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Evaluation of Capacity Development Activities of CGIAR

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Abbreviations

AFAAS	African Forum for Agricultural Advisory Services
ACBF	African Capacity Building Foundation
ACT	African Conservation Tillage Network
AERC	African Economic Research Consortium
AGRA	Alliance for a Green Revolution in Africa
AIS	Agricultural innovation systems
AKIS	agricultural knowledge information system
AR4D	Agricultural Research for Development
ARPPIS	African Regional Postgraduate Programme in Insect Science
ASARECA	Association for Strengthening Agricultural Research in Eastern and Central Africa
ASTI	Agricultural Science and Technology Indicators
AWARD	African Women in Agricultural Research and Development
BDS	Business Development Services
BecA	Biosciences eastern and central Africa
CAADP	Comprehensive Africa Agriculture Development Programme
CARDESA	Centre for Coordination of Agricultural Research and Development for Southern Africa:
CATIE	Tropical Agricultural Research and Higher Education Center
CD	Capacity Development
CIAT	International Centre for Tropical Agriculture
CIFOR	Center for International Forestry Research
CIMMYT	International Maize and Wheat Improvement Center
CORAF	West and Central African Council for Agricultural Research and Development
CMAAE	Collaborative Master of Science in Agricultural and Applied Economics
CMAPE	Collaborative Master's Programme in Economics
CPP	Collaborative PhD Programme
CRP	CGIAR Research Program
FAAP	Framework for African Agricultural Productivity
FARA	Forum for Agricultural Research in Africa
FSR	farming systems research
GFRAS	Global Forum for Rural Advisory Services
HAE	Higher Agricultural Education ()

IARC	International Agency for Research on Cancer
ICARDA	International Center for Agricultural Research in Dry Areas
ICIPE	International Centre of Insect Physiology and Ecology
ICRA	International Centre for development oriented Research in Agriculture
ICRAF	World Agroforestry Centre
ICT	Information and Communication Technology
IDO	Intermediate Development Outcome
IEA	Independent Evaluation Arrangement
IFPRI	International Food Policy Research Institute
IITA	International Institute of Tropical Agriculture
ILCA	International Livestock Centre
ILRAD	International Laboratory for Research on Animal Diseases
ILRI	International Livestock Research Institute
IP	facilitating innovation platforms
IPG	International public goods
IPM	Integrated Pest Management
IRRI	International Rice Research Institute
ISNAR	International Service for National Agricultural Research
IWMI	International Water Management Institute
KIT	The Royal Tropical Institute
NAADS	National Agricultural Advisory Services
NARI	National Agricultural Research Institute
NARS	National Agricultural Research System
NGO	Non - Governmental organizations
NPP	Network, programs and projects
NRM	Natural Resource Management
PABRA	Pan-Africa Bean Research Alliance
R&D	Research and development
RELASER	Latin American Network for Rural Extension Services
ReSAKSS	Regional Strategic Analysis and Knowledge Support System
RinD	Research in Development
RUFORUM	Regional Universities Forum for Capacity Building in Agriculture
S3A	Science Agenda for Agriculture in Africa

SLO	System-Level Outcome
SME	Small and Medium Enterprises
SMS	Short Message Service
SRF	Strategy and Results Framework
SRO	Subregional Organizations
SSA	sub - Saharan Africa
STEM	Science, Technology, Engineering and Mathematics
T&V	Training and Visit
TSBF	The Tropical Soil Biology and Fertility Program
WARDA	West Africa Rice Development Association

ANNEX A: Capacity Development and Relations Between the CGIAR and Agricultural Extension

By Ian Christoplos

1. Introduction: Implications of the new institutional landscape of extension

1.1 Background to this issues paper

This paper has been prepared as an input to the Evaluation of Capacity Development (CD) Activities of CGIAR. A major reason for the inclusion of this issues paper in the evaluation process is that financing of the CGIAR centers is being increasingly directed towards explicit causal chains demonstrating impact on development (agricultural research for development - AR4D). This is in contrast to past assumptions that quality research outputs can invariably be expected to lead to positive development impacts. Extension, in a wide perspective of making information and advice available for farmers, is an inherent part of this process. Even if the CGIAR system has relatively little direct collaboration with extension, as will be described below, the importance of enhancing the flow of information and advice is fundamental to developing the ‘right’ capacities to achieve AR4D aims, as demanded in current AR4D priorities. The inception report of the Capacity Development Evaluation states:

“The growing interest of linking funding to demonstrated development results has increased incentives for CGIAR Centers and CRPs to increase – to the extent possible – the degree of control and influence they have over uptake and application of their research products and, ultimately, the development outcomes for ultimate beneficiaries their research is intended to contribute to.”

This issues paper is based on literature review and perspectives drawn on the author’s extensive engagement in the international extension community. The conceptual framework describing pluralistic extension synthesizes policy discussions that emerged in the 1990s as part of the Neuchâtel Initiative, which have developed further in recent years with the Global Forum for Rural Advisory Services (GFRAS), as well as regional and national initiatives to bring forward new extension thinking. The findings also reflect the outcomes of the recent FAO Expert Consultation on “New Directions for Inclusive Pluralistic Service Systems”, held in May 2016.

An intention of this issues paper is to provide a formative basis for considering what the CGIAR role might be in relation to developing capacities with extension actors in the future. If such relations were to play a more central role in CGIAR ‘partnerships’, then it will be important to frame these efforts within an understanding of what extension consists of in today’s agricultural innovation systems (AIS). The concept of AIS is usually used to refer to the pluralistic set of actors involved in market - driven innovation directed towards economic benefits (World Bank 2012), and as such includes AR4D, but frames innovation in a wider perspective. This issues paper differentiates between AR4D, used here to refer to research - driven innovation models, and the more comprehensive AIS concept as a heuristic device to highlight the differences between these perspectives in relation to the role of extension. This issues paper takes a different perspective than the World Bank on AIS in stressing that, in addition to market forces, innovation is also being driven by pressures towards

greater environmental sustainability, equity, conflict management and other societal goals.

It is hoped that this issues paper can provide indicators of where a modest and appropriate niche for the CGIAR might be found in engaging with extension, and what this implies for mutual CD as part of future partnerships. This issues paper does not present recommendations for overall CGIAR research priorities. Instead, suggestions are presented for where some tweaking of the CGIAR research agenda may be needed to harmonize efforts with a somewhat more proactive effort to support the capacities that extension actors need in their work. Suggestions are also presented regarding how greater engagement with extension could inform CGIAR research priorities so as to be better aligned with AIS trajectories.

1.2 *Should researchers support extension or do extension?*

A core (but perhaps controversial) assumption of this issues paper is that the CGIAR cannot achieve significant AR4D impacts by doing an inevitably very small amount of extension itself and then expecting unassisted diffusion to ‘do the rest’. A theory of change such as this, even if it is implicit in some CGIAR programming, is judged by this author to be highly implausible. Achievement of effective, efficient, sustainable and widespread impacts from the CGIAR’s work is therefore dependent on collaboration with and support to extension. **This means that the CGIAR needs an articulated and substantial relationship with extension service providers.** Nonetheless, it must be acknowledged that the CGIAR often does undertake its own extension services. A recent survey found that even though extension related collaborations were rare (234 reported out of 7 376 collaborations overall), far more extension efforts were undertaken *within* the CGIAR and with National Agricultural Research System - NARS (107) than with extension agencies (14) (Ekboir and Sette 2015).

One reason for this lack of engagement with extension agencies may be the long - standing recognition of the very weak state of extension services in most contexts (Anderson et al 2006; Rivera et al 2001; Christoplos 2010), which may have generated a certain exasperation with what may appear to be a momentous task. It can perhaps be construed that the extremely limited scale of current CGIAR partnerships with extension may be related to concerns about raising expectations that the decline of extension could be reversed by the modest CD support that the CGIAR could provide. A more appropriate response to possibly well - grounded fears of ‘mission creep’ in terms of either providing major CD support, or (even worse) being drawn into undertaking extension directly, is to identify more manageable entry points for CD collaborations with extension, which is an intention of this issues paper. An initial overall message of this issues paper is that **Achieving scale in extension efforts requires selecting a viable niche for the CGIAR amid the vast capacity gaps that exist in agricultural extension today.**

In some countries research and extension have traditionally been fully integrated, thus making the issue of whether or not research should engage directly in extension as somewhat of a moot point. The land grant system in the United States was, and to some extent still is, based on close integration of research and extension, with a strong structure of governance from farmers’ organizations. With some exceptions (most notable Brazil and to some extent China) this integration has not taken hold in most developing countries. This may seem surprising, but is related to the lack of drivers for integrating research and extension in most contexts. One paper notes “The dependence of extension programs on science and technology (and generation thereof) and viceversa is strong, ... and yet

research scientists do not have strong incentives to interact with extension.” (Anderson et al 2006:6).

During the 1980s and early 1990s the importance of finding better ways to build links between research and extension was a ‘hot topic’, with the International Service for National Agricultural Research (ISNAR) playing a major role in the discourse that prevailed at that time (see, e.g., Merrill - Sands and Kaimowitz 1989). Training and Visit extension systems (Benor and Harrison 1977) were at that time being widely promoted by the World Bank and others. The concern with solving the research - extension linkage issue was partly due to a growing recognition that the lack of these linkages constituted a fundamental weakness in the Training and Visit model. Engagement from research to address these problems was described as limited since “...the incentives for research scientists to invest heavily in interaction with extension have generally been slow to change if at all...” (Anderson et al 2006:14). Indeed, the rather traumatic emerging failures of massive World Bank investments in the Training and Visit system were instrumental in leading to the calls to embrace pluralism (rather than linear public sector led research - extension structures) that began to emerge in the 1990s. The failures of the Training and Visit model culminated with declarations such as the Neuchâtel initiative’s Common Framework on Agricultural Extension in 1999, which strove to replace the science - driven technology transfer perspective with a primary focus on markets and institutional change.

Since the late 1990s the topic of research - extension linkages has fallen by the wayside. References to and guidance regarding research - extension linkages are glaringly absent in, for example, the work of GFRAS and others in the extension community. Illustrative of this decline of interest in research - extension linkages, the “five key areas for mobilising the potential of rural advisory services” (GFRAS 2010) presented at the GCARD conference in Montpellier in 2010 make no reference to engagements with research. When research - extension linkages are referred to in more recent extension analyses it is mostly in relation to how to establish stronger understanding and engagements with the private agritech firms that are expected to be their primary links to new technologies (see, e.g., Swanson 2008).

A review of CGIAR efforts, most notably the CGIAR Capacity Development Community of Practice, suggests that interest from researchers in addressing this issue is equally weak, with very little explicit mention of extension as part of the CGIAR CD agenda apart from vague references to ‘partnerships’ (or more recently ‘boundary partners’). CGIAR researchers queried identify very few CD related efforts at all (Ekboir and Sette 2015), which may be interpreted as suggesting that the concept has not gained traction among the overwhelming majority of researchers.

To a large extent, as will be discussed below, the question is no longer how research should engage with extension, but rather how both should operate within AIS. These far more comprehensive systems approaches have highlighted that the main drivers of innovation are likely to be market forces and the interests of farmers themselves. Both research and extension are service providers within the AIS, but they are not the only service providers and are unlikely to lead AIS processes. The viability of smallholder agriculture has been recognized as being reliant on their access to a range of services, including finance, inputs, etc. (Poulton et al 2010). The potential role and niche of the CGIAR in strengthening extension capacities therefore needs to be considered within an analysis of the full range of actors and services in the AIS. For example, it may be farmers’ organizations or supermarkets that are dominating the agenda for these capacity development efforts for those advising farmers. The CGIAR may only have a more limited technical assistance role, or none at all, if the farmers’

organizations or supermarkets are accessing research elsewhere. **Therefore the central message of this issues paper is the importance of ‘not missing the forest for the trees’ by falling back into an analysis of research - extension linkages, but rather to look at this relationship within a far more wide - ranging web of interconnections in AIS around the world.**

1.3 *What is pluralistic extension today?*

The starting point for exploring where extension fits into the AIS needs to be a recognition of who it is that provides extension services today. When the term ‘extension’ is mentioned, for many observers this conjures long out - of - date images of men (almost never women) from the ministry of agriculture on bicycles and wearing gumboots (see Leonard 1977). Pluralism, involving a wide variety of service providers, methods and institutional relations, has long been ostensibly recognized as being the true reality of extension (Christoplos 2010; Christoplos and Farrington 2004; Neuchâtel Group 2007; Christoplos 1996), including service providers in the public and private sectors, non - governmental organizations (NGOs), farmers’ organizations and others. Pluralism has been recognized as being good for farmers since it is assumed that they will be able to choose the most appropriate services to meet their needs and as competition is expected to enhance the quality of services. Furthermore, the increasingly important facilitation role of extension has meant that many extension officers are ‘multitasking’ in bringing together a variety of services that farmers need from across the AIS (Poulton et al 2010). Providing access to research findings is just one of those tasks.

In light of this pluralistic perspective, extension is defined in this issues paper as “all the different activities that provide information and advisory services that are needed and demanded by farmers and other actors in agrifood systems and rural development” (Christoplos 2010:2). This can include both public and private agencies and can involve promotion of technologies, ensuring quality of products, advising about how to respond to climate forecasts, legal assistance when managing land disputes and conflicts over natural resources, facilitating access to credit or insurance, etc. Even if there are sometimes expectations that a given extension agency (or even a given extension agent) can have its capacities developed to manage a most of these tasks, a more realistic understanding of pluralistic extension is that it is instead a call to recognize and support the myriad of actors who are involved in providing information, advice and facilitation within the AIS. At best, it is a call to support collaboration and synergies among these different actors. More modestly, it is a call for recognizing the messy nature of AIS and the futility of efforts to design tightly coordinated approaches.

Assumptions about the advantages of pluralistic extension have long been questioned as expectations about the emergence of dynamic and competitive service provision markets have seldom lived up to expectations (Rivera and Zijp 2002). The decline of public extension services in most countries has rarely been matched by a scaling up of alternative services, and only relatively wealthy farmers offer a sufficiently attractive market to stimulate private service providers to compete for their business. The result is that pluralism has in most countries resulted in patchy service provision with few indications that the presumed advantages of demand - driven extension are materializing (Christoplos 2010), particularly for the poor and smallholders more generally (Christoplos and Farrington 2004).

Furthermore, some countries have rejected pluralism in order to retain political control over extension and the benefits it can supply. Ethiopia has ignored donor pressure for a shift to pluralism in order to use large numbers of frontline extension agents for political ends (Berhanu 2012). Under Evo Morales,

Bolivia has rejected the ‘capitalist’ (i.e., pluralistic) models that had emerged in Bolivia in the period before his regime. But there have been difficulties in reestablishing a strong public bureaucracy (Cordoba and Jansen 2013, see also Grugel and Riggirozzi 2012). Nicaragua and Uganda have rolled back what were initially pluralistic reforms in order to use the extension service as a tool to show the leadership’s commitments to provide concrete commitments (in the form of inputs) to support farmers. These experiences thus point to the contentious nature of pluralism. Some observers (particularly in parts of Latin America) have seen pluralism as a neo - liberal agenda, others simply prefer to retain state control for political purposes (parts of Africa) or due to perception that a strong state role in agriculture is the norm and part of the overall social contract (in much of Asia). This is in contrast to the aid discourse, wherein pluralism is seen as being driven by an assumed inevitable trend towards a diminishing role for the public sector operating alone, with research and extension coming together through public - private partnerships in the AIS (Swanson 2008, World Bank 2012).

Some have even suggested that the debate about the supposed relative advantages of public versus private extension has overshadowed the importance of emphasizing the question of how extension providers of any type are able to enhance accountability to farmers working collectively (Bingen and Simpson 2015; GFRAS 2015; Hellin 2012). Stimulation of informed demand for extension from farmers and their organizations has been recognized as the most important factor in ensuring quality advice and information (Chipeta 2007). **Pluralism is likely to help enable farmers to demand appropriate services, but is not a panacea, and should rather be seen as a partial means to contribute towards the desired end objective of accountable service provision.**

Furthermore, even if farmers may obtain more information from different service providers, e.g., their local agricultural input dealer or a NGO project, it is all but impossible to obtain an overview of these forms of pluralistic extension as “there is no Agricultural Science and Technology Indicators (ASTI) equivalent for agricultural extension expenditures” (Anderson and Roseboom 2013: 14). weak and uneven data (Swanson and Davis 2014) about the messy mix of people that farmers talk to about farming (and the media sources that they listen to) has meant that it may remain easier for a research institution that wants to engage with extension to just ‘call the ministry’, even if it is increasingly apparent that the ministry is no longer ‘calling the shots’ in the current landscape of pluralistic extension.

The central implication of pluralistic extension for the CGIAR relationship is that it can no longer be assumed that there is a single, obvious actor whose capacities need to be developed. In order to select appropriate entry points for engaging with extension it is essential to wade into what may appear to be a morass of uncoordinated actors and work with a range of service providers that will differ depending on the target groups and the types of technologies and institutional processes that are being promoted. **The CGIAR cannot afford the transaction costs of dealing with ‘everyone’ involved in extension, but it is important to retain a broad overview so as to identify the most appropriate extension actors to engage with.**

1.4 Who controls and under what mandates/policies/incentives does extension operate today?

An implication of pluralism is that the complex and intertwined interests of different actors in the AIS will frame which extension actors are engaged in providing a given service. This includes the mandates, policies and incentives that determine their engagement and their interests. **For this reason, a**

political economy approach is necessary to obtain an accurate picture of who is mandated or incentivized to provide a given service and why. As noted above, the Training and Visit system was based on a model for research - extension integration that failed to take into account the lack of systemic incentives for this to occur. Despite the lessons from past failures, in reviewing the (admittedly limited) references to extension in researcher - led AR4D plans national policies, the economic and political aims and incentives that promote or discourage extension to engage in a given area of service provision are still rarely mentioned.

As noted above, another aspect of who 'calls the shots' in extension is that of the extent to which services are controlled by farmers' organizations. The prioritization of areas where extension is being strengthened is in many countries being made by national farmers' organizations, and effective CGIAR CD support would ideally need to be aligned with these priorities. There have been calls for AR4D efforts to be better anchored in accountability to farmers' and their organizations, with some significant evidence that this is happening on national levels through, for example, competitive funding schemes that include farmer organizations in the selection of priorities and research projects (Wennink and Heemskerk 2006). There is little evidence though of these types of collaboration, much less accountabilities to farmers, are becoming part of CGIAR partnerships (Ekboir and Sette 2015).

Another factor impinging on what 'stakes' a given extension stakeholder may have is that of decentralization, which has major implications for the efficacy of different CGIAR entry points to engaging in the AIS. Many countries are placing even public sector extension in the hands of local government, which has major implications for engagements at the systemic level. Before the Morales regime (which has attempted to re - establish centralized control over extension, albeit with limited success), Bolivia was often cited as an example of how empowering local government was profoundly changing the landscape for extension provision (Bojanic 2004). Asian countries such as China, India and Indonesia have experimented with decentralized models (Swanson 2008) with the tightly structured but pluralistic Agricultural Technology Management Agency in India often cited as a major success (Singh et al 2006). In Viet Nam overall decentralization and a withdrawal of the state from its once highly directive role in agriculture has had major impact on both vertical state structures within line ministries and horizontal public - private relations within the AIS (Christoplos et al 2014). Decentralization could work to the advantage of CGIAR investments in CD with extension as relevant decisions may be anchored at the more manageable local level, rather than within national political processes where interest in new agricultural technologies may be faint. It is important, however, to take this into account regarding theories of change for how 'models' may be scaled up when, for example, CGIAR advice to central level ministries may have decreasing influence on the work of extension actors at field level. It has been suggested that a major role for the CGIAR is to counter - balance the disadvantages of decentralization through the establishment of regional centers of excellence (Anderson and Roseboom 2013), but this implies the need for a strategy to link these regional centers to other levels of the AIS, which is not easily accomplished in decentralized systems.

Finally, as food security is increasingly seen as a key strategic component of political security at national levels, this has implications for political interests in extension as a visible frontline public service provider (Berhanu 2012). Strong or weak extension efforts can demonstrate the commitments of the state (or lack thereof) to supporting the rural poor. Even in global policies (e.g., the U.S. Global Food Security Act 2016), there is a recognition that extension is a tool for post conflict recovery (McNamara and Moore 2016; Longley et al 2006). **The scale of investments in research and extension**

for *food security* as part of the changing mix of humanitarian and development programming is likely to grow further in the coming years as donors give increasing priority to conflict and post conflict aid programming. This has implications for the role of extension as a figuratively ‘frontline’ institution operating at the literal ‘frontline’ of efforts to link humanitarian and development programming. Some CGIAR institutions are being drawn into related engagements with extension as part of developing seed enterprises, such as ICARDA’s work in Afghanistan (ICARDA 2005), so the implications of these factors are already being felt within the CGIAR.

1.5 *Linkages to research within agricultural innovation systems*

As stressed above, the topic of research - extension linkages is not firmly on the agenda today. The reports and publications of GFRAS and regional networks such as the African Forum for Agricultural Advisory Services (AFAAS) or the Latin American Network for Rural Extension Services (RELASER) scarcely mention the topic. At the other end of the spectrum, it is also hard to find evidence of agricultural research institutions paying attention to the complexities of pluralistic extension.

The concept that has been expected to overcome the research - extension chasm is that of agricultural innovation systems. In 2012 the World Bank produced an extensive AIS Sourcebook (World Bank 2012) that included some reference to the need for renewed attention to research and extension as part of an AIS perspective. Despite the holistic emphasis of AIS advice from the World Bank, there is little evidence of broad emerging commitments to better linking research and extension. **A major reason for this is that the AIS agenda has tended to primarily emphasize the central role of markets and value chains (rather than research and extension) as driving innovation.**

Furthermore, a synthesis analysis of commitments to AIS in tropical countries concluded that CD interventions tend to be implemented in a fragmented manner, and are generally small in scale and narrow in scope. The CD emphasis tends to be on quick human resource fixes that neglect institutional and organizational capacity dimensions (Aerni 2013). **Staff are trained to undertake roles in implementing a project, while the capacity of their organizations to promote innovation in a broader perspective is neglected.** There are, however, a number of individual AR4D and AIS funds and programs that have proven effective in developing capacities that are intended to feed into relationships including (and transcending) research and extension (for example, in Papua New Guinea, see Mbabu and Hall 2012). It is impossible to judge the prevalence of these arrangements, but based on the absence of references to extension in research programs and vice versa, the author of this issues paper judges that these programs do not represent a major trend. **Furthermore, although a few policy frameworks place CD for research and extension together in AIS policies (Tropical Agriculture Platform 2016), some of the major recent calls for a focus on AR4D and AIS make no reference to extension as a major partner in these efforts (see e.g., Juma et al 2013). It is within these constraints, and in efforts to transcend them, that CGIAR engagement with extension needs to be considered.** The possible emergence of a CGIAR agenda in relation to developing extension capacities (and extension’s role in enabling the CGIAR to also assume a more holistic AIS perspective) needs to be assessed in the perspective of extension’s place in today’s AIS.

