultural Research (CGIAR). Innovation Platforms promotes the use Innovative Partnerships to promote interaction. By this we mean the assemblage of partners that have the potential, ability and willingness to work on the identified problems which have been regarded as the compelling questions to be answered by the Platform. Invariably, identified areas where changes are desired determine the members of an innovative partnership and the innovative partnerships membership changes as the problems are reviewed and problems or areas of desired changes change.

Although the Innovative partnerships membership is cantered on the central area of change it is not limited to this area as it also covers areas of ancillary changes which complement and facilitate the central change. Rather than being limited to the resolution of technology related changes innovative partnerships also anticipates associated institutional and infrastructural changes and draws its membership to resolve these accordingly. It therefore provides a holistic environment for the attainment of overall changes desired in ARD.

Operation of Innovation Platform: The partners involved in an innovative partnership interact on the basis that ensures that there is integration of the perspectives, knowledge and actions of different stakeholders around a common theme. This is accomplished by establishment of viable partnerships between stakeholders through the development and management of an Innovations platform (IP). This is different from previous approaches which over-emphasized the contribution of research related sectors over the non-research related sectors. This interaction basically integrates changes in the components for the derivation of overall system wide changes.

Innovation Platform and Learning Across the Range of Membership: Working on the principle thatall the stakeholders in the innovation sphere who have been drawn up unto the Platform have relevant knowledge and experiences to sharepromotes learning at three different levels:

- Individual level: Individuals learn about their own experience and interaction with each other and how their own personality, attitude and mind-set affect the interaction.
- Organizational level: member of the organization learns about how their administration and management practices, incentives structures etc. limit interacting between individuals within the organization and between the organization and other stakeholders.
- Institutional, individuals and organizations learn how they interact to facilitate innovations i.e. how to collectively create enabling environment that encourages the interaction and how to share information and manage knowledge across such networks.

Innovation Platform and Big Impact Beyond the Islands: As a mechanism for change, the Innovation Platform integrates the technological, institutional (including policy and markets) and infrastructural dimensions of change to support broad development strategies. It is therefore robust enough to perform well under different scenarios concerning future environmental, social, institutional, policy and commercial developments thereby converting the "Islands of successes" into mighty oceans of demonstrable changes within the shortest possible time.

Innovation Platform and the Integration of Relevant Domains of Research: For a theory of change to be effective and sustainable it has to integrate research and enable integration of different domains of research as it does this. Without disregard for the problem area, Innovation Platform regularly draws research partnership in seven discipline namely –productivity, markets, policy, natural resource management, product development, nutrition and gender. Research activities form tables within each discipline and at all possible interphases between the disciplines.

In addition, the model makes room for equitable acquisition of benefits to all contributing stakeholders, this is unlike the wide inequality in benefit that grossly marginalizes the smallholder farmers and keeps them in poverty cycle despite the efforts to increase their production. The need for the smallholder to completely move from the subsistence mind-set is vital to initiate their transformation from poverty. The model thus needs to have a structure that will gradually ensure that the smallholders' practices are transformed to small and medium scale commercial enterprise. This will foster an effective partnership between the farmers, the public sectors partners and other private sector stakeholders.

The Theory and the Pathway of Change for the Innovation Platform Model: The theory of change for the innovation platform model as depicted in Figure 3 indicates the role of effective partnerships in the provision of holistic solution to agricultural research and development issues. The multidimensional and multi-institutional nature of constraints confronting agricultural development really necessitates such approach. The engagement of all the stakeholders along the innovation process of a particular system or commodity is vital, but such is only effective when the dichotomy in interest between the public and the private sector practitioners is harmonised. Speilma and Klaus [22] made several recommendations on the techniques to positively ensure the private sector contribution to agricultural research and development. An addition to Speilman and Klaus proposition is the need to aid the commercialization of the smallholders system by transforming them from subsistent producers into small scale enterprises. This is doable with supportive policies in the presence of effective input and output market. Thus the theory of change sees this partnership as the first indicator of success.

