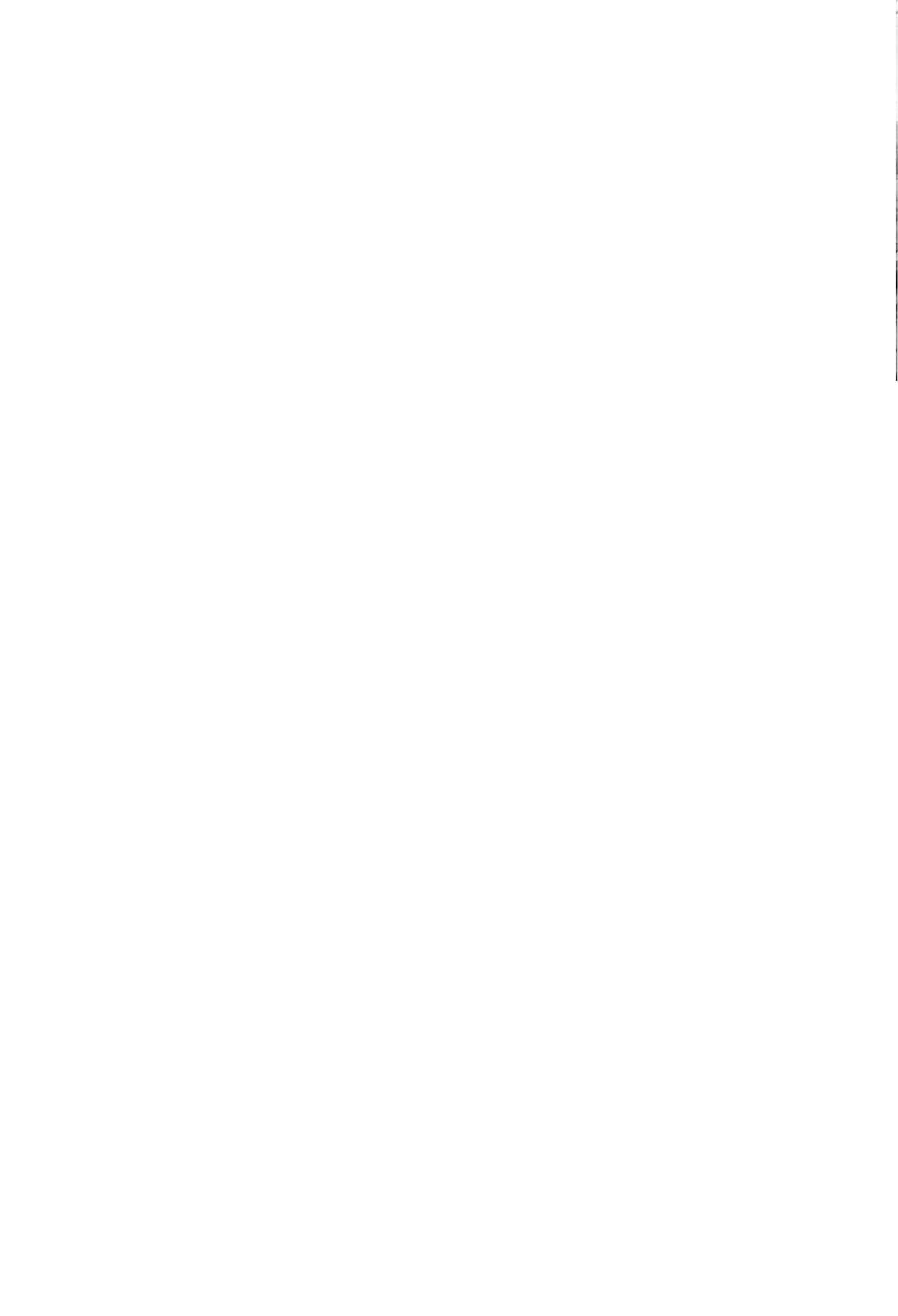
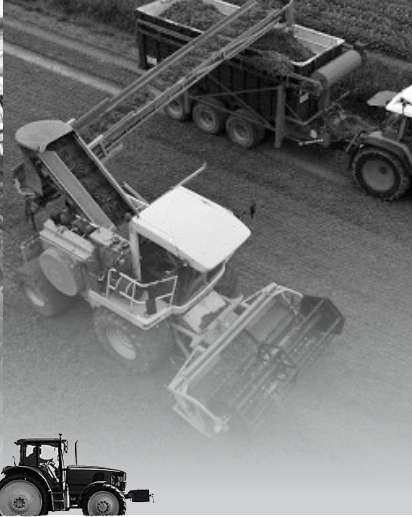


STRATEGIES FOR SCALING AGRICULTURAL TECHNOLOGIES IN AFRICA

■ **AJAYI Tunde**
FATUNBI Oluwole and
AKINBAMIJO Yemi







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BY AJAYI Tunde, FATUNBI Oluwole and AKINBAMIJO Yemi



Citation

Ajayi M.T, Fatunbi AO and Akinbamijo O. O (2018). Strategies for Scaling Agricultural Technologies in Africa. Forum for Agricultural Research in Africa (FARA), Accra Ghana

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ISBN: 978-9988-8776-1-3



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Abbreviations

ADP	Agricultural Development Programme
AEZ	Agro-Ecological Zone
AGRA	Alliance for a Green Revolution in Africa
AfDB	African Development Bank
AIS	Agricultural Innovation System
ARD	Agricultural Research and Development
ASERECA	Association for Strengthening Agricultural Research in East and Central Africa
AU	African Union
CA	Conservation Agriculture
CAADP	Comprehensive Africa Agriculture Development Programme
CBO	Community Based Organisation
CCARDESA	Centre for Coordination of Agricultural Research for Development for Southern Africa
CGIAR	Consultative Group on International Agricultural Research
CIAT	International Centre for Tropical Agriculture
CIMMYT	International Maize and Wheat Improvement Center
CORAF/WECARD	-West and Central African Council for Agricultural Research and Challenge Programme
CP	Challenge Programme
CRST	Cross Site Research Support Team
DFID	Department for International Development
DONATA	Dissemination of new agricultural technology in Africa
DRC	Democratic Republic of Congo
EAC	East African Community
ECOWAS	Economic Community of West African States
EU	European Union
FAO	Food and Agriculture Organisation of the United Nations
FARA	Forum for Agricultural Research in Africa
IAR4D	Integrated Agricultural Research for Development
ICT	Information and Communication Technology
IFAD	International Funds for Agricultural Development
IFPRI	International Food Policy Research Institute
IITA	International Institute for Tropical Agriculture
ILRI	International Livestock Research Institute
IP	Innovation Platform
IPTA	Innovation Platform for Technology Adoption
IS	Innovation System
KALRO	Kenya Agricultural and Livestock Research Organisation
KKM	Kano Katsina Maradi
KTARDA	Katsina State Agricultural and Rural Development Authority
LKPLS	Lake Kivu Pilot Learning Site

MFIs	Micro-finance Institutions
MLL	Maize Legume Livestock IP
NARO	National Agricultural Research Organisation (Uganda)
NARS	National Agricultural Research System
NASRO	Northern Africa Sub Regional Organisation
NGO	Non-Governmental Organisation
NGS	Northern Guinea Savanna
NOGAMU	National Organic Agricultural Movement of Uganda
NRM	Natural Resources Management
OTSP	Orange Fleshed Sweet Potato
PARI	Programme of Accompanying Research for Agricultural Innovation
PLS	Pilot Learning Site
PSTAD	Promotion of Science and Technology for Agricultural Development
R&D	Research and Development
SADC	Southern African Development Community
SRO	Sub Regional Organisation
SSA	Sub Saharan Africa
SSA	CP Sub-Saharan Africa – Challenge Programme
SSA CP	Sub-Saharan Africa Challenge Programme
TAAT	Technology for African Agricultural Transformation
TCS	Target Country Site
TF	Taskforce
TFs	Task Forces
UNBS	Uganda National Bureau of Standards
UNDP	United Nations Development Programme
USAID	United States of America International Development
USDA	United States Department of Agriculture
WAAP	West Africa Agricultural Productivity Programme
WHO	World Health Organisation

Foreword

Advances in Africa agriculture is contingent on the volume of technologies that is available for use in the sector. Apparently, the same condition was responsible for the agricultural transformation and food sufficiency in the advanced world. Every development in the history of mankind is orchestrated by technological revolutions; more specifically when technologies meets up with felt needs and social political will for change. The precarious state of Africa agriculture seems to have attain this threshold of pain more than a decade ago and triggered the action of different organization and pollical structures through the Africa Union Commission. The development of the Comprehensive Africa Agricultural Development Program (CAADP) in 1994. The CAADP ideal proposed a budgetary allocation of 10% at the country level to agricultural sector in order to yield six percent annual growth on the average. A key pillar of the earlier days of CAADP subscription by the countries was the pillar four which stood for actions around technology generation, dissemination and adoption. This was led by the Forum for Agricultural Research in Africa and its stakeholders, FARA thus took the pillar 4 action as its focus for contributing to the transformation of Africa agriculture. The efforts yielded ample attention to technology generations across board, and series of technology testing actions in several pilots. Some of the technologies have potentials and a handful also stood at bay requiring further development to yield the desired outputs.

Despite the efforts into technology generation, introduction, adaptation etc. the agricultural sector development only experiences a slight move and it seems to plateau suggesting that other actions are required to sustain the growth of the sector. A more recent effort at the continental level is the commitment of the head of state in Malabo, to sustain the CAADP momentum. The Malabo declaration came up with various targets including the doubling of the Total factor productivity by 2025 as well as eradicating hunger among others. Attaining these targets will be elusive without a firm commitment to technology generations, dissemination and adoption in a very systematic way. FARA has developed the Science Agenda for Africa Agriculture (S3A) to fast-track the broad contribution of science to deliver technologies and knowledge to ensure the delivery of agricultural growth and transformation. The S3A has four thematic focus and there cross cutting area, this is currently getting grounded at the country level with the expectation of yielding sustainable broad based socioeconomic benefit from the agricultural sector.

In addition to these efforts, the need to bring existing and upcoming technologies to scale has been highlighted broadly by policy makers and development practitioners in Africa. This felt need came along with the mantra that Africa have a lot of technologies on the shelve that are yet to be translated to socio economic benefit for the stakeholders in the sector. Whether this is factual or not, Africa agriculture requires a systematic way of bringing technologies with very high potentials to scale. This book aims to bridge this gap

in knowledge, by reviewing the existing knowledge on scaling technologies and innovation. It provides a comprehensive review of knowledge and systematically propose various strategies to ensure that agricultural technologies are scaled up and scaled out for mega social and economic benefits.

The book contains seven chapters that exhaustively covers the subject matter and make a smart proposition on the plausible pathway to ensure that agricultural technologies delivers a vibrant and economically sustainable agrarian sector.

I wish you a fruitful reading expedition.

Executive Director, FARA

Acknowledgements

The authors wish to acknowledge the efforts and contribution of the different individuals that contributed to the technical review of this book to ascertain its peer review status. We acknowledge the efforts of Dr. Abdulrazak Ibrahim who read through the manuscript, We are also grateful to Mr. Joseph Mugha for undertaking the language editing work on this manuscript.

The studies and documentation endeavor for this book was carried out within the Program of Accompanying Research for Agricultural Innovation (PARI). The PARI project is coordinated at the global level by the Center for Development Studies (ZEF), University of Bonn in Germany and the Forum for Agricultural Research in Africa (FARA) is coordinating the action in 12 Africa countries. The funding for this work was provided by the German Federal Ministry of Economic Cooperation and Development (BMZ).

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Introduction

GLOBAL FOOD PRODUCTION



SHOULD INCREASE BY

80% BY **2050**

TO MEET THE **GROWING**
POPULATION NEEDS

Agricultural technologies have the power to drive economic development and improve food and nutritional security around the globe (USAID, 2014). According to the International Food Policy Research Institute (IFPRI) as cited by Linn (2014), global food production will have to increase up to 80 percent by 2050 in order to meet the growing demand. Furthermore, there are also a number of proven agricultural technologies that are yet to be widely utilised in the developing world.

There has been an assumption in the past that if technologies or practices proved useful to farmers, then technology diffusion would occur naturally through peers (scale-out on its own), family and members or farmer associations. Sometimes good ideas that meet pressing needs spread on their own as they may be ground breaking. They therefore proliferate seamlessly from person to person, organisation to organisation and country to country. However, most good ideas do not spread with such ease. Rather, they require the backing and energies of committed individuals and organisations to design and carry out strategies for expansion that are carefully tailored to the realities of their settings. This is why agricultural researchers and scientists often face the problem of moving beyond testing technologies with farmers on a small scale, to enabling livelihood impacts across larger numbers of households, villages, and districts (Harrington et al., 2001).

In practice, many technologies on the shelf are either not useful in real life or are not reaching enough farmers. Technologies that can truly solve farmers' problems and provide opportunities for productivity growth, improved food safety, and greater farm income may not stay long on the shelf (Lele et al., 2010). However, scaling out does not just happen by itself; it needs to be well planned and facilitated.

Providing improved technologies to smallholders is essential, but their uptake is often limited by the legal, regulatory, policy, and institutional framework. This often restricts the development and distribution of agricultural technologies within countries and across borders. As a result, smallholders are faced with artificial constraints and higher costs that limit their ability to access and invest in existing, proven agricultural technologies (USAID, 2014). Therefore, there is a great need to rapidly scale up agricultural technologies to enhance the scope for increasing production, especially among smallholders, and to reduce rural poverty and hunger (Linn, 2014),

Scaling up the impacts of agricultural research has become the centre of recent debate; the debate is based on the recognition that many relevant technologies and approaches are not achieving their full impact because of low levels of adoption. The first emphasis was to enhance the effectiveness of research to produce adoptable technologies and options. Therefore, reduced financial support to agricultural research and development, and increased pressure from donors, policymakers, and civil society, have compelled researchers and development workers to expand impact and scale up the development process (Harrington et al. 2001).

Scaling out and scaling up of improved agricultural technologies and practices are terms that are increasingly used to describe a desired expansion of beneficial impacts from agricultural research and rural development.

International organisations such as the World Bank, IFAD, WHO and UNDP are among the most prominent proponents of an increased focus on processes of scaling up in order to enhance the impact of development from various technology generation actions (Wigboldus and Leeuwis, 2013). Cooley and Kohl (2006) also indicated that *“the persistence of poverty and preventable illness in low-income countries after 30 years of development efforts has drawn attention to the relatively poor record of pilot and demonstration projects in successfully stimulating systemic change and reaching large populations.”* Linn (2014) asserted that to scale the use of agricultural technologies, governments, aid agencies, foundations, NGOs, and the private sector need to focus on systematic scaling. Systematic scaling explores potential scaling up pathways throughout the programme cycle that can ensure a successful project is not a one-time event, but a stepping stone towards wider and sustainable impact.

USAID (2015) highlighted a few lessons drawn from available literature on scaling technologies, yet wide gaps in knowledge still exist on strategies to bring specific technologies to scale. The reasons adduced for this include the poor availability and access to data on technology scaling, lack of clear strategy and stepwise action for scaling technologies that do not have immediate economic benefits, and limited published research on learning from field activities. Nevertheless, the notion of scaling out and scaling up technologies has provided a convenient way of explaining the desire to achieve a widespread impact from proven technologies after testing them with farmers. Thus, scaling technology will be about the “how” rather than the “what” and therefore there is a need for better documentation of how to do scaling, written down and accessible in public documents. This assertion has justified the documentation of strategies for scaling agricultural technology and innovation in Africa.

Theories of scaling up and scaling out technologies and innovations

A handful of meanings and definitions have been propounded for scaling up and scaling out of technologies and innovation. This is because different definitions and interpretations were adduced to scaling in different disciplines, sectors and walks of life (Wigboldus and Leeuwis, 2013). “Scaling up” is commonly used in literature, while scaling out was only found recently. Menter et al. (2004) noted that there has been much interest in the subject of scaling up in areas of development and natural resource management and to some extent in agricultural research.

SCALING OUT SCALING UP



USAID (2014) defined scaling as the process of distribution and transfer of technologies to new beneficiaries in a given space or into larger geographic areas. The World Bank (2005) described scaling up as expanding, adapting, and sustaining successful policies, programmes or projects in different locations and over time to reach a greater number of people. This is in contrast to the description by IIRR (2000) which explains scaling up as a process or action that brings more quality benefits to people over a wider geographical area, more quickly, more equitably, and in a sustainable version. Simmons et al. (2007) defined scaling up as efforts to increase the impact of technologies that have been successfully tested in pilot or experimental projects to benefit more people and to foster policy and development in a programmatic version.

The definition of IIRI (2000) draws attention to the issues of equity and speed in the delivery of developmental outcomes. These issues are vital in the context of Africa’s agricultural development and are often the focus of non-governmental organisations (NGOs). Nonetheless, Hatmann and Linn (2008) explained that these issues are only relevant where interventions are principally designed to reduce inequities and poverty. They should therefore not be taken as keywords in the definition of scaling but rather treated as relevant issues as the case may require.

The scaling up processes can take many forms and involve a range of activities from a national outreach covering the entire population to a policy reform spurred by successful pilots (UNDP, 2013). This can be in the form of expanding, replicating, adapting and

sustaining successful policies, programmes, or projects in a geographic space and over time to reach a greater number of rural and urban poor. Ubels and Floortje (2016), asserted that most meaningful scaling processes will take substantial time, starting from 5–7 years, but with 10–15 years as a more realistic time frame.