Furthermore, it is broadly recognized that extension agents in most countries today are rarely up to the tasks inherent in an AIS approach. Their skill sets and attitudes are not adapted to these new challenges. For this reason, GFRAS and others in the extension community are calling for CD

investments in supporting the emergence of what has been referred to as the “new extensionist” (Davis and Sulaiman 2014; Sulaiman and Davis 2012). **Some of the characteristics of the new extensionist include capabilities to find new ways to engage with research as part of the changing nature of AIS, but research is not a major priority.** In the GFRAS position paper on the new extensionist (Sulaiman and Davis 2012), passing reference is made to the need for “technical backstopping” from research, but the overwhelming majority of recommendations for the new extensionist refer to building links elsewhere in the AIS.

2. Where is extension accessing CD and what are the drivers in these relations with actors serving the extension system?

2.1 *The scale of the capacity challenge*

In contrast to the grand aims of calls for upgrading skills to become new extensionists, systems for basic training of extension agents are in a shambles in most countries. Despite the scale of the problem, as noted above, solutions being applied are still usually in the form of short - term project fixes (Aerni 2013). Donor investments have been insufficient and in decline for many years (Rivera 2009). It has long been recognized that effective extension is reliant on its human resources and that this requires training institutions. In most of the world these have long been in decline. **Individual projects to promote different aspects of the new extensionist agenda may be effective in a narrow perspective, but the failure of governments to invest in a foundation for ongoing secondary and tertiary training (and failure of donors to invest in longer term CD as part of their aid effectiveness commitments) has meant that CD for extension is currently not reversing prevailing decline.**

Part of the challenge relates to the fact that tertiary level agricultural education in most countries has yet to shift from more traditional production priorities to providing a basis for the market and communication related approaches that are required if an AIS perspective is to take hold (Spielman et al 2012; Rivera 2009). Even where extension staff are receiving relatively advanced training, they are not being equipped for challenges such as engaging with a range of actors.

It is, of course, not a responsibility of the CGIAR to address this fundamental human resource gap as part of its own CD efforts, but it is important to take into account the scale of this gap and its implication for theories of change.

2.2 *Contradictory trends in extension priorities*

In order to find common ground with the priorities of extension providers, it is important to recognize what these priorities are and what is driving them. The following five somewhat contradictory trends in extension priorities suggest examples of where a common ground between CGIAR and extension may need to be found.

First is the focus of reform on enabling extension to better engage in market oriented agriculture (Rivera 2009; Chipeta et al 2008; Christoplos 2008), implying a stronger role in value chains. Extension services are often ‘embedded’ within value chains, for example where supermarket chains finance extension as a way of ensuring that they receive produce with the required quality, bulk and

timeliness, a process that took hold first in Latin America (Reardon and Berdegúe 2002) and has expanded to varied extents in Asia and Africa. The presumed role for research institutions in extension related CD is therefore expected to be mediated within efforts to develop value chains. Market - driven AIS are broadly assumed to be the norm (World Bank 2012) and fieldwork has shown that many actors see market - driven AIS as central to their work (Triomphe et al 2013). **However, the extent to which there is coherence between claims regarding market - orientated reforms and actual CD initiatives at national levels appears to be low.** Looking at Latin American experience a major study found: “Neither universities nor national agricultural research institutes have taken any lead in any of these efforts to improve capacity development for agricultural innovation. They are largely decoupled from market driven private sector activities.” (Aernis 2013: 38).

The second CD focus is on methods, with Farmer Field Schools and other methods such as Management Advice for Family Farms the most popular solutions. But a problem with the drive to find methodological ‘silver bullets’ such as these is that although they are often very effective within projects (Davis et al 2011; Friis Hansen and Duveskog 2012), there is less conclusive evidence of scalable and sustainable outcomes, given the human resource and organizational capacity requirements to undertake these methods. **Challenges with using a new ‘method’ to enhance extension effectiveness relate to both the limited pre-existing human resource and organizational capacities required to use relatively complex methods, and the financial ability to sustain CD processes and even actual use of these methods once project funding ends.**

Third are efforts to skip the problematic, bureaucratic and expensive approach of working with extension agents and focus instead on investing in Information and Communication Technology (ICT) solutions. There has been a significant amount of hubris regarding the potential of ICT to at least partially replace face - to face contacts in the AIS (World Bank 2011), some of which has begun to be debunked (Sulaiman et al 2011; Steyn 2016). Paradoxically, these initiatives that were expected to be a way to bring extension to a larger scale have themselves tended to remain as small, donor - funded pilots (Gakuru et al 2009). **Questions exist regarding the extent to which complex research findings and recommendations can be communicated through SMS and other ICT based systems** (Christoplos 2012). One observer writes: “In fact, the take - over of the technology agenda by the cell phone and SMS promoters was so complete that we were asked to believe that the ‘know how’ and ‘how to’ of African agriculture could be reduced to a series of ‘practices’ to be pushed out through SMS messaging or accessed by one mobile platform or another.” (Sumberg 2013).

Fourth, as noted above, it is now largely acknowledged that extension should be largely owned by farmers’ organizations. It is essential to emphasize extension agents’ accountability to these organizations and their capacities to support collective action. **Despite calls for these changes, CIMMYT research has shown that the prevalence of linear technological approaches continues to stymie support to more appropriate farmer owned extension engagements** (Hellin 2012). Furthermore, the extent to which farmers’ organizations are prepared ‘to bother’ to exert demands on research and extension institutions that they see as having ignored their needs in the past is often very low. One major study in Africa found that “producer organizations do not appear to be actively engaged in determining research and extension priorities, except in some isolated cases.” (Aerni 2013: 30). Another observer has noted that due to the vested interests of (some) farmers in existing production patterns they may even be hostile to innovation: “collective - action groups not only can contribute to innovation, they can also use their bargaining power to block it.” (Anderson and

Roseboom 2013: 8).

Fifth, many ministries are falling back on seeing the public extension service as a channel for distributing subsidized inputs and/or as a way to ensure political support and control (Berhanu 2012). Extension reforms in Uganda were much lauded in the past as a model for pluralism, but have since been largely rolled back and replaced with a public sector agency used to provide input handouts to selected farmers. Changes such as this may be driven by political imperatives or a desire for a quick fix to produce more cheap food for the urban population. **This raises questions about whether there is even a role for research, or if these input distribution focused ‘extension agencies’ should be avoided as they often distort markets and feed into political processes that contradict CGIAR goals and principles.** It would seem that these disturbing trends would be central to developing a politically informed research agenda around support to extension.

2.3 The need for a long - term CD relationship

The complexity of these five elements suggests the need for a broader and more long - term CD relationship to understand and address capacity gaps between extension and research in a way that builds on endogenous CD processes and responds to political pitfalls and opportunities. The need for long - term commitments to AR4D is certainly not new, but needs to be perceived in a broader systems perspective (Posthumus et al 2013). Projects still dominate CD for extension (Christoplos 2010), which leads to patchy training rather than systemically informed interventions. **There is a need for strengthening extension organizations and renewing the institutional relationships that tie extension to research. This cannot be accomplished with a one - off training project.**

Many piecemeal efforts are undertaken by agencies with specific interests that are not aligned with the drivers of institutional development in the AIS. Such efforts may be related to, for example, climate change, links to humanitarian response in agricultural rehabilitation programming, etc. Intentions may be laudable, but the result is often instrumental engagements motivated by a need to have an extension organization capable of acting in a project implementation role, for example informing farmers about a technological package being provided by a project. **Such efforts to ‘use extension’ (rather than develop its capacities) may overshadow calls for the investments required for AIS approaches and the ‘new extensionist’ agenda, and are likely to undermine sustainability and ownership.**

A question for the CGIAR is whether it is part of the solution or part of the problem in this regard. Solutions require a longer - term relationship that not designed around narrow, time - bound projects. Even if the emergence of AIS is recognized as a long - term process, this is not reflected in the project - driven realities of aid - funded development. Triomphe et al write:

“Yet the relationship between innovation and projects seems ambivalent at best. On the one hand, projects contribute to creating innovation dynamics embedded in a temporarily favorable (and artificial) enabling environment, shielding the process from the usual inhibiting factors. They are able to do so because of the leverage they exert on human and financial resources, the opportunities they create for linking stakeholders to each other and the intensity of innovation - related activities they activate and support. ...On the other hand, projects often artificially trigger and support activities and short - term uses of technologies and other innovations which may not be sustainable, at times not even desirable, on their own.” (2013: 318 - 319).

3. Lessons: What the CGIAR should know about extension

The following five points briefly summarize the key messages for the CGIAR from the preceding analysis.

3.1 *Extension is a messy business*

Researchers cannot just ‘call the ministry’, but need to carefully select entry points to engage with an appropriate extension service provider for a given CD effort (e.g., perhaps the public sector or agribusiness for genetic improvements or farmer organizations for changes in practices). But this should also contribute to the wider endogenous processes underway in enhancing pluralistic extension systems.

3.2 *CD should always be driven by an intention to scale - up influence*

Scaling - up involves identifying what parts of the research agenda are likely to generate interest and investment among different organizations providing extension services. Scaling - up of extension efforts supported by CGIAR would require that potential AIS synergies are central to prioritization and analysis of how the extension organization wishes to build on their ongoing endogenous CD and reform efforts. Recognizing where these processes exist means taking into account the (systemic) incentives, mandates and policies in which they operate.

3.3 *Support only those capacities that extension organizations themselves want to develop*

Enhancing extension capacities needs to be based in an understanding of the political economy of these organizations in relation to the broader AIS systems at both local and national levels. Extension organizations (and their staff) may be interested in improved agricultural and animal husbandry practices and genetic improvements, but increasingly this is indirectly, i.e., in relation to primary objectives, such as:

- helping farmers engage in value chains and meet consumer demands;
- promoting the inputs being sold by suppliers that are financing extension;
- selection of technologies promoted by governments to increase production and/or be distributed to attract political support.

Indeed, given that extension is deeply involved in applying research within these complex systems, the CGIAR may also benefit by learning from these frontline service providers about which capacities the CGIAR itself needs to develop.

3.4 *Work within the realities of existing extension capacities*

The basic education level of most extension staff is low (and often declining), which has significant implications for the design of short term CD support that must take this as ‘a given’. Efforts to develop *specific* capacities should be anchored in an understanding of the extension capacities prevailing in the broader AIS. It may therefore be more appropriate to focus on niche skills and address manageable organizational issues regarding extension performance, rather than trying to establish grand but isolated complex models. In order to be effective over time and at scale, these niches must be carefully selected to ‘go with the grain’ of broader CD efforts underway in the AIS.

3.5 *Recognize that The CGIAR system is very rarely 'on the radar screen' of extension today*

Pragmatism and acknowledgement of the current dearth of research - extension linkages are important starting points for judging how to work with extension. Researchers in general, and the CGIAR in particular, are not well integrated into AIS efforts (Aernis 2013). Extension actors do not perceive themselves to be 'stakeholders' in relation to the CGIAR system, and even those few who do consider themselves to be stakeholders judge that one of the CGIAR's greatest weaknesses is "the inability of CGIAR to systemically implement its research findings in countries that need it through extension services, etc." (Globescan 2013: 26).

It may therefore be most effective to focus on working together with those national organizations that already have collaborative relations with extension. Private companies, NGOs and farmers' organizations would, in principle, be appropriate, but would depend on the capacity of CGIAR organizations to engage with them (and also their interest in working with research organizations). It may be difficult for CGIAR institutions to engage with politicized farmer organizations. A natural entry point may be the NARS, but the efficacy of this channel to reach extension will be related to the NARS' commitments to work within the AIS, which is also often limited.

Despite considerable attention to 'partnerships', the CGIAR relations with extension are currently virtually non-existent. A recent analysis of CGIAR engagement with extension found that out of 7 376 collaborations reported by 934 researchers, only 28 collaborations were done with extension agencies (Ekboir and Sette 2015). This rather grim starting point is important to acknowledge.

4. *Conclusions: CGIAR comparative advantage, niche and entry points for greater CD synergy with extension*

4.1 *Where does AR4D meet the AIS?*

The CGIAR must find synergies between its own research - driven imperatives (inherent in the AR4D concept) and CD efforts among AIS actors that are not necessarily demanding research, but are more concerned with the local/global market, managing natural resource conflicts or dealing with the political and bureaucratic factors that drive the AIS. The extent to which the CGIAR system contributes to CD for extension is in some respects a reflection of efforts to ensure that AR4D is contributing to wider efforts to strengthen AIS.

There are, however, counterproductive incentives. Donor pressures to demonstrate 'results' may lead the CGIAR to undertake or promote unsustainable or inefficient project - driven extension efforts that fail to reflect a plausible comparative advantage or niche for the CGIAR in the AIS. **The search for 'results' may lead to piecemeal training inputs intended to merely use (rather than strengthen) extension for a specific project, or it may lead to taking the even more inefficient path of skipping CD altogether by undertaking extension directly. Where this happens the AR4D agenda becomes detached from the AIS.**

Where then should CGIAR ambitions be focused? A counterintuitive conclusion of this issues paper is

that it is unlikely that the CGIAR could or should engage by itself on a broad scale with CD for extension. **In a period of major fiscal constraints this would require an improbably high level of investment. Instead, the CGIAR may find a more appropriate niche in new forms for collaboration with farmers' organizations, NGOs, NARS and others that can provide a basis for moving to greater and more cost efficient scale in enhancing extension capacities.** This would involve approaching extension within efforts to become better integrated into national level AIS. It would also involve addressing CD as part of *triangular cooperation modalities* wherein the CGIAR identifies modest and focused entry points to support wider sets of relations among Southern research, extension, market, natural resource management and other initiatives. Engagement with regional extension institutions such as AFAAS or RELASER, and their colleagues in regional research institutions such as FARA or CATIE could generate ideas of ways to join these emerging triangular cooperation modalities.

4.2 Genetic improvements

The inception report for this evaluation (Palenberg et al 2016) identifies impact pathways used by the CGIAR that are particularly relevant for engagements with extension, specifically genetic improvements and integrated approaches for sustainable agriculture. Suggestions for entry points to build links to these impact pathways are presented below.

Despite the widespread recognition of the non-linearity of technological change in AIS, extension is still often seen as primarily a channel for transferring genetic improvements developed by research to farmers. This is not just a matter of perceptions. Although technology transfer is not as dominant a role for extension as it once was, these tasks remain an important part of what many extension services do. **A decisive aspect of the quality of CGIAR commitments to CD for extension is in the ways that 'old' approaches to technology transfer are being reconsidered to reflect current institutional relations wherein the value of new technologies is increasingly determined by market and other factors.**

Even if the CGIAR and extension providers are both committed to promoting genetic improvements, it should not be taken for granted that the suppliers of research and those engaged with farmers (and consumers) have similar perceptions of what constitutes 'improvement'. It is currently largely acknowledged that farmers frequently use different indicators for quality than researchers. **It is important to identify how extension can be better capacitated to act as a 'mediator' between researchers and farmers (rather than just a delivery mechanism) regarding what constitutes a 'genetic improvement'. This is particularly important when extension is being run or trained by a private firm (e.g., a supermarket chain) that is entirely focused on qualities related to consumer demands, market structures, competitiveness, etc.**

If there are disjunctures in perceptions of 'genetic improvement', this has implications for *mutual* capacity development of researchers and extension in using the complementary skills of both to analyze and understand farmer perspectives. **The CGIAR may be able to enhance its own capacities to understand what constitutes a genetic improvement if it works with extension to serve market actors who are acutely aware of these parameters. This requires transcending old, perhaps subconscious, linear paradigms of technology transfer.**

In this respect the realignment of CGIAR CD efforts needs to build on the CGIAR's other efforts to recognize and find a complementary role in relation to the private sector. The majority of extension

efforts to encourage genetic improvements today are probably related to promoting technologies developed in the private sector. Some extension services are provided directly by agrochemical and seed firms. Even public sector extension agencies often find the only available training and other CD support for their staff is that being offered by these firms.

It has been suggested (Christoplos 2010) that the role of publicly financed and farmer organization - led extension should be to provide farmers with more objective assessment of the relative qualities of the different products on offer. Supporting capacities for such objective assessment may be a role for publicly funded research institutions such as the CGIAR. In order to undertake tasks such as these, the CGIAR system needs to develop its own capacity for AIS analyses through systematic feedback loops to learn from the experience of extension in introducing genetic improvements at scale.

4.3 *Integrated approaches for sustainable agriculture*

The importance of institutional factors in integrated approaches, including access to services, farmer cooperation, market systems, natural resource tenure issues, etc., are well acknowledged. **It would therefore seem particularly important for the CGIAR to find a niche and collaboration modalities to build on the prevailing institutional brokerage roles of extension actors.** As noted above, the AIS discourse stresses market - driven integration in particular. Even if the heavy focus on these aspects can be criticized as overlooking other drivers, such as smallholders' struggles to manage their natural resources in a sustainable and resilient manner, extension is increasingly becoming locked into seeing integration as primarily focused on value chain development. If the CGIAR is to find a demand for CD related to integrated approaches, it is here that this is most likely to be found.

Key to this is dealing with the paradox that extension services are, on the one hand, inevitably embedded in the complex array of public, private and civil society AIS organizations. On the other hand, they generally lack human resource and organizational capacity to apply integrated methods in acting as an effective broker. **The CGIAR's work with integrated approaches should include CD for extension that reflects their roles in the wider AIS, while at the same time avoiding repeating past failures related to over - ambitious and unsustainable models and methods.** Extension is part of the process of integration, but (despite the grand aims of the new extensionist) should not be expected to assume a leading role. Intense and brief injections of training for extension services to facilitate broad multistakeholder collaboration may work in the short - term for implementing integrated projects, but the prospects for sustainable change are poor.

In order to avoid such pitfalls, the CGIAR needs to develop its own capacities to utilize its understanding of the determinants of changing farming practices and integrated approaches. Feedback loops to learn from the experience of extension in rolling out these new approaches may be one important aspect of this.

5. Lessons for different levels in the CGIAR

5.1 For the individual researcher

- When developing research proposals or designing CRP components, researchers should include CD for pluralistic extension as part of overall engagements with the AIS, rather than selecting specific skills as a 'tool' for achieving 'results'.
- The point of departure for selecting priority opportunities for CD for extension should be in a focus on how to enable extension staff to do their existing jobs better, which involves looking closely at the mandates and incentives of a given extension organization. The endogenous process of CD in extension institutions should be respected.
- Researchers should make more proactive efforts to learn from their collaboration with extension about the dynamics and variables related to innovation that determine the values of new agricultural technologies and the paths towards more integrated approaches from the perspectives of farmers.

5.2 For research management

- CGIAR institutions and CRPs at national and regional levels should ensure that they base their CD plans on solid analyses of the policies and actual praxis that steer extension in their operational areas.
- Research managers should strictly avoid plans that involve CGIAR researchers undertaking extension activities directly. Pressures for 'results' in terms of application of research results should instead be seen as a clarion call for better collaboration with extension and advocacy (perhaps directed towards donors demanding a 'quick fix' to demonstrate achievement of adoption targets) for related CD investments.
- Research managers should seek to situate the CGIAR within triangular cooperation modalities with regional and national research and extension institutions and networks. It should not seek to lead in these relationships.

5.3 For the CGIAR system

- The CGIAR system should transcend the currently vague discussion of CD guidelines through the establishment of concrete and proactive norms for engaging with extension.
- A more explicit stance on CD relations with extension, based on frank acknowledgement of the CGIAR's limits and constructive exploration of alternative approaches, should be used by the CGIAR system to better clarify its comparative advantages and niches in the AIS.
- Furthermore, such a modest and constructive approach could serve to demonstrate a commitment to overcoming long-standing perceptions of CGIAR as being aloof (Madeley 2002). There is little available empirical evidence regarding extension perceptions of the CGIAR since extension actors generally do not consider themselves to have a relationship. The 2012 CGIAR Stakeholder Perceptions Survey (Globescan 2013) only succeeded in obtaining two responses of 1071 respondents from extension actors. The sample for the survey was drawn from stakeholder and partner lists compiled by the CGIAR with support from GFAR, which may have skewed the sample against contacts with extension, but this is in itself telling and is consistent with the impressions of the author of this issues paper (based on many years of discussions within the extension community). Trust is dependent on establishing a modest and constructive starting

point for a renewed relationship with extension.

6. Lessons for CGIAR CD synergies in other 'partnerships'

This issues paper concludes with lessons for other forms of partnerships beyond extension. The experience and problems in linking research and extension carries with it a range of lessons for how the CGIAR can better define its niche in partnering across the AIS.

6.1 *The 'partnership' concept need to be concretized*

There is a causal relationship between the decline of past research - extension linkage efforts and the growing lack of clarity regarding the meaning of 'partnership' in the CGIAR. There are lessons from this regarding the importance of concretizing the roles and responsibilities in partnerships more generally in relation to (a) whose capacities are being developed by whom, and (b) if and how those capacities are being developed for implementing a project versus wider future endogenous capacity development aims of the different 'partners'. Transparent and practical analyses of what is intended and why are a precondition for more effective and 'owned' CD initiatives.

6.2 *AR4D needs to be recognized as just one aspect of AIS*

Even if the CGIAR has limited tools and little comparative advantage to engage directly in the wider AIS, it should be more clearly recognized that the capacities for AR4D are just one element of how other partners are operating in the AIS. The core lesson here is that the two concepts of AR4D and AIS should not be conflated. Developing capacities for AR4D can contribute to AIS engagements, but much of the far more pluralistic AIS is beyond the sphere of influence (albeit part of the sphere of interest) of those developing AR4D.