The further need for effective engagement and interaction of all the stakeholders on an innovation platform is necessary to identify the problem, prioritize them, source solutions, implement the solution and learn lessons in an iterative manner. The successful operationalization of the innovation platform lies much in vision and competence of the facilitator to scale over the initial fuzzy front head. The Sub-Saharan African Challenge Program (SSA CP) experience using the innovation platform as the operational frame for the Integrated Agricultural Research for Development (IAR4D) Concept suggests that, where the farmers and other private sector practitioners developed the sense of ownership early, the speed for innovation is faster [15-22]. Thus the second break through point is the effective operationalization of the innovation platform at both the implementation and at the strategic levels.

An effective innovation platform with the requisite research issues being pursued effectively and with the full complement of the needed stakeholders will often generates the technological, institutional and the infrastructural innovations. This often leads to good socio-economic benefits for the stakeholders on the innovation platform followed by the outcome categories in terms of Increase in commodity yield, increase in income & overall productivity of the smallholder system. Enhanced agrarian livelihood, leading to national food security, rural poverty reduction, Job creation etc. as the medium terms outcome of the model. These outcomes constitute an important breakthrough indicator for the Innovation platform concept.

The obvious assumptions of this model include the following;

- The model assumes that there will be effective communication on the innovation platform, such that all stakeholders out-rightly see the goal and get a buy-in in pursuing the goal. Where this is lacking the

Box 1. Early examples of Innovation Platform for Agricultural (Ago-Are Maize & Water melon IP)

The early days in the development of the innovation platform model cut across research and development activities in a number of rural communities; these provides learning opportunities to perfect the concept. One of such is the Ago Are town in Oyo North local government area of Oyo State in Nigeria. Ago Are lies in the derived savannah agro ecological region of Nigeria, it is predominantly agrarian town, The climate favours the growth of food crops like yam, cassava, millet, maize, fruits, rice and plantains, citrus, tobacco and timber. Prior to intervention, the livelihood of the smallholders in the community was threatened by the obvious disadvantages of the smallholder's system viz., poor access to technologies, inputs, market etc. the cultivation of food crops were abandoned and farmers have shifted to more tedious tobacco cultivation because it fetches cash from the tobacco companies. The farmers were participating in an out-growers scheme where all inputs are supplied by the tobacco company and the cultivation is keenly supervised. After harvest the factory takes the commodities, fixed the price and subtract the cost of inputs; the balance is paid to the farmers. The farmers were largely ripped off under this arrangement as they could not negotiate the price for their commodity.

The research and development intervention was carried out as a project under the International Institute of tropical Agriculture; it was partly supported by commonwealth of learning and later by the British America Tobacco Company. Within the Ago-Are community, the farmers are already organized into a group with a leader called "Baba Agbe", although the group lack the required capacity to effectively orchestrate good development. The intervention started with the set-up of a platform with the farmers' association and the researchers from IITA, at this stage the problems were identified from the farmers and researchers perspective. The constraints boarders around the lack of information on elite varieties and production system, lack of access to input, lack of financial resources to purchase the inputs and access to information on the right pricing for the commodities. The platform then agreed to start activities on two prioritised commodities, Maize and water melon. The understanding of the problem led to the expansion of the platform with more members to contribute to its business, the platform engaged an end user (Livestock feed miller) for maize that made a concrete demand for the commodity to be produced. An input dealer was also engaged, the impute merchant had the capacity to supply fertilizer and herbicides for maize production. In the first year, about 500 farmers mobilized by the farmers' association participated using the available commercial variety, good supply of input and supervision by the extension officers from the agricultural office of the local government. The output was good and the researchers selected some farmers to conduct an evaluation of new varieties. Two top varieties were selected and adopted for use by farmers on the platform; some of the farmers turn out to be seed producers for the platform. New issues emerged after the second run of production; issues of post-harvest handling, grain quality and qualitative packaging emerged from the end user, the platform took best practices in processing bagging and storage method from the IITA researcher. As at the fourth year, the number of farmers on the platform has grown up to more than 5000, ICT facilities has been installed in the community canter for instant communication with research output help desk situated in IITA and a bank has been engaged on the platform to provide finance for the activities.
The alternative crop on the platform, catered for the women participant, who does not want to participate in the maize enterprise, the same model as used for the maize enterprise was used starting from the assured market in Lagos. This became more profitable and it attracted more male farmers
Researchers were actively engaged on the platforms, due technologies demand arising from observed constraints and several development issues on the platform; issues of productivity of the commodity system, sustainable natural resources management, market development, policy, nutrition etc.
The platform also fosters effective exchange and iterative learning, which brings to bear the different stakeholders innovative capacities for the benefits of all on the platform. There was high socio-economic benefits in terms of increased income, acquisition of livelihood assets (trucks, tractors and implements, generators, ware houses etc.), and diversification into alternative enterprises, generation of new jobs etc.
The engagement of the local agricultural officer on the platform as the policy maker also provided legitimacy and enhances the confidence of the private sector practitioners to participate.