According to Lattimer (2013), scaling up is replicating and expanding pilot approaches, while at the same time transferring longer-term ownership to government counterparts, to ultimately bring positive results for a greater number of people. He indicates that scaling up can happen in terms of expanding the geographic scope of an intervention within a state, bringing in increasing numbers of villages and districts until an initiative is rolled out district-wide; from district-to-district; and ultimately up to the national level.

Multiplier effect and up-stream influence

Pilot interventions can be scaled up by using the evidence from small-scale interventions to advocate for policy and institutional level reforms.

Gundel-Hancock and Anderson (2001), described scaling up in **two dimensions**:

Vertical scaling up, which is the expansion higher up the ladder. It is institutional in nature and involves other sectors and stakeholder groups, from grassroots organisations to policymakers, donors, development institutions and international investors.

Horizontal scaling up, which is the geographical spread and expansion to more people and communities within the same sector or stakeholder group. Others refer to it as a scaling out process across geographical boundaries.

Menter et al. (2004) corroborated the definitions by Gundel-Hancock and Anderson (2001). In their own contribution, they described scaling up as both horizontal and vertical with the former referring to adoption and the latter to institutionalisation. Horizontal scaling up, according to them, is also known as “scaling out”. Thus, they proposed an equation as:

**Horizontal scaling up = scaling out = adoption, and
Vertical scaling up = institutionalisation = decision making at higher levels.**

Menter *et al.* (2004) further distinguished horizontal scaling up, vertical scaling up and institutionalisation as follows:

Horizontal scaling up is a geographical spread to cover more people and communities

- 1 through replication and adaptation, and involves expansion within same sector or stakeholder group. The decision making is at the same social scale. It involves getting institutions to accept and internalise the underlying principles of an innovation so that these will remain as guiding principles of practice even after the initial innovative project or programme has ended. They however pointed out that integrated agricultural research outcomes differ in many respects from the process of disseminating a new variety. This is because these complex research outcomes involve the end users and work with several different components of a complex system; immediate research outcomes may be less applicable for others.
- 2 **Vertical scaling up** refers to expanding an innovation beyond the original participants and objectives. This almost certainly implies an increase in the geographical scale of the unit in which the technology is adapted and applied. However, the key variable is that decisions are being made at a higher level. The sustainability condition within scaling up implies leaving people with the adaptive capacity to deal with problems as they arise.
- 3 **Institutionalisation** occurs when the development of adaptive capacity involving a range of activities, including training, building networks, creating functional, organisational structures, and gaining institutional support have become an internal part of an institution in a sustainable way. This implies not only a change in the way people work, but also a change in the written and unwritten rules of the institution and a change in the way people within that institution think.

As a result, Menter et al. (2004) concluded that scaling up requires adapting knowledge and innovations to end users, be they farmers or institutions, and to variable conditions. They went further to indicate that scaling up requires adaptation of innovations, understanding of underlying principles, capacity building and substantially greater investment.

In a similar vein, Wigboldus and Leeuwis (2013) explained the difference and the connection between scaling up/out and horizontal/vertical scaling as in Table 1.

Table 1: The difference and the connection between scaling up/out and horizontal/vertical scaling

	Scaling out	Scaling up
Horizontal scaling	Multiplication at same scale level (e.g. spreading processes, such as wider adoption of technology or of and institutional arrangement within e.g. same district)	Innovation/development institutional/ technological/...) at same scale level (e.g. from local cooling system to local dairy business hub, or from local regulation to local regulatory framework)
Vertical scaling	Multiplication towards different scale levels (e.g. extension processes or policy adoption of local practice towards country-wide application)	Innovation/development (institutional/technological/....) towards different scale levels (e.g. from local dairy business hub to national fresh-food system, or from local regulatory framework to national policy)

Source: Wigboldus and Leeuwis (2013)

Wigboldus and Leeuwis (2013) also indicated that in actual fact, scaling out refers to quantity while scaling up refers to quality (properties). They also indicated that based on the object of scaling, “scaling out” will mean replication, copy-paste, more of the same, expansion, extension, adoption, dissemination, transfer (of technology), mainstreaming, roll-out, or multiplication” and scaling up will mean “transition, institutionalisation, transformation, integration, incorporation, evolution and development.”

Lobo (1995) as cited by Gundel et al. (2001) points out that the processes of horizontal and vertical scaling up have to be linked in order to make a sustainable impact. He argues that: Up-scaling individual success stories to a larger scale calls for a perspective of macro- management, which at the same time has to be rooted in and be responsive to the micro- level. Unless there is continuous and enabling cooperation between the key sectors and actors, such a process would be bound to get unstuck, thus seriously jeopardising sustainability as well as ability to replicate.

However, IFAD (2010) indicated that scaling up involves two types of possible errors: “type 1 error”, which is too little scaling up; and “type 2 error”, which is scaling up the wrong technologies.

Dimensions of scaling up and out

Scaling up rarely occurs in one dimension only. As programmes scale up quantitatively and functionally, they typically need to scale up politically and organisationally. According to IFAD (2010), scaling up pathways can follow in different “dimensions”: They may simply expand services to more clients in given geographical space. They can also involve “horizontal” replication, from one geographical area to another; “functional” expansion, by adding additional areas of engagement; and “vertical” up-scaling, i.e., moving from a local or provincial engagement to a nation-wide engagement, often involving policy dialogue to help achieve the policy and institutional conditions needed for successful national level scaling up.

Uvin (1995) identified **four different dimensions** of scaling up as quantitative, functional, political, and organisational. He explained them as follows:

- 1 Quantitative scaling up** is the geographical spread to more people and communities within the same sector or functional area. It is also referred to as horizontal scaling up or scaling out. It occurs when a programme expands its size by replication in various places or by increasing its beneficiary base in a given location.

- 2 Functional scaling up** is expansion by increasing the scope of activity. For instance, a programme initially specialised in agricultural development may add nutrition, health, or literacy activities.

- 3 Political scaling up** refers to expansion through efforts to influence the political process and work with other stakeholder groups, with state agencies, parliamentarians and political parties among others. He mentioned that through political scaling up, individual organisations can achieve greater influence, protect their efforts from countervailing political interests and affect political and institutional change that sustains scaled up interventions.

- 4 Organisational (or institutional) scaling up** means the expansion of the organisation implementing the intervention, or the involvement of other existing institutions, or the creation of a new institution. This can involve both horizontal and vertical organisational expansion, the former involving similar institutions while the latter means going up the ladder from community to local to regional to national (and in some cases even supra-national) institutions.

Similar to that of Uvin (1995) a framework for the dimensions and approaches to scaling up was presented by Gundel et al. (2001) as shown in Table 2. This is a demonstration of the different scales on which research projects and outputs have a potential impact that ranges from family level impact to an impact on a national scale or beyond. Secondly, the table also shows how the different processes of scaling up can lead to quantitative or qualitative changes. That is, horizontal scaling up is about involving more people at a certain scale, whereas vertical scaling up is about involving different stakeholders across different scales.

Table 2: Typology of scaling up

Type	Description	Alternative terms
Quantitative scaling up	'growth' or 'expansion' in their basic meaning; increase the number of people involved through replication of activities, interventions and experiences	dissemination, replication, 'scaling out' or 'horizontal scaling up
Functional scaling up	projects and programmes expand the types of activities (e.g. from agricultural types of activities, intervention to health, credit, training	'vertical scaling up'
Political scaling up	projects/programmes service delivery and towards change in structural/institutional changes	'vertical scaling up'
Organisational scaling up	organisations improve effectiveness to allow for growth and through increased financial resources, staff training, networking, ...c	'institutional development'

Source: Gundel et al. (2001)

The various classifications and models discussed have been combined, reorganised, and edited by USAID (2015) to act as an organising strategy for scaling up, in the context of the development of competitive, inclusive, and resilient market systems. This is shown in Table 3

Table 3: Organising framework drawing on multiple scaling up theories

Types of scale up	Intervention areas	Emerging market system strategies
Vertical	Business-enabling environment and policy reform	Facilitate policies that drive behaviour changes needed for technology adoption to facilitate policies that spur demand- and supply-side scaling of agricultural technologies
	Support markets development	Facilitate financial service provision, including by technology providers, to incentivise adoption and scaling; strengthen markets for the servicing and repair of technologies. Work with R&D systems to stimulate local, market-driven processes
	Stakeholder engagement and information flow	Facilitate information flows within market systems that drive technology scaling. Align market actors' incentives to encourage scaling
Horizontal	Commercial distribution and promotion	Focus on the business model as much as on the technology. Buy down the risk of market actors taking on new behaviours to catalyse technology uptake. Employ demand and supply side strategies for effective scale up
	Leveraging champions and networks	Encourage market actors to target "early adopters" to drive adoption and technology improvements. Support clear visions for scaling. Ensure local opinion leaders are adequately informed about technologies. Support market actors in using social networks that engender trust and facilitate information dissemination. Promote professional networks and linkages to diverse market actors
	Strategic partnerships	Promote the inclusion of the local private sector in partnerships for scaling up. Strengthen the capacity of national and local institutions responsible for coordination. Bring partners together to strengthen the service offerings of entrepreneurs

	Appropriate and relevant technology	Build the capacity of technology distributors to understand features that act as drivers for scaling. Facilitate market actor adaptation and localisation strategies. Use piloting and local testing to confirm the potential of a new technology and build local experience and capacity. Use smart subsidies to buy down initial investments in new technologies or technology adaptation
	Extension services and behaviour change strategies	Support extension service delivery through various market system actors. Target underlying behaviours and attitudes that eventually lead to technology adoption
Functional	New emerging needs	Strengthen feedback mechanisms to address emerging needs and spur scale up.

Source: USAID (2015)

However, MSI (2012) indicated that the extension of a pilot project's services or benefits can occur along any of the following five vectors:

- 1 Geographic coverage (extending to new locations)
- 2 Breadth of coverage (extending to more people in currently served categories and localities)
- 3 Depth of services (extending additional services to current clients)
- 4 Client type (extending to new categories of clients)
- 5 Problem definition (extending current methods to new problems)

Institutional approaches and organisational pathway for scaling up technologies

Hatmann and Linn (2008) postulated that appropriate institutional approaches and organisational paths must be chosen depending on the development intervention to be scaled up. This is because according to them, different development interventions have different institutional needs as some may be designed and implemented through top-down approaches while others may be deeply embedded in the local communities and based on the inputs and thrust of the people involved.

They therefore highlighted three types of institutional approaches for scaling up: *hierarchical, individualistic, and relational*. They also highlighted three types of organisational paths: expansion, replication, and spontaneous diffusion.



Hierarchical approach involves top-down, planned programmes and is often driven by strong central leadership. On the other hand, an individualistic approach is seen as one that looks at society as made up of individuals motivated by self-interest. Effective development is therefore largely the result of individuals' actions, mediated in a market place for goods, services, and ideas. Also, an individualistic approach is seen to stress the need for effective incentives and accountability for individual actors.

Finally, a relational approach is seen as viewing societies as a set of networks, social links and informal groupings that aim to promote the accumulation of social capital through decentralisation, participatory methods, and empowerment techniques.

However, Hatmann and Linn (2008) concluded that in practice, elements of each of the three approaches are best combined for successful scaling up as individualistic and relational approaches cannot achieve scale and be sustained without some form of institutional support and well-planned processes.

Regarding organisational paths, expansion is seen to involve scaling up from a pilot within the organisation that developed it, possibly along with organisational reforms, such as decentralisation or restructuring. While 'expansion path' has the advantage of allowing for uniformity of approach, it is believed to be generally limited to cases where a hierarchical approach is feasible. This is because in most other situations, organisational inefficiencies that come with increasing size and lack of adaptation to contextual differences will make

the expansion model problematic. Furthermore, the organisation that invented or tested the pilot may not be interested in or capable of managing the transition to a larger scale (Cooley and Kohl, 2005). In those other situations, replication is suggested to be the better option (Hatmann and Linn, 2008).

To Hatmann and Linn (2008), replication means scaling up by others, not by the organisation that originally developed the initial pilot or model intervention. This assertion was supported by Cooley and Kohl (2005), who pointed out that replication can occur between organisations of the same type, such as NGO to NGO or government to government, or between organisations of different types, such as, NGO to government. Similarly, local and provincial governments as well as NGO and private sector can replicate successful initiatives.

Spontaneous diffusion on the other hand, is seen to involve the spread of good ideas or practices largely of their own accord. It may be so ground breaking, involving such pioneering technology and meeting such pressing needs, that it proliferates seamlessly from person to person, organisation to organisation, and country to country. Hatmann and Linn (2008) indicated that the Green Revolution is an example of successful diffusion of innovation but it requires functioning extension systems; without such systems, agricultural innovations are difficult to spread and unlikely to be adopted.

Hatmann and Linn (2008) also indicated that the drivers for scaling up of intervention are ideas, vision, leadership, external factors and incentives and accountability. They concluded that programmes to be scaled up should include the three key determinants for functioning accountability mechanisms:

I availability and use of information;	II mechanisms for monitoring and performance; and	III the existence of adequate incentives for compliance.
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In addition to having appropriate approaches, paths and drivers for scaling up, Hatmann and Linn (2008) posited that there is need for interventions/innovations to have room to grow. This may involve replacing existing institutions, activities, policies and expenditure, which can affect the scaling up programme. Seven spaces have been found to be relevant to the scaling up of innovation or intervention. These are fiscal spaces, political, policy, organisational capacity, cultural partnership, and learning.

Though research on the cost implications of scaling up has been limited, it has been found that programmes will require more financial resources to meet capital outlays and increased operating and maintenance expenditures. However, fiscal expenditures implications need to be assessed before scaling up is attempted, including a realistic assessment on whether unit costs will increase or drop as innovations expand as lack of funding for the scaling up process and uncertainty of funding may be as much of a constraint as lack of overall financial resources.

There is however, a theory that costs of enlarged programmes may be prohibitive or unsustainable because pilot projects rely on expensive technology, inputs, staff, and advisers or on special provisions of public infrastructure, which could not be replicated on a larger scale (Hatmann and Linn (2008). It is however, suggested that if scaling up efforts are supported by donors, there is a need to address the issue of financial resource sustainability after the donors have withdrawn their support.

Fiscal allocations for scaling up programmes need the support of the political leadership, of elected parliamentary bodies, where they exist, and of a variety of stakeholders. More generally, scaling up requires finding ways to make political space for the programme (Hatmann and Linn, 2008),.

Organisational roles

According to Simmons and Shiffman (2006), **two different organisational** roles are involved in scaling up. These are the role of the “**originating**” organisation that develops and pilots the model, and that of the “**adopting**” organisation, which takes the model to scale. As a result, Cooley and Kohl (2005) have suggested that it would be helpful to use an intermediary institution between the originating and the adopting organisation. This intermediary organisation would be a process facilitator focused on the scaling up process.

One other theory about organisational capacity space is that adopting organisations can be newly set up specifically for the purpose of scaling up an intervention or they can already exist. Creating new institutions often involves lengthy start-up periods, while using existing organisations to adopt new programmes means that they may have to accept significant institutional change to succeed in scaling up. Such changes may be resisted by the managers and staff of the adopting institution if they displace well-known old ways of doing business. At the same time, the leaders and staff of the originating institution may resist handing off the programme, since they feel they “own” the initiative. Public sector and NGO workers alike, whether teachers, health workers or extension agents, may fear losing their jobs when they hand off a programme, or resist new demands on their time and energy when adding a new programme. Competing bureaucracies or civil society organisations may act as rivals rather than collaborators, undermining the scaling up process by fragmenting it institutionally, rather than creating synergies through bundling efforts.

There is no clear guidance from the literature on whether to go with new or existing institutions in scaling up. While some authors advocate building on past experience and utilising existing institutions, others emphasise the need to draw on or create new institutions in the scaling up process, as those involved in the original pilot phase may be unwilling to adjust and carry out required changes (Hatmann and Linn, 2008).

However, most scaling up discussions assume that the originating organisation is also the organisation that does the work needed to transfer the model or to take the model to scale. Experience and theory both suggest, however, that many of the tasks involved in successfully transferring or expanding a model can be best done by or with the assistance of a neutral third party or intermediary organisation specifically charged with assisting in the scaling up process. The tasks these organisations perform can include conducting visioning and planning exercises, project evaluation and process documentation, political mapping and stakeholder assessments, coalition building, convening, design and conduct of advocacy campaigns, and fundraising. In the case of collaborative strategies for scaling up, intermediary organisations can also be essential in designing and forming innovative partnerships. In strategies that depend on expansion or replication, they often play necessary roles in assessing and strengthening the internal capacities required of originating and adopting organisations (Management Systems International (MSI), 2012).