6.3 *Selecting a manageable and effective niche should rely on political economy analyses*

Part of the above mentioned concretization is that of critical reflection on the 'stakes' of the different stakeholders in the CD relationship at national and local level. A pluralistic AIS is seldom the 'happy family' it is portrayed to be in many models and methods. It has been pointed out that the AIS stakeholders in natural resource management may be 'on the same platform, but waiting for a different train' (Hildyard et al 1997). Research's role in agricultural and rural development is not neutral and this needs to be reflected in the choice of partnerships, most particularly in the analyses of whose capacities need to be developed for what. Conflicts in the AIS are inevitable and usually cannot be resolved by the CGIAR, but can and should be recognized and managed as part of both the research and the CD process.

6.4 *CD needs to be demand - driven but anchored in recognition of the comparative advantage of the CGIAR*

A paradox in CD efforts in general is that ownership of these efforts is dependent on a demand - driven selection of aspects and methods, but at the same time must reflect the skills and mandates of the organization providing support. This is exemplified by the inherent contradictions of the new extensionist agenda wherein it is recognized that farmers need a grand array of extension services but

the capacity of service providers is limited and in many respects even shrinking. Similar observations can be made about the CGIAR, which in an ideal world could be expected to provide a huge array of much needed CD support to partners, but must carefully choose a niche that reflects its limited and in some cases shrinking capacities and comparative advantages. An important output of the Evaluation of CD by the CGIAR should be to provide a conceptual framework to emphasize where these efforts can be more demand - driven, while focusing on comparative advantages. This should ideally help to rein in tendencies to pander to unrealistic donor expectations about how much capacity development can be accomplished by organizations that are primarily mandated and incentivized to undertake research (see Christoplos and Matavele 2011).

Ultimately, the role for the CGIAR in CD for extension may not be by 'doing it', but rather in advocating for systemic investments in stronger extension institutions. The evidence base for this advocacy could be the CGIAR's own analyses of the gaps in the AIS agendas. The CGIAR system carries significant weight at policy levels, and this could be brought to bear on drawing attention to the need and opportunities to better link NARS with extension. A precondition for this is of course that the CGIAR itself moves out of its prevailing 'comfort zone' within AR4D technology transfer efforts and embraces opportunities to learn from its partners' roles in the AIS.

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ANNEX B: Assessing the CGIAR's approach to Capacity Development in R&D in sub-Saharan Africa

By John K. Lynam

The CGIAR Centers are research organizations that pursue development objectives. Capacity development (CD) in most of the countries in which the Centers work is essential in achieving these end objectives. Over the past three decades these objectives have broadened significantly, which in the last Strategic Results Framework (SRF) have been sharpened into performance criteria against which the Centers are held accountable. A result of this has been to broaden the range of program activities of the CGIAR across the research and development (R&D) spectrum into what is commonly referred to as research for development R4D. The focus on impact has in turn led to an enhanced incorporation of CD into R4D programs, particularly in sub-Saharan Africa (SSA). CD is thus used to achieve the objectives of the Center - which tend to broadly align with development objectives of the country -, and are instrumental in nature. At the same time, the capacity needs of African institutions are changing, and there is thus an issue of how close an alignment there is between African CD requirements and the supply of CD offered by the CGIAR Centers with programs in the region.

The CGIAR Centers have tended to focus much of their CD efforts on enhancing human capital, primarily through thesis research, short courses, or joint research programs. There is no inherent strategic framework that drives these investments; rather they depend primarily on CD activities built into projects. There are still training needs in Africa, but the more pressing challenge is in strengthening institutional performance for key agricultural R&D organizations, where human capacity development is only one element of an overall improvement in organizational effectiveness. However, at its core CD requires ownership of the activity and its objective. For human capital development this is inherent in the relationship between the trainee and the Center. For institutional CD this is a far more difficult undertaking, particularly given that such CD must also contribute to the objectives of the Center. As will be discussed below, there are examples of such institutional strengthening CD by Centers. Such activities require dedicated entities within the Centers of a longer term nature and to develop African ownership, are managed independently of the Center. Such examples are not widespread and their development has many aspects of being path dependent. The paper will discuss whether the CGIAR should invest more in these type of programs.

A more recent and alternative approach to CD by the Centers follows a more systemic approach as is developed within the agricultural innovation systems (AIS) framework. Many Centers have experimented with the approach, most often through the development of innovation platforms and primarily in SSA. The innovation platforms tend to be organized around the mandate of the Center. AIS provides the Center a framework to move along the impact pathway and with the integration of key functions necessary for impact. The innovation platforms thus tend to be organized around commodity value chains, and allow the integration of markets, technology extension, and credit, all key constraints to the adoption and impact of improved technologies. CD within an AIS framework, however, tends to focus on improved linkages between key institutions, rather than directly on institutional strengthening *per se*. How effective then is the CGIAR in the choice of where and how it organizes its CD investments in an African context?

The three levels of CD investment is the central framework for an evaluation by the Independent Evaluation Arrangement (IEA) of capacity development investments by the CGIAR. Moreover, the evaluation uses an impact pathway logic to assess recent changes in the focus of CD activities and their effectiveness. This paper was written as background to that evaluation, and is organized around these two dimensions of system level and impact pathway. The paper is not an evaluation *per se*, but rather provides regional context to the evaluation. The trust of the analysis assesses the CD needs of agricultural R&D in SSA and the providers of CD services in response to those needs. These needs are then framed against the provision of CD services by the CGIAR in Africa using three generic impact pathways, namely genetic improvement, production systems/natural resource management, and policy. This paper explores the gap between African needs and CGIAR supply of CD services, and the potential for greater alignment between CD needs in SSA agriculture and the evolving structure of CD activities in CGIAR Centers.

The paper is laid out in five sections. The first introductory section provides a very brief history of CD by the CGIAR in Africa. The second explores the broadening scope of CD within changing organizational models within CGIAR Centers, particularly in relation to how Centers have responded to the need for a more integrative, if not systems, approach to achieving impact on smallholder agriculture on the continent. The third section then explores CD needs and responses for African R&D institutions¹, using the three system levels. The fourth then assesses the provision of CD services by the CGIAR in SSA using the framework of the three impact pathways. The final section provides an overall assessment of how the CGIAR might better bridge the gap between changing CD needs and the necessarily instrumental nature of supply of CD services by CGIAR Centers.

1. Building on the CGIAR's Past History of Capacity Development in Africa

Sub-Saharan Africa got a late start in developing its human and institutional capacity, with colonial regimes only beginning to invest in educational capacity after World War II and with a particularly limited investment in university level education. At the same time public institutions were essentially inherited from colonial administrations and staffing of ministries became a real constraint on their performance. The 1970's and 1980's were a period of donor investment in human capacity development and institutional reforms, none more so than in agricultural research. This was a period of major investment in post graduate degree training primarily in Northern universities and in consolidation of research units in various ministries into a National Agricultural Research Institute (NARI), which was usually governed as a parastatal. This was also the period of the establishment of the network of international agricultural research centers that became the CGIAR, with four at that time based in Africa, namely the International Institute of Tropical Agriculture (IITA), the International Institute of Tropical Agriculture (WARDA), the International Livestock Centre (ILCA), and the

¹As distinct from the economic and development literature, organizations and institutions are used interchangeably in this paper. Within the three levels of analysis, i.e. human capital, institutional and systemic, institutional primarily refers to organizations and actors.

International Laboratory for Research on Animal Diseases (ILRAD) - the latter two would eventually be merged into the International Livestock Research Institute (ILRI) and another African based center would join the CGIAR, namely the International Center for Research in Agroforestry (ICRAF). In many ways the CGIAR Centers replaced the regional research centers set up in the colonial period, although with a shift from cash crops to staple food crops. During this period the CGIAR Centers were a major source of CD within African NARI's. Within the CGIAR the dominant organizational model at that time was the multi - disciplinary commodity research program. The Centers focused on developing similar capacities in the NARI's through post graduate training, disciplinary and commodity courses, and provision of trials for germplasm evaluation. There was a close alignment between the objectives of the CGIAR Centers and the evolving capacity in commodity research programs in the NARI's.

The 1980's also featured the development of farming systems research (FSR) across most of the CGIAR centers, including many of the commodity centers. This was a new area of investigation, eventually evolving into what would be termed adaptive research, and required changes in how research itself was organized in NARI's, particularly development of an on - farm research capacity. There was significant funding support during this period for FSR. This came at a period in the early organizational development of the NARI, a process in many cases facilitated by ISNAR. There was debate on whether FSR capacity should be developed within the NARI or in the extension system. This was a period when there were a lack of effective institutional links between the two, and because extension was adopting the Training and Visit model in SSA, FSR devolved primarily to the NARI. The 1980's was a period when the CGIAR came close to developing an institutional approach to capacity development, focused on how adaptive research capacity could be developed in the NARI's and this during a period of institutional restructuring in agricultural research in many countries in SSA. There has not been an evaluation of the CGIAR's impact on institutional development during this period, although Collinson's history of FSR has several chapters on the institutional response to FSR in several African countries and as well reviews training in this area (Collinson, 2000)².

Over the intervening two and a half decades much has changed in both the CGIAR and the agricultural research and extension systems of sub - Saharan Africa. However, CD and institutional performance remain continuing issues. In a 1999 paper for the CGIAR on African agricultural research capacity Carl Eicher observed, "Because of time optimism it is easy to downplay the time and resources that will be required for building scientific and managerial capacity and moving low - income nations in Africa into the ranks of middle income countries. Surely it is a challenge for the coming 25 to 50 years"³ (p 15). Yet for the CGIAR the institutional boundaries within which CD takes place have significantly expanded, the needs in support of a commercializing, smallholder sector have changed, and with the change in funding of the CGIAR capacity development has been subsumed within projects. Matching capacity needs of evolving African agricultural sectors with capacity development programs of the CGIAR Centers that respond internally to changing research agendas, organizational structures and financing instruments potentially suggests a growing gap between needs and program response. At the same time, with the increased focus on the impact orientation of CGIAR research and the demand of investors to demonstrate greater impact, capacity development, together with effective

²Collinson, Michael (2000). *A History of Farming Systems Research*. Wallingford: CAB International

³Eicher, Carl (1999). *Institutions and the African Farmer. Issues in Agriculture 14*. Washington, DC: Consultative Group on International Agricultural Research (CGIAR)

partnerships, have become an increasing focus of current CGIAR research programs. For the CGIAR capacity development will continue to provide an instrumental function in Center AR4D programs but the question is whether these programs can as well be designed to better contribute to capacity needs on the continent.

2. Organizational Models for Impact Oriented Agricultural Research

2.1 *Exploring the Interface between Research and Development*⁴:

Funding for CGIAR Centers is primarily dependent on international aid funds. The production of international public goods (IPG's) has provided the rationale for utilizing development funds to support international agricultural research. Similarly over the last decade development agencies have moved to improving the effectiveness of their development aid investments. This was codified in the Paris Declaration in 2005 of the OECD's Development Assistance Committee and development agencies agreed to manage their aid budgets on the basis of five principles. Most of these were utilized in the development of the operational policies in the reform of the CGIAR in 2008 and are reflected in the recent SRF, namely: (1) country ownership of their national development strategies; (2) donor alignment around country priorities in these strategies; (3) donor coordination, often leading to pooling of resources around a strategy; (4) managing development funds for results; and (5) mutual accountability, including donor accountability to their governments.

As a result of this process, IPG's were not sufficient to justify the investment of international aid funds in the CGIAR but rather had also to be managed to produce the development outcomes that were generated from the adoption of new agricultural techniques. Impact orientation has thus become a principal design criterion in the organization of Center research programs. Impact has shifted from a focus on evaluating those cases where Center technologies have been adopted at a relevant scale to produce impact to designing research programs, capacity strengthening, and institutional partnerships in a manner that addresses potential development outcomes and which can be continually assessed in achieving those outcomes. This shift to an impact orientation has led to exploration of alternative models for organizing research within the CGIAR, which will be defined here as Agricultural Research for Development (AR4D), Research in Development (RinD), and Agricultural Innovation Systems (AIS). These organizational models have significantly changed the organizational framework within which CD is designed with a significant shift in the institutional boundaries within which the CGIAR works.

These models have only come into practice in the last decade or so, in part as a response to the Paris Declaration. In the R&D continuum these models attempt to address how research is organized at the interface with development programs. In the past, particularly in relation to the interface between research and extension, this was operationalized as adaptive research. These models are much more than that and essentially argue for a wider engagement with development processes and with a wider

⁴Paragraph 2.1 is in part adapted from Lynam, John (2015). *Design Issues in the Evolution of ICARDA's Decentralization Strategy*. Unpublished paper.

array of potential interventions that extend from technical innovations through to organizational and institutional innovations. In an African context the latter are essential to improving productivity given the heterogeneity of smallholder agricultural systems, underdeveloped market and road infrastructure, and high transaction costs inherent in integrating smallholders into markets. In effect these models move research further downstream into the development domain and in the process into research areas not traditionally dealt with by more traditional genetic and natural resource management (NRM) research.

AR4D (also termed Integrated Agricultural Research for Development) has its origins in ensuring that agricultural research is both relevant to the needs of rural communities and is organized with an impact orientation. The focus on integration essentially argues that there is a higher probability of achieving impact by exploiting synergies with multiple technological components. This concept, and thus the precursors to AR4D, derived from the development of integrated natural resource management (INRM) within the CGIAR at the turn of the century⁵. This approach anticipated the development of sustainable intensification by outlining the need for integrating genetic improvement and natural resource management in order to achieve sustainable increases in productivity. The operational methods necessary for implementing the approach were outlined in Campbell and Sayre (2003)⁶ and then fleshed out in Campbell, et al (2006)⁷. Over the last decade markets, particularly in the form of value chains, have been added as a critical dimension of AR4D. This extended the focus from sustainable increases in productivity to improved livelihoods, and particularly allowed a focus on improving livelihoods of women.

AR4D focuses on organizing the interface between research programs and delivery or dissemination of technologies, management practices, and/or organizational innovations. This is usually done through projects and normally involves a combination of adaptive research, multi - site testing, targeting of appropriate agroecologies or systems, partnerships with technology delivery organizations, appropriate extension methods, and community level innovations, for example village based seed enterprises. For a particular context a technology adaptation, capacity strengthening, and delivery program was necessary to at least initiate the process of farmer adoption and diffusion. CD through such projects were both localized and spread across the institutions necessary to achieve such integrated results. Moreover, most Center initiated projects focused on a particular technology, e.g. grain legumes, zero tillage, improved forages or agroforestry. At the same time these components were embedded in a representative farming system and thus combined that component with other management practices or technology components. This reviewer's summary of experience with AR4D suggests (1) that for African farming systems the achievement of productivity and income impacts requires an organizational and methodological interface in delivering research outputs, (2) that system

⁵A synthesis of three cross Center meetings is found in Science Council. 2003. *Towards Integrated Natural Resource Management: Evolution of NRM Research within the CGIAR*. Rome: CGIAR Science Council Secretariat.

⁶Campbell, B.M. and J.A. Sayre. 2003. *Integrated Natural Resource Management: Linking Productivity, Environment, and Development*. Wallingford, UK: CABI.

⁷Campbell, B.M., J. Hagmann, A. Stroud, R. Thomas, E. Wollenberg 2006. *Navigating amidst complexity: Guide to implementing effective research and development to improve livelihoods and the environment*. Bogor, Indonesia: Center for International Forestry Research.

approaches to date are built around entry points based on particular technology components, and (3) that the learning from AR4D projects is difficult both to systematize and to generalize.

RinD essentially moves the research process further downstream with a resulting shift in research questions. RinD recognizes the critical need in organizing the interface between research and the achievement of development impacts, and has been portrayed as developing boundary work in moving knowledge into action. “Boundary work” signifies the processes through which the “research” community organizes its relations with the worlds of action and policy making, on the one hand, and with practice - based and other forms of knowledge on the other. Originally developed to help understand efforts to demarcate “science” from “non-science”, the idea of boundary work has since been applied to the interface between science and policy and, more broadly, to the activities of organizations that seek to mediate between knowledge and action. The central idea of boundary work is that tensions arise at the interface between actors with different views of what constitutes reliable or useful knowledge, and that those tensions must be managed effectively if the potential benefits of research-based knowledge are to be realized by society”⁸.

The argument in RinD is that boundary work, particularly facilitating the uptake of research products in order to achieve impact at a significant scale, implies its own research agenda with accompanying research methodologies. Coe, et al (2014) summarize this research agenda in terms of three main characteristics, namely “First, fine-scale variation in social, economic and ecological context and how this creates a need for local adaptation. Second, the importance of developing appropriate service delivery mechanisms, markets, and institutional contexts, as well as technologies. Third, appropriate research design, within the scaling process, that enables co-learning amongst research, development and private sector actors. This requires a new paradigm that builds on previous integrated systems approaches, but goes further, by embedding research centrally within development praxis”⁹ (p.73). Given the extraordinary spatial heterogeneity and temporal variability in African smallholder systems, understanding how to achieve impact at scale with increasingly system based technologies generates its own research agenda where such learning improves the cost effectiveness of scaling strategies - these issues are developed in section 3.2. This requires building a research design into more development oriented projects and in essence undertaking research on the development process itself. This shifts the disciplinary demand very much to that of social sciences, including the expanding field of evaluation science. Capacity development would then include the multi institutional needs in project implementation (essentially the same as R4D) and the evolving research skills required to undertake RinD.

AIS focuses on the innovation process in rural areas, where research is only one among several sources of innovation. Rather it combines technological, social, economic, institutional, and organizational

⁸Clark et al. 2010. *Toward a general theory of boundary work: Insights from the CGIAR’s natural resource management programs*. CID Working Paper No. 199. Center for International Development, Harvard University. Cambridge, MA: Harvard University, July 2010.

⁹Coe, R., F. Sinclair, and E. Barrios. 2014. *Scaling up agroforestry requires research ‘in’ rather than ‘for’ Development*. *Environmental Sustainability*. 6: 73–77.

change¹⁰. AIS particularly puts emphasis on the organizational and institutional context within which innovation takes place, on fostering institutional linkages, on providing a range of options to farmers to ensure adaptation to farmer conditions, and on facilitating farmer networks through which innovation takes place and are diffused.

AIS is process oriented, where those processes seek to build the capacity to innovate in rural areas¹¹. Within the CGIAR, AIS has been explored as a process methodology to facilitate farmer adoption and diffusion of new technologies but usually in association with innovations in markets, farmer organization, and local policies. For example, ILRI developed AIS approaches in the improvement of smallholder fodder production¹². These primarily involve the development of institutional partnerships usually organized through an innovation platform which also incorporate farmer networks. Innovation platforms were the central implementation modality for the sub-Saharan Africa Challenge program, have been utilized within the Drylands and HumidTropics CRP's, and have been deployed by other CRP's in promoting testing and diffusing particular technologies. These are often but not always integrated into value chain approaches. Innovation platforms can be developed from national down to local, sub-district level, with some programs having a hierarchy of platforms. How to use them cost effectively in achieving impact at scale remains to be developed. The research questions in AIS tend to revolve around the effectiveness of the methodology, although it does not rule out action research in the piloting of organizational, market, or institutional innovations. AIS is increasingly becoming a dominant framework within the CGIAR for promoting and understanding how to achieve impact at scale.

2.2 Organizing Research with an Impact Orientation

The CGIAR invests the majority of its resources in SSA, which is in turn a reflection of both donor priorities and the challenges to date in generating sustained agricultural growth on the continent. Experience developed by the CGIAR over the last four decades or so suggests a need to develop agricultural technologies within an African context. This applies to crop breeding programs as well as research on soils management, livestock production systems, agroforestry systems, integrated pest management (IPM), and in effect the range of biophysical research that supports improvement in smallholder productivity in SSA. Capacity is needed in all these thematic research areas on the continent. Such capacity within the CGIAR is distributed across the various Centers, each with a global mandate, and since the 2008 reform process, also across 12 (in 2017 the number was reduced from an initial 15) global CGIAR Research Programs (CRPs). Organizing research globally has made sense in terms of both the production of international public goods and economies of scale and scope in at least some areas of agricultural research. CGIAR research in SSA, however, tends to focus on the

¹⁰Klerkx, L., B. van Mierlo, and C. Leeuwis. 2012. *Evolution of systems approaches to agricultural innovation: concepts, analysis and interventions*. In Darnhofer, D. Gibbon, and B. Dedieu (eds.), *Farming Systems Research into the 21st Century: The New Dynamic*. Dordrecht: Springer Science.

¹¹Leeuwis C, Schut M, Waters-Bayer A, Mur R, Atta-Krah K and Douthwaite B. 2014. *Capacity to innovate from a system CGIAR research program perspective*. Penang, Malaysia: CGIAR Research Program on Aquatic Agricultural Systems. Program Brief: AAS-2014-29.

¹²Ayele, S., A. Duncan, A. Larbi and T. Tan Khanh. 2012. *Enhancing innovation in livestock value chains through networks: Lessons from fodder innovation case studies in developing countries*. *Science and Public Policy* 39: 333–346.

production of regional public goods, which can be characterized as international public goods. This produces a basic dilemma (explored in section 4) of how research programs organized globally produce the public goods specific to the African context. At the same time interfacing research with development also requires a much more regional perspective.

SSA agriculture is characterized by a high level of heterogeneity, high diversity in cropping and animal activities at all scales, a smallholder asset base, and high cost and limited access to inputs, especially fertilizer. Organizing research with an impact orientation where productivity gains are highly context specific and constrained by smallholder assets has required targeting and differentiation of component research (such as crop improvement) and as discussed in section IA an organizational model to interface with downstream development efforts, often involving systems approaches. Experimentation with the alternative organizational models have primarily been done in SSA. As would be expected, impacts of particular technologies tend to be differentiated spatially and by farmer income strata, with relatively low returns for specific technologies. Maredia and Raitzer (2006)¹³ find that around 80 percent of benefits of CGIAR research in SSA are due to the biocontrol of cassava mealybug, a technology that only required release of the agent into the cassava agroecology, often just by plane - that is, it did not require farmer adoption. Currently there is much written that includes the idea of achieving impact at scale without defining what scale that is or how such impact is to be achieved. SSA has been a persistent conundrum for the CGIAR, made even more so with the increased focus on impact¹⁴.