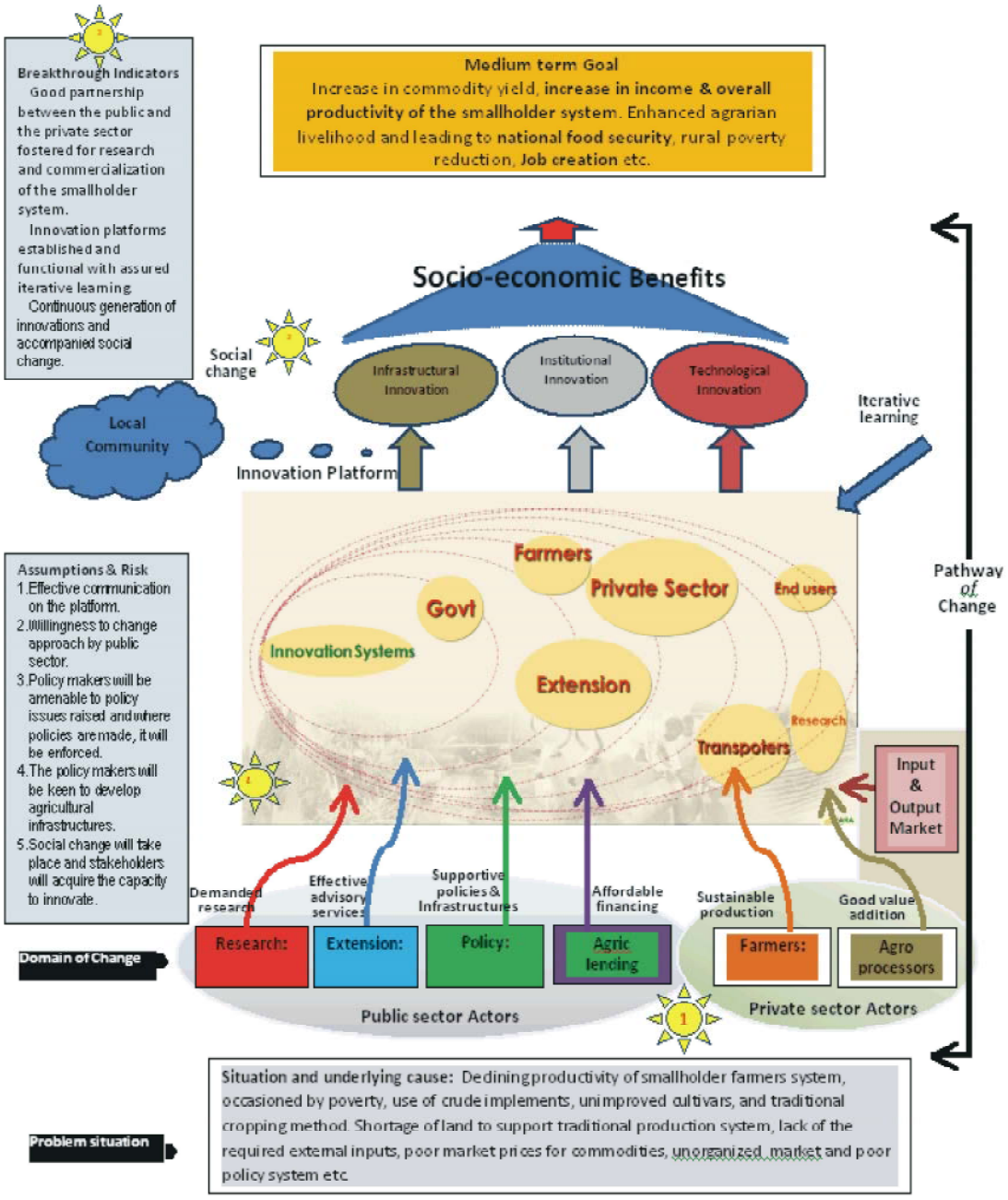

Fig. 3: Pathway of change diagram for the Innovation Platform model for ARD

platform stand the risk of not generating any innovation. However, the way to mitigate this risk is to adequately train the innovation platform facilitator and ensure that the facilitators are equipped with leadership and motivational skills.

- The innovation platform concept assumes that the traditional stakeholders of ARD especially the research partners willbewillingto change the approach by accepting to work with the private sector actors. Researchers erstwhile have the total control of the entire process and are used to provide leadership in any research and development endeavours. The likelihood that the researchers will admit the multi-stakeholders approach where every stakeholder on the platform has a stake and the research issues are demanded is much assumed.

- It is assumed that the policy makers on the platforms will be keen to take up the policy issues that emanate from the activities of the platform seriously. Where the policy maker on a platform is not actively engaging with the issues will portends a risk to the generation of policy support for the platform enterprise. It is further assumed that when policies are made, such policies will be enforced adequately for it to generate benefits for sector. The role of the policy makers to facilitate the development of the agricultural infrastructure is assumed in this model. It is postulated that if the policy maker is engaged on the platform and have a privy to information on extent of limitation the sector encounter due to lack of infrastructure, the policy maker will be keen to direct resources into the development of the infrastructure. If this assumption fails and infrastructure are not developed the speed of progress of the platform in generating innovationwill be slowed down and the likelihood for the commodities to attain price competitiveness may be affected.