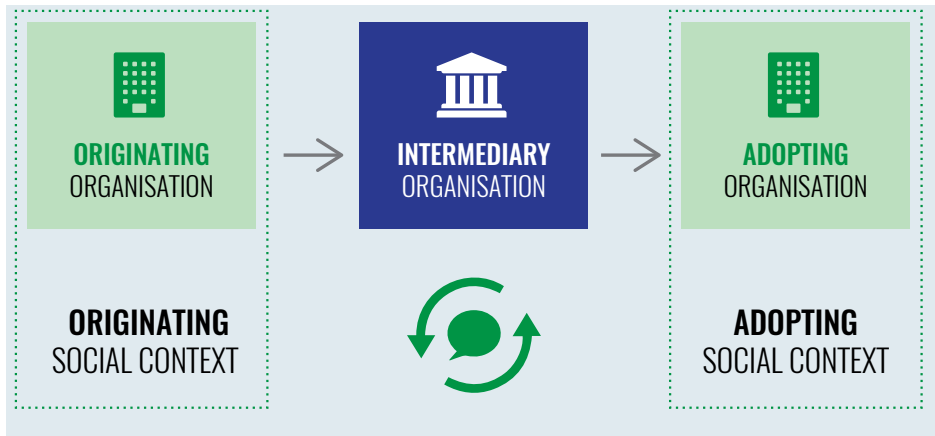
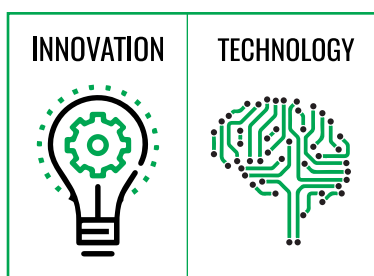


Figure 1: Organisational role in scaling up. Source: MSI (2012)

Characterisation of technologies and innovation for scaling

Meaning and definitions of technology and innovation

There are many different terms that are often used interchangeably especially about innovation, technology, good practices and invention. Many authors have also given different meanings to innovation and technology



Lattimer (2013), defined innovation as a new approach that has not been tried or tested elsewhere, that can generate learning for the stakeholders involved, and that has strong potential to be scaled up to bring positive results for the people. The term innovation is often used to refer to the use of new technology in development. Adekunle et al. (2010) defined an innovation in agriculture as the process of ensuring that a new product or knowledge is converted to use and it leads to social and economic benefit. Fatunbi et al. (2016), further described innovation as a product of application of new knowledge and or a combination of new and existing knowledge for economic gain. Their definition projected innovation as a product of the use of either knowledge, technologies or invention in a way that it yields socio- or economic benefit to the different stakeholders. Apparently, the translation of the research products viz., knowledge, technology and inventions to measurable developmental outcomes and impact does not happen in a vacuum. Rather, it happens when the research products are streamed in with complimentary institutional and infrastructural arrangements that enhance the delivery of benefits. Thus, in the agricultural innovation systems parlance, an innovation is more technically knitted to benefits from research product than a mere description of something new.

As regards technology, Lattimer (2013) sees good practice/technology as an intervention or approach that has been tried and tested elsewhere either within a country or in other countries and that can be built upon and/or adapted. FARA (2015) however, sees technology as the outcomes of the modulation of science that could bring about positive change to agricultural practices and systems in continuous and sustainable ways with resultant



increase in productivity. USAID (2011) defines technology broadly to include improved agricultural practices, crop varieties, inputs and associated products such as crop insurance. In technical terms, technology derives its definition from knowledge, where knowledge is defined as a set of concepts, meanings, skills, and routine developed over time by individuals or groups as they process information. Thus, “technology is defined as the sum of knowledge derived from received information, which allows a thing to be done; technology is a flow of new knowledge” (Fatunbi et al., 2015).

Millar and Connell (2010) also classified proven technologies as those ones that have gone through trials with farmers and are found to benefit them.

A school of thought also sees technologies as a vital component of the innovation process and feels that it should not be considered as innovation because innovation is considered as knowledge, technologies and inventions that have been used and it has resulted into socio-economic benefits. Technologies need to be accompanied with other institutional environment for it to yield its outputs and benefits. Connell et al. (2004) and Fatunbi et al. (2016) supported the view that improved technologies derived from research require some degree of adaptation to be integrated into local farming systems. Indeed, new production systems are always needed before technologies can affect livelihoods.

Surbhi (2016) postulated that “that nothing is permanent in this world, neither products nor technology, day by day, improvements and updates are made in technology, leading to new inventions and innovations in every sphere of life.” Thus, he defined invention as the act of creating, designing or discovering a device, method, process, that has not existed before. In finer terms, it is a novel scientific idea conceived through research and experimentation that turns into a tangible object. It can be a new process of producing a product or may be an improvement upon a product or a new product. Inventions can be patented, as they provide security to the inventor for intellectual property rights, and also identifies them as actual inventions. Furthermore, different countries have different rules for obtaining a patent and the process is also costly. To be patented, an invention must be novel, have value and be non-obvious.

On innovation, Surbhi (2016) reported ‘innovation’ as the transformation of an idea into reality. In the purest sense, innovation can be described as a change that adds value to the products or services; that fulfills the needs of the customers. It is when something new and effective is introduced to the market that fulfills the needs of the customers by delivering better products and services. Innovation can be an introduction or development of new product, process, technology, service or improving/redesigning the existing ones

that provide solutions to the current market requirements. All the processes that help in the generation of the new idea and translating it into the products demanded by the customers are covered under innovation. This definition further confirms that technology is a vital component of the innovation process.

Surbhi gave the significant differences between **invention** and **innovation** as follows:

- 1** The occurrence of an idea for a product or process that has never been made before is called the invention. The implementation of the idea for product or process for the very first time is called innovation.
- 2** The invention is related to the creation of a new product. On the other hand, innovation means adding value or making a change in the existing product.
- 3** The invention is coming up with a fresh idea and how it works in theory. As opposed to innovation, it is all about practical implementation of the new idea.
- 4** The invention requires scientific skills, unlike innovation, which requires a broad set of marketing, technical and strategic skills.
- 5** The invention occurs when a new idea strikes a scientist. Conversely, innovation arises when a need is realised for a new product or improvisation in the existing product.
- 6** The invention is concerned with a single product or process. As against this, innovation focuses on the combination of various products and services.
- 7** While the invention is limited to the Research and Development Department of the organization, innovation is spread all over the organisation.

He then concluded that innovation is not the same thing as invention, as these are two different concepts. One significant difference between invention and innovation is, an idea when proved workable, it is called an invention. On the other hand, an innovation is when the idea is not only proved workable but also requires to be economically feasible and fulfill a specific need.

One other terminology that is common with technology and innovation is piloting. Piloting is the testing of an approach on a limited scale for a pre-defined period to assess and document the results of an intervention and its potential for future replication on a larger scale (Lattimer, 2013).

Types of technologies

is considered to be a complex blend of materials, processes, and knowledge. According to USAID (2014), there are two main categories of technology: material technology that takes the form of a physical product (i.e. agricultural tools, improved plant varieties, agrochemicals) and knowledge-based technology such as technical knowledge, farm management skills, and other processes that assist farmers' production (i.e. soil and water management practices).

AGRICULTURAL TECHNOLOGY



HARDWARE



SOFTWARE



ORGWARE

However, according to Christiansen et al. (2011) and UNFCCC (2014), technologies are often classified into three types: hardware, software, and orgware. In considering adaptation, it is important to understand the differences between these technology types, as well as their synergies and complementarities. Hard technologies, or hardware, refer to physical tools; soft technologies, or software, refer to the processes, knowledge and skills required using the technology; and organisational technologies or orgware, refers to the ownership and institutional arrangements pertaining to a technology (Christiansen et al., 2011, UNFCCC, 2014). In the agricultural context, hardware is exemplified by different crop varieties, software by farming practices or research on new farming varieties, and orgware, by local institutions that support the use of agricultural adaptation technologies.

Two other important types of technology and innovation are the Bottom-up (farmers generated) and Top-down (conventional researcher generated) Technologies and innovations.

Bottom-up (farmer-generated technologies/innovation)

Wu and Zhuang (2013) define farmer innovation as any technology, invention or improvement made by rural people to cope with the complexity of local resource, ecological, economic and social conditions. This is sometimes referred to as Small-Scale Farmers (SSF) innovation/technology

Under the definition of bottom-up approach are identified those interventions that originate from the users, from the citizens themselves, that take possession (sometimes also independently) and modify spaces giving them new quality and function that might be agricultural or social and enhancing participation and social inclusion (Casazza and Pianigiani, 2016).

The body of literature emphasises farmers' immense capacity to innovate. This is because farmers are active, understand the impacts of their own practices, and are both sources and users of knowledge and information in agriculture (Engel, 1997). According to Hounkonnou et al. (2012), farmers are knowledgeable, skilled, motivated and empowered to develop technologies suited to their circumstances and farming objectives. The main actors in SSF innovation systems are farmers themselves, including informal networks among farmers, grassroots farmers' organisations and cooperatives.

Fundamental to the concept is that farmers have the capacity to innovate, experiment and adapt, and are viewed primarily as innovators themselves rather than implementers of innovation. Farmers' innovation systems are recognised as fundamentally unique from formal sector innovation systems. However, some authors have seen small-scale farmers' innovation systems to be synonymous with farmer-led innovation systems (Wettasinha et al. 2014), local innovation systems (Sanginga, 2009), micro-level innovation (Läpple et al., 2015) and grassroots or bottom-up innovation systems (Seyfang and Smith, 2007, Smith et al., 2014) among others.

According to Sanginga (2009), the SSF innovation systems perspective represents a merger between Agricultural Innovation System (AIS) and development studies. SSF innovation systems are understood as social phenomena in which individuals and communities in a specific locality share and adapt local knowledge, integrate scientific knowledge, and develop better ways of managing resources and overcoming local challenges.

Farmers are innovators and experimenters and not just adopters of introduced technologies. The innovations developed by farmers could complement the highly promoted externally driven technologies in addressing the numerous challenges facing agriculture.

Despite the importance of innovations and technologies generated by farmers, relatively little attention has been given to farmers' capacities to experiment and adapt to meet their own needs (Waters-Bayer et al., 2009). However, Wettasinha et al. (2014) indicated that SSF

innovation remains largely unrecognised by academics for two reasons. First, farmers do not attach their names to innovations or apply for patents, write scientific papers on their discoveries or otherwise document their work (Rhoades, 1989). Not all SSFs are innovators and there are degrees of participation and involvement of SSFs in local innovation processes. Scholars have debated the extent to which SSF innovation systems should be supported for scaling up and diffusing outputs. Liniger et al. (2011), suggest that local knowledge and practices should be documented in a standardised and accessible way so that lessons can be shared across the world.

According to Waters-Bayer et al. (2009), events that facilitate exposure to local innovations such as farmer innovation fairs, workshops, agricultural exhibitions, and conferences may encourage SSF innovation by increasing their exposure. Farmer innovation fairs, for example, bring together farming communities with policy makers and government representatives, formal research institutions, academia, NGOs, and private sector stakeholders to learn about farmer innovation processes and identify areas for future collaboration.

These types of events provide legitimacy to SSF innovation, present opportunities for public recognition and publication in academic journals, and defend the intellectual property of farmer innovators by putting innovation into the public domain. Publication of innovations in catalogues and radio may also be beneficial, particularly if farmers receive support in documenting their own innovations (Wettasinha et al., 2006). In conjunction with these farmers' awareness campaigns, product supply chains must be streamlined toward "last mile" agro-dealers and needed products displayed alongside extension advisory materials.

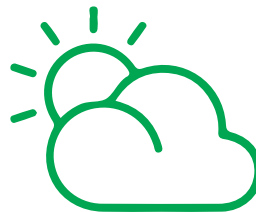
According to QUNO (2015), SSF innovation systems are both a resource for responding to new opportunities and a coping mechanism for responding to the challenges faced by vulnerable populations in the absence of outside support. As such it is believed that the issue of SSF needs to be brought to the forefront of discussions regarding sustainable agriculture, poverty alleviation and global food security.

Whatever the way scholars must have assessed farmers' innovations, they have their own value. According to Tambo and Wünscher (2014), farmers are innovators and experimenters and not just adopters of introduced technologies. The innovations developed by farmers could complement the highly promoted externally driven technologies in addressing the numerous challenges facing agriculture. To support the view that farmers are innovators, Tambo and Wünscher (2014) identified up to 29 promising innovations in northern Ghana alone in addition to 19 innovations scouted through a household survey out of which six were most highly ranked innovations. These are presented in Box 1. There may be many of such in different countries of Africa, to which attention has not been paid.

Similarly, the study by ActionAid (2014) in Tanzania shows that farmers innovate by developing their own climate-smart agricultural practices that could be recommended for scaling. Examples are smallholder farmers' climate change adaptation practices presented in Box 1.

BOX 1 Technologies/innovations generated by farmers

- 1 Suppression of striga using onion residues, which is an innovation of a 33-year-old farmer
- 2 Reduction of mortality of Guinea keets using ethnoveterinary medicine, which is an innovation of a 76-year-old livestock and poultry farmer
- 3 *Sida acuta* in a semi-intensive system to protect birds from hawks, which is an innovation of a poultry farmer
- 4 Storage of onion seed and treatment of livestock wounds using Barakuk, which is an innovation of a 56-year-old farmer.
- 5 Integrated aquaculture–agriculture, which is an innovation of a 55-year-old farmer.
- 6 Multiplication of sweet potato vine under artificial shade, which is an innovation of a 46-year-old farmer.



Farmers' climate change adaptation practices:

- change in crop varieties,
- change in planting days,
- crop and livestock diversification
- erosion control

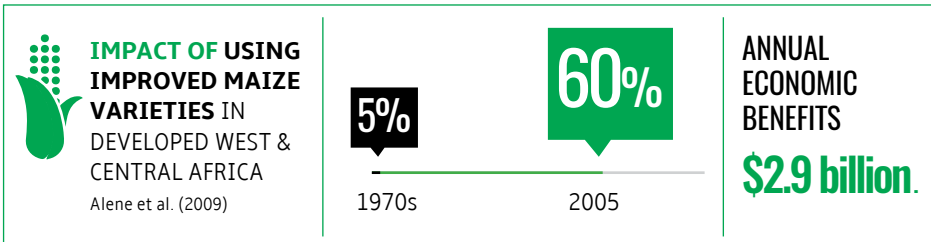
ZEF research reports presentations (unpublished)

These results provided further proof that smallholder farmers do develop diverse and spectacular innovations to address the myriad challenges they face, and these need to be recognised and promoted.

With the interest shown by many initiatives in the innovations generated by farmers, it is imperative to recognise innovative behaviour of farmers, design opportunities for them to innovate and strengthen their innovative capacity. Scaling of these technologies will no doubt reduce hunger and poverty in the farming communities. However, before scaling can be done, farmers' innovation will have to go into a pilot phase for testing and validation. A process for identification of the farmers innovation is vital and should be followed by the characterisation of the technology, testing, refinement and repackaging for scaling.

Top-down (conventional researcher generated) technologies

Top down approaches are typically research-led and often start with the formulation of visions of future production systems. Much research has been done on top-down approaches. This basically involves knowledge generation by scientists, transfer by extension, and adoption by farmers. The apparently weak role for the knowledge-producing organisations in supporting farmers suggests that universities and research institutes are 'still stuck' in what Gibbons et al. (1994) called 'mode one science'. The characteristics of mode one science suited the transfer of technology (ToT) models, in which research was conducted by the universities and research institutes and the findings were passed on to extension agents for onward transmission to farmers for adoption.



An overview of agricultural research and what was achieved from 1990 to 2010 shows that many of researchers' technologies have been developed in Africa. Many of these technologies have been developed by the CGIAR and their National Agricultural Research Systems (NARS) partners. According to Alene et al. (2009), improved maize varieties were developed in West and Central Africa; the varieties increased adoption from under 5 percent percent in the 1970s to about 60 percent percent in 2005 and with annual economic benefits estimated at \$2.9 billion. Similarly, improved varieties of cowpea, which provide both human food and livestock feed, are being widely adopted in the dry savannah of West Africa.

Eastern and Southern Africa have also registered impressive gains, where improved varieties of common bean, developed with farmer participation, have been adopted on about 50 percent of the total bean area over 15 years (CGIAR, 2011). New Rice for Africa, or NERICA, which combines the high yields of Asian rice with African rice's resistance to local pests and diseases, has spread to about 250,000 hectares in upland areas. This has helped to reduce national rice import bills and generate higher incomes in rural communities (Seck et al., 2013).

Recent research has also begun to document nutritional benefits from improved crop varieties. In Mozambique, the introduction of new orange-fleshed sweet potato significantly increased the intake of vitamin A among young children (Low et al., 2007). According to Herforth (2010) in Kenya, Farm Concern International undertook work targeting women on commercialisation of traditional leafy vegetables. The intervention was later shown to be

effective in increasing consumption of the micronutrient-rich vegetables. Singh (2012) also indicated that millet had been found to be very beneficial because of its high content of the minerals phosphorus, manganese, and magnesium.

The benefits of the researchers' technologies reported suggest that the major difference between the top-down and bottom-up technologies is that in contrast to most of the bottom-up technologies that have not been piloted or proven, most of the top-down technologies have been tested on-farm and proven and are ready for scaling.

Technology characterisation based on impact

Literature also indicates other types of classification of technologies. For example, Jack (2013) indicated that agricultural technologies are categorised by the impact of their use as follows:

- 1 Higher yield technologies, such as improved varieties of seeds;
- 2 Lower risk technologies, such as weather insurance, and drought resistant crops;
- 3 Better quality products, such as storage technologies;
- 4 Cost reduction technologies, such as animal-driven ploughing, and nitrogen fixing crops; and
- 5 Reduced externalities, such as no-till agriculture, and terracing.

<p>Similarly, USAID's Bureau for Food Security and USDA have categorised technologies as follows:</p>	<ol style="list-style-type: none"> 1 ICT and insurance 2 Post-harvest losses 3 Cereals 4 Sustainable intensification 5 Vegetables, fruits, roots and tubers 6 Livestock and aquaculture 7 Legumes
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Characterisation based on scalability of the technology

Scalability is an important quality characteristic for technologies and innovation. Hatmann and Linn (2008) indicated that not all innovations can be scaled up. Technologies do have certain characteristics that define the scope of scalability.