First, generating sustainable agricultural growth in SSA requires a strategy specific to the region, as reflected in the CAADP process, the Science Agenda for Agriculture in Africa (S3A), and the recent agricultural strategy of the African Development Bank. More or less each Center has an African program. Yet, the CGIAR has shied away from developing an overall strategy for SSA. Partly this is due to a preference for a degree of fuzziness in Center division of labour on the continent, partly to the branding of the CGIAR as a global research institution, and partly to the development of the CRP's as research networks organized around global problems. Second, the organization of the CGIAR around global mandates limits the CGIAR in employing systems approaches, either in research, in organizing delivery or in facilitating innovation systems approaches. Basically this is because systems research requires a definition of the system, which is contextually defined. The elimination of the System CRPs in the development of the second phase portfolio in this reviewer's view was primarily driven by the inability to build internal capacity through the CRP modality in a relatively new area such as systems research. Moreover, the Centers' experimentation with innovation system approaches have necessarily been limited to a commodity or technology focus, which results in significant inefficiencies in the approach, particularly in a SSA context. This particular constraint was overcome in the

¹³Maredia, M.K. and D. A. Raitzer. 2006. *CGIAR and NARS partner research in sub-Saharan Africa: evidence of impact to date*. Consultative Group on International Agricultural Research. Rome, Italy: Science Council Secretariat.

¹⁴A clear example of this is the Sub-Saharan Africa Challenge Program. See the discussion in the review of that program: Lynam, J., K. Harmsen and P. Sachdeva (2010). *Report of the Second External Review of the Sub-Saharan Africa Challenge Programme (SSA-CP)*. CGIAR/ISPC Secretariat, Washington, DC Retrieved from: www.sciencecouncil.cgiar.org/publications/reviews/challenge-programs/en/.

HumidTropics CRP¹⁵ but it will be phased out in 2017. The solution to this conundrum is to argue that such impacts will depend critically on strategic partnerships and enhanced capacity of local institutions. But how is the CGIAR to lead the development of such systems capacity when it has been difficult to develop it internally. The reliance on partnerships and CD goes back to the earlier development of the CGIAR system priorities in 2005, as expressed in the following:

The vision for the longer term is one in which the CGIAR is a provider of international public goods through agricultural research aimed at the alleviation of poverty. The CGIAR aims to progressively devolve some current research [particularly aspects of breeding for germplasm enhancement and site - specific natural resource management (NRM)] to national agricultural research systems (NARS) with increasing capacity. Devolution and enhanced delivery to the poor in different localities will be effected through a range of partners. The CGIAR will move towards the solution of the complex system issues undermining moves out of poverty and the success of agriculture in developing countries, supported by genomics research and provision of science - based policy advice. It is clear that the staging of such a strategy will be different in regions where NARS have different strengths. Special attention will be paid to the building of partner capacity in sub - Saharan Africa (SSA)¹⁶.

The SRF¹⁷ of the CGIAR follows a similar logic, which is where partnerships and CD are central to “scaling up”, but broadens the types of partnerships as follows:

In some cases, particularly where countries have recently emerged from conflict or crisis or national research systems are severely under-resourced, the capacity of partners may not be sufficient to support relationships as defined above. In such cases, CGIAR will, upon invitation, work with implementation partners (often international NGOs or development organizations) and national clients to define the knowledge agenda and capacity development needed to accompany a development intervention. (p24)

Both these statements reflect a basic dilemma for the CGIAR in Africa in, on the one hand, concentrating on its comparative advantage of producing international public goods, and, on the other hand, being accountable for impact on sub-IDO's as laid out in the SRF. To square this circle requires strategic partnerships and CD. Yet, CD that accomplishes these tasks much be both long term and strategic in nature, which is difficult given the project basis of CD investments by the CGIAR. The SRF recognizes that achieving impact where institutional capacity is weak will require other types of competencies that are found in international NGOs or multinational development agencies, or both since the CGIAR Centers and international NGOs will require funding to execute such downstream development oriented programs. This statement recognizes that in certain circumstances which are both location and time bound CD would require more resources and time than are available and

¹⁵See Dror, Iddo, Jean-Joseph Cadilhon, Marc Schut, Michael Misiko and Shreya Maheshwari eds (2016). *Innovation Platforms for Agricultural Development: Evaluating the mature innovation platforms landscape*. New York: Routledge.

¹⁶CGIAR Science Council. 2005. *System Priorities for CGIAR Research 2005–2015*. Science Council Secretariat: Rome, Italy.

¹⁷CGIAR *Strategy and Results Framework 2016-2030: Redefining how CGIAR Does Business until 2030* (2015). Montpellier: CGIAR Consortium Office.

second best strategies are required for achieving impact which are particularly adapted to project-based funding with limited time frames. However, Eicher's point that CD requires long term strategies becomes even more germane in an African context. The question then is to what extent can CGIAR CD investments in Africa match the CD needs on the continent? To assess that question requires a review of what those needs are.

3. Capacity Development in an African R4D System

3.1 *Intersecting Capacity Requirements in an R4D System*

As would be expected, the boundaries on capacity development have expanded significantly with the shift in focus from NARI or NARS in the 1980's and 1990's to R4D since the turn of the century. This broadening has coincided with fundamental changes in the overall policy environment of African states as a result of structural adjustment and market liberalization programs starting in the 1980's and running through the 1990's. This was a shift from state controlled management of the agricultural sector, where the focus was on capacity development in the public sector, to a market oriented agricultural sector where the state played a facilitating role and supported the provision of public goods. This transition period, where there were severe constraints on private sector development and capacities, was characterized by a lag in private sector investment and development that was filled by civil society organizations both national and international. This varied by country with, for example, farmer cooperatives, playing a larger role in Sahelian countries, and national NGO's filling much of the extension role created by the collapse of Training and Visit (T&V) extension in East and southern Africa - giving rise to pluralistic extension systems -as well as facilitating the development of agro-stockist networks, input markets, collection and aggregation points, and pilots of warehouse receipt systems. While the expansion in NGO's attracted a significant portion of the educated and entrepreneurial talent, spatial coverage was far from universal and NGO's tended to specialize in specific services. Moreover, capacity was an issue even in NGO's, as reflected by the experience with the National Agricultural Advisory Services (NAADS) in Uganda, where extension services were to be provided by contracting local providers. Capacity development needs thus expanded to a range of very different actors requiring a range of very different competencies - for example, lack of these competencies was found to be a major constraint in the performance of NAADS.

An expanding CD need has been slowly evolving into a market demand for skills enhancement with an increasing array of providers extending beyond purely educational providers. For example, there has been a real increase in the last decade or so in the provision of business development services (BDS) for agricultural market actors, often provided by large accounting firms through donor project support. Such training is often tied to credit guarantees in areas such as input stockists, warehouse receipt system operators, and other types of agricultural SME's. As these markets develop and there are more entrants, there is the development of effective demand for these CD services. However, this varies significantly across the continent. The other area responding to demand is in the area of university education, which is discussed in more detail in the next section below.

Public versus private provision of capacity development services is a major issue in a context of limited budgetary resources, real concerns about equity and inclusiveness in the growth process, and providing sufficient incentives to attract rural youth to remain in agriculture. Moreover, public sector capacity is acknowledged to be weak and increasingly uncompetitive with the private sector for relevant skills. A 2005 assessment of the World Bank's capacity development activities in Africa¹⁸ finds (p 1):

Three developments have brought public sector capacity building to the forefront of international assistance to Africa in the past decade. Most African countries have established a reasonable degree of macroeconomic stability and moved toward a democratic form of government. These transformations, often referred to as “first-generation reforms,” have intensified internal demand for better governance and improved public service. At the same time, changes in the practice of development assistance aimed at improving aid effectiveness through greater country ownership of development strategies and programs have highlighted capacity building needs.

In the more limited area of agricultural research, that is within an R4D framework, national capacity essentially resides in the public sector with very limited private sector investments (Pray, et al, 2016)¹⁹. Capacity in African NARI's has been reviewed in a recent book by IFPRI²⁰. In SSA NARI's are embedded in an organizational architecture consisting of subregional organizations (SRO's), continental programs, particularly FARA and CAADP, and international networks, especially the CGIAR. Given the heterogeneity in rainfed, smallholder agriculture in SSA, the NARI is a foundational component in this architecture. However, national agricultural research capacity has continued to remain a concern, particularly to other components of the architecture, due to underinvestment (especially compared to other items in the agricultural budget)²¹, inability to maintain the quality of human capital required²², and a consistent deficit in operational budgets. Most countries in SSA are characterized by what is termed the small - country problem. That is, given the diversity in agricultural sectors even in small countries and the need to have a program structure to address that diversity, given the economies of scale and scope in many areas of agricultural research, and given the immediate demands for services on both national and agricultural budgets, most countries in SSA do not have

¹⁸World Bank Operations Evaluation Department (2005). *Capacity Building in Africa: An OED Evaluation of World Bank Support*. Washington, DC: The World Bank.

¹⁹Pray, Carl, Derek Byerlee, and Latha Nagarajan (2016). *Private-Sector Investment in African Agricultural Research*. In Lynam, John, Nienke Beintema, Johannes Roseboom, and Ousmane Badiane (eds). *Agricultural Research in Africa: Investing in Future Harvests*. Washington, DC: IFPRI.

²⁰ Lynam, John, Nienke Beintema, Johannes Roseboom, and Ousmane Badiane (eds). (2016) *Agricultural Research in Africa: Investing in Future Harvests*. Washington, DC: IFPRI.

²¹Stads, Gert-Jan (2016). Public Agricultural R&D Investment in Africa: *An Account of Two-Speed Growth, Underinvestment, and Volatility*. In Lynam, John, Nienke Beintema, Johannes Roseboom, and Ousmane Badiane (eds). *Agricultural Research in Africa: Investing in Future Harvests*. Washington, DC: IFPRI.

²²Beintema, Nienke and Howard Elliott Securing (2016). *Human Resource Capacity to Ensure Agricultural Transformation*. In Lynam, John, Nienke Beintema, Johannes Roseboom, and Ousmane Badiane (eds). *Agricultural Research in Africa: Investing in Future Harvests*. Washington, DC: IFPRI.

the size to fund NARI's at the required level. This has created a dichotomous structure in NARI capacity across the continent, namely seven large countries that have a critical size and investment in agricultural research (Ethiopia, Ghana, Kenya, Nigeria, South Africa, Tanzania and Uganda). The remaining 45 countries may be considered to fall into the small country classification. This structural issue has given rise to regional approaches and the question of how to design research institutes within such small country contexts²³.

The NARI is the essential building block of AR4D systems in SSA and yet it has faced persistent capacity problems in its post - independence history. This has produced something of a conundrum in meeting the complex challenge of raising agricultural productivity in SSA. On the one hand, governments have more immediate demands on limited budgets and have limited their investment in long - term agricultural research²⁴. On the other hand, international aid support to agricultural research in SSA is limited, primarily targeted to the large countries - partly due to the country priorities that currently characterize bilateral aid in SSA -, is now wavering in support to regional approaches, and is in general daunted by the capacity needs across the continent. CD is recognized as a critical constraint but with a lack of a clear vision how to invest, both on the part of national governments and the international aid organizations. The following provides a summary review of capacity needs and the current²⁵ state of meeting those needs at the individual level (human capital investment), the organizational level, and at the level of the agricultural innovation system.

3.2 Supplying Critical Competencies in a Differentiating Labour Market

An appropriate array of staff competencies is in many ways the most critical requirement for the development of effective R4D organizations and for NARI's these competencies are most effectively used if they are at the level of MSc or PhD. National higher agricultural education (HAE) institutions are instrumental in providing the disciplinary training that staffs both NARI's and HAE departments as well, and also including an expanding range of employers in the private and NGO sectors. Provision of CD services for the development of human capital in agricultural sciences is thus tied to the capacities of HAE institutions, although universities in the North and the BRIC countries also provide such training, but this is declining as a percentage and in relation to the requirements in the sector. This section will assess the effects of the recent rapid expansion in universities on the ability of HAE to maintain quality of their curricula and teaching, the ability of HAE to meet the growing demand for agricultural graduates, particularly at the post graduate level, and the ability of agricultural faculties to attract the best talent.

²³See Eyzaguirre, Pablo (1996). *Agricultural and Environmental Research in Small Countries: Innovative Approaches to Strategic Planning*. New York: John Wiley & Sons.

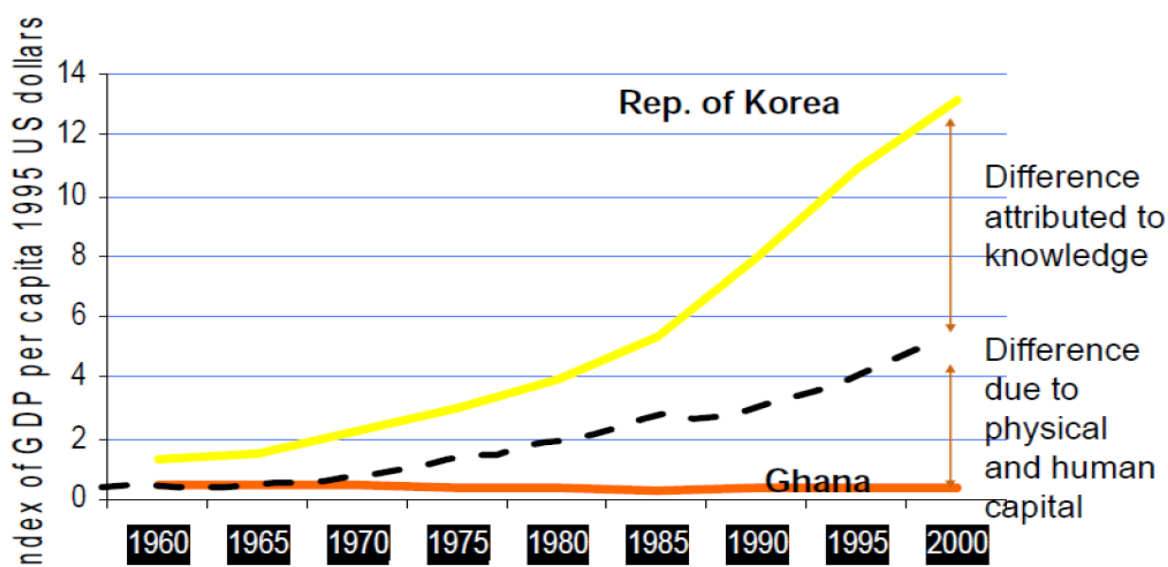
²⁴See Benin, Sam, Linden McBride, and Tewodaj Mogues (2016). *The Political Economy of Public Spending on Agricultural R&D: Why Do Countries Underinvest?* In Lynam, John, Nienke Beintema, Johannes Roseboom, and Ousmane Badiane (eds). *Agricultural Research in Africa: Investing in Future Harvests*. Washington, DC: IFPRI.

²⁵This section is adapted from Lynam, John, Beth Medvecky, William Lyakurwa (2013). *An Evolving Regional Platform for Higher Agricultural Education: A Review of RUFORUM*. Unpublished report to the Bill and Melinda Gates Foundation.

3.2.1 University Expansion and the Crisis of Quality

In a globalizing economy, education is key to competitiveness and economic growth. Sub-Saharan Africa is playing catch up (World Bank, 2008)²⁶ in terms of investing in the human capital needed to participate effectively in the world economy, as is shown in a World Bank chart (Figure 1) explaining the difference between the economic performance of South Korea and that of Ghana since 1960. This period of catch up is reflected in rapid growth in investment in education at all levels, with an increased recognition over the last decade of the need for increased number of graduates at the tertiary level. Rwanda is portraying its economic development as based on a knowledge economy. Moreover, Kenya had only two public universities in 1984 and Ethiopia only two up to 1991. By 2007 Ethiopia had 22 and by 2013 Kenya also had 22, adding 15 public universities in that year. In Kenya in 1983 there was a university enrolment of about 6 800 students. This grew to 60 000 by 2002 and to 200 000 by 2012 and by 2016 the University of Nairobi alone, Kenya's first university, had an enrolment of 90 000 students. This extraordinary growth reflects a similar growth in graduates from primary and secondary education institutions, the associated demand that created, and the higher private returns to a degree at the tertiary level (Table 1).

Figure 1: Economic Growth as Determined by Knowledge and Skills²⁷



Adapted from: World Bank, 1998

The rapid expansion in the number of universities and student enrolments has led to what many term a crisis of quality in higher education (Ogachi Oanda and Jowi, 2012)²⁸. Declining quality of educational outcomes is primarily driven by falling expenditure per student, rising student to staff ratios, and

²⁶World Bank (2008), op cit

²⁷World Bank (1998). *World Development Report 1998/1999: Knowledge for Development*. Oxford University Press USA.

²⁸Ogachi Oanda, Ibrahim and James Jowi (2012). *University Expansion and the Challenges to Social Development in Kenya: Dilemmas and Pitfalls*. JHEA/RESA 10(1): 49–71.

reduction in the level of training of teaching staff. In Kenya there are 5 186 lecturers for the 160 000 students in public universities, indicating one lecturer for 70 students when the international standard is closer to 1 to 25 or 30. The situation is summarized in the World Bank report on tertiary education in Africa (2008): “The problem of quality is being exacerbated by the rapid expansion of tertiary education without a corresponding increase in resources to universities to accommodate such an increase. This has resulted in higher student teacher ratios and lower expenditures per student. In addition, training of future faculty members is not keeping pace. Furthermore, equipment used at universities in places like Kenya and Nigeria tends to be outdated, and has often been retired by local firms. The average age of laboratory equipment was reported to be 12 years for basic sciences and 16 years for engineering. This deficiency in resources (coupled with brain drain and low salaries of faculty) is a severe constraint on teaching and research at universities”²⁹.

Table 1: Private returns to investing in Primary vs. Tertiary Education

<i>Country/Region</i>	<i>Private Returns to</i>		<i>Authors</i>
	<i>Primary education</i>	<i>Tertiary education</i>	
World	26.6%	19.0%	Psacharopoulos and Patrinos 2004
Papua New Guinea	6.0%	9.2%	Gibson and Fatai 2006
Philippines	9–10%	17.0%	Schady 2003
India	2.4%	10.3%	Dutta 2006
Kenya	7.7%	25.1%	Kimenyi, Mwabu, and Manda 2006
Nigeria	2–3%	10–15%	Aromolaran 2006
Ethiopia	25.0%	27.0%	World Bank 2003

Source: World Bank, 2008

The increase in enrolments is principally driven by the rapid expansion in first degree students. The expansion in private universities is in response to the rising demand for bachelor degrees. At the same time, public universities are increasingly dependent on tuition fees for operational costs. This creates a very competitive environment for student enrolments, which is reflected in matching curricula to trends in the labour market (see next section). Business studies, information technology, and social sciences are particularly in demand. Very few of the private universities have degree programs in agriculture, although this is not universal. The need for universities to develop capacity for first degree students constrains ability to invest in post graduate programs, and yet for CD needs of African R4D institutions, this is where the greatest need lies. Only the older, elite universities, where agricultural faculties were part of their establishment, have the depth of staff to consider post graduate training in the range of agricultural disciplines required in an agricultural faculty. However, quality of post graduate degree programs is an issue, as these depend on PhD level staff and research capacity.

²⁹World Bank (2008), op cit

Table 2: Degrees held by teaching staff in 10 public universities in Ethiopia and all private higher education institutions, 2008³⁰

<i>Qualification</i>	<i>Total</i>	<i>Female</i>	<i>Total percentage</i>
<i>Public HEIs^b</i>			
Undergraduate	2,159	243	42.3
Masters ^c	1,880	135	36.8
MD/DVM ^c	317	14	6.2
Ph.D. or equivalent	749	45	14.7
<i>Total</i>	<i>5,105 (474)^d</i>	<i>437(8.6%)</i>	<i>100.0</i>
<i>Private HEIs</i>			
Undergraduate	624	77	56.5
Graduate	409	44	36.9
Ph.D. or equivalent	75	7	6.8
<i>Total</i>	<i>1,108</i>	<i>128</i>	<i>100.0</i>

Source: Semela, 2011

An indicative picture of university staffing is a study of private universities and 10 of the older, public universities in Ethiopia (Table 2). Only about 15 percent of staff have PhD's in public universities (and this does not include the newer universities) and as in the rest of East and Southern Africa a significant proportion of these are nearing retirement. Even Masters holders are lower in percentage terms than undergraduate teaching assistants. The low percentage of PhD's in the teaching staff has a number of implications for the overall quality of degree programs. The ability to mount effective post - graduate degree programs is compromised, both in terms of teaching quality but also the ability to stay at the forefront of their disciplines. The latter is also related to the ability to establish international linkages and thus to participate in scientific fora and conferences. As well, it limits the ability of departments to carry out quality research, which in turn is critical to the quality of post - graduate degree programs. The ability of faculty to undertake quality research is essential in the supervision of the research of MSc and PhD candidates. Finally, and most important, because universities and other national research institutes are dependent on elite national universities to produce the postgraduate degree holders that will fill the expanding demand for MSc and PhD's, declining quality in graduates is perpetuated in terms of research and training into the future.

3.2.2 An Expanding Labour Market for University Graduates

The most critical shortage for R4D institutions is in post graduates, namely MSc's and PhD's. The post - independence gap had been filled by large aid investments in post graduate training in Northern universities, but this was not an option for the "second and third generation" of agricultural scientists,

³⁰Semela, Tesfaye (2011). *Breakneck Expansion and Quality Assurance in Ethiopian Higher Education: Ideological Rationales and Economic Impediments*. Higher Education Policy 24:399–425.

given the expanding demand for post graduates and the increasing costs of university education in the North. The overall labour market for MSc and PhD's has changed significantly since the turn of the century with the expanding demand from the NGO sector (Blackie, et al, 2009)³¹, the significant growth in universities themselves, international agencies that require an African complement on their staff, and a limited number of positions in the private sector, which tend to hire secondary school leavers³².