- The model also assumes that social change will take place from the interaction on the platform; in the course of this process, the stakeholders will acquire the capacity to innovate. This is likely to happen if good interactions takes place on the platform and rules and regulations are adhere to strictly. The sense of ownership of the process by the stakeholder is pertinent to the development of their capacity to innovate. Adequate participation, training and joint learning are also very vital to developing capacity to innovate. The risk in this assumption is the likely redundancy of the system and or the triggering of innovation only by the stakeholders outside the rural community.

CONCLUSION

Africa agriculture has come of age and the sector is required to deliver more developmental outcomes for the continent than at any other time. The high population of Africans engaged in agriculture and its low productivity is a major factor that is responsible for poverty and food insecurity. If the productivity of agriculture could increase by a rational but significant margin, then the continent can feed itself and provide food for the expected increase in global population.

To ensure sustainable productivity from the sector, the way agricultural research and development activities are carried out needs to change. The linear model has been cut short in many ways and has failed to deliver the much needed socioeconomic change, as such a new ways of conducting agricultural research and development activities is necessary.

The innovation platform model relies on the innovation systems approach and embraces multi-institutional and multi-stakeholders engagement to identify problem and provide solution to them; using a combination of soft and hard sciences. The innovation platform itself constitutesan institutional creation for stakeholders to interact and generates solutions that provide socioeconomic benefits to all on the platform. The use of innovation platform concept as the implementation framework for the IAR4D concept in the SSA CP has provided a good proof for the effectiveness of the concept. However the theory of change behind the concept clearly showed that it could turn around Africa agriculture if it is scaled out.

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