- 1 Technologies are often location specific; Accordingly, location-specific variables such as climate, topography, and soil type define them. These variables are given consideration during the technology generation process to ensure that the technology meets the specific needs for which it is intended. This does not preclude the possibility of having technologies that could perform well across a wide range of locations and conditions. To pitch technology up for scaling, it is essential to characterise such technology and define its scope and relevance.

2 Social and cultural delineations also affect technologies; certain technologies may not be socially acceptable in some locations due to socio-cultural and religious factors. Their scalability will therefore be limited to cultures where the content of such technologies are acceptable. According to Wigboldus and Leeuwis (2013), in Agricultural Research for Development (AR4D), natural scaling processes are connected to social scaling processes. This is because an agricultural practice may be deemed scalable because of its natural properties (for example, removing virus-infected leaves from sweet potato plants is something that could be done in many places), but because of cultural preferences, it may still not go to scale.

3 Technology does not deliver good benefits alone but in a group of complementary technologies and other well-aligned institutional conditions. This is vital to the scaling potential of such technologies. It is necessary to consider technology packages with the notion of scaling; part of the packaging should also include complimentary issues such as institutional arrangements, trainings, input delivery, and output market that enhance the delivery of outputs from such technology. According to Cooley and Kohl (2005), scaling up should only take place after the model/pilot conducted on a limited scale has been evaluated and found to be effective and efficient, and after adapting and, where appropriate, simplifying the model to focus on those aspects critical to its successful scaling up.

However, Cooley and Kohl (2006) identified the following variables in relation to scalability mainly in terms of scaling out of technologies. The technologies must be:

- 1 Credible, based on sound evidence or espoused by respected persons or institutions
- 2 Observable, to ensure that potential users can see the result in practice;
- 3 Relevance, for addressing persistent or sharply felt problems
- 4 Having a relative advantage over existing practices
- 5 Easy to transfer and adopt
- 6 Compatible with existing users' established values, norms and facilities; and
- 7 Able to be tested and tried without committing to the potential user the complete adoption when the results have not been seen.

To enhance the scalability of a technology, WHO (2010) highlighted the factors that are needed; the technology should have:

- * credibility (if the innovation has sound evidence or proven advocates);
- * relevance (if the innovation adequately addresses problems at hand);
- * advantage (if the innovation has a positive edge over other alternatives);
- * appropriate (if the innovation fits the needs and context of the user); and
- * capacity (if the user organisation has a perceived need for the technology, the motivation to advocate for its introduction, and has prioritised capacity-building. User demonstrations or pilot testing are helpful in creating this condition.)

Characterisation based on utility and appropriateness of technologies for scaling

In assessing the utility and appropriateness of an agricultural technology for farmers and other actors along the value chain, it is important to consider multiple interlinked factors (USAID, 2011). According to USAID (2011), appropriate technology adoption is defined to mean the take-up and use of a technology in a way that proves utility enhancing, profitable, and/or welfare increasing for farmers and others along the agriculture value chain. These include the potential for risk exposure, the availability of complementary inputs, and the reliability of delivery institutions. The decision to introduce or promote a new technology should out-weigh the potential pitfalls such as increased risk to farmers or environmental degradation alongside the magnitude of potential benefits.

As a result of these attributes, USAID (2011) designed the Agricultural Technology Assessment Tool, which is designed as a framework for assessing the potential scalability of an agricultural technology and to facilitate decision-making discussions by NGOs, donors, governments, technology developers and other stakeholders. The tool is broken into three sections as follows:

1 Problem identification

This helps to identify the problem that the technology seeks to address and to identify alternative solutions. What problem is the technology intended to address? On what evidence is the definition of the problem based? What are alternative or competing technologies (or non-technological approaches) for addressing this problem? Where did the idea for the proposed technology come from? What evidence is there on what has worked/failed in addressing similar problems?

2 Magnitude and certainty of benefits

This offers a rubric for estimating the magnitude and certainty of a technology's benefits to smallholder farmers, their communities, and to other actors in the agricultural value chain.

What is the magnitude of the technology's benefits for small-holder farmers?

The benefits for each technology will be different; a technology might reduce yield variability, increase yields, or reduce labour costs, for example. There are trade-offs between benefits and costs, but one should begin by identifying and listing the types of benefits and their magnitudes.

How certain is the estimate of magnitude? Is there high-quality evidence to support that prediction?

Consider whether this technology is new or has been adopted elsewhere. If a technology in the latter category, has a rigorous impact assessment carried out to measure not only changes in yield/output, but also changes in household welfare (such as in nutrition or consumption), how extensively has the technology been adopted elsewhere? What is the take-up rate? Who are the main adopters in these settings? How do these settings differ from the proposed context?

Table 4: Measuring the magnitude of technology potential benefit

		Magnitude of the potential benefits		
		Low	Medium	High
Certainty about the magnitude	Low			
	Medium			
	High			

Source: USAID (2011)

3 Pitfalls of scaling up

This provides a framework of potential pitfalls to consider. Each type of potential pitfall is accompanied by a series of questions intended to stimulate discussion. Not all questions are relevant to all settings, and many relevant questions are omitted, so those included should be used to start the conversation, not as an exhaustive list.

The listing in a to k below shows potential barriers to the appropriate (i.e. profitable or utility enhancing) adoption of a new technology. For the technology under consideration, please explain how appropriate adoption might be affected by each of the barriers listed. How problematic is each barrier likely to be in the proposed context (magnitude of problem)? Is there any evidence to support this prediction (certainty of failure)? For each potential pitfall, describe and discuss how it applies to the setting and technology under consideration.

A Does this technology increase the amount of risk that farmers or other actors in the agricultural value chain face?

Are yields, sales or profits highly variable? Is the risk known and understood by users of the technology? Are benefits from the technology dependent on unreliable or uncertain access to other inputs or complementary technologies? Will profits become more dependent on output prices?

B Does this technology require any other inputs, systems, institutions, or supporting markets?

Are credit, insurance or other financial services required? Does it require complementary inputs like irrigation or fertiliser? Are seed sources or other supply chains reliable? Does it require post-harvest processing, additional labour, or linkage to new markets? Is the technology distributed by agricultural extension workers? Is contract enforcement or other supporting legal or political institutions required for scale up?

C Does the use of this technology require any information or training?

Will diffusion and scale-up of the technology require knowledgeable trainers or marketers? If this is a new technology, how is information made available? Is there a need for training for users? Who will need to maintain or fix the technology? Do men and women have equal access to information about the technology?

D Are there social or cultural constraints to adoption of this technology, or its product?

Is there low willingness to pay for the technology or its outcomes? Are there cultural preferences (i.e. food flavour or appearance) that could cause failure to adopt? Is there community sanctioning of certain activities associated with the technology or its adoption (e.g. gender constraints)? Are there local traditions that might inhibit adoption? Are there power dynamics within the household or community that would affect adoption?

E Are profits, benefits or yields shared among many people?

Do some benefits (or costs) accrue beyond the direct user? Do some benefits (or costs) accrue to society at large? Do benefits (or costs) accrue preferentially for women or men?

F Are yields and profits distributed across time?

Are some benefits delayed into the future? Do additional costs come before benefits are realised? If so, is the technology accompanied by sufficient short run incentives to encourage adoption? Will the technology deliver profits in the short and long term?

G Will geographical constraints or a need for targeting make distribution difficult?

Are communities too sparsely settled for efficient distribution of the technology (or associated marketing information)? Will the product require targeting to certain groups? Is it only appropriate for some types of users, and not others? Is there demand from only certain types of users, such as farmers with very small or very large landholdings?

H Does the purchase or use of this technology have any negative spillover effects?

Does the technology cause environmental degradation? Does it displace other important (economic or household) activities? Does it displace other purchases? Will introduction of the technology cause rapid changes in other market prices? Are there negative health consequences?

- I Are local microclimates or agro-ecological zones appropriate for this innovation?**
Is the technology designed or adapted for different rainfall patterns or soil types? Is it vulnerable to local pests and diseases? Is high quality evidence available on the agro-ecological appropriateness of the technology? How adaptable is the technology to variations in microclimates?
- J Does this technology require cooperation among groups of farmers or households?**
Does the technology generate unequal benefits among group members? If a cooperative or other collective institution is required, is there risk that resources or decision-making will be “captured” by community elites? Is there a risk that some group-members will “free ride”?
- K Is this technology sustainable?**
What is the long-term growth opportunity? Does this technology help a dying market or a declining crop? Is the technology accessible/affordable for farmers? Does the technology require long-term support from the public sector (NGOs, donors, governments)?

In using this tool, one should be able to roughly estimate the probability of appropriate technology adoption and the scalability of the technology, given existing knowledge of potential benefits and failures.

Factors to consider for successful scaling of technologies

Many successful scaling up project case studies have been reported in literature and factors responsible for successful scaling of technologies and innovation were outlined from these successful projects. Many of the factors from authors overlap but most of the factors are mentioned here.

Scaling up needs leadership, vision, and values

Hatmann and Linn (2008), reported that scaling up requires extensive political and organisational leadership, vision, and values. If leaders do not drive the process of scaling up with a clear vision, if institutions do not embody a clear set of values that empower managers and staff to continuously challenge themselves to scale up, and if individuals within institutions are not offered the incentives to push themselves and others to scale up successful interventions, then the current pattern of pervasive “short-termism” and fragmentation of effort will continue to characterise national policies and programmes as well as policies and approaches of donors. No scaling up manual, no check list, and no compilation of case studies will make a lasting difference. The view of Hatmann and Linn was supported by USAID (2014) that the key ingredients for successful scaling up include the vision of the ultimate scale at which the technology will be judged to be successful.

There is need for credible and proven technology

For a technology to be adjudged scalable, the following characteristics are essential (WHO, 2010)

- * Credibility (if the innovation has sound evidence or proven advocates)
- * Relevancy (if the innovation adequately addresses problems at hand)
- * Advantage (if the innovation is advantageous over other alternatives)
- * Appropriateness (if the innovation fits the needs and context of the user)

For successful adoption to occur, there is need to prioritise simplicity in implementation. In other words, implementation or use of the technology or innovation should be as simple as possible. This calls for a thorough validation process before releasing a technology or innovation for scaling up.

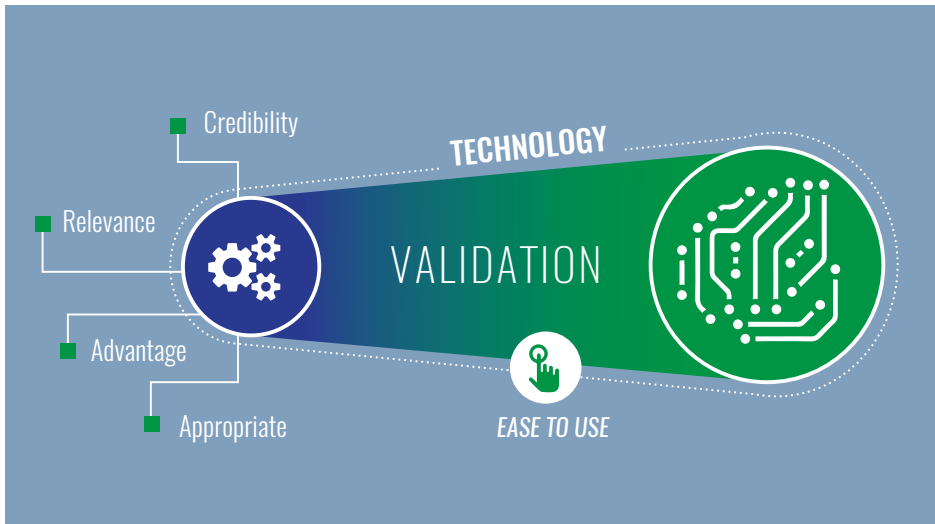


Figure 2. Appropriate characteristics for scalable technologies

There is need for scaling pathways

In general, there are many possible pathways for scaling up a successful intervention. IFAD (2010), defined “pathway” as an understanding of the sequence of steps that need to be taken in the innovation learning-scaling up cycle to assure that a successful pilot is taken from its experimental stage through subsequent stages to the scale ultimately judged to be appropriate for the desired level of impact. To achieve vision, key actors must explore and implement scaling up pathways that involve bringing a known technology to farmers, testing introduction at the local level, evaluating the impact and process of adoption and, based on the lessons learned, pushing forward with replication and adaptation (USAID, 2014). Cooley and Kohl (2005) emphasised the critical importance of the pathway for scaling up more than the technology or innovation itself. He pointed out specifically that “getting the pathway right” is determining what makes people adopt a new product, process, practice, or service.

There is need for effective partnerships

Many authors have laid emphasis on effective partnership as a major factor for successful scaling of technologies and innovation. This is because there is need for a coordination platform for strategic collaboration between key stakeholders. According to Jonasova and Cooke (2012), key partners in scaling up must always be mobilised and brought on board. Partnerships are essential, especially for reaching out to end users. Partnership has been found to play a major role in scaling up of intervention because it is important to determine whether domestic or external partners will continue or step up to support the programme. In most successful scaling up initiatives, partners were a key factor in helping to keep the momentum and focus (Mansuri and Rao, 2004).

There is need for an enabling environment

Almost all the authors on scaling have mentioned the enabling environment as an important factor in scaling. This means creating the space (i.e., fostering the right conditions) for scaling up, which may include building effective extension systems; policy reform; expanding access to credit and financing; conserving natural resources; accounting for social, cultural and political realities on the ground; and building local cooperation and partnerships.

In support of an enabling factor, Jonasova and Cooke (2012) indicated that scaling initiatives requires enabling environments to grow. These are summarised as follows:

Policy

Literature has shown that innovations and programmes to be scaled up must have policy, regulatory and legal framework support. Policy issues typically cause obstacles to scaling up initiatives, in particular in areas of value chain development. Policies such as price regulation, burdensome regulatory requirements, subsidies directed to selected market actors, or monopolies in processing or trading can act as disincentives. The policy and legal frameworks in the countries of focus must be adopted to support scaling up activities. Similarly, Hatmann and Linn (2008) indicated that the policy framework, laws, regulations and norms have to be supportive if the scaling up process is to succeed. At the same time, most policy reforms need to be underpinned by programmes and projects that lead to the effective implementation of the policy regime if it is to achieve its intended consequences. According to USAID (2014), scaling up productive technologies can be severely constrained or rapidly advanced by the policy environment. Policy consists of laws, treaties, regulations, statements, administrative actions and funding priorities. Policy approaches, implementation processes and activities that guide government actions and enforcement do influence scaling activities. Policy comprises the rules of the game that establish who can do what and subject to what conditions. Among those policies that can constrain or advance the scaling of technology, are policies related to: inputs (seed, fertiliser, veterinary medicine, equipment, etc.), regulations regarding food safety and product quality, output markets and trade.

Markets

When trying to scale up agricultural products, potential market constraints need to be considered and addressed to avoid negative price effects. IIRR (2000) indicated that market development (access and viability) is essential for scaling up.

Institutional capacities

Institutional and organisational capacities must be up to the task, and the staff must have the requisite skills.

Culture and gender

It has also been found that cultural space is important to determine whether the scaled-up programme will fit culturally but this is particularly important for participatory programmes and for programmes that deliver culturally sensitive services (education, health, family planning). Potential cultural or gender obstacles should always be identified and adaptations made to allow scaling up. Possible cultural obstacles or support mechanisms need to be identified and the intervention suitably adapted to permit scaling up in a culturally diverse environment (USAID, 2014).

Scaling up needs political constituencies

According to Hatmann and Linn (2008), one key way to ensure that leaders and institutions continue to pay attention to scaling up is to create an effective demand for it through the political system. Social change needs to be embedded in a society and needs to be supported by political constituencies. These constituencies generally do not emerge by themselves; they need to be created and nurtured. Political constituency-building involves more than providing information about a successful programme. Political constituencies need to become actively engaged in the process, and leaders need to be reminded that it is in their interest to place the scaling up process on their agendas. USAID (2014), also supported the issue of political space that important stakeholders, both those in support and those against the intervention need to be attended to through outreach and suitable safeguards to ensure the political support for a scaled up intervention.

Advocacy is needed for scaling up

FAO (2009) emphasised the importance of advocacy in scaling agricultural technologies. Political outreach, constituency building and proactive advocacy are generally required, including lobbying to influence policy makers, training civil servants, mobilising the media and networking via professional and political channels. Kohl (2007) indicated that for programmes to be expanded and sustained, political support needs to be secured through explicit strategies of advocacy that are built early on into the scaling up process. Advocacy often needs to be built around individual champions, but it should aim to create broad coalitions, as sustainable programmes require constituencies that reach beyond individual actors. It should focus not only on the key ministers of the day, but should seek to build coalitions of stakeholder support and political commitment that outlast particular ministerial appointments and government administrations. This is because political parties move in and out of power, but scaling up is a long-term process and the agenda needs to be broadly anchored in the political system. However, it is pointed out that the risk of using scaling up processes to secure political advantage should be avoided.

Scaling up needs institutions that are willing and able to support change

Successful scaling up programmes need organisations with the institutional and human capacity to deliver on the scaling up mandate. Institutions lacking the capacity to operate the larger programme can be serious obstacles to scaling up. There are two problems involved in this, an unwillingness of organisations to carry through the required change needed to create the capacity for scaling up, and lack of skills, systems, and manpower to manage the increased programme. There are no blueprints for institutional change that would guide the approach to reform, and different models will work in different contexts.

Setting up new institutions and bypassing existing institutions should be the exception rather than the rule. Where new or specialised institutions are created, they should be continuously evaluated in their performance relative to appropriate benchmarks such as the performance of alternative existing institutions. The option of merging the old and the new and thus reducing fragmentation should always be kept in mind.