The expanding and diversifying labour market creates two different challenges for agricultural faculties, namely how to compete more effectively for better students given the growth in more urban - based employment and second, how to better differentiate skills development in postgraduates in relation to a differentiating labour market. The percentage of university students enrolled in agriculture varies significantly across countries, for example from 15.4 percent in Malawi (although only 490 students) to 8.5 percent in Ethiopia (17,884 students), 7.4 percent in Kenya, to 1.6 percent in Uganda (see Table 2 in Dramé-Yayé, et al, 2011)^{33 34}. In many ways such enrolments do not match the strategic needs of the country, as the World Bank (2008, p. 82) has recommended, "Within tertiary institutions, strategic focus on strengthening those disciplines deemed most relevant to a country's economy and future growth prospects is recommended"³⁵.

Agriculture remains a critical economic sector in the economy and since market liberalization in the 1990's, it has begun to grow and diversify with increasing private sector investment in input supply firms, agro-processing, food wholesaling and retailing. The public sector remains the principal employer of agricultural post - graduates and even in this sector supply is not meeting demand. This differentiating labour market is creating an expanding need for different disciplinary specializations as well as different skill sets to meet employer needs. A good example of this is the study by Davis, et al (2007)³⁶ which argues for the need for soft skill development to complement disciplinary depth, and perceived weaknesses in postgraduates as reported by Dramé-Yayé, et al (2011): "Insufficient

³¹Blackie, M., M. Mutema, and A. Ward (2009). "ASARECA/RUFORUM Thrust 4: A Study of Agricultural Graduates in East, Central and Southern Africa: Demand, Quality and Job Performance Issues." A report to ASARECA and RUFORUM.

³²See Scheltema, Nico, Ferdi Meyer, Francis Ejobi, Jorge Tinga, and David Tschirley (2014). *Evolving Skill Needs in the Food System of East and Southern Africa: Results from Agribusiness Company Interviews*. MAFS Working Paper No. 11. East Lansing: Michigan State University.

³³ Even lower percentages are reported for West Africa. See Table 1 in World Bank (2013). *Africa Higher Education Centers of Excellence Project: Project Appraisal Document*. Washington, DC: The World Bank.

³⁴ Dramé-Yayé, Aissetou, Sebastian Chakeredza, and August B. Temu (2011). "Why Do Agricultural Faculties Fail to Attract the Best Students?" Background paper prepared for the ASTI-IFPRI/FARA Conference "Agricultural R&D: Investing in Africa's Future: Analyzing Trends, Challenges, and Opportunities," Accra, Ghana. Washington, DC: IFPRI.

³⁵World Bank (2008). *Accelerating Catch-up—Tertiary Education for Growth in Sub-Saharan Africa*. Washington, D.C.: World Bank.

³⁶Davis, Kristin, Javier Ekboir, Wendmsyamregne Mekasha, Cosmas, M.O. Ochieng, David J. Spielman, and Elias Zerfu (2007). "Strengthening Agricultural Education and Training in Sub-Saharan Africa from an Innovation Systems Perspective: Case Studies of Ethiopia and Mozambique." IFPRI Discussion Paper 00736. Washington, DC: IFPRI.

communication skills, insufficient managerial and financial management skills, poor skills in coordinating with other stakeholders, resistance to challenges, insufficient hands-on skills (too theoretical at times), poor reading culture³⁷. Disciplinary knowledge is expected, but at the same time the application of that knowledge requires different types of skill sets that are expected to be developed in both the pedagogy and the experience of undertaking the thesis research. The challenge is how to develop those skills within the postgraduate training and how to better target those skill sets within individual degree programs.

African universities remain the principal supplier of human capital essential for the functioning of R4D institutions. However, HAE programs have difficulty competing for students, in general enrolling the second and third best students, require an evolving curricula that meets the needs of a rapidly changing labour market, and yet face capacity challenges derived from a rapidly expanding university sector. Training programs such as those of the CGIAR assist at the margins and primarily in disciplines critical to their mandate. Moreover, CGIAR Centers fill a critical gap in providing high quality research supervision of post-graduate students. However, the need, as suggested above, lies more at the institutional level and that is a far more complex and resource intensive undertaking. Aspects of CD at an institutional level are discussed in the following section.

3.3 Organizational Capacity: NARI and University Capacity within an AIS

Moving beyond project driven modalities for CD that primarily focus on human capital development to programs that foster positive institutional change in core agricultural organizations has been on the African agricultural development agenda for decades. At the turn of the century, Eicher framed the problem thusly, in many ways anticipating the development of AIS frameworks:

Over the past 10 to 15 years, there has been an on - going debate about the need to move beyond the project - by - project approach to a systems approach to coordinate and sequence interlinked investments in agricultural research, extension, and education. Various scholars have articulated this approach under the following rubrics: agricultural knowledge system, agricultural knowledge information system (AKIS), and what I call the agricultural knowledge triangle. Basically, these approaches argue that public and private managers of separately governed institutions should come together and “coordinate” decisions on the size and sequencing of complementary investments, because the payoff has been found to be higher if they are planned and executed as a joint activity rather than pursued as freestanding extension, research, or education projects³⁸.

In assessing approaches to organizational capacity, the paper will adopt Eicher’s research triangle and focus particularly on NARI’s and HAE - agricultural extension is covered in a separate working paper³⁹. Methodologies for fostering institutional change under low resource conditions are in many ways lacking for NARI’s and only somewhat better developed in the area of university organizational change. There has been a tendency to focus on structural reform in these organizations rather than a more evolutionary approach to institutional change, especially with a focus on strengthening core

³⁷Dramé-Yayé, et al (2011), op cit

³⁸Eicher (1999), op cit, p 33

³⁹Need reference for Ian’s paper on extension

functions and their integration. These are briefly reviewed with an emphasis on identifying organizational change approaches.

3.3.1 CD in NARI's: Matching Finances and Problem Scope

The NARI model was developed and applied in the 1970's and 1980's in a resurgence of support to agricultural research by donors in the region. This was the period of the Green Revolution in Asia and the development of the CGIAR network of international research centers. A colonial legacy, agricultural research was characterized by a range of specialized research units, often disciplinary based, in various ministries. There were also a smattering of subregional research networks that focused primarily on cash crops. The latter lost the funding support from colonial administrations and were absorbed into national systems, often exploding capacity in those countries, such as Kenya. This was the period of moving away from the disciplinary research structures of the colonial period to multidisciplinary research teams. To create such teams required the consolidation of these various research units into a national agricultural research institute, often governed as parastatals, and donor projects were designed to assist in this process, including the MSc and PhD training in donor universities. "By 1991, 28 of the 47 countries in Africa had adopted this structure for their national research programs"⁴⁰.

These project based initiatives, often of 10 years duration or more, proved to be financially unsustainable for national governments during a period of economic stagnation in the 1980's, in large part due to macroeconomic instability. As well, "Donor funding facilitated this process but it also resulted in a shift to reliance on donor financing, as agricultural research lost its traditional budget within the line ministries at a time of budget stringency and reordering of government budgets.... The World Bank has been the largest supporter of national research systems. After more than 40 years of independence, however, many of those systems are weak and financially unstable"⁴¹ (p 43).

Weak capacity within the context of lack of financial support by national governments led donors to support research networks facilitated by CGIAR Centers and regional support structures in the form of the subregional organizations (SRO's), ASARECA, CORAF and CARDESA. The following World Bank quote characterized donor investment strategies at the turn of the century: "The pooling of scientists for research on common problems, and exchanges of experience and cooperation among countries with common agro-ecological conditions can be a more efficient use of donor support than that provided by individual NARS"⁴². These two regional approaches were integrated in the sense that SRO's initial program focus was in developing a framework to coordinate regional programs and networks, particularly of CGIAR Centers. For example, ASARECA would eventually coordinate 17

⁴⁰World Bank Independent Evaluation Group (2007). *World Bank Assistance to Agriculture in Sub-Saharan Africa: An IEG Review*. Washington, DC: The World Bank. (p 43)

⁴¹World Bank Independent Evaluation Group (2007), *ibid*.

⁴²Venkatesan, V., J. Kampen (1998). *Evolution of agricultural services in Sub-Saharan Africa: trends and prospects*. World Bank discussion paper no. 390. Washington, DC: The World Bank.

regional networks, programs and projects (NPP's)⁴³. The SRO's provided an institutional framework for CGIAR Centers to organize joint research with NARI's. However, by 2007 most but not all donors had stopped funding CGIAR research networks in favour of SRO programs based on competitive grants which supported NARI's within a regional context⁴⁴. These were highly targeted grants within ASARECA's program structure, tended to have adverse equity problems as most of the grants went to the larger NARI's with the stronger capacity, and severed the coordinated link between CGIAR Centers and African NARI's. Over the past five years or so, it is this reviewer's sense that donors are moving away from funding SRO's, particularly as bilateral donors have tended to focus their funding on a set of priority countries.

The World Bank, on the other hand, has continued to pursue regional approaches, particularly through support to "centers of excellence" in both universities and NARI's. The approach for NARI's is couched within the Framework for African Agricultural Productivity (FAAP)⁴⁵ and has been implemented in each of the three regions through loans to national governments for selected commodity programs in NARI "centers of excellence" and coordinated by the SRO's. These programs have recently been compromised by the decline in funding to the SRO's. Regional programs and frameworks essentially depend on donor grant support and that support seems to have run its course. The original justification for these programs have not disappeared and it leaves a gap in the institutional architecture for agricultural research on the continent and a continuing lack of coherent approaches to CD for NARI's - this is explored in section 4 below.

A recent review of NARS charts the evolution of reform of NARI's since the 1990's⁴⁶. Such institutional reform was essentially driven by donor support programs, primarily the World Bank. As the report notes, "With the demise of ISNAR, training opportunities in agricultural research management have become scarce"⁴⁷. With the lack of suppliers of practice in organizational change and management, institutional change tended to be biased toward structural reform. These reforms tended to reverse the focus on aggregation and centralized management of the NARI, as many reviews suggested a complacency attached to being virtually the only supplier of agricultural research. Thus, "After a period of consolidation of agricultural research capacity into larger entities in the 1970s and 1980s, there seems now to be a tendency in the opposite direction in the form of greater institutional

⁴³See Wood, S. and J.R. Anderson. 2009. *Strategic Priorities for Agricultural Development in Eastern and Central Africa: A Review of the Institutional Context and Methodological Approach for Undertaking a Quantitative, Subregional Assessment*. In *Prioritizing Agricultural Research for Development: Experiences and Lessons*, D. A. Raitzer and G. W. Norton, eds. New York: Oxford University Press.

⁴⁴This programmatic change within ASARECA is assessed in Lynam, J.K. (2016). *Balancing International Public Goods and Accountability: Exploring the Impact of IFPRI's Policy Research on Science, Technology, and Innovation*. Independent Impact Assessment Report No. 43. Washington, DC: IFPRI.

⁴⁵FARA (2006). *Framework for African Agricultural Productivity/Cadre pour la productivité agricole en Afrique*. Accra, Ghana. 72 pp.

⁴⁶Anderson, Jock, Johannes Roseboom and Weidemann Associates, Inc. (2013). *Towards USAID Re-Engaging in Supporting National Agricultural Research Systems in the Developing World*. Washington, DC: USAID.

⁴⁷Anderson, et al (2013), *ibid* p. 33.

diversity within NARS⁴⁸. Many Bank loans for agricultural research, such as to Uganda and Kenya, supported decentralization through creating semi - autonomous research stations, management structures similar to research councils, a component of competitive grants for which the research stations (and universities) competed, and a separation of funding decisions and research implementation⁴⁹. In many ways these reforms do not get at the principal capacity constraints on NARI performance, namely human resources, management, and program organization. Most of these relate to developing appropriate systems and processes, as suggested in the following:

In addition to basic organizational and managerial processes (such as proper management of human, physical and financial resources, strategic planning, programming of activities, information management, monitoring and evaluation, etc.) that are inherent to all organizations, there are also several processes that are specific to agricultural research organizations such as: (i) Mobilization of political and financial support for agricultural research; (ii) Consultation of stakeholders during the various stages of the research process (i.e., identification, prioritization, implementation and valorisation) and responsiveness to their needs; and (iii) Effective collaboration with a wide range of other actors such as other research organizations (both local as well as abroad), agricultural advisory services, development agencies, market organizations, etc.⁵⁰

Anderson, et al (2013) discuss CD at an institutional level for NARI's. They summarize such requirements with a quote from Mbabu and Hall (2012), who report on a CD program for the NARI in Papua New Guinea: "NARS capacity building needs to be learning - based and participatory; it needs to be results - driven and explicitly link research to development; it needs to take a systems view, whereby research is planned and executed as part of wider development agenda and involves partnerships with policy and practice stakeholders; and it needs to be a conscientious process whereby capacity building responds to the evolving context of the agricultural sector"⁵¹. Putting in place the management and operational systems to achieve these results requires processes that are not usually found in NARI's in SSA. These require longer term support programs, as noted in an assessment of Dutch government funded CD projects: "...the (CD) projects as they are currently carried out are not able to successfully achieve the sustained (organizational) changes required. That is, changes in how an organization functions, its cultural norms and rules, and also in how it interacts within wider networks. In other words, long - term institutional change is needed"⁵².

⁴⁸Anderson, et al (2013), *ibid* p. 21.

⁴⁹See Section 5.3 in Anderson, et al (2013) for more detail on NARS reform.

⁵⁰Anderson, et al (2013), *ibid*, p 31

⁵¹Mbabu, A.N. and A. Hall (eds.). 2012. *Capacity Building for Agricultural Research for Development: Lessons from Practice in Papua New Guinea*. Maastricht, The Netherlands: United Nations University-Maastricht Economic and Social Research Institute on Innovation and Technology (UNU-MERIT).

⁵²Salm, M., G. Baltissen, R. Hawkins, J. Sol, R. Ludemann, A. van Eerdewijk, M. Wongschowski, D. Enserink and M. Roefs, 2014. *The need for Institutional Change in capacity development of tertiary agricultural education organisations*; Report from CDI-ICRA-KIT Writeshop, October 2013. Centre for Development Innovation, Wageningen UR (University & Research centre). CDI report CDI-14-012. Wageningen. p 3

Such change involves facilitated processes. Over the past decade or so there have been a range of organizations that have developed organizational change programs for agricultural institutions. These would include KIT, ICRA, and the Centre for Development Innovation, all in the Netherlands. PICOTEAM (Institute for People, Innovation and Change in Organizations) is another umbrella organization that provides such services, especially in SSA⁵³. Contracting such services requires funding and this is most often provided by international aid donors, again within a project framework. Getting the longer term commitment to institutional change would require buy in and funding by national governments through the NARI themselves. Such commitment has yet to express itself across NARI's in SSA. This this will require successful examples of organizational change and that is yet to be developed.

3.3.2 CD in Higher Agricultural Education (HAE)

Since Eicher's assessment in 1999 that "In most countries universities are the weak link in the (agricultural knowledge) triangle"⁵⁴, institutional change has been most rapid in universities and faculties of agriculture, in part because among the three change has been demand driven. HAE is embedded within university structures and CD for HAE in part involves institutional change at university level. However, universities in several countries are also undergoing internal restructuring, in part to compete more effectively for private students whose tuition payments make up an increasing percentage of university budgets. This is being driven by the increasing size of the universities and the need to decentralize decision-making. Thus, many universities are forming constituent colleges, which have much more autonomy and where the principal has assumed many of the responsibilities formerly held by the vice chancellor. At the same time, and in response to increasing competition from private universities opening in more rural areas - where a few offer agricultural courses at first degree level - many larger universities are opening branch campuses (see Table 1 in Ogachi Oanda and Jowi, 2012)⁵⁵. The increasing reach to more rural communities has improved rural - urban equity in access to university and should be particularly important in increasing access to students interested in studying agriculture. Moreover, the decentralization to more rural areas should expand the potential for closer community outreach and research targeted to the needs of smallholders.

Tertiary education is increasingly being set within an innovation systems framework, both more generally⁵⁶ and for higher agricultural education (HAE) in particular⁵⁷. Placing higher agricultural education in an AIS attempts to redress "the declining quality of many AET systems, the general failure

⁵³<http://www.picoteam.org/picoteam-ltd.html>

⁵⁴Eicher (1999), op cit. p 32

⁵⁵Ogachi Oanda and Jowi (2012), op cit

⁵⁶World Bank (2008), op cit

⁵⁷See Maguire, Charles (2012). "Agricultural Education and Training to Support Agricultural Innovation Systems: Overview." In Agricultural innovation systems: an investment sourcebook. Washington, DC: The World Bank, and Swanepoel, Frans, Zenda Ofir and Aldo Stroebel, eds (2014). Towards Impact and Resilience: Transformative Change In and Through Agricultural Education and Training in Sub-Saharan Africa. Newcastle upon Tyne: Cambridge Scholars Publishing.

to articulate a strong policy framework for agricultural education, and the corresponding failure of educational institutions to build a strong and vocal constituency within the agricultural sector” (Maguire, 2012) ⁵⁸. Reform of HAE attempts to ensure the curriculum meets the demand for graduates, there are better linkages to other actors in the agricultural sector, and skills are better matched to expected employment needs.

What is not as explicit is the role that faculties will play in the development of new knowledge, technology and innovation within the agricultural sector. Currently universities in general and agricultural faculties in particular do not have access to sustained levels of research support (see Table 3). This is primarily because research funding for universities comes mainly the ministry of education and research is not budgeted for education ministries. Agricultural research budgets come through the ministry of agriculture and these are used to support NARI’s, although there have been some move to develop small competitive grant facilities. Faculties of agriculture thus depend on periodic outside funding sources. Expanding research capacity in faculties of agriculture is critical for the effective quality of post - graduate training, as well as ensuring that universities participate in the larger agricultural R&D system, including access to regional and international research networks. In terms of published research in peer reviewed journals, agricultural sciences only trails health sciences in terms of overall scientific output. Even though published output has been increasing, it still is a low percentage of world scientific output and a significant part is produced by researchers with origin outside of SSA⁵⁹.

Table 3: Higher education research expenditures in five countries in the WEF study, 2007

Country	Total research expenditures (US\$ millions, PPP)	Percent of GDP	Per capita expenditure (US\$ PPP)	Percent performed by higher educational institutions
Botswana	84.91	0.38	46.30	5.80
Ethiopia	106.79	0.17	1.30	14.60
Kenya	n/a	n/a	n/a	n/a
South Africa	3,654.27	0.92	76.20	19.30
Tunisia	660.61	1.02	65.41	38.41

Source: World Economic Forum, 2012⁶⁰

What is apparent given the increasing demand for PhD’s, due to the expansion in universities, the impact of AIDS, and the retirement of those trained in the 1970’s and 1980’s, is that HAE must develop a capacity to train at the PhD level. There has been little capacity to do this in the past, apart from the occasional thesis-based PhD, and building such capacity requires an appropriate curriculum, research infrastructure, PhD level faculty, and quality assurance. It is not every faculty that has the staff and capacity to develop PhD programs and not every faculty can develop PhD training in every disciplinary department. This has led to regional approaches for developing MSc and PhD training, and the two

⁵⁸Maguire, Charles (2012). Ibid.

⁵⁹World Bank and Elsevier (2014). *A Decade of Development in Sub-Saharan African Science, Technology, Engineering & Mathematics Research*. Elsevier Research Intelligence.

⁶⁰World Economic Forum (2012). *The Africa Competitiveness Report 2011*. Washington, DC: World Bank.

existing regional programs either are designed around networks (Regional Universities Forum for Capacity Building in Agriculture -RUFORUM) or centers of excellence.

RUFORUM has positioned itself as a regional platform that can foster economies of scope and scale in improving both the relevance and the quality of postgraduate education in member universities. This role is explored in more depth by Moock:

RUFORUM is the only network...deliberately designed to connect investments in individuals and faculties to improvements in the wider university body. It does so mainly in three ways: (1) focusing on commonalities at the margins of agricultural disciplines and overlapping methodologies (for example, its highly popular network wide research methods courses); (2) working with a wide-ranging committee of university deans; and (3) instituting a board composed of vice-chancellors of member universities who pay annual membership fees and cover their own travel expenses to meetings. It might be argued that with such layering, RUFORUM operates at too broad a level and that viable networks are best grounded in single professional disciplines with reach to external constituencies that provide essential feedback loops. In the end, however, lasting gains in strengthening institutions and raising professional standards may best be realized if networks put a premium on diffusing new ideas and practices throughout individual universities and across them to a variety of agricultural system stakeholders⁶¹.

RUFORUM programs focus on strengthening post - graduate education initially in East and southern Africa and now increasingly in West Africa. RUFORUM develops PhD programs in a limited number of disciplines at selected member universities that serve all member universities in the region. The programs involve curricula development, the creation of a joint teaching facility, and quality assurance of the specific PhD programs. There is also a competitive grant fund to support MSc and PhD research but led by a faculty member. Finally there is a community development program that supports the formation of linkages between faculties and rural actors. To a significant extent RUFORUM programs track the suggested reforms in Table 3 and the best universities are already reaching many of the future goals suggested in Table 3, thus providing a model for the smaller and younger member universities.

An alternative model is that of the World Bank, which builds on its centers of excellence model for agricultural research within subregions. To date this has focused on Science, Technology, Engineering and Mathematics (STEM) and includes a significant support to agriculture⁶². The African Centers of Excellence program is divided in two parts, one for West and Central Africa and the other for East and Southern. In East and Southern eight universities have been selected as centers of excellence in areas running from crop improvement, agroecology, to climate smart agriculture⁶³. The two are very

⁶¹Moock, Joyce (2016). *Network Innovations: Building the Next Generation of Agricultural Scientists in Africa*. In Lynam, John, Nienke Beintema, Johannes Roseboom, and Ousmane Badiane (eds). *Agricultural Research in Africa: Investing in Future Harvests*. Washington, DC: IFPRI.

⁶²See World Bank (2014). *Africa Higher Education Centers of Excellence Project (P126974): Project Appraisal Document*. Report No: PAD332. Washington, DC: The World Bank.

⁶³See <http://www.ace2.iucea.org/index.php/2016-09-15-07-45-41/agriculture>

different models and linkages to the CGIAR Centers would in many ways be easier through the network model.

3.4 Conceptualizing CD at a Systemic Level: AIS in Practice

Agricultural innovation systems are at this stage primarily a conceptual framework. AIS provides a systems framework to earlier attempts (NARS, AKIS) to frame agricultural research within a systems approach and AIS in focusing on innovation provided practical interventions through improving institutional linkages. CD within this framework is framed more within aspirations of how an AIS should function than an overall systemic approach to improving AIS functionality. There have been very few attempts at understanding that functionality. In many ways the best approach has been that of Spielman and Kelemework (2009)⁶⁴. They develop a framework for benchmarking the performance of an AIS in Ethiopia. The framework is made up of principal domains that encompass the principal actors in an AIS, the external institutional context such as science and technology policies, and the internal processes, particularly “...the development of capacity among individuals and organizations to learn and change the ways in which they organize production and the iterative learning processes that occur among different actors through different forms of interaction.... the innovation systems framework captures something more than a linear interpretation of innovation as a sequence of research, development, and dissemination. Rather, it portrays innovation as a complex web of related individuals and organizations that all contribute to the application of new or existing information and knowledge to production”⁶⁵. To capture this process component, especially in terms of networking, the paper uses the following measures: “effectiveness of organizations and organizational collaborations; responsiveness of organizations to technological, market, and other opportunities; accountability of organizations to different types of stakeholders; accessibility of organizations to different types of stakeholders; and the innovativeness of organizations in terms of introducing new efficiency-improving products and processes”⁶⁶.

A key finding in Ethiopia was that “... while respondents from all domains were satisfied with linkages with bridging institutions (in this case, linkages with public extension services), they were largely dissatisfied with their linkages with collaborators in all other domains, particularly the knowledge and education domain (in this case, public research organizations and institutes of higher learning)”⁶⁷. Clark, et al (2016) similarly assess CD at an AIS level and argue that “Understanding what makes knowledge usable for sustainable development is of limited value unless we also have the capacity to transform such understanding into practice. “Capacity,” as we use the term here, includes the capability to act and the competence to do so effectively. We argue that to support the crafting of usable knowledge for sustainable development, researchers can and should help build core capacities for stakeholder

⁶⁴Spielman, D., and D. Kelemework (2009). *Measuring Agricultural Innovation System Properties and Performance: Illustrations from Ethiopia and Vietnam*. IFPRI Discussion Paper 851. Washington, DC: IFPRI.

⁶⁵Spielman and Kelemework (2009), *ibid* p 2.

⁶⁶Spielman and Kelemework (2009), *ibid* p 19.

⁶⁷Spielman and Kelemework (2009), *ibid* p 22.

collaboration, social learning, knowledge governance, and researcher training⁶⁸. A dominant mechanism for developing such capacities and organizational linkages is the innovation platform⁶⁹. This is primarily a mechanism for facilitating different actors in the rural economy to organize around a particular problem. Implementation most often involves outside facilitation and ability to cover transaction costs inherent in the process.

There have been a number of initiatives in SSA that have attempted to use an AIS approach to fostering rural innovation⁷⁰. Given that these initiatives have large CD components, there is a natural question how should CD within an AIS framework be carried out in SSA and how does that compare to current practice⁷¹. As the last section concluded, for most of the principal organizational actors within an AIS there are classic CD needs of human capital, financial resources, programmatic structures, and management constraints. If each type of actor fulfills a necessary function in an AIS, a functional AIS would require each actor providing that function at a critical minimum level with integration at different scales. For CD at this level the question would be which functions are not being provided at the required level, in essence a prioritization of the weakest link in the overall system. In practice there is not such a prioritization but rather programs that focus on improving the innovation capacity (regardless of other capacity constraints) of specific organizations or actors. These are organized at the level of farmers (capacity to innovate)⁷², farmer organizations - both informal with a focus on group dynamics and formal with a focus on agribusiness capacities⁷³, innovation platforms and innovation brokers⁷⁴, higher agricultural education⁷⁵, and agricultural research institutes⁷⁶. CD within an AIS framework is thus primarily implemented at an organizational level rather than a systemic level and primarily within a project modality. The analytical frameworks do not exist to go from the

⁶⁸Clark, William C., Lorrae van Kerkhoff, Louis Lebel, and Gilberto C. Gallopin (2016). *Crafting usable knowledge for sustainable development*. PNAS: 113 (17) p 4573-4.

⁶⁹Dror, Iddo, Jean-Joseph Cadilhon, Marc Schut, Michael Misiko and Shreya Maheshwari eds (2016). *Innovation Platforms for Agricultural Development: Evaluating the mature innovation platforms landscape*. New York: Routledge.

⁷⁰See the cases in Lynam, John (2016), *Integrating Agricultural Research into an African Innovation System*. In Lynam, John, Nienke Beintema, Johannes Roseboom, and Ousmane Badiane (eds). *Agricultural Research in Africa: Investing in Future Harvests*. Washington, DC: IFPRI.

⁷¹The larger question for which there has yet to be any dedicated work is whether CD should be conducted within an AIS framework.

⁷²Leeuwis C, Schut M, Waters-Bayer A, Mur R, Atta-Krah K and Douthwaite B. 2014. *Capacity to innovate from a system CGIAR research program perspective*. Penang, Malaysia: CGIAR Research Program on Aquatic Agricultural Systems. Program Brief: AAS-2014-29.

⁷³Rwelamira, Juliana (2014). *Strengthening Farmers Organizations and Civil Society Organizations*. Background Paper. Feeding Africa Conference. Abidjan: African Development Bank.

⁷⁴Dror, et al (2016), op cit and Klerkx LWA, Hall A and Leeuwis C. 2009. *Strengthening agricultural innovation capacity: Are innovation brokers the answer?* International Journal of Agricultural Resources, Governance and Ecology 8(5/6): 409–438.

⁷⁵Ochola, Washington, Willem Heemskerk, Mariana Wongtschowski (Eds.). 2013. *Changing agricultural education from within: lessons and challenges from the GO4IT programme*. RUFORUM, KIT Publishers.

⁷⁶Lynam, John, Joseph Methu, and Michael Waithaka (2016). *Integrating Agricultural Research into an African Innovation System*. In Lynam, John, Nienke Beintema, Johannes Roseboom, and Ousmane Badiane (eds). *Agricultural Research in Africa: Investing in Future Harvests*. Washington, DC: IFPRI.

diagnosis of performance of an AIS to the specification of critical entry points in the system and finally to the design of an appropriate CD program. Thus, the scope of CD within an AR4D system has significantly broadened with a multiplicity of CD initiatives but without an integrated approach combining capacity development for target organizations, organizational and behavioural changes across organizations in the AIS, and facilitating the linkages between these organizations.

4. CGIAR Capacity Development along Research Impact Pathways

As the last section argues, the capacity needs in R4D in SSA pervade the agricultural sector and limit its ability to develop market - based growth. This is particularly so where improved technology and increased productivity are seen as a principal driver of growth. The legacy of the Green Revolution in Asia has had to be adapted to SSA conditions, as is done in a continuing refining of strategy at the Alliance for a Green Revolution in Africa (AGRA). This continuing adaptation is also the case for the CGIAR in SSA. The CGIAR has a 50 history in SSA with the establishment of IITA in 1967. The CG now has four Centers based on the continent and all the other Centers have programs in the region. This history is characterized by a process of learning and adapting strategy. The initial phase was in learning how to adapt biological technologies to the rather unique agroecologies of SSA. The initial reliance on extensive international varietal testing networks gave way to the development of breeding populations particularly adapted to African conditions. Since input markets were not well developed, research developed approaches to integrated pest and disease management and integrated soil fertility management, the latter which broadened into integrated natural resource management. However, since the turn of the century and broad scale market liberalization, research has further broadened to R4D approaches and an understanding of the larger context necessary to foster the adoption of techniques within smallholder agriculture. Since the CGIAR reform process begun in 2008, this shift has coincided with the increased focus on accountability and impact.

Over time the CGIAR has responded to the challenge of CD in Africa by developing dedicated African research/CD organizational structures. The Biosciences eastern and central Africa (BecA), the African Women in Agricultural Research and Development (AWARD), the Pan-Africa Bean Research Alliance (PABRA), and in the past the Tropical Soil Biology and Fertility Program (TSBF) are examples of these and have common characteristics. They are in many ways an institution within an institution, i.e. Center. They have independent governance systems that reflect African ownership and their management is also independent - in many ways similar to a CRP. Operationally programs are developed in a network modality and provide core services in relation to their mandate. They have had long term funding support and in effect operate as African entities, although can draw on the capacities and programs of their Center. They have origins in particular R4D needs in Africa and have been able to operate effectively through Center legal structures. The relationship is very much symbiotic. These programs provide very much a model for developing ownership by African institutions while at the same time being part of a global partnership. AfricaRice in its organization and management has many of these same characteristics, including a two tier governance structure that represents both African and global interests. IITA, on the other hand, operates as a CGIAR Center

but interprets its mandate as focusing only on SSA. Overtime the CGIAR has evolved structures that meet the particular needs of the African context while at the same time operating as a global entity.

That said, the CGIAR does not have the resources or the capacity to meet the needs for CD on the continent. Focus is required for a CGIAR CD strategy in SSA and yet this must be done within a broadening scope of activities, actors, and a multiplicity of partners required for impact. Center strategies, for example of CIFOR and IFPRI, frame impact in terms of appropriate alignment of partnerships, CD, and communications. Defining key partners within an impact pathway would be a means of providing such focus and identifying relevant needs. This would also be a means of moving from a CD focus on human capital to a more institutional focus for a CD strategy. Implicit in the last section is that the priority for CD in SSA lies at the organizational/institutional level. However, such a focus requires longer term investments which is difficult given the dependence on restricted funding. The rest of this section will assess CD strategies within three generic impact pathways, namely genetic improvement, production systems/NRM, and policy.

4.1 CD in the Genetic Improvement Impact Pathway

Genetic improvement is one of the core functions of the CGIAR and much of the impact of the CGIAR has been measured in terms of the productivity gains due to the adoption of improved varieties.⁷⁷ Assessing CD needs and investments by the CGIAR along an impact pathway requires an assessment of the alignment between institutions and the different functions required in that impact pathway. For varietal development this requires some assessment of the division of labour between CGIAR research and NARI crop breeding programs, where such a division of labour depends on the capacity of the NARI and the mode of organization of the impact pathway. Moreover, there are also choices to be made in terms of breeding methodology that will influence capacity requirements.

To make the above more explicit it is useful to develop a schema for such an impact pathway. The impact pathway in Figure 2 sets out one such impact pathway that provides a flow of activities and options resulting in two outcomes, namely yield gains and yield stability. This impact pathway essentially illustrates the decision points in the breeding process itself (and organization of the breeding program) and has less to say about the organization of the seed system. Moreover, it is necessary to extend this pathway to assess actual impacts on IDO's and SLO's, which will be quite context dependent.⁷⁸ There is a fine line between the CG building capacity or adapting the research pathway to existing capacity. In crop improvement the first is most often favoured, as the choice of breeding strategy is more often based on best practice in the field - PABRA and AfricaRice balance both approaches. The choice is also influenced by the interaction with regional approaches, where stronger NARI's can become locations for regional breeding activities. Such a strategy was the basis for the extensive array of regional breeding networks that came under the coordination umbrella of

⁷⁷Walker, T.S., et al (2015). *Varietal Adoption, Outcomes and Impact*. In T.S. Walker and J. Alwang (eds). Crop Improvement, Adoption and Impact of Improved Varieties in Food Crops in Sub-Saharan Africa. Wallingford: CABl.

⁷⁸A cursory review of the impact pathways in the Agri-food system CRP proposals did not yield impact pathways sufficiently detailed to assess CD requirements. The focus was primarily on contribution to IDO's and SLO's.

the SRO's. However, as was outlined previously and is discussed in Lynam (2010), most of these networks were closed due to shifts in donor funding, again apart from PABRA and AfricaRice⁷⁹.

CD as Human Capital. Over the last decade or so there has been a major investment in the training of crop breeders. Capacity to undertake MSc and PhD training in plant breeding now exists through the RUFORUM degree program at Makerere University and the AGRA supported programs at the University of KwaZulu - Natal (African Center for Crop Improvement) and the University of Ghana (West Africa Centre for Crop Improvement), both in association with Cornell University. In some cases AGRA has supported the training of national plant breeders that will then link to CGIAR Center breeding programs, e.g. CIP's sweet potato program in SSA. Plant breeding is a particular area where human capital has been significantly strengthened over the last decade⁸⁰. The CGIAR has contributed to this expansion in plant breeders through providing research support for theses and through in-service short courses.⁸¹ Nevertheless, there is a significant disparity across crops in terms of breeders, with maize having by far the largest number of breeders followed a distant second by cassava and then rice⁸². The number of breeders is primarily defined by national priorities and this can result in a capacity gap when assessed at national versus regional level. Also, there has been a shift in short courses from more conventional breeding approaches to emphasizing more courses on molecular methods and genomics⁸³.

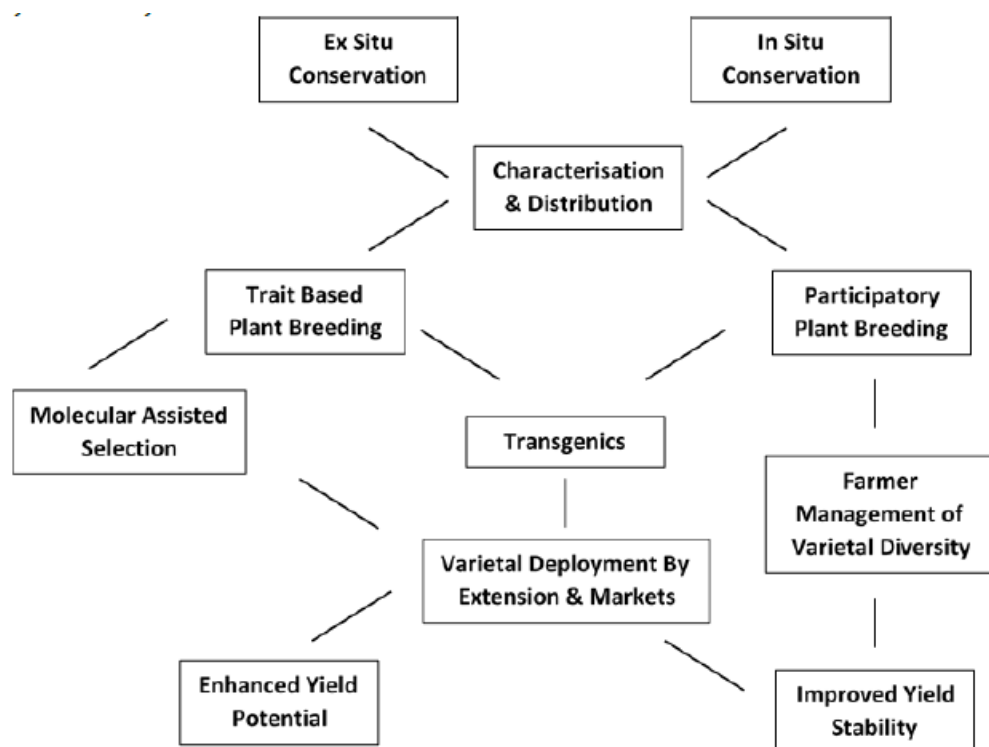
⁷⁹Lynam, John (2010). *Evolving a plant breeding and seed system in sub-Saharan Africa in an era of donor dependence*. FAO Plant Production and Protection Paper 210. Rome: FAO.

⁸⁰Guimarães, E.P., E. Kueneman, and M.J. Carena (2006). *Assessment of National Plant Breeding and Biotechnology Capacity in Africa and Recommendations for Future Capacity Building*. HortScience 41:50-52.

⁸¹Khush, Gurdev S. (2006). *Impact of International Centers on Plant Breeding Training*. HortScience 41:48-49.

⁸²See Table 18.1 in Walker, T.S., et al (2015). *Varietal Generation and Output*. In T.S. Walker and J. Alwang (eds). *Crop Improvement, Adoption and Impact of Improved Varieties in Food Crops in Sub-Saharan Africa*. Wallingford: CABI.

⁸³See Table 3 in Khush (2006), op cit. and Diop, Ndeye Ndack, Fredrick Okono, Jean-Marcel Ribaut (2013). *Evaluating Human Resource Capacity for Crop Breeding in National Programs in Africa and South and Southeast Asia*. Creative Education 4 (10A): 72-81.

Figure 2: An Impact Pathway for Crop Improvement⁸⁴

Building capacity in biotechnology, including molecular breeding, has benefited from donor support. In fact, it is difficult to identify a country apart from South Africa where national budgets have been used to support the development of such capacity. Also, the operational costs for reagents is significant. The “large” countries have developed laboratories where such research can be done, particularly Kenya, Ethiopia, Tanzania, Uganda, Ghana and Nigeria. Scientists have also been trained in the North to staff these laboratories. Donors with significant programs in this area have included the World Bank (particularly through their FAAPP regional mechanism), SIDA, and the Gates and Rockefeller Foundations. Much of the ongoing operational costs are also supported by donor projects, most often through CGIAR Centers and particularly through the Gates Foundation. A dedicated research cum capacity development facility has been developed at ILRI, the Biosciences eastern and central Africa (BeCA - ILRI) Hub. Virtually all of the research is project driven, most through the CG Centers, but others such as the Danforth Center also have programs, particularly on virus diseases in cassava.

CD at an Institutional Level: CD at an institutional level is in many ways the greater need in terms of generating greater impact with crop improvement in SSA. This is best analysed in terms of the impact pathway above and might be summarized as how to build a varietal pipeline that meets the needs of the majority of smallholders and at the same time connects to and capacitates the seed system for

⁸⁴Lynam, John (2016). *Balancing International Public Goods and Accountability: Exploring the Impact of IFPRI's Policy Research on Science, Technology, and Innovation*. Independent Impact Assessment Report No. 43. Washington, DC: IFPRI.

delivering those varieties. The two will be considered separately but it should be emphasized that CGIAR crop breeding has expanded from a singular focus on varietal development to adaptive and action research that supports varietal release, foundation seed production, development of private seed companies or community seed multiplication, and creation of agro - stockist networks. This shift is in many ways best represented by the change in the International Maize and Wheat Improvement Center (CIMMYT) breeding priorities from solely producing OPV's in Africa (because of the lack of hybrid seed production capacity, to solely producing inbreds and hybrids. All of this has been a response over the last decade and a half to market liberalization and the increasing demand to ensure impact. The vision is to use the base that CG Centers have in the large countries to meet the needs of the small countries, which in many ways have a far greater need for improved varieties but at the same time have much more limited capacity. In these countries the task is how to adapt the breeding system to that limited capacity.

Plant breeding is a long term enterprise, has large fixed costs in genetic resource banks, breeding populations with known traits, supporting labs, especially with the increasing use of marker assisted selection, and the infrastructure supporting crossing blocks. Supporting such ongoing research through project funding has been difficult for CG Centers but has so far proven tractable⁸⁵. Such high fixed costs result in significant economies of scale in plant breeding but at the same time the need for locally adapted varieties - the widely adapted varieties of the Green Revolution have proven not to be suitable for the heterogeneity of smallholder farming systems in SSA. Meeting these two objectives, i.e. attaining the cost efficiencies in scale economies and yet meeting the preferences of smallholder farmers, is the organizational challenge for plant breeding in SSA and in significant ways defines the division of labour between national, regional and international actors and provides a framework for identifying CD requirements for a cost effective breeding pipeline to serve the continent. These options are outlined in the following extract:

International and regional breeding capacity is not a substitute but rather a very strong complement to plant breeding capacity at the national level in Africa, even in small and medium - sized countries. The objective of any breeding program is to produce adapted germplasm with the requisite complement of priority traits that meet the needs of farmers. The issue in a resource constrained environment is how to organize the breeding effort to attain the cost efficiencies in large - scale breeding efforts with the requirements in Africa for significant local adaptation to farmer needs. Various models have been used in subregional breeding networks in attempting to achieve these two objectives through closer integration between CGIAR breeding programs and evolving capacity in national programs. The following models have been developed:

1. Centralized cultivar development. The IARC program develops fixed lines and these are either tested in a regional variety trial or integrated into the national performance trials of individual countries. For countries with a crossing program, varieties may enter as a parent, but that is relatively inefficient compared to the provision of nurseries and populations.

⁸⁵It might be argued that the same approach could be used for CD. However, while the Centers have been able to develop a portfolio of projects that funds critical breeding activities, dedicated projects for CD are rare and CD is primarily built into projects with other primary objectives, limiting the development of a coherent portfolio.

2. Centralized crossing and dispersed selection. This model is particularly used in rice and is especially useful when priority traits are common to a region but their combination will vary across markets or production systems. Thus, the Africa Rice Center (AfricaRice) can feed traits from wide crosses into its crossing block and work with a significant range of genetic variability, but then the early generations undergo selection across a wide range of conditions in national programs.

3. A division of labour across multiple breeding projects. This derives primarily from the bean breeding model used CIAT. Traits such as colour and grain size, where preferences vary by country, must be segregated into different breeding populations and these in turn combined with disease and pest resistances specific to principal agroecologies. Each national program can thus concentrate on the market type most demanded in their country but draw on varieties for more minor market types or agro - ecologies from other countries.

4. Centralized population breeding supporting national crossing and selection programs. Such a model appears to be particularly applicable to sub-Saharan Africa, at least in terms of the combinations of traits that need to be assembled for particular agro - ecologies. Such prebreeding within broad agroecologies could feed directly into national crossing and selection programs or into the other three models, depending on capacity at the national level. This model is being pursued in the International Potato Center's sweet potato breeding program⁸⁶.

The shift in donor priorities away from funding networks has reduced the ability of many Centers to develop an integrated breeding capacity that optimizes the potential for varietal adoption and impact. This reviewer's view is that rebuilding that capacity or extending it is probably the most significant CD priority in SSA and capacity needs within NARI's follow as a second stage priority within the strategic dimensions of the breeding network. Such overall strategic planning, however, is limited by the reliance on project funding.