Many scholars have also discussed the role of innovation intermediaries. These are supporting actors that facilitate interaction among disparate or isolated innovation networks, and between farmers and supporting actors such as researchers, policy makers and other industry stakeholders. Intermediaries are identified in the literature as brokers between two or more parties. The majority of literature describing innovation intermediaries comes from an AIS perspective, that is, the role of intermediaries in facilitating more reciprocal relationships between innovators and beneficiaries of innovation. Intermediation is presented as a formal, professionalised role in development, where intermediaries are hired consultants or internet-based platforms for brokering exchange among actors in agri-food systems (World Bank, 2012).

Capacity building is essential for scaling

Training and development of the staff in charge of implementing scaling up initiatives is important, but it is not a panacea on its own, because without the other key elements of institutional capacity building as well as leadership, political support, incentives and so on, training will not have a lasting impact.

It has also been reported that the lack of adequately trained human resources is often a major constraint to scaling up. Quality training coupled with appropriate incentives has therefore been recommended as an essential component of scaling up. The pilot process is meant to develop an effective and efficient programme design, but the efforts are wasted if the lessons learned are not consistently applied. Training helps to transmit procedural and technical expertise and organisational values to new hires, and helps ensure that these critical, if intangible, assets are not diluted as the organisation expands. Existing personnel need training to support continuing professional development as a growing organisation

presents them with new challenges. Binswanger and Nguyen (2005) stress the importance of training in the scaling up of community-driven development programmes. Binswanger and Aiyar (2003) focus on the development of manuals to support the implementation of such programmes.

Kohl (2007), however, noted that too often training is seen as the universal response in the face of capacity shortfalls, forgetting the importance of other factors that are critical to success, in particular the creation of adequate incentives and accountabilities.

Scaling up needs incentives and accountability

Without appropriate incentives, innovation would be hampered and the process of scaling up would not be successful. Scaling up processes need to include incentives for the key actors. These can be positive rewards for achieving scaling up goals or penalties for failing to achieve them. They can be monetary or non-monetary (recognition and status, also promotion or election to office and hence influence). One important tool for creating incentives is to plan for incremental steps with early results, rather than building the perfect programme to be rolled out after a long preparation time without intermediate results (Hatmann and Linn (2008).

Accountability in turn is necessary to ensure that incentives are aligned among the individual actors, the goals of the organisations they work for, and the broader goals of society. Furthermore, accountability is needed to ensure incentives can be linked to shared objectives.

Benefits of Scaling up should accrue in a gradual and orderly manner

The literature on the diffusion of innovations focuses on the spontaneous spread of innovations and observes that some ideas or innovations can spread very quickly, especially when they are market driven (for example, the diffusion of information and communications technology, such as the cell phone). However, social process innovations, which rely on political processes, public sector bureaucracies and often on participatory, bottom-up community engagement generally, do not spread spontaneously. An orderly and gradual process, careful logistical planning, a clear definition of partners' roles and good communication are important ingredients to scale up development interventions. However, there is the need to keep processes simple, goals manageable, and accountabilities clearly identified

Scaling up needs effective monitoring and evaluation

According to Hatmann and Linn (2008), successful scaling up requires regular feedback from monitoring and evaluation systems. This allows the programmes to be adjusted as they are expanded in the light of well-understood experience. Evaluation can clearly demonstrate the impact of the programme and thus plays an important role in convincing politicians to expand and maintain the programme. Similarly, simple evaluations can play an essential role in providing feedback on whether scaling up is embedded in the institutional and managerial culture and values of an organisation, provided that the evaluations actually focus on scaling up as a key dimension of success, which unfortunately is still the exception rather than the rule.

IFAD (2010) emphasised that monitoring and evaluation are key ingredients of a successful scaling up strategy in various important respects: First, during the implementation of the pilot or experimental stage, the intervention needs to be monitored to learn what are the drivers and spaces (opportunities and constraints) that may affect an eventual scaling up process. Also, the impact of the pilot in terms of the lives of the rural poor needs to be evaluated, (preferably against a control group). Second, during the scaling up process, monitoring will provide important feedback on any unforeseen aspects of the scaling up pathway and permit adapting the pathway as needed. Intermittent evaluation of the impact of the scaled up programme during implementation and after completion is needed to ensure that the expected results are actually realised.

Korten (1990) noted that scaling up requires a “learning by doing” culture, one that values adaptation, flexibility, and openness to change. Scaling up is not a linear process; it extends over many years and travels many uncharted territories. While a solid process needs to be laid out, processes need to be adjusted regularly. Regular monitoring and evaluation and feedback from beneficiaries, communities, and field-based staff are important for learning and adjustments to take place.

Mansuri and Rao (2004) posited that there has been a broad consensus among practitioners that careful and well-designed monitoring and evaluation were crucial for effective scaling up. However, two types of evaluation are relevant to scaling up. The first is the evaluation of the pilot programme to establish whether or not the innovation tested has been successful and what lessons can be learned from it. The other is a monitoring and evaluation of the scaling up process (Hatmann and Linn, 2008).

Scaling requires awareness and learning

Knowledge about what works and what does not in scaling up is essential and must be harnessed through a continuous process of monitoring and evaluation and sharing the knowledge with the relevant actors. Finally, throughout the scaling up process, there is a need for an effective learning process through systematic monitoring and evaluation focused not only on impact, but as importantly on the effective deployment of the drivers and enabling conditions for the scaling up process (Hatmann and Linn, 2008).

There is need for fiscal/financial space for scaling:

Fiscal and financial resources need to be mobilised to support the scaled up intervention and/or the costs of the intervention need to be adapted to fit into the available fiscal/financial space. IIRR (2000) indicated that there is a need for financial sustainability in scaling up and out of technologies.

There is need for protection of intellectual property:

Intellectual property rights (IPR) are awards to inventors and institutions of certain exclusive rights to produce, copy, distribute, and license goods and technologies (World Bank, 2005). According to USAID (2014), IPR gives innovators personal property ownership rights and a means to prevent unauthorised use of their work (e.g. patents, copyrights, and trademarks). IPR systems must balance public interest in accessible, affordable, livelihood-enhancing technologies with the reality that some market power may stimulate innovation by facilitating the recovery of related expenses and financial risk management. It follows that the policy implications should be guided along the lines of a country's level of development and its level of imitative or innovative capacity.

Protection of intellectual property is crucial to private sector engagement, which is fundamental to scalability. Such protection has been found to be responsible for the success of the seed industry across Africa.

The expediency of the agricultural innovation systems approach for scaling technologies in Africa

Organisational and institutional challenges continue to limit the widespread use and adoption of promising technologies and practices in smallholder agriculture in many parts of sub-Saharan Africa. Part of Africa's problem is that conventional approaches to agricultural research and extension have failed to address the chronic problem of low agricultural productivity. A major challenge is that smallholder farmers who are the majority are not linked to agribusiness value chains, and as a consequence, are not motivated to produce more than they need for their subsistence.

The Integrated Agricultural Research for Development (IAR4D) was thus proposed as a way to tackle these constraints. The IAR4D was intended to create a departure from the conventional linear approach to agricultural research and development by engaging multiple stakeholders along the commodity value chains. According to McEwan (2009), the agricultural innovation systems approach using the innovation platform builds on earlier approaches for strengthening farmer participation and farmer organisation. It also seeks to create linkages among a broader range of stakeholders within and beyond the agricultural sector. This is in part a reaction to the failure of the linear model of technology transfer (i.e. from researcher to extension agent to farmer) to deliver sustained and wide-spread benefits from research outputs to farmers.

Principles of IAR4D.

The IAR4D concept operates with specific principles that regulate its delivery of impact, which is an indication that it is a good platform for scaling agricultural technology and innovation. The IAR4D principles include:



- A** IAR4D simultaneously addresses research and development as a fused continuum for generation of innovation.
- B** IAR4D proposes to carry out research in a demand-driven mode and the impact of such endeavors will be measured in terms of meeting the demand.
- C** Research activities on an IP are all-encompassing, covering natural resource management, productivity, market policy, product development, nutrition, and gender. These will often yield technological, institutional, and infrastructural innovations leading directly to socio-economic benefits.
- D** IAR4D is a multi-stakeholder approach; as such, it accommodates and gives adequate recognition to the complexities of the situations that affect sustainable production, marketing and utilisation of each commodity in designing a solution.
- E** IAR4D engages the policy makers at different levels all along the process of R&D till innovation is generated.
- F** IAR4D will adopt the innovation systems approach and create innovation platforms.
- G** All stakeholders on an IP have a contribution and benefits that sustain their interest and continued participation.
- H** Innovation generated using IAR4D will benefit all stakeholders on the IP.
- I** The IP operates in a business mode to ensure delivery of measurable socio-economic benefits from ARD and smooth public-private partnership in ARD.

These principles imply a new way of doing research to ensure development outcomes and impact. The approach gives attention to (a) intensification of subsistence-oriented smallholder farming systems; (b) prudent management of natural resources while intensifying their use; (c) development of more efficient markets; (d) creation of enabling policies; (e) attention to development of new product; and (f) consideration for nutrition and gender as crosscutting issues.

To foster the integration of the various dimensions of agriculture development, IAR4D requires additional supportive mechanisms in terms of:

<p>I promotion of organisational and institutional changes to enable cross-disciplinary research and development and multi-institutional collaborations;</p>	<p>II capacity building for stakeholders on the innovation platform viz., farmers, other private sector partners, extension agents and scientists;</p>
<p>III information and knowledge management; and</p>	<p>IV continuous monitoring and evaluation with a systemic approach to impact assessment.</p>

The essential character of the IAR4D concept that supports the scaling of agricultural technologies is its unique blend of research and development confines. This necessitates an operation in a commercial mode and ensures effective partnership of the public and the private sector actors. It is known that where commercial opportunities abound, users will necessarily embrace the use of needed technologies that will aid production and profit.

Innovation platforms are multi-stakeholder configurations established deliberately to facilitate interaction and partnership formation and to undertake joint activities relating to agricultural innovation at the region, country, sector, or value chain level (Kilelu et al., 2013).

The vital elements for orchestrating agricultural innovation are illustrated in Figure 2. A multi-stakeholder platform is a necessity to foster the interaction of stakeholders with a personal stake in the commodity of interest or the systems of production

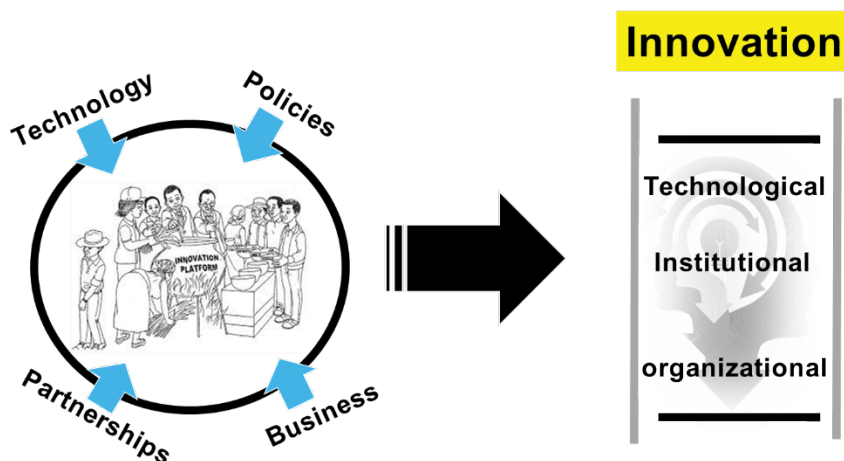


Figure 3. Elements for generating agricultural innovation

The IAR4D proof of concept research provided empirical evidence of the efficacy of the concept in fostering effective identification of research issues, development of relevant research outputs leading to high adoption of technologies and other research outputs. The concept also fostered the generation of solutions to various issues in the processes of translating research outputs to development outcomes and impact. Thus, the IAR4D concept was proven to lead to higher income for the different stakeholders on the innovation platforms; it led to drastic reduction in income inequality (Adekunle et al., 2013).

According to USAID (2014), scaling up is a multi-stakeholder process and therefore, getting multi-stakeholder buy-in from the beginning is crucial for its success. Other stakeholders that influence the value chain are also engaged in interacting in identifying problems, sourcing solution options including the technologies and modification of the institutional arrangements, and learning lessons.

The IAR4D concept is implemented on an innovation platform. This is a physical or virtual platform that engages multidisciplinary stakeholders drawn along the commodity and system value chain to interact to identify problems, source solutions, and implement solution options till an innovation is generated. An attempt to scale the IAR4D concept and the innovation platforms is believed to have the potential to ensure the realisation of broad-based benefit from research outputs.

Literature has shown many different projects where the innovation system has been a major conduit for the generation, adoption, and scaling of agricultural technologies and innovation. According to Francis and Huis (2016), the innovation platform (IP) is an effective mechanism for mobilising key actors at local, district and/or national levels for negotiation about collective action and concerted decision-making to create conditions that are conducive to continuous innovation. The platforms can occur spontaneously or be organised, operate independently or be facilitated, and can evolve or dissolve over time.

The IP has been classified into **two**:

Type 1 IPs can bring together value chain actors to support the identification, evaluation, and adoption of a given technology (e.g. a new or improved variety) or a 'good/best' practice, and are effective in bringing about change. They can eventually address wider policy and institutional issues such as financing.

Type 2 IPs can initially bring together key decision-makers who are able to change the institutional conditions to enable innovation. Once this is achieved, other issues such as technology adoption can also be addressed. Ownership of the IP should eventually rest with the farmers and other agri-entrepreneurs to ensure sustainability.

Bolo (2016) indicated that the relevance of the innovation systems (IS) approach to agriculture in developing countries is evident. He gave an example of the results of pilot case studies supported by CTA and the World Bank, which demonstrate that the IS approach can be used to determine and explain how different policies, institutional frameworks, and combinations of actors are involved in innovative activities, and how their interactions or lack thereof contribute to or undermine learning and innovation. Technology transfer

alone does not translate directly to productivity gains or other desired improvements. Improvements are contingent upon constantly changing relationships among actors and evolving ecological, technological, cultural, social, economic, and political environments (Spielman et al., 2009; Kraemer et al., 2010).

The African Development Bank (AfDB)-funded project on the promotion of science and technology for agricultural development (PSTAD) is also a good example of the usefulness of IPs for scaling technologies in Africa. The project did not only seek to build the capacity of the national agricultural research system (NARS) to manage its knowledge resources. It also sought to facilitate an innovative process of adoption of such technologies to improve food security and reduce poverty.

PSTAD also supported the dissemination and adoption of improved and proven agricultural technologies and innovations along the value chains in selected commodities. In addition, the platforms also facilitate business development based on the opportunities recognised on the platforms. They also improve engagement by stakeholders' thereby enabling decisions on the most critical interventions to implement so as to resolve critical challenges to increasing productivity in the commodity value chain.

According to CORAF (2009), the IPTA comprises researchers, extension or advisory service, policymakers including community leaders, and civil society organisations in agriculture notably farmer organisations, agric-business, and NGOs. The CGIAR Centres, universities, and other technical institutions provide technical backstopping, and training and skill development at the appropriate level of intervention.

Furthermore, each innovation platform for technology adoption (IPTA) selects technology including processing and value addition or best-bet practice for dissemination in a given agro-ecology for every target country site (TCS) based on agreed criteria. The platforms share a common agro-ecology to facilitate cross site analysis through joint monitoring and evaluation, and learning and sharing of experiences. Priority technologies and best-bet practices are disseminated over two years before expanding to new sites. This is to cultivate a culture of self assessment through monitoring and evaluation, and experiential learning and sharing, in using the IPTA tool for large-scale technology dissemination and adoption, and enhanced productivity.

According to McEwan (2009), under the Dissemination of New Agricultural Technology in Africa (DONATA), Orange Fleshed Sweet potato (OFSP) project, and Innovation Platforms for Technology Adoption (IPTAs) were formed in Ethiopia, Kenya, Rwanda, Tanzania, and Uganda. The IPTAs brought together relevant value chain stakeholders to develop institutional mechanisms that supported the up-scaling of OFSP technologies (e.g. new varieties, agronomic practices, and post-harvest activities). Similarly, other commodities like cassava, maize, and sorghum were scaled up and out in the West Africa sub-region through the innovation platforms.

Based on the experience from DONATA, Sanyang et al. (2016) concluded that "maize- and cassava-based technologies on their own will not result in the level of change and impact that is needed to improve smallholder agriculture and livelihoods. Multi-stakeholder processes,

including IPs around key value chains and food systems are needed to diagnose constraints, explore opportunities, investigate solutions, and catalyse collaborative learning and collective action. In this regard, agro-food product processors and farmer entrepreneurs, many of whom are smallholders, will continue to play a pivotal role in innovation and entrepreneurship for food and nutrition security and increased incomes in African agriculture. Institutions at the community and regional levels are critical to the innovation process and can influence the wider national system.

With the proof of concept of IAR4D and the successes recorded by the PSTAD project using innovation platforms as a mechanism for facilitating technology uptake in about 25 countries, the use of the concept of IAR4D will be a suitable platform for out-scaling technologies and innovations. It will no doubt benefit majority of the stakeholders across the continent by promoting increased productivity and transforming Africa's agriculture. Moreover, according to Millar and Connell (2008), scaling out positive impacts from systems change requires field-tested and proven technologies, evidence of significant livelihood impacts, fostering of local innovation, competent field staff, effective peer learning, and ongoing institutional support, which are characteristics of the innovation platform. Therefore, the concept of agricultural innovation system is vital to achieving structured scaling of agricultural technology. Figure 3 shows the setting up of an Innovation Platform (IP) for technology dissemination and scaling under DONATA project.