The other critical dimension of the impact pathway is the organization of the seed system for delivery of improved varieties. As mentioned earlier, the CG Centers have significantly increased their work in this area over the last decade or so. Impact pathways divide between cross pollinated crops - with the potential for hybrid production and therefore private sector approaches to seed production and distribution - and cross pollinated and vegetatively propagated, clonal crop species, where approaches tend toward a division of labour between public sector multiplication, more formal community seed systems, and informal seed systems⁸⁷. Most commodity Centers in SSA will have some capacity in seed systems. Some argue for private sector approaches even for cross pollinated and vegetatively propagated crops, the latter based on investments in tissue culture. Private sector investment in these crops is still very limited.

⁸⁶Lynam, John (2010). *Evolving a plant breeding and seed system in sub-Saharan Africa in an era of donor dependence*. FAO Plant Production and Protection Paper 210. Rome: FAO.

⁸⁷See for example Lynam, John (2011). *Seed Systems in Clonally Propagated Crops in Africa*. Unpublished paper prepared for the Bill and Melinda Gates Foundation.

Hybrid maize is the driver of private sector seed investment. Hybrid maize generates the principal returns for a seed company in SSA and some market share in this principal market is necessary, which potentially provides a base to diversity into seed production of other crops. Downstream distribution depends on a network of agrostockists and local investment at this level is generally tied to fertilizer and policy related to that essential input. Input markets have developed most rapidly in those countries with port facilities, which have a large cash crop sector dependent on fertilizer, and where maize is a dominant staple in consumption patterns. Input market development is therefore quite context dependent, relies on public - private partnerships, and in general is tied to investment funds. AGRA has carved out approaches to these three issues and is dominant in terms of fostering private sector approaches to input market development and capacity building, especially in the area of private seed companies. Seed system development is now the rule in terms of varietal development projects. An example of a CD approach to seed system development is given by CIMMYT in the following:

CIMMYT is working with partners to increase farmer preference for DT (drought tolerant) seed by supporting promotional and marketing activities, and improving seed production capacity. CIMMYT will also work to ensure local institutions have the technological and production capacity to independently produce and distribute seed throughout DTMASS (Drought Tolerant Maize for Africa Seed Scaling project) target countries.

Scaling activities will allow DT seed to spread across various geographical areas (scaling “out”) and build the capacity of local institutions to independently control sustainable seed production (scaling “up”). Both scaling up and out rely on giving stakeholders in the maize value chain compelling reasons to continue producing, distributing and consuming DT maize varieties.

Over 50 selected small - and medium - scale seed companies will be supported through training workshops on seed production and seed business management. Seed companies will also receive financial grants to support expansion activities such as purchasing special seed processing and packing equipment, restoring seed storage and other facilities, and marketing.⁸⁸

Strategically, the question might be asked whether this seed system project focusing only on DT maize varieties would be different from a project building seed sector capacity on the continent with the potential of “crowding in” capacity in cross pollinated crops, particularly grain legumes. A mandate and project focus potentially constrains institutional approaches to building capacity in input market development. Is there the need for a more integrated approach to CD in more downstream areas of technology delivery? In many ways this was the objective of the three “System” CRP’s, which have been eliminated in the second phase of CRP’s. Moreover, in developing the downstream delivery capacity there is also the need for public sector capacity that underlies PPP’s and that primarily involve soft skills. These include varietal release management, marketing and targeting of new varieties, managing IP, communication and negotiation with seed companies, and analysis of end consumer, trader and processor preferences as input for both product/varietal design and marketing strategies. Integrating such skills into relevant projects is perfectly feasible, given approaches to the development

⁸⁸<http://www.cimmyt.org/maize-seed-systems-in-africa-understanding-the-basics/>

of such skills. However, the question of an integrated approach to downstream capacity provides a natural transition into analysis of the next impact pathway on production systems and NRM and the paper comes back to this question in the last section.

4.2 *CD in the Production System/NRM Impact Pathway*

There is increasing evidence to suggest that the principal yield gains in African smallholder systems will be achieved through intensification in crop and soil management, or at least this is necessary to achieve the yield gains from improved cultivars. This was in many ways the rationale for the development of farming systems research (FSR) in the 1970's and 1980's, which evolved into the development of adaptive research. With the evolution from multi-disciplinary crop research programs (and the closing of FSR programs) to a focus on the production of international public goods, agronomy, and to a significant extent soil science, essentially disappeared as a discipline in the CG and was assumed to be undertaken by NARI's, particularly given the location specificity of the research. Crop management, however, was maintained in short course training programs. With the advent of the sustainability agenda and the expansion of the CGIAR to 18 Centers in 1991, particularly the NRM Centers, there was a return to production systems in the guise of sustainable management of soil, water, and tree resources. At the turn of the century this was distilled into integrated natural resource management, with a particular focus on production systems⁸⁹. In part this has evolved to the concept of sustainable systems and sustainable intensification, which provided the rationale for the System CRP's in the CGIAR reform of 2008.

This potted history emphasizes that production system/NRM research has evolved to both develop a more coherent agenda and to adapt to rapidly changing global agendas; climate change and planetary boundaries in future food scenarios being the most prominent. This has principally arisen because production system/NRM research employs a very different research methodology from that of genetic improvement, both in the production of international public goods and in achieving impact. In some sense the plant breeding and production system impact pathways are competing visions and in an African context have found expression in debates over an African Green Revolution. At its simplest the argument is over whether smallholder development will be driven primarily by seed and fertilizer technologies (and the implications for input and output market development) or through system intensification involving complementary technology components, efficient use of the limited and expensive fertilizer available to smallholder farmers, and integration of trees and livestock into the farming system. The first approach describes an impact pathway similar to that developed above for improved varieties, while sustainable intensification involves a very different impact pathway, one that combines adaptation to local conditions within a framework for achieving impact at scale - what has been termed contextualized scaling⁹⁰.

Capacity in adaptive research and expanded advisory services are at the heart of the impact pathway for production systems/NRM. The continuing research question is how to best organize the

⁸⁹See Science Council. 2003. *Towards Integrated Natural Resource Management: Evolution of NRM Research within the CGIAR*. Rome: CGIAR Science Council Secretariat.

⁹⁰See Coe, Richard, Fergus Sinclair and Edmundo Barrios (2014), op cit.

downstream delivery and application of what are knowledge intensive techniques. Two approaches dominate in exploring dissemination approaches. The first is framed as knowledge into action⁹¹. This approach, which tends to focus on higher scale NRM issues, is framed at an institutional level and explores the interface between research institutions and application of NRM knowledge in implementing institutions. Much of this knowledge is distilled into simulation models and decision support systems that the improved management of natural resources within programs of the organization. The second approach tends to focus on production systems and seeks to understand how farmers adopt complex system technologies that then feeds into the design of extension approaches⁹². Both approaches involve a potential range of institutional actors and involve new skills and competencies which has implication for CD. The discussion of CD within this impact pathway will focus on the second approach, which has been more widely applied in SSA.

CD as Human Capital: Given the evolving nature of research on production systems within the CGIAR, it is probably fair to say that there has been no coherent approach to human capital development in this area. In many ways production system scientists have come out of more traditional disciplines and developed their research approaches within ongoing research programs. Probably the closest fit of the approach and degree training is provided by the Plant Production Systems Group in Wageningen University. Post graduate students from this program are often attached to CGIAR Centers in SSA to undertake their thesis research. In many ways the lack of a strong cohort of production system scientists was a major constraint on the more rapid development of a research agenda in the System CRP's. This reviewer would argue that there is a significant gap between need in SSA and what the CGIAR currently offers in terms of training in production systems, at least in terms of developing a generation of scientists in the region with research skills in this area.

The area encompasses a combination of production or farming system and agroecology and involves skills in modelling, spatial analysis, experimentation and elements of more traditional disciplines such as agronomy, soil science, and pest management. Integrating all of this into a training program is complex, both at the level of degree programs, joint research, and dedicated courses. Again Wageningen potentially comes closest to having developed such a curriculum. This combination of skills is critical in new areas of research being promoted by the CGIAR, including sustainable intensification, climate smart agriculture, sustainable landscapes, and crop - livestock integration. From a google search it is difficult to identify the existence of Center courses or training programs that cover these areas. The tendency is to disaggregate the topic into more technical areas.

In the recent past training programs were developed and offered in what could be called sub - system disciplines. ICIPE has been most successful in this area with its long term African Regional Postgraduate Programme in Insect Science (ARPPIS) with its focus on integrated pest management. By 2016 it had

⁹¹Clark, William C., Thomas P. Tomich, Meine van Noordwijk, David Guston, Delia Catacutan, Nancy M. Dickson, and Elizabeth McNie (2016). *Boundary work for sustainable development: Natural resource management at the Consultative Group on International Agricultural Research (CGIAR)*. PNAS 13 (17): 4615–4622.

⁹²See for example Kassie, Menale, Hailemariam Teklewold, Moti Jaleta, Paswel Marennya, Olaf Erenstein (2014). *Understanding the adoption of a portfolio of sustainable intensification practices in eastern and southern Africa*. Land Use Policy 42: 400–411.

trained 608 post graduate scientists⁹³. ICRAF invested in a long - term program to develop the science of agroforestry and its development in universities in the region through the African Network for Agriculture, Agroforestry and Natural Resources. TSBF - which was absorbed into the International Centre for Tropical Agriculture (CIAT) - developed a research agenda for biological approaches to managing soil fertility and supported course revisions in soil science departments in the region. Dedicated funding for such programs essentially stopped - except for ARPIS - and yet the need remains. Some of that gap has been filled by RUFORUM. It has established three regional PhD programs in the area of production systems, namely dryland resource management at the University of Nairobi, soil and water management at Sokoine University, and aquaculture and fisheries at University of Malawi. There is also a quite innovative PhD program on agriculture and rural innovation managed jointly between Makerere, Egerton, and Sokoine. There is only minimal interaction between the development of these programs and Center input into curricula development. Again funding streams have precluded much of this interaction but the opportunity still exists for influencing Africa's transition to PhD training in these critical areas.

CD at an Institutional Level. CD at an institutional level focuses on the downstream objective of adapting technical options to local context but doing this at a relevant scale. There is a critical lacunae in lack of capacity at the NARI level to complement this objective. Building capacity in NARIs in production systems is made difficult given a program structure that usually is a matrix of national commodity programs and agroecological research stations. Cross cutting research such as soils, pest and diseases and agroforestry is difficult to staff and develop a strategic research agenda. There has been a similar difficulty within the CGIAR itself, apart from agroforestry which has a dedicated Center. TSBF was quite successful in using a research network approach. This was built around a well defined set of research hypotheses that were tested within standardized research methodologies across a range of contexts. Given the critical importance of soil management to productivity in SSA, the lack of CD at a NARI level is a mismatch between need and the CGIAR inability to organize dedicated program support in integrated soil fertility management. Conservation agriculture would be another example of a network approach to CD. The African Conservation Tillage Network (ACT) uses a community of practice framework in developing conservation agriculture in particular contexts and has four centers of excellence across the continent that provide training on the subject. However, there is a lack of research questions except at the level of how to adapt the conservation agriculture principles to local contexts⁹⁴. Building capacity in production systems in African NARI's remains a challenge and one for which CGIAR Centers have not been able to develop a coherent strategy.

The principal target of CD in production systems is how most cost effectively to build capacity to adapt and disseminate "system" technologies. Both ACT and ICIPE's push pull work with a range of extension methods. ACT describes the approaches as follows: "Several participatory approaches to CA adoption

⁹³Niang, Amy, Edinah Maina, Dorothy Mwangi (2012) *An Outcome Report of the Tracer Study on the Grantee Beneficiaries of the African Regional Postgraduate Programme in Insect Science*. Nairobi: ICIPE.

⁹⁴See for example Giller KE, Corbeels M, Nyamangara J, Triomphe B, Affholder F, Scopel E, Tittonell P (2011). *A research agenda to explore the role of conservation agriculture in African smallholder farming systems*. Field Crops Research. 124:468-472.

and scaling have been tested successfully. These include Farmer Field Schools, Lead Farmer Networks, and No-Till CA Associations” (p 18)⁹⁵. Understanding the effectiveness and costs of different extension approaches for complex technologies has become a research question central to the issue of how to build capacity in this area. ICRAF is undertaking randomized control trials of different methods for agroforestry systems⁹⁶. Understanding the cost effectiveness of methods to take system technologies to scale is very much *RinD* and central to future CD in this area. CD approaches in production systems thus remain an open question but one central to agroecological intensification of smallholder agriculture.

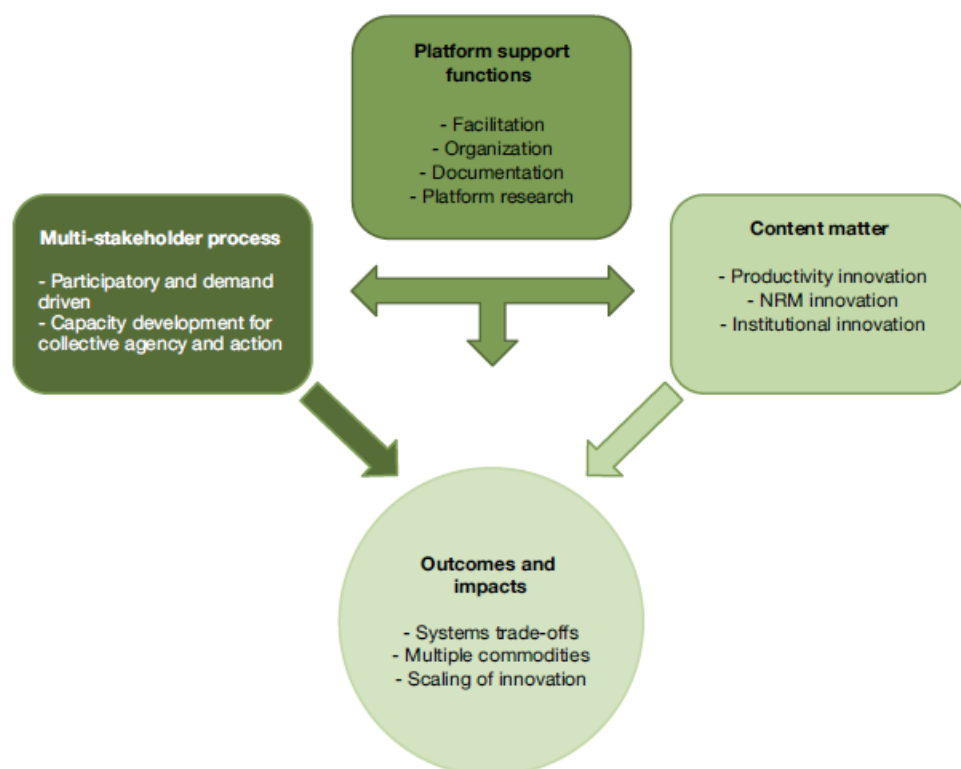
Much of the recent focus on developing capacity for going to scale has been on facilitating innovation platforms (IP). This is a very different type of capacity and has been most often employed in individual commodity value chains. HumidTropics has employed them within a more production systems framework with explicit objectives for systems trade - offs, multiple commodities and scaling innovation outcomes⁹⁷. Approaches such as HumidTropics are much more appropriate for diversified, smallholder farming systems. However, as the authors of the IP case studies note, “multi - commodity cases were often a combination of crops, as opposed to the holistic crop–livestock–tree interactions that many researchers advocate”⁹⁸. The “extension problem” for complex systems remains but the IP’s allow integration with innovations in input and output markets, although only at the scale of operation of the IP. The ingredients that go into the development of IP’s is shown in Figure 3 and capacity is best defined in terms of platform support functions and multi - stakeholder processes. IP’s are facilitated processes outside formal organizations who take part and with financial support to cover the transaction costs. How sustainable such capacity is remains to be seen, with some arguing that they do not have to be permanent and that such capacity is time limited. What remains unexplored is the feedback loop to these formal organizations and whether participation in such IP’s changes internal behaviours and capacities.

⁹⁵African Conservation Tillage Network (2014). *International Conservation Agriculture Advisory Panel for Africa (ICAAP-Africa)*. Nairobi: ACT.

⁹⁶<http://www.slideshare.net/agroforestry/session-63-taking-tree-based-ecosystem-approaches-to-scale>

⁹⁷Dror, et al (2016), op cit

⁹⁸Dror, et al (2016), *ibid* p 182.

Figure 3: Relation between four key components of Innovation Platforms

The impact pathway for production systems/NRM is a work in progress in SSA, as is CD along that impact pathway. Yet CD needs are in many ways greatest in this impact pathway compared to the other two and has the potential to constrain the progress in this area of AR4D. Moreover given that systems research will itself remain fragmented within the CGIAR with the loss of the System CRP there is limited potential to develop a strategic approach to CD in this critical area. One area that influences the success of the more downstream work is the enabling environment, particularly policies, with a very significant one being the recent bandwagon for fertilizer subsidies. This provides a natural transition into the policy impact pathway.

4.3 CD in the Policy Impact Pathway

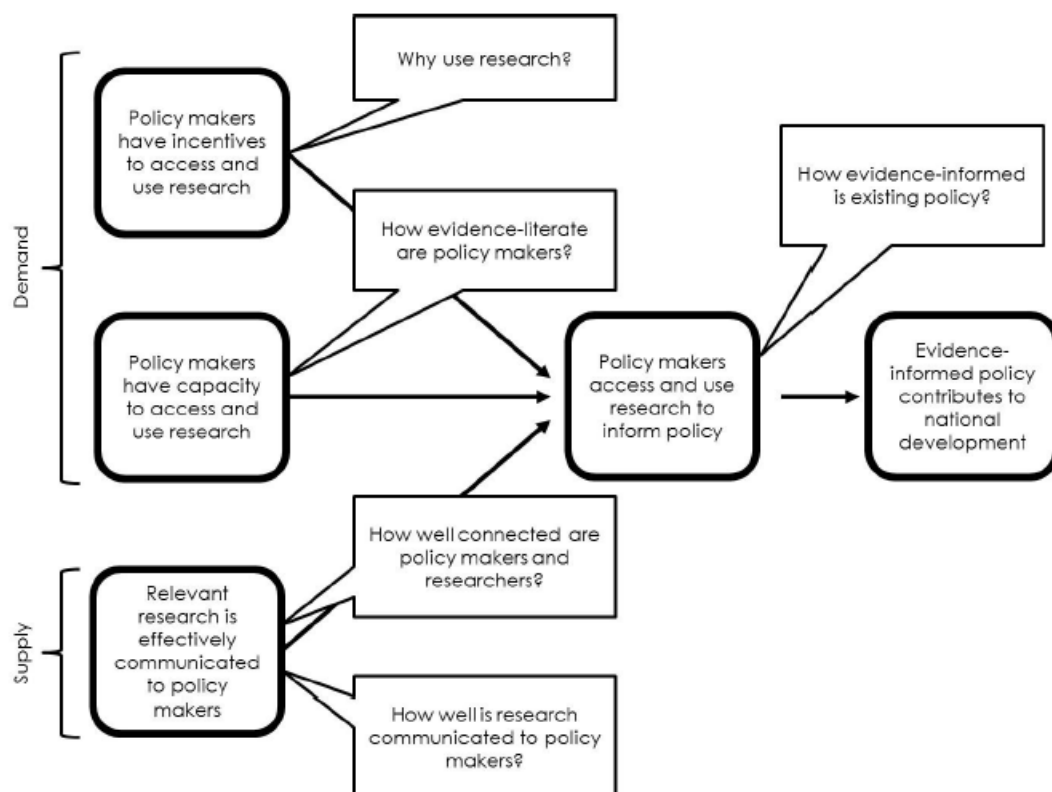
Market liberalization in the 1980's and 1990's was adopted to varying degrees by countries across the continent, from for example a quite market-based agricultural economy in Kenya to still significant intervention by state agencies in agricultural markets in Ethiopia. The enabling environment for private sector investment in input and output markets thus varies significantly across the continent but with virtually all CAADP investment plans designed around the commercialization of smallholder agriculture. Market development and market integration remains spatially fragmented, in part due to the underinvestment in road transport infrastructure and in part to state intervention in markets, and this has obvious implications for the adoption of improved technologies. The policy environment is thus a major determinant of the effectiveness of the other two impact pathways.

The impact pathway for policy is quite different from that for the other two pathways and relies on a very different set of institutional actors. Evidence - based policy change - and the impacts that follow from that - requires an interaction with the policy process that can be both context specific and time sensitive. Impact oriented policy research is most often country specific and principally focused on outcomes, that is changes in investment decisions, regulatory policy, institutions, or legislation. Figure 4 outlines a generic impact pathway for policy research and is framed around matching the demand and supply of such research as critical to achieving such outcomes. Outcomes are best achievable if the research is demand driven but the time frames for this are usually very short and to develop a better linkage between the demand for and the supply of policy research requires local capacity. In turn, there is a fine line between presenting research evidence and advocacy on the basis of that evidence. To circumvent that fine line CG Centers tend to focus advocacy at a more general level through broad based communication programs. Building outside consensus in key areas such as climate change can bring indirect influence on national policy processes. The CGIAR is one among several providers of CD in the agricultural policy area. CD by the Centers has involved achieving a balance between individual and institutional CD and between direct support to national policy processes and broader based communication programs.

There are two policy research institutes in the CGIAR, namely IFPRI and CIFOR. Many of the other Centers have economic research on their mandate areas, many with policy implications. The cross cutting policy CRP (Policy, Institutions and Markets) provides a framework for integrating much of this research across the Centers - five of the 15 Centers participate in PIM. CD (and communications) is a core “pillar” in the strategy and impact pathways of both CIFOR and IFPRI. IFPRI has just developed a new strategy for CD in the policy area⁹⁹, based on an impact evaluation of its CD investments through the history of the Center¹⁰⁰.

⁹⁹IFPRI (2016). IFPRI Strategy 2016-2018: Capacity Strengthening. Washington, DC: IFPRI.

¹⁰⁰Kuyvenhoven, A. 2014. *Impact Assessment of IFPRI's Capacity-strengthening work, 1985–2010. Independent Impact Assessment Report 38*. Washington, DC: IFPRI.