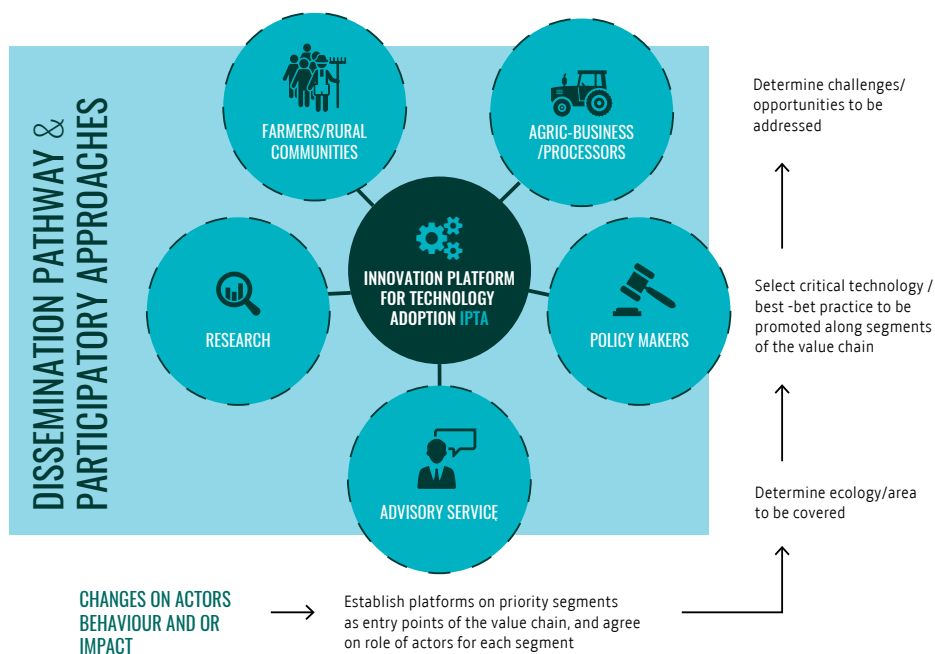


Figure 4: Setting up of an Innovation Platform (IP) for technology dissemination and scaling
Source: CORAF (2009)

The IAR4D will also enhance the use of IPs for concerted engagement with relevant actors in the other productive sectors of the economy to invest in adding value, processing and marketing of produce and thereby enhance the business side of agriculture in Africa.

This chapter will be concluded with the comment of the Director of Sinana Agricultural Research Centre in Ethiopia as indicated by Africa Rising Partnership (2016) "The use of innovation platforms and farmer research groups (FRGs) has encouraged and motivated farmers to participate in different research activities and develop positive attitudes toward using new technologies' says Soleyman. Specific interventions for scaling up by partners in Mozambique are shown in Figure 4.



Figure 5: Farmers field day in Mozambique

Strategies for scaling technologies and innovation in Africa

Developing a practical strategy is often the key to scaling out and up of proven agricultural technologies and innovations for increased productivity along selected commodity value chains while promoting inclusive growth, green economy, climate change adaptations, and agricultural infrastructure enhancement for food and nutrition security and wealth creation. The strategies proposed here focus on the existing framework for enhancing the effectiveness of agricultural research and development in Africa.

A continental coordination for the scaling of technologies, could play the following roles in Africa:

1 Facilitating the sharing of available knowledge on new technologies and innovations through establishment of innovation platforms	5 Where possible, facilitating the development of agribusinesses along commodity value chains
2 Facilitating the development and sharing of scaling up methodologies	6 Advocating for a policy environment that will facilitate scaling in all member countries
3 Coordinating the sharing/movement of recent technologies and innovations across borders	7 Strengthening institutional and individual capacities for scaling
4 Facilitating networking amongst extension service providers in each sub-region	8 Mobilising and allocating resources for scaling activities

Two types of technology pathways are indicated by the authors: the bottom-up or farmer-generated technologies and innovations and the top-down or researchers' technologies. Examples of both generated technologies have been described under types of technology and innovation in Chapter 3.

Technology adoption and dissemination has two phases. The first is the testing and validation phase. Here the efficacy of a technology or innovation is tested and validated and then demonstrated to farmers and agribusinesses. The bottom-up or farmer-generated technologies and innovations will go through these farmers and agribusiness before moving into the second phase.

The second phase is the scaling up phase of the proven technologies or innovations. Most of these are from the researchers’ technologies and farmers’ technologies and innovations that have been piloted. Simmons et al. (2007) defined scaling up as efforts to increase the impact of innovations successfully tested in pilot or experimental projects so as to benefit more people and to foster policy and programme development on a lasting basis.

For adequate scaling of the bottom-up technologies, the specific technology will need to be refined and tested to ascertain its suitability for implementation in a pilot project. Piloting refers to testing a technology on a limited scale for a pre-defined period to assess and document the results of an intervention and its potential for future replication on a larger scale. Figure 5 graphically illustrates the essential steps and actions to run a pilot that was established with the intention of scaling up technologies. The illustration emphasises the role of knowledge collation and monitoring and evaluation in informing the next scale and impact. Spreading bottom-up technology will require good coordination and collaboration between many different stakeholders, including governments, farmer groups, NGOs, CBOs and local leaders. In addition, Figure 6 shows a framework for piloting and scaling farmers’ innovations.

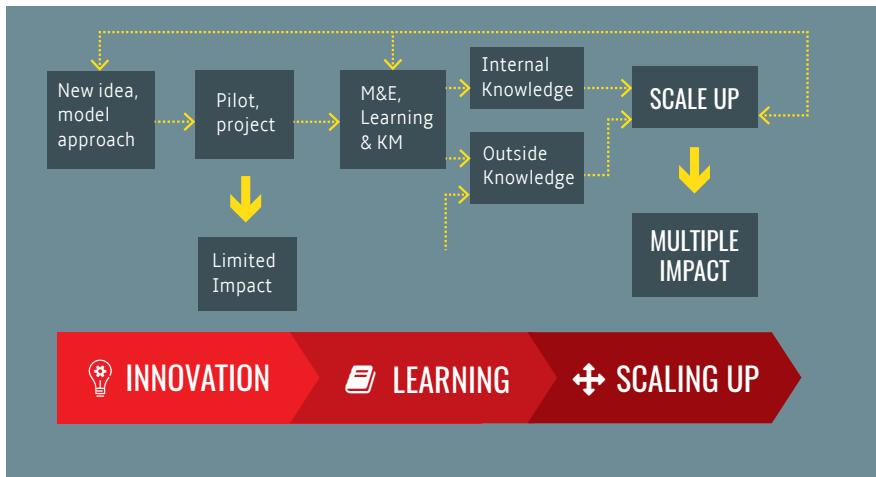


Figure 6: Innovation, learning and scaling up linkages (Adapted from IFAD (2010).

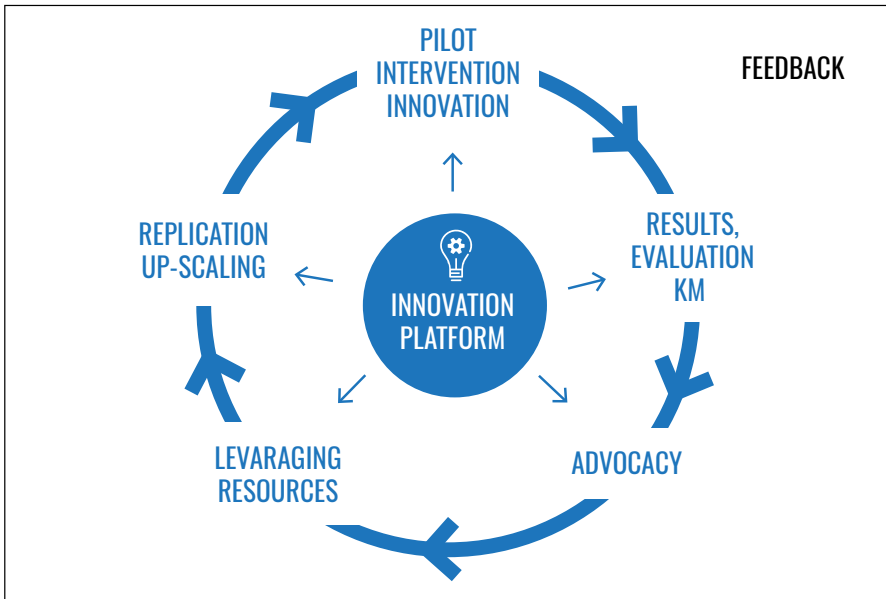


Figure 7: Overview of the piloting and scaling up cycle. (Adaptation of Lattimer (2013))

On the other hand, the researchers' technologies and innovation, some of which must have gone through a pilot phase, will be scaled out. For example, technologies such as Orange Fleshed Sweet potato (OFSP), Vitamin A-rich cassava, High-quality protein maize and sorghum that have been proven, can be scaled. Cooley and Kohl (2005) reported that scaling up should only take place after the model/pilot conducted on a limited scale has been evaluated and found to be effective and efficient. After adapting and, where appropriate, simplifying, the model should focus on those aspects critical to a successful scaling up.

The take-off of proven technologies to a higher scale often requires alignment with other complementary technologies and institutional processes. Figure 7 presents a workable framework for scaling proven technologies in Africa. The framework uses a multi-stakeholders' platform or agricultural innovation system approach as the mechanism of scaling. The components of the framework are the proven technologies, the complete stakeholders' configurations drawn along the innovation sphere of the specific commodities or system of production that the technology addressed. Implicit in the innovation sphere is complete value chain actors. The framework also gave consideration to the issues of productivity, natural resource management, value chain development, business development, and policy engagement as critical issues in sustainable scaling of technologies. Apparently, the interactions of these issues and concurrently sourcing solutions to them ensures that the scale of the specific technologies and/or group of technologies does not plateau or drop. This framework also considers commodities as the focal home for the technologies and the driving point for measuring productivity and economic gains from the technology. Hence the specific commodities are the basic commercial object for bringing technologies to scale.

The framework finally uses the agricultural innovation platform as a partnership tool for systemic interaction among all stakeholders to ensure continuous refinement of processes and technologies for socio-economic benefits of different stakeholders.

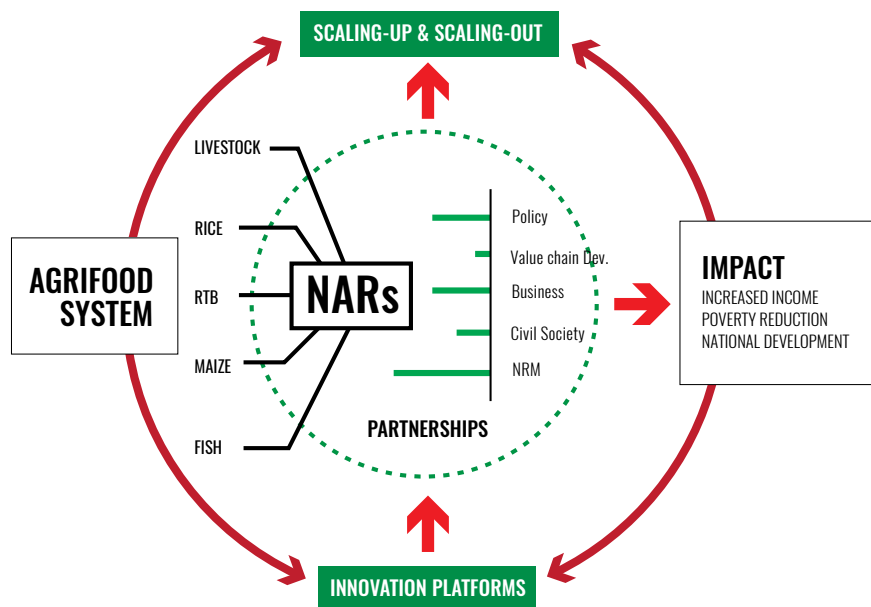


Figure 8: A framework for proven technology scaling using Agricultural Innovation System (AIS) (Fatunbi A.O unpublished 2016).

Proposed options for scaling agricultural technologies in Africa

Getting technologies to scale in Africa could follow two distinct pathways, the sporadic pathways and the systemised pathway. “Sporadic pathways” refers to scaling with little intervention, i.e., generating the technology and carrying out few dissemination activities. Technologies with potential for sporadic scaling out will necessarily be novel and produce an invention. In turn, it must provide a solution to a problem that has attained a threshold that significantly limits productivity. Such technologies naturally find acceptance as core stakeholders are actively searching for solutions to the problems they address. On the contrary, the systemised pathway requires stepwise interventions to create the needed environment for the technologies to move beyond the zones of its generation. Often technologies that require systemised scaling pathways would also address a problem limiting productivity, but the problem is yet to attain a threshold. Technologies that result in improved performance or better ways of doing things fall into this category. There are a number of models that fit into the systemised scaling pathway; some pathways are recommended in Table 1.

Table 1: Mediators of scaling strategy

Sporadic scaling	Systemised scaling
Technologies with superior performance over the current practice	Technologies developed with benefit pathway in view
Technologies that generate products that align with mega trends in social awareness and societal changes	Technologies that address improvement over the current practice
	Cost effective; socially acceptable;
	Reduction in drudgery (time; rigour; complication); and timeliness among others.
Technologies with invention characteristics that provide a solution to a problem that has attained a threshold	Technologies that foster the development of a new product (require market stimulation)
Technologies that respond to market pull for specific output	Technologies that target commodity competitiveness (price/quality)

A Technology scaling through Agricultural Innovation Platform

The theory and practice of the agricultural innovation platform have been reported elsewhere by Adekunle and Fatunbi (2010); Adekunle et al. (2012) and Fatunbi et al. (2016). The model placed emphasis on effective partnerships, multiple stakeholders configuration, market end as a precursor of impact and technology generation pathway that addresses complementary issues of productivity, natural resource management, market, gender, nutrition, product development, and policy. Scaling agricultural technologies using innovations systems approach especially the innovation platforms involves good partnership. Jonasova and Cooke (2012) reported that key partners in scaling up must always be mobilised and brought on board to interact in problem identification, sourcing and mainstreaming solutions and utilising the technologies to generate socio-economic benefits. Obviously, lessons are learnt in the process of their interactions and further innovations are generated.

According to Kilelu et al. (2013), innovation platforms are multi-stakeholder configurations established deliberately to facilitate interaction and partnership formation and to undertake joint activities relating to agricultural innovation at the sub-regional level of the continent or value chain level within the sub-region. The platforms are multi-stakeholder entities that will be established in a given geographic area or community that holds great potential for impact in the selected agricultural commodities value chains. A platform of multi-stakeholders therefore comprises key actors along the selected commodity value chains. These include farmers (male, female, and youths), processors, marketers, input dealers, micro-finance, research and extension personnel and other interested persons. And each platform would have sub-platforms or groups based on the potential action point on the commodity value chain. For example, there may be sub-platforms for testing and validation of farmers' innovations for adoption, production of proven technologies, adding value or processing, and marketing among others, that would enable more decisive action for creation of the desired impact.

FARA and its partners have proved, on pilot basis, that the Integrated Agricultural Research for Development (IAR4D) using the IPs works and that it can produce positive fruits within a very short time. This approach has been very successful and will be a good approach for scaling technologies and innovations in Africa. The uptake pathways for quality protein maize (QPM) and orange fleshed sweet potato (OFSP) were promoted in this way across six countries in East and Central Africa sub-region using the DONATA project (<http://faraafrica.org/programmes/strategic-priorities/enabling-environment-for-implementation/donata-dissemination-of-new-agricultural-technologies-in-africa/>).

To use the agricultural innovation platforms for scaling technologies in Africa, the following strategic activities should be carried out.

- 01** Conduct scoping studies to establish an intervention status (that is, to establish the technology constraint or gap and determine the solutions for each agro-ecology). This serves as the needs assessment and provides an impetus to acceptance of the technology as a solution to an identified problem.
- 02** Identify and establish IPs (strategic and operational) where necessary in the sub-regional countries based on agro-ecology and constraints (that is, the technology to be piloted or scaled should determine the agro-ecology to be selected for setting the IP within the country and sub-region). For example, stakeholders can be brought together to form IPs that will promote quality protein maize (QPM) scaling within many countries as in East and Central Africa while one or two IPs can also be set up in Northern Guinea Agro-ecological Zone of West Africa in scaling sorghum and maize-legume technologies as well as other technologies.
- 03** Conduct a stakeholder analysis for each of the selected sites and facilitate development of guidelines for management and operation of the IPs. This is because the number of partners varies from one IP to another. Clarifying the stakeholders for each IP and agreeing on roles of different stakeholders in supporting the piloting and scaling of proven technologies

will be necessary to support the research at the piloting of the farmers' innovations. The success of the IPs depends heavily on leadership within the group of stakeholders brought together by the innovation platform. Endorsement by local government or NGOs also helps greatly in successfully establishing an innovation platform for scaling technologies.

- 04** Conduct a value chain analysis for each technology and the hosting commodity; this will help to determine the challenges and opportunities to the effectiveness of the chain and the relative contribution of the specific technology to the improved benefit.
- 05** Facilitate establishment of innovation clusters in the different locations for scaling technologies where most of the stakeholder farmers (male, female, and youths), processors, marketers, input dealers, micro-finance institutions, research and extension personnel) come together. The Innovation clusters (IC) is a smaller variant of IP in several locations running production to marketing activities in a business mode.
- 06** Conduct workshop on value chain analyses and determination of areas of focus of IPs intervention activities for setting up IPs.
- 07** Facilitate early research and testing by farmers on-farm, of options for addressing opportunities especially farmers' innovations/technologies that are being tested for scaling in similar agro-ecologies.
- 08** Ensure early involvement of the private sector in input supply, marketing, and provision of finances. For example, a maize–legume IP at the NGS in West Africa provides a concrete example of the involvement of private sector. The decision by Premier Seed Company in Nigeria to use participating farmers as out-growers of improved seeds after a visit of the company by the farmers was very useful in adoption and scaling of technology.
- 09** Organise technical backstopping of the operations of the IPs in terms of guiding technological and innovative interventions on business opportunities and development, policy guidance, and strengthening of multi-stakeholder engagements or participation in each IP as this is important for smooth operation.
- 10** Establish networks to enhance information exchange among countries. Network analysis is a useful tool to map the linkages between the different actors in the agricultural innovation system (use of information technology for information dissemination is important. This will be discussed more under ICT in subsequent sections).
- 11** Establish targets and a time table of number of IP sites for scaling technology based on stakeholders' constraints (for example, all the farmers' innovations going into pilot should be carried out for not less than 2 years while the scaling of proven technologies should be carried out for not less than 5 years) before final evaluation of the success of scaling of the technologies and innovations can be conducted.

- 12** Facilitate advocacy: The positive impacts of bottom-up technologies are not well known. Accordingly, there is a need for strong advocacy towards governments, extension services, development agencies and the private sector. It is only through advocacy that a mind shift can occur. This should not only be among farmers but also among extension personnel, government officials, researchers, and others involved in agriculture for legitimacy and adoption by farmers and farmer organisations. According to ActionAid (2014), government support to indigenous knowledge plays a significant role in adoption and scaling up of agricultural technologies. This means that local governments or district governments or state officials should be carried along in piloting and scaling of technologies.
 - 13** Facilitate cross site visits of similar constraints and agro-ecology IPs for joint monitoring and evaluation, and learning and sharing of experiences. Farmer associations, extension service and other stakeholders can visit one another's farms/IPs to learn and gain experiences on the technologies for adoption, adaptation, and scaling.
 - 14** Set up more IPs to promote proven technologies gradually to other similar agro-ecologies in entire states, nations, and sub-regions.
-

B Technology scaling through sustainable intensification practices

Scaling of technologies can be systemised through the sustainable intensification thoughts and practices. Sustainable intensification endears the derivation of more return from either the same or smaller input, thus intensification derives its benefit from either technological advantage (biological or chemical) or mechanical advantage. The other advantage could result from institutional arrangement that enhances smooth operations, reduction in drudgery and better delivery of outcomes among others. This relies more on social network advantages. To achieve sustainable intensification, external impetus is often required in terms of support to the actors in the production chains of the selected commodities and inputs to carry out intensive production of the commodities and technologies to ensure efficiency in production systems. Elite varieties of the commodities should be made available as well as effective linkages to all the required suppliers and end users of the commodities.

Furthermore, the support for sustainable intensification should also embrace investment in infrastructure and provision of policy incentives to achieve the overall goal for agricultural development through science. The philosophy behind this strategy is the notion that where all the necessary inputs and institutional arrangements to ensure effective use of technology and the delivery of requisite outcome are made available, technologies will necessarily be taken to scale.

The major strategic activities to implement this strategy include:

- 1** Carrying out a thorough technology validation process before releasing a technology into the system for scaling up. This will include the technology characterisation and verification of the suitable agro-ecologies, the resource use domain, and the useful socio-cultural requirements.
- 2** Identifying farmers' technologies or other indigenous practices that are ready for piloting (i.e. farmers' generated technologies that can benefit stakeholders than the one they have been using before).
- 3** Taking inventories of the producers of the selected commodities and ascertaining their farm holdings, practices, and procedures as well as the challenges and opportunities.
- 4** Establishing and maintaining a database of available successful technologies with agro-ecologies of where they can be used. This is useful for farmers who will want to acquire such technologies as they know where they can find them.
- 5** Determining the input needs and developing an efficient inputs delivery system (seeds/fertilisers, agro-chemicals machineries,) to support their intensive cultivation.
- 6** Developing an efficient policy linkage for development of needed policies and infrastructure.
- 7** Establishing broad-based capacity development systems for value chains to enhance the use of the specific technologies and their companion technologies to achieve the desired impact. The extension personnel, NGOs, and CBOs will be useful for this assignment as they are involved in dissemination of these technologies.
- 8** Creating systems that organise and facilitate learning, i.e., field or farmer field days, shows, posters, radio, TV messages, and pamphlets for example, for farmers, policy makers, and decision makers to learn by seeing. This helps raise farmers' awareness about the technologies and demand for them. For example, intensification of awareness through regular radio programmes on the benefits of organic agriculture enhanced participation of many farmers in the production of organic vegetables and fruits in South-West Nigeria within one year of the three IPs set up in the zone.
- 9** Conducting training workshops on intense cultivation of the selected commodities for key actors to enhance their production practices.

C Facilitation of value addition and agribusiness incubator

The value chain development of agriculture is the recognition of the value adding that takes place in the agricultural production activities from the time production begins to the time the final product reaches the consumers. According to USAID (2014), a well-defined value chain should highlight all actions, people, and institutions needed for transformation and scaling of impact. There needs to be ample discussion between project management and scaling processes in order to plan across value chains and anticipate who will be winners, or losers.

The use of value chain development will ensure that the key actors at each value point are sensitised and empowered to be able to receive good returns to their investment of money, time, and energy. Value chain analysis for the commodities of focus in the various countries should be undertaken. The challenges and opportunities that emerge will form a basis for project interventions in the scaling of technologies and innovations so as to ensure optimal benefit from the project investment.

Value addition and product development from the selected crops and animals is also a way to extend shelf-life and preserve the produce as well as ensure availability of the crop produce/products to a wide variety of consumers. Increased and sustainable consumption of the produce/products would drive sustainable production of the crops to guarantee steady income and better livelihood for the producers and other actors along the commodity value chain.

Facilitation of agribusiness incubator calls for support for value addition and product development in assisting to identify potential agribusinesses associated with the produce of the selected commodities. It also facilitates access to technical and financial support services required to enable the available potentials to be translated into viable business enterprises. The enterprises will also serve as a source of employment generation for the many unemployed youths.

The idea behind this approach is that if the product or technology is part of an agricultural commodity value chain or supply chain, its commercialisation helps increase demand for the commodity. It therefore improves farm outputs, which invariably may lead to the adoption and scaling process to be faster and more widespread.

Collaboration with financial institutions should be initiated to explore the options to facilitate negotiation of low-interest financial facilities. This will boost activities of such produce-related emerging agribusinesses and grow them into viable enterprises to enhance their potentials for employment creation and income generation. Support to such agribusiness incubators will reduce post-harvest losses as well as harness agricultural waste by exploring and exploiting the resultant biomass value webs for green growth and a cleaner and healthier environment.

An example of scaling through business linkage with farmers is presented in Box 2.

BOX 2 Example of scaling through agribusiness linkage with farmers



**ADOPTS INNOVATIONS
AND PARTNERS WITH**

9,000 SORGHUM FARMERS > Uganda
1,500 CASSAVA FARMERS. > Mozambique

SABMiller is one of the largest beer-making companies in the world. It owns breweries in all the five continents. It goes as Nile Breweries in Uganda, Kenya Breweries Limited in Kenya, and as SAB in Mozambique. Whereas globally, beers are made from barley, the beer company has tried to adopt innovations that use local ingredients—sorghum in Kenya and Uganda, and cassava in Mozambique—to produce its product. In all cases, the company has partnered with local farmer groups and encouraged them to grow the variety of sorghum or cassava needed in beer making. In effect, the company has created market opportunities for smallholder farmers in its agribusiness value chain, which has led to scaling of the particular varieties of sorghum or cassava. In Uganda, SABMiller is so far working with 9,000 sorghum farmers while in Mozambique it is working with 1,500 cassava farmers. Commodity agribusiness value chains such as this have the potential to transform the livelihoods of many smallholder farmers (ASERECA,2014).

The proposed activities for this strategy include:

- 01** Survey the potentials for value addition and product development in the selected commodities within the immediate and possible external environment of the IPs.
- 02** Determine market requirements for the produce and the potentials for value addition as well as the processing of the produce.
- 03** Develop relevant value chain product bases for the selected commodities and their acceptability in the available markets within the IPs.
- 04** Prepare feasibility studies for the development of the various identified potential products. This will guide the IPs in product development from the technologies being promoted.
- 05** Conduct training workshop on potential agribusinesses for actors on the Innovation Platforms to enhance their entrepreneurial skills and assist their decision value to invest.
- 06** Ascertain and promote entrepreneurship for product development from the selected crop produce and determine the infrastructure requirements to make this happen.

- 07 Link and establish collaboration with the private sector for agribusiness incubator development in the processing, packaging, and marketing of produce/products to enhance utilisation and further increases in production of the selected crops.
 - 08 Establish systems and networks for information and knowledge exchange and link growth poles for more harmonised agricultural, business, and social transformation.
 - 09 Link with Africa Agri-business Incubator Network (AAIN). This is the current continental network on agri-business incubator. It has a Web site: www.africaain.org.
 - 10 Collaborate with financial institutions such as the micro-finance on the IPs and others in support of promoting agro-enterprises.
 - 11 Develop modalities for collaboration with business information providers.
 - 12 Facilitate protection of property right.
-

D Facilitation of markets and access to knowledge and information

The major thrust of this strategy is that markets, and not technology, are increasingly becoming the drivers of agricultural development in many countries. Successful private sector-driven scaling has the effect of providing markets for farm products, which in themselves act as an incentive for increased farm output (Swanson, 2008).

Availability and access to markets will be a game changer in the scaling of technologies and innovations in agriculture. This is because market enhances consumption, which drives production of goods and services. FAO (2014) recommends increasing access to markets as a means of giving family farmers incentives to innovate. Barriers to farmers adopting innovative practices include absence of physical and marketing infrastructure, financial and risk management instruments, and secure property rights. This logic is based on the assumption that technology scaling is motivated primarily by commercial 'pull' factors and does not consider that only relatively resource-endowed farmers may be able to respond to new market opportunities.

Therefore, it will be necessary to identify available markets and facilitate access to them by actors in the selected commodity value chains. Identification of markets would be in terms of who and where the key consumers of the products are. Facilitation of access would require project support in clarifying and developing marketing channels and structures that would enhance unencumbered sale of produce/products by the actors in local and external (inter-country and inter- regional) markets.

Experience from India shows that provision of market information can greatly assist farmers to choose what commodities to produce, what production technologies to apply, when to produce, and indeed for whom to produce. In other words, for smallholder farmers to change their situation and improve their livelihoods, provision of market information to them will be key to their transformation.

Therefore to get technologies and innovations adopted and scaled by smallholder farmers, the farmers not only need to be informed about the technologies or innovations themselves, but also the market opportunities for what they produce. ICT has the potential to deliver market information to these rural farming communities. It has been described as any device, tool or application that permits the exchange or collection of data through interaction or transmission (McNamara et al., 2012). ICT is an umbrella term that includes anything, ranging from radio to satellite imagery and to mobile telephones. Their affordability has resulted in their spread and use even in rural areas. Furthermore, using ICT to facilitate knowledge sharing among disparate networks of farmers may also serve to increase exposure among policy makers, which may in turn promote institutional change at the systems level.

A good example of the use of ICT for disseminating technologies was the PSTAD project, which built capacity of NARS in knowledge management using ICTs. An African portal on Agricultural Information System (AIS), the eRAILS (www.erails.net) was established to link the target NARS to develop websites to enhance learning, and information and knowledge exchange among scientists and researchers. It gave researchers and scientists a platform to engage and exchange ideas and resources and thereby reduce duplication of efforts, save time and make research efforts more meaningful and rewarding for the actors and African agriculture. Farmer organisations are also using the eRAILS portal to increase their visibility and share information related to their activities not only to the external world, but also to their members. This approach will be a good mechanism for disseminating information on available technologies and market information, which will subsequently result in adoption and scaling.

Strengthening and supporting information and knowledge sharing at all levels

As part of the information sharing aspect of scaling, the use of the Dgroup system is also good for knowledge sharing as used in the PSTAD project, which is a good mechanism for scaling agricultural technologies and innovation.

To widen the scope for technology dissemination as well as lessons learnt at national, sub-regional and continental levels, steps were taken to establish online communities at each of the above levels using the Dgroup system. Dgroups is an online communication tool that makes it possible for individuals and organisations in the development sector to come together and interact with one another, and share knowledge between and among themselves. The establishment of Dgroups communities is improving communication and knowledge sharing among PSTAD stakeholders at national, sub-regional, and continental levels. Figure 8 shows the example of Dgroups created during the PSTAD project.

National Dgroups

ASARECA	CORAF	SADC	
Burundi**	-Burkina	Zambia****	Contributions rate * Low: < 50 ** Medium: >100 *** High:>200 **** Very High: >250
DRC**	-Cameroon		
Kenya	-Congo Brazza***		
Sudan*	-Cote d'Ivoire**		
Tanzania**	-Gambia**		
Uganda***	-Ghana		
	-Guinea*		
	-Liberia		
	-Senegal*		
	-Togo*		
	-Mali*		
	-Mauritania		

Image 1: National Dgroups and usage rate. Source: FARA, (2011)

The major activities of this strategy will include:

- 01** determination of the marketing needs of the IPs. There is need to determine from the beginning the market needs of the stakeholders based on the value chain analysis.
- 02** ascertaining the marketing channels and structures to meeting the identified needs, noting the challenges and opportunities to explore;
- 03** promoting the development of appropriate channels and structures to enhance effective marketing of the produce/products from the IPs;
- 04** strengthening the capacity of the IPs on packaging, markets and marketing of products and services;
- 05** facilitating access to national, regional, and other markets suitable for the disposal of IP products;
- 06** facilitating the establishment and proper management of product quality and standards to ensure better market share and good return to investment;
- 07** establishing a system for market information exchange and management for better flow of agricultural business;
- 08** facilitating policy improvements for better agricultural market integration across the various divides in Africa;
- 09** developing modalities for collaboration with appropriate (ICT) institutions for disseminating market information;

- 10** developing modalities for collaboration with appropriate agribusinesses in linking with farmers;
 - 11** maintaining available functioning eRAILS at the continental and country levels and establishing new ones where necessary;
 - 12** sensitising stakeholders and building capacity on use of eRAILS for easy access to information is essential.
 - 13** advocating harmonised institutional policies that support open access to information;
 - 14** installing compatible systems (both hard and software) at the hub and in primary information centres; and
 - 15** using other communication channels such as fliers, booklets, radio, TV, jingles, meetings, brochures, and fact sheets.
-

E Facilitation of capacity building on skills for scaling of technologies

It has been reported that the lack of adequately trained human resources is often a major constraint to scaling up. Quality training, coupled with appropriate incentives, has therefore been recommended as an essential component of scaling up. Capacity building at all levels is the key to technology adoption, use, and impact creation. One of the lessons learnt on IP management is the need for capacity improvement on the IAR4D concept among the project implementers, especially the Task Forces, collaborating institutions, and IP partners. According to Adekunle et al. (2013), the capacity development activities of SSA CP were found to assist researchers and extension agents in using participatory research and extension methods better than before the establishment of SSA CP. Similarly, farmer organisations' capacity has been strengthened in improving leadership skills, communication systems, and bargaining power. As a result, farmers' organisations in villages used the knowledge gained to register with local authorities.

Existing personnel need training to support continuing professional development as a growing organisation presents them with new challenges. Trained extension workers can become effective intermediaries between farmer innovators and external experts such as specialists, breeders, researchers and academics, and especially help authenticate the results of farmer-led research and experimentation. Binswanger and Nguyen (2005) stress the importance of training in the scaling up of community-driven development programmes. Binswanger and Aiyar (2003) focus on the development of manuals to support the implementation of such programmes. Therefore, capacity building of stakeholders for scaling of technologies should be an important strategy for success.

The major strategic activities of the capacity building strategy will include:

- 1 identifying capacity building needs for scaling up in IPs for piloting and scaling;
- 2 undertaking development of an inventory of potential partners, specifically farmer organisations and their capacity needs for scaling up;
- 3 designing a capacity building programme to address the identified skill gaps in resource persons;
- 4 Training stakeholders in application of scaling methodologies and approaches;
- 5 engaging high-level policy makers through advocacy on issues of technology adoption and scaling up, especially the need for greater capacity and a conducive policy environment.
- 6 developing a collaborative programme with regional and national farmer organisations to mobilise and build capacities of farmers at sub-regional level;
- 7 developing collaboration with the African Forum for Agricultural Advisory Services (AFAAS) for training and extension services for building the capacity of stakeholders;
- 8 building capacity for resource team with advocacy skills, facilitation skills, training, monitoring and evaluation, gender issues, and strategic management among others.
- 9 developing a manual for implementing IAR4D and scaling up to assist stakeholders.

For example, a manual titled, "A Resource Manual for Training in Integrated Agricultural Research for Development (IAR4D) in Innovation Platforms" by Fatunbi et al. (2015) has been developed and is expected to be very useful for this purpose.

F Monitoring and evaluation of technology scaling

Monitoring and evaluation has been reported to be part of scaling of technologies. According to Hatmann and Linn (2008), successful scaling up requires regular feedback from monitoring and evaluation systems. For any type of scaling, monitoring and evaluation are key ingredients of a successful scaling strategy in various important respects.