Figure 4: A generic impact pathway for policy research¹⁰¹

CD as Human Capital. Economics is the principal discipline that undertakes policy research, although other skills and capacities are also necessary in the policy change process, including communication, negotiation and advocacy. Investment in developing a pool of African economists trained at the MSc and PhD level got an earlier start on the continent than in the other two impact pathways. With structural adjustment the World Bank and IMF found that there was a severe lack of macroeconomists in Ministries of Finance with which to design and implement these programs. The African Economic Research Consortium (AERC) was established in 1988 to fill this gap. Its programs have developed over time moving beyond macroeconomics to micro and applied economics, where most of the policy issues resided post structural adjustment. AERC now runs three post graduate programs:

AERC supports the Collaborative Master's Programme in Economics (CMAP) for Anglophone Africa (excluding Nigeria and South Africa), the Collaborative Master of Science in Agricultural and Applied Economics (CMAAE) for Eastern, Central and South Africa, and the Collaborative PhD Programme (CPP) in Economics, along with targeted support for PhD thesis research. The collaboration features joint faculty for electives, enforcement of standards through

¹⁰¹Newman, K., A. Capillo, A. Famurewa, C. Nath, and W. Siyanbola. 2013. *What is the Evidence on Evidence-informed Policy Making? Lessons from the International Conference on Evidence-informed Policy Making*. Oxford, UK: International Network for the Availability of Science Publications (INASP).

internationally recruited external examiners, a common curriculum and a joint development of teaching materials¹⁰².

The CMAAE, which started in 2002, is a collaboration between agricultural economics departments in East and southern Africa and had initial input from IFPRI in its design¹⁰³. This initiative has not yet extended into developing a collaborative PhD program, although the specialization is offered in the CPP program. Most of the PhD's in agricultural economics continue to be trained in Northern universities. IFPRI in countries where it has dedicated country strategy support programs (CSSP's) has direct MSc thesis support, although not particularly linked to CMAAE. Rather training tends to focus much more on targeted short courses, where "researchers and analysts ... engage in evidence based analysis of food policies and subsequently identify problems, solutions, and shortcomings"¹⁰⁴. The latter depends on targeted institutional partnerships and these are primarily embedded in joint research projects.

A study at the turn of the century presented evidence for a significant gap between the supply and the market demand for agricultural economists in East and southern Africa¹⁰⁵. The increase in supply coming from the CMAAE program as well as continued training outside the continent has in many ways not closed that gap. As in other disciplines there is a continuing need for increases in MSc and PhD's to staff university departments, policy research institutes, ministries, NARI's, and positions in regional and international agencies in SSA. How to do this is still an open question.

CD at an Institutional Level. The scope of institutional partnerships has a very different pattern to that of the other two pathways. In the other two, the issue is how to support a number of potential actors providing different functions. In the policy research area there are a range of different organizations essentially providing the same function, namely policy research. Such an array could include "universities, policy research institutes, statistical agencies, NARS, and staff bureaus at ministries"¹⁰⁶. How then to think about CD at an institutional level given this range of actors. Experience can be drawn from the African Capacity Building Foundation (ACBF), which was established in 1991 as a grant-making institution to support the development of capacity in economic policy. One of its principal programs in the first decade or so was institutional support to policy research institutes across the continent. The experience is summarized by an evaluation of the World Bank's CD programs in SSA:

Through its core institutional support, the ACBF has played a catalytic role in creating a network of some 40 new or strengthened national and regional policy analysis units. The units, which have been mandated and contracted to provide research, advisory services, and training to government ministries and other public agencies have demonstrated

¹⁰²<http://aercafrica.org/index.php/training/training-overview>

¹⁰³See Kuyvenhoven (2014), op cit P 35-36.

¹⁰⁴IFPRI (2016), op cit p 3.

¹⁰⁵Obwona, Marios and David Norman (2001). *Status of Agricultural Economics in Selected Countries in Eastern and Southern Africa*. Washington, DC: IFPRI.

¹⁰⁶Kuyvenhoven (2014), op cit p 60.

considerable impact on policy. Independent units, in contrast, have produced high-quality policy research, but have had less direct policy impact because of difficulties in obtaining data from government agencies, weak dissemination practices, or lack of government receptivity to independent research¹⁰⁷.

The problem is highlighted in the impact evaluation of institutional capacity development at IFPRI:

A key lesson that emerges is the importance of picking the right partner organizations. For data collection and food policy research, an action oriented government ministry can be a poor partner (though possibly a good client for technical assistance), while research organizations and universities may be better partners for research but less effective for achieving policy influence. A better approach is to take a strategic approach to the CD of the entire food chain or policy cycle¹⁰⁸.

The latter argues for a more systemic approach to institutional CD in the policy arena. In Kenya CD might focus on KIPPRA in the Ministry of Planning, Tegemeo, an independent policy institute, and depending on the topic, KALRO. This would only be possible in one of IFPRI's country support programs. An impact assessment of IFPRI's Ethiopia CSSP found that the program worked with 3 principal institutions and that "The institution - building component of these actions is achieved, in part, by concentrating ... training on selected institutions and tailoring it to their specific needs.... However, no plan to identify capacity gaps and appropriately calibrated ways to address them was laid down"¹⁰⁹. Such a systemic approach requires careful diagnosis of which institute can produce quality research and which is more influential in the policy process itself.

As with the crop improvement impact pathway there is also an emergent regional architecture in support of policy research (Regional Strategic Analysis and Knowledge Support System - ReSAKSS). "Established in 2006 under the Comprehensive Africa Agriculture Development Programme (CAADP), ReSAKSS supports efforts to promote evidence and outcome - based policy planning and implementation as part of the CAADP agenda.... Capacity strengthening to generate and disseminate knowledge products to support CAADP implementation particularly shared standards and protocols for collecting data and conducting analysis in ways that effectively contribute to informing policy and decision - making processes in Africa"¹¹⁰. ReSAKSS has direct entry in each country through the CAADP process and particularly focuses on standards in data collection as central to the policy process. However, policy research does not rely on a functional division of labour at regional and national level, as with crop improvement. Rather national capacity is necessary to adapt research methods, analytical frameworks, and thematic reviews to policy contexts in individual countries, which again highlights the critical importance of local capacity in generating policy outcomes.

¹⁰⁷World Bank Operations Evaluation Department (2005), op cit. p 39.

¹⁰⁸Kuyvenhoven (2014), op cit p xvi.

¹⁰⁹Renkow, Mitch and Roger Slade (2013). *An Assessment of IFPRI'S Work in Ethiopia 1995–2010: Ideology, Influence, and Idiosyncrasy*. Washington, DC: IFPRI. p 44.

¹¹⁰<http://www.resakss.org/about> .

5. Where and how to deploy limited CGIAR CD investments in a SSA context

This assessment has attempted to evaluate the need for CD in R4D in section III and the supply by the CGIAR and other providers of CD through the CGIAR's three principal impact pathways in section 4. The evaluative question is then how well does supply match need and whether looking forward the two can be made more congruent. An alternative approach is taken by the African Capacity Development Foundation which has developed an index of African capacity for economic development and as part of that a sub-index for capacity for agricultural transformation and food security. The index is developed on the basis of four clusters as follows:

The first is having a good agricultural sector strategy, which has leadership embedded in the vision for agriculture at the country level and a set of vision - driven activities that can transform the sector and have it contribute to development. The second cluster captures the investment in dynamic capacity, including the skills, knowledge and innovation needed to get results. The third cluster recognizes the explicit role of the private sector in the agricultural supply chain and the capacity of the sector to contribute to the process of transformation. The last cluster relates to the information system that supports farmers, buyers and sellers and other stakeholders in the supply chain including making research relevant for farmers¹¹¹.

R4D has activities in each of these clusters but focuses on the second on knowledge and innovation. The ACDF uses the index to rank countries both in terms of the overall index and each of the four components. What it finds is that "More effort needs to go into 'training, research and innovation in agriculture". Not a single country featured in the highest levels (High or very High) and close to half (47.6 percent) were ranked low in this measure. The finding also suggests that there is an inadequate skill pool available to employ research-related and other information"¹¹². If research and innovation is the weakest link in overall capacity for agricultural transformation, then it argues for focusing on how to improve CD in this area.

5.1 An Assessment of Overall Need

The following will be a qualitative and subjective assessment of overall need based on the discussion in sections 3 and 4. This reviewer would argue for the following CD priorities:

1. There is a clear gap between the demand for and the supply of MSc's and PhD's in the range of agricultural disciplines. This gap will have to be filled by developing post-graduate degree training in African faculties of agriculture but at the same time ensuring that these degrees meet international quality standards. Moreover, the curriculum should reflect the state of the art in research findings for smallholder agriculture on the continent, much of which has been produced by the CGIAR. Meeting this quality standard will depend on increasing the funding for and the quality of the research carried out in faculties of agriculture, both of which remains heavily constrained. Given that the capacity to meet all these requirements across the range of disciplines is limited in any particular faculty, there is

¹¹¹African Capacity Development Foundation (2012). *Africa Capacity Indicators 2012: Capacity Development for Agricultural Transformation and Food Security*. Harare: ACDF. p 34

¹¹²ACDF (2012), *ibid* p 38.

an argument for pooling capacity across faculties. Regional collaborative MSc and PhD programs have been initiated by RUFORUM and AERC but still in a limited range of disciplines, and there is a particular lack of support to disciplines that are critical to the impact pathway on production systems/NRM.

2. NARI's remain fundamental to achieving the impact objectives in both the genetic improvement and the production system/NRM impact pathways. Yet effective capacity in most NARI's is highly constrained due to the small country problem. Investment in long term research by national governments is highly limited in most countries and with a significant dependence on development aid. With the recent movement of aid donors away from regional approaches and to focusing on a limited number of priority countries, a bifurcation has developed between the capacity in seven "large" countries and the rest. Moreover, much of the investment by the CGIAR is focused on these seven countries, where impact is much less limited by capacity constraints. Regional networks and SRO's have proven effective in the past in addressing this small country problem but these depend on international aid funding and these have lost out to other donor priorities in the last decade. Maintaining capacity at a subregional level is critical to ensure research capacity at a national level across the continent. Support to SRO's and regional programs is at a potential inflection point at the moment, where CAADP processes are seen as a viable alternative rather than a complement to regional approaches.

3. Providing the incentive for national governments to invest in agricultural research depends on providing the capacity for achieving impact on smallholder productivity, or what is now termed capacity for agricultural transformation. Such capacity depends on a more systemic view and requires interlinked capacity in input and output markets, extension/rural advisory services/knowledge brokers, finance/credit/insurance, and private sector agribusiness skills and investment. Such capacity has been framed as agricultural innovation systems but as with any systemic framework it does not identify priorities for investment in CD but rather focuses on improving linkages and interactions within the system. Existing capacity in each of these four areas defines the context for farmer adoption of improved technologies and the type of technology best suited to that context. Building capacity in these downstream functions will be incremental and will bound achievable impacts with new technology.

5.2 CGIAR Contributions to CD in SSA

As has been said by many, the CD needs for agriculture in SSA are far beyond the resources or capabilities of the CGIAR. Yet, all Centers have a CD scientist or program. All CRP proposals have a section on CD, and most Centers have CD in their strategy as a necessary means to achieving impact. How then does the CGIAR use those limited resources to best effect, in terms of both meeting its own mandate and contributing to enhancing CD initiatives on the continent.

The CGIAR Centers have a long and consistent history in agricultural research on the continent, reinforced by experimental, laboratory, and field capacity across the continent. The CGIAR is an inherent part of the R&D institutional architecture in Africa. This history and capacity produces certain inherent comparative advantages in the provision of CD services. One is building capacity in new areas of agricultural science. Examples are genomics provided by BECA, molecular breeding provided by Center breeding programs, soil analysis using near infrared spectroscopy, and even gender equality in agricultural science through AWARD. Equipment is provided by project support but the real

contribution is in the ongoing support to national staff. The second is research support to post graduate students, a particularly weak area currently in faculties of agriculture. A third comparative advantage is the CD inherent in the development of more downstream R4D activities in areas such as seed companies, innovation platforms, new extension methods, and PPP's, all of which derive from the Center's field capacity and long term engagement in Africa. A final potential comparative advantage, but one with a more checkered history, is location of Center research programs and capacity on national experimental stations, such as Kawanda in Uganda, Kiboko in Kenya, and Chitedzi in Malawi. The extreme of this was the original design of ICRAF as a council and a center without walls where all research was done in national programs. The difficulty was in maintaining research quality without basing staff there as well. The challenge has been in program changes in Centers that result in relocation of these capacities.

However, the question is whether the CGIAR can be more strategic in the application of this comparative advantage in SSA. This will be explored in terms of identifying a number of areas that would

5.2.1 Matching Funding Sources and Investor Expectations

There is something of an expectations gap in approaches to CD in the current CGIAR. This reviewer's view is that funders expect that the CGIAR invests in CD but the System is not provided with the funding modalities to do this effectively. There is no unrestricted funding available for CD either in the CRP's or the Centers, apart from support for the CD coordinator in the Center. Moreover, it has been very difficult to develop dedicated programs or projects for CD. AWARD and BecA are exceptions to this rule but these are very tightly focused programs that meet specific, though important needs. Dedicated projects for CD are rare and the principal modality has been to build CD components within projects which support project objectives. This is not unusual, as the World Bank evaluation of CD in Africa suggests:

The international development community, including the World Bank, has traditionally treated public sector capacity building as a collateral objective - that is, as a by - product or instrumental measure to advance near - term project outcomes - rather than as a core goal in its own right, along with intended developments on the ground. As a result, capacity building has not developed as a well - defined area of development practice with an established body of knowledge about what works in meeting different needs under different country and sector conditions¹¹³.

Project driven CD leads to lack of strategic coherence in CD, to fragmentation of CD activities, and to a concentration primarily on training through either short courses or thesis research. At the same time there is not a focal point within the CGIAR for investment in CD, as there was when ISNAR existed. Developing such a focal point would appear to be a pre - condition for changing the funding modality for CD in the CGIAR. It is not apparent at this stage whether the CGIAR COP on CD would provide such a focal point, given its decentralized structure and the still limited set of activities which it oversees.

¹¹³World Bank Operations Evaluation Department (2005), op cit. p xiii.

5.2.2 CD and Impact

The SRF argues that partnerships and CD are essential for achieving impact. It also argues that there need to be capacity changes within the CGIAR itself, namely “mainstreaming previously under - resourced areas such as nutrition, data management, information technologies, gender and resilience in research programs; engaging stakeholders and partners in new ways to ensure research leads to development; creating a culture of accountability and results-based management; and developing skills in resource mobilization and partnership building.”¹¹⁴ Building internal capacities and competencies is thus necessary to build them in partner institutions but again this building new capacities is highly constrained by dependence on restricted funding. At the same time the scope of partnerships has broadened significantly, the thrust of CD activities has moved significantly downstream, and there is an emerging trade-off between Centers implementing development projects or building the capacity in national institutions to do so. The latter requires long term investments while the former is usually framed in terms of strict project milestones that depends on existing capacity.

A strategic approach to partnerships in major part defines the CD requirements, particularly on the downstream, innovation side of the R&D spectrum. Impact requires an “ecosystem” of organizations. In market economies such as in Latin America and Asia, the market provides the institutional framework for self-organization of such an ecosystem, as outlined in the following:

The functionality of an AIS rests on increasing connectivity within a widening organizational “matrix” in the agricultural sector. A growing private sector, increasing commoditization, and expanding market opportunities lead to an increasing array of organizations to promote their interests, most often in relation to government policy but also in relation to establishing norms of operation within their respective subsectors. The proliferation of formal seed, chemical, and fertilizer associations, agroprocessing associations, animal feed milling associations, and commodity organizations reflects the higher and more concentrated end of the value chain.... Such an organizational matrix balances competition with cooperation and organized collective action to further the interests of the subsector. Information flows are good. The subsector’s needs are easily articulated, and appropriate institutional linkages and arrangements formulated, usually on a task basis¹¹⁵.

In agrarian economies such as in SSA, such self-organization is not possible given the underdeveloped nature of agricultural markets. Rather these linkages require external facilitation, which is the basis of the CGIAR’s work on innovation platforms in SSA. However, providing a platform for such organizational linkages is only a first step in developing this organizational matrix. The next step returns to institutional capacity requirements and the continued development of efficient and integrated markets. As discussed previously, developing a CD strategy at a systemic level has yet to be

¹¹⁴CGIAR Strategy and Results Framework 2016-2030: *Redefining how CGIAR Does Business until 2030 (2015)*, op cit, p 26.

¹¹⁵Lynam, John (2012). ‘Agricultural research within an agricultural innovation system: Overview’, in *Agricultural Innovation Systems: An Investment Sourcebook*, Washington, DC: The World Bank, p 265.

broached in SSA, which leaves the CGIAR with a question of whether there is a strategic next step beyond innovation platforms.

5.3 *The CGIAR and CD Providers in SSA*

As the discussion of CD within the three impact pathways illustrates, there are few linkages between the CGIAR and principal CD providers in those impact pathways in SSA, or at least from this reviewer's perspective. It can be argued that this is a major missed opportunity to expand the reach of the rather limited CD activities that the CGIAR undertakes in the region. There are obvious reasons for this, particularly the instrumental and fragmented nature of CD embedded within a broad array of R4D projects. If there are no linkages to these initiatives built into projects, then the potential for this multiplicative contribution to CD is lost. This finding in itself suggests the limited contribution that CGIAR CD investments have in meeting the CD needs on the continent. These impact pathways are the core business of the CGIAR in SSA and yet there is little synergy with principal CD initiatives within them, particularly in regards to human capital development.

5.4 *The Potential of CD through Networks*

The CGIAR was one of the first organizations to develop research networks as the means of organizing their research with national institutions in SSA, certainly in the 1980's and 1990's and midway into the new century. As discussed in the genetic improvement impact pathway, networks were a means of both defining a division of labour with NARI's and in building capacity of national programs. The rationale for networks was captured by Prewitt, and applies to CGIAR research networks:

... networks were designed as research environments brought into being because of the failures or limitations of other research settings. This point is important. In many parts of the world, professional networks draw from a strong research and training core located in functioning institutions, primarily universities. In Africa, by contrast, it is the weakness of the core that motivates the establishment of networks¹¹⁶.

CG Centers both provided that core and led to the development of a research architecture that had reach to most countries and could provide materials to national programs based on their existing capacity but with potential for improving that capacity. Research networks were thus central to capacity development of national research programs but within an overall organizational architecture, as again emphasized by Prewitt:

... as a broad generalization, the capacity-building effort in Africa should take as its focus the system of research and learning institutions, and recognize that networks will be integral and increasingly prominent. The challenge confronting donors is therefore not one of factoring networks *per se* into capacity - building, but rather of adopting a systems-oriented strategy toward strengthening research and learning in sub-Saharan Africa¹¹⁷.

¹¹⁶Prewitt, Kenneth ed. (1998). *Research Networks in Sub-Saharan Africa: Success in Capacity-Building and Further Challenges*. New York, NY: Social Science Research Council. P 11-12.

¹¹⁷Prewitt, *ibid*, p 39.

Donors, on whom such networks depend, lost that view of the critical role of research networks, particularly in promoting a change in the function of SRO's. A decade hence and the focus has shifted to capacity in priority countries. There does seem to be some recent shift in some donor priorities toward post-conflict countries, which expands the country coverage. This reviewer would argue for a return to research networks as central to CD in SSA, but that is not a unilateral decision of the CGIAR but by necessity requires consensus among funding agencies. A second best strategy returns to country approaches within the CAADP framework and with a focus on institutions, as discussed in the next section.

5.5 *A Shift from Human Capital to Institutional Strengthening*

Given the shift in donor funding to priority countries, most of which have stronger research capacity - that is, are among the seven “large” countries -, the CGIAR might ask itself how best to accommodate this trend in terms of its CD activities in SSA. The opportunity would suggest how to move from a primary focus on human capital activities to more of a focus on organizational and institutional strengthening in priority countries. Here the difficulty is how to move beyond mandate to organizations themselves, which was the original mandate of ISNAR. Since the closure of ISNAR, the CGIAR has not had the capacity to undertake such a shift in CD focus. The discussion of site integration across the CRP's offers such a possibility but building such a CD focus into site integration is not straightforward, as suggested in the discussion of the policy impact pathway. Nor is it apparent that there would be dedicated funding to pursue such a shift. In the SRF CD is presented as a cross cutting activity and “enhanced institutional capacity of partner research organizations” is identified as a sub-IDO for that activity. However, the task is to go beyond strategy to a more detailed understanding of implementation in building institutional capacity, particularly in a context such as SSA. In particular, this would require building some capacity within the CGIAR in facilitating organizational change and effective research management, again expertise lost with the closing of ISNAR.

5.6 *RinD as Research on CD*

RinD, particularly as is being developed within the production system/NRM impact pathway has CD at a systemic level at its core. How to develop capacities to go to scale at the same time as adapting to local context is central to the system CRP's and the NRM Centers. How to think about a CD research agenda within this larger agenda gets to such issues as what capacities and competencies, what organizational arrangements, and how cost effective are alternative approaches. The task will be to convince development partners that investing in such research within the frame of implementing large scale development programs will yield sufficient returns to outweigh the increased management and field costs, potentially at the loss of effectiveness of the development program. The recent discussions between the CGIAR and multilateral donors, particularly the World Bank, IFAD and the AfDB on how best to bridge the CG's research programs with country agricultural programs will potentially test the RinD approach in terms of how best to achieve impact. This is a System issue for the CGIAR and yet it is not clear that the CRP programmatic framework provides the correct entry point for this type of research. How does the CG think about its own internal organization in undertaking such a research agenda and achieving downstream impact?

Postscript

With a 50 year history in Africa that has coincided with the development of R&D capacity on the continent, the CGIAR is part of the institutional DNA for agricultural research on the continent. In the area of capacity development the CGIAR has several clear areas of comparative advantage compared to other CD providers. However, the very strong training programs of the Centers have closed and at the same time the CD needs of agricultural R&D on the continent have changed. Similarly African institutions themselves have taken ownership of an agricultural development and food security strategy for SSA. This includes new strategic plans for agricultural transformation by AGRA and the African Development Bank, the next phase of CAADP with increased focus on implementation of country investment plans, FARA's Science Agenda for African Agriculture, and an increasingly vibrant private sector and civil society. Yet large CD challenges remain and as argued in this paper the CGIAR could be more strategic in its approaches to providing CD in Africa with the potential for far greater impact in this critical area. The CGIAR is at an inflection point in regards to providing CD in an African context and the question is how does it best organize itself to better improve the capacity of Africa's R&D institutions to achieve this agricultural transformation?