First, during the implementation of the pilot or experimental stage, the intervention needs to be monitored to learn what drivers and spaces (opportunities and constraints) may affect an eventual scaling up process. Moreover, the impact of the pilot in terms on the lives of the rural poor needs to be evaluated, preferably against a control group.

Secondly, during the scaling process, monitoring will provide important feedback on any unforeseen aspects of the scaling pathway and permit adapting the pathway as needed. Intermittent evaluation of the impact of the scaled programme during implementation and after completion is needed to ensure that the expected results are actually realised.

An appropriate monitoring and evaluation system that captures performance information at different operational levels and documents progress towards achievement of higher level objectives, outcomes and impact of the scaling activities will be developed to support the scaling up initiatives.

The **key objectives** in the monitoring and evaluation plan include:

1 tracking implementation of scaling activities and effectiveness of delivery for each key strategy;	2 tracking the outcomes and impacts of the scaling up efforts; and	3 facilitating learning of lessons.
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For successful monitoring and evaluation, the following activities should be carried out.

- 1 Establish baseline data before intervention. This will identify constraints, gaps, training needs, level of adoption of technology... for the IPs.
- 2 Develop relevant indicators for monitoring processes of successful technology piloting and scaling. This can be in the form of a Logical Framework: Giving key result areas, activities/deliverables, Indicators, and Means of Verification.
- 3 Use existing service statistics for monitoring.
- 4 Conduct rapid qualitative evaluation to gain insight into the process of scaling and constraints.
- 5 Conduct studies to evaluate outcomes and the impact of the technology scaling process.
- 6 Use results of the study to adjust the strategy as technology scaling continues.

G Facilitation of funds for scaling of technology

Fiscal and financial resources need to be mobilised to support the scaled-up intervention, and/or the costs of the intervention need to be adapted to fit into the available fiscal/financial space. IIRR (2000) indicated that there is a need for financial sustainability in scaling up and out of technologies. For sustainability of scaling technologies and innovations in Africa, there is a need for adequate funding.

The following activities should be undertaken for sustainability of financing.

- 1** Write a proposal for funding of scaling up to donors and internal organisations.
- 2** Budget costs of scaling out of technologies based on the strategy to be used for scaling.
- 3** Partner with relevant initiatives on funding to reduce costs and achieve economies of scale. For example, other initiatives like TAAT and PARI can collaborate in funding scaling of technologies in Africa
- 4** Advocate with policy makers to allocate funds for scaling of technologies in their different countries. For example, FARA or SROs can advocate through AU to different governments in the continent to pay attention to funding of scaling of technologies.

Adaptation of Scaling Knowledge in Aiding Delivery of Broad-Based Agricultural Productivity Within the Different Initiatives in Africa

Adaptation of scaling knowledge is very important for different initiatives working towards rapid agricultural transformation across Africa through raising agricultural productivity. Advances in scaling science suggest that there are a few technology scaling pilots that could be studied to advance learning, and develop a more robust and generic strategy that could apply to different ecological, social and economic terrains across Africa. This process may include consideration of approaches through which to link multiple factors, which could include: accounting for diversity and maximising co-benefits; promoting the employment, development, and transfer of technologies, including knowledge; and developing platforms for knowledge and sharing of experiences.

Before any strategy is developed on adaptation of scaling knowledge, knowing the objective of each of the initiatives is important so as to know if they have common objectives and are in line with the scaling knowledge. This is because the existing and proposed continental initiatives and frameworks such as CAADP, Science Agenda for Agriculture, and TAAT will require a high-level buy-in at the policy and technical level. The need will be at the continental, regional, and national levels, as well as at the active operational levels in the relevant research and development organisations for effective implementation. The existing initiatives with their thrusts are presented in Box 3.

BOX 3: Some of the current agricultural initiatives interested in technology generation and scaling

Comprehensive Africa Agricultural Development Programme (CAADP)

The African Union in 2014 at Malabo, Equatorial Guinea, reiterated its belief in developing agriculture to drive the economic growth of the continent. It therefore re-affirmed its commitment and support to CAADP as a framework for bringing this to reality. This is in conformity with the AU declaration of the year 2014 as the Africa Year of Agriculture, Food and Nutrition Security, which thus reinforces this commitment.

The AU has also, in its Agenda 2063, provided for science, technology and innovation (STI) within which agriculture receives prominent attention. The development of the Science Agenda for Agriculture in Africa (S3A) by FARA within this context received AU's endorsement as the mechanism for promoting the agriculture sector.

African agriculture needs to significantly benefit from improvements in science, technology, and innovation to bring about the significant change required to drive its agricultural transformation.

Technologies for African Agricultural Transformation (TAAT):

This is a collaborative plan for CG centres and FARA support of the AfDB-convened African Agricultural Transformation Agenda

The rationale for TAAT: The Dakar High Level Conference conducted from 21 to 23 October 2015 on an Action Plan for Agricultural Transformation in Africa and concluded with emphasis from the African Development Bank's President on the need "to execute a bold plan to achieve rapid agricultural transformation across Africa through raising agricultural productivity. The Dakar meeting also provided direction for the Work Stream on Research and Development as focusing on strengthening regional and national institutions; scaling up readily available technologies; and identifying best-practice technologies. Therefore, TAAT will be promoting the adoption and scaling of about eight technologies in Africa.

The Programme of Accompanying Research for Agricultural Innovation (PARI)

This is an initiative of the German Government, which brings together partners from Africa, India, and Germany to contribute to sustainable agricultural growth and food and nutrition security in Africa and India. PARI also offers independent scientific advice to the special initiative of the German Government "One world without hunger" (SEWOH) which, among other activities, supports the improvement of food and nutrition security and sustainable agricultural value chains by setting up Green Innovation Centres.

The specific goals of PARI are to promote and support the scaling of proven innovations in the agri-food sector in partnership with all relevant actors; to support and enhance investments in the GICs through research; and thereby to contribute to the development of the agri-food sector in Africa and India through the identification, assessment, and up-scaling of innovations

The Science Agenda for Agriculture in Africa (S3A)

The Science Agenda for Agriculture in Africa (dubbed 'Science Agenda' / S3A) is an African-owned and African-led process that articulates the science, technology, extension, innovations, policy, and social learning that Africa needs to apply in order to meet its agricultural and overall development goals. The strategic thrusts of the S3A in the short to medium term are: implement CAADP; increase domestic public and private sector investment; create an enabling environment for sustainable application of science for agriculture; and to double the current level of Agricultural Total Factor Productivity (ATFP) by 2025 through application of science for agriculture.

Box 3 shows that all the agricultural initiatives have a common goal and objectives. The goal is the rapid agricultural transformation across Africa through raising agricultural productivity. However, for successful adaptation of scaling knowledge in aiding delivery of broad-based agricultural productivity within the different initiatives, certain strategies must be put in place.

1 Collaboration and partnership

It has become evident all over the world that many agencies have recognised the importance of developing synergies with initiatives that have common goals and purposes. This is because when they are aligned around shared goals, they can work collectively, sharing knowledge and experiences to improve individual projects that work towards a similar objective. This may involve different ways of working, thus providing good opportunities for sharing lessons learned and avoiding duplication. This can be in the form of workshops, seminars, and meetings, for instance. Agricultural innovation systems and scaling up research has become a highly dynamic subject of interest to a number of initiatives operating within the continent, as shown in Box 3. They may engage in dialogue to agree on concrete working arrangements, action plans, and indicators of progress; and develop a strategy of how they can share knowledge, support scaling, and adapt scaling knowledge.

2 Learning from successful agricultural technology scaling projects

There have been reports of some successful agricultural technology scaling projects within the continent and all over the world where learning of scaling of technologies can be used to adapt scaling knowledge.

For example, the African Development Bank-funded Dissemination for New Agricultural Technologies in Africa (DONATA) programme has been found to be a successful mechanism for adoption and scaling of technologies and innovations. FARA and the SROs documented a number of lessons learnt in scaling, which have been part of knowledge that can be tapped.

Also, implementation of IAR4D for adoption and scaling of technologies has gained widespread popularity not only in Africa but all over the world. Experiences and lessons have been documented by FARA where scaling knowledge can be tapped. For example, the recently implemented West Africa Agriculture Productivity Programme (WAAPP) has learnt from DONATA's successes in 2011 in establishing the WAAP commodity value chain innovation platform. In addition, DONATA focal point is assigned to continue as WAAPP focal point in the innovation platform component of WAAPP (Jarju, 2012). IP pilot farmers and processors have been involved in mentoring in the WAAPP innovation platform.

3 Platforms for information/experience sharing and learning

Coordination and knowledge sharing among actors is key. Scaling requires multiple actors across various landscapes to coordinate together to adapt scaling activities. Sharing lessons learned is the most important enabling condition in scaling.

Knowledge, experience sharing, and cross-learning are important avenues for enhancing adaptation of up-scaling successful technologies and processes. There are many initiatives on agricultural research and development that have in-built mechanisms for sharing and disseminating project results and achievements. For example, the CGIAR centres have events and forums to disseminate and to share theme-based experiences and achievements among themselves and other partners as do the National Agricultural Research Institutes (NARIs). Often the focus is on outcomes, impacts, and to some extent research methods. More recently, attention is being directed towards participatory processes, such as the CIAT initiatives on scaling up and learning alliances (Kimenye and McEwan, 2014).

Sharing knowledge and experiences is a powerful tool for facilitating innovation systems. It can also enable other initiatives to identify and adapt extension models and systems for their situations based on solid empirical evidence.

4 Use of ICT knowledge portal

Using ICT to facilitate knowledge sharing among different partners may serve to promote institutional change at the systems level.

The eRAILS (www.erails.net) was established to develop websites to enhance learning, information, and knowledge exchange among scientists and researchers during the DONATA Project. It gave researchers and scientists a platform to engage and exchange ideas and resources and thereby reduce duplication of efforts, save time and make research efforts more meaningful and rewarding for the actors and the African agriculture. This will be a good platform for adaptation of scaling knowledge by different initiatives in the continent. The strategic theme is about collating, analysing, synthesising, learning, and making available to stakeholders a web-based database and documented materials on the best-bet technologies, approaches, and other research outputs. The aim is to enhance availability and potentially increase access to available promising best-bet technologies and approaches to wider audiences.

As part of an information sharing aspect of adaptation of scaling knowledge, use of the Dgroup system is also good for adaptation of knowledge sharing as used in the PSTAD project, which is a good mechanism for scaling agricultural technologies and innovation.

The Dgroup system is an online communication tool that makes it possible for individuals and organisations in the development sector to come together and interact with one another and share knowledge between and among themselves. Establishment of Dgroups communities is improving communication and knowledge sharing among PSTAD stakeholders at national, sub-regional, and continental levels; it can also be a good forum for adaptation of knowledge by different initiatives in the continent.

5 Funding of scaling technologies

Learning and knowledge do not come for free. They require equipment, personnel, and other resources to establish a platform for learning and knowledge sharing and adaptation. In the process of striving to gain knowledge and adapt scaling of agricultural technologies through these initiatives, efforts should be made to employ different modalities, funding structures and activities. This way, they will provide excellent opportunities to exchange experiences and lessons. Interaction among such initiatives could reduce transaction costs and achieve economies of scale. Funding of scaling of technologies should be a joint programme of many initiatives as an important component of adapting scaling knowledge. This approach has worked in many conservation agricultural projects.

6 Monitoring and evaluation framework

One of the major objectives of monitoring and evaluation is learning lessons. An appropriate monitoring and evaluation system that captures performance information at different operational levels and progress of documents towards achieving higher level objectives, outcomes, and impact of the scaling activities should be developed to support the scaling of technologies. Therefore, the use of monitoring and evaluation reports will not in any way contribute to knowledge gain and adaptation of scaling knowledge by agricultural initiatives. This can influence the initiatives to learn from participatory evaluation.

Technology and Innovation Scaling Strategy at Country Level in Africa

There is need to develop a good strategy as what works in one country may not work in another because of some factors like governance, policy, agro-ecology, and the technologies and innovations to be scaled. However, the strategy being developed is a comprehensive one that is important for successful sustainable vertical and horizontal scaling of technologies and innovations for any country in the continent. Figure 8 can serve as a conceptual framework for scaling technology and innovation within each country in Africa. In this framework, the sustainability is considered so that scaling activities will be sustained scaling after donor funding in case the activities are sponsored by a donor.

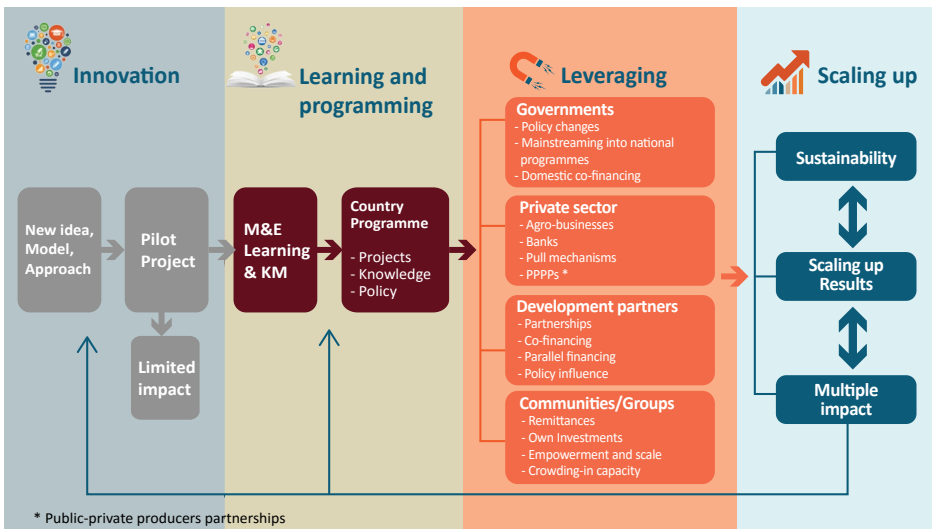


Figure 9: Framework for scaling technologies and innovations in individual countries of Africa (Adapted from IFAD (2015)).

At the country level, the national institution will collaborate with other relevant national agencies to ensure they effectively contribute to the realisation of scaling of technologies as may relate to their area of mandate. An institutional mapping should be undertaken at the inception to determine the relevant institutions and the roles they may play in the

accomplishment of the scaling of technologies and innovations. That is, each country will have to get a focal institution especially from the National Agricultural Research Institution (NARI) that will coordinate the scaling of technologies and innovations.

The following strategies are recommended for successful scaling of technologies in individual countries.

A Selection of scalable technologies and innovations

Many authors have indicated that not all technologies and innovations are scalable as they may need to meet certain criteria. Each country must consider this factor when selecting new technologies for scaling. Cooley and Kohl (2006) identified the following variables in relation to scalability mainly in terms of scaling out of innovations. The innovations must be:

- 1 Credible, based on sound evidence or espoused by respected persons or institutions;
- 2 Observable, to ensure that potential users can see the result in practice;
- 3 Relevant, for addressing persistent or sharply felt problems;
- 4 Having a relative advantage over existing practices;
- 5 Easy to transfer and adopt;
- 6 Compatible with existing users' established values, norms, and facilities;
- 7 Able to be tested and tried without committing to the potential user the complete adoption when the results have not been seen.

The following strategic activities must be considered when scaling technologies

- 1 There is need to gather successful pieces of evidence of technologies and innovations from the pilot and document them.
- 2 Documentation should be shared widely and disseminate success stories and best practices that will be beneficial to the stakeholders.
- 3 Select simple technologies that can be easily trialled in diverse environments by a wide range of people.
- 4 Challenges and lessons learnt on the technologies and innovations should be addressed before scaling up.
- 5 Technologies should be expanded gradually to new geographical zones and population groups. That is, horizontal scaling should be stepwise, i.e., moving from one agro-ecology or community to another and then to LGA/district, and state.

B Use of innovation platforms as a mechanism for scaling of technologies

An innovation platform is a strategic collaboration between key stakeholders. Participatory approaches and learning tools are used to analyse technology dissemination and adoption based on the context and specificity of the beneficiary communities. The aim of the innovation platform is to bring together relevant value chain stakeholders to develop institutional mechanisms that will support up-scaling of technologies such as new varieties, agronomic practices, and post-harvest activities.

The following activities are to be carried out:

- 1** Each country will select technologies and innovations based on the country constraint identified. One country may select maize and cassava while another may select sorghum and millet depending on the agro-ecology where the commodity can thrive.
- 2** Where necessary, identify and establish IPs in the district or local government areas of the country (Establish platforms on segment of value chain.)
- 3** Select areas for establishing IPs where the environment is conducive for scaling. That is where the policy environment is good and stakeholders are interested to support adoption and scaling of the selected technologies.
- 4** Conduct stakeholder analysis studies for each of the selected sites, clarifying and agreeing roles of different stakeholders.
- 5** Establish IP for scaling technologies where most of the partners are present in order to discuss the situation of farming and marketing of the product and the related problems and the responsibility of each actor.
- 6** Conduct value chain analysis for each technology (commodity) and site to determine challenges and opportunities.
- 7** Facilitate early research and testing of options by farmers on-farm, for addressing opportunities, especially farmers' innovations that are being tested for scaling in similar agro-ecologies.
- 8** Ensure early active involvement of relevant stakeholders, especially agri-business, women, and the private sector in input supply, marketing, transporting, and financing.
- 9** Organise technical backstopping of the operations of the IPs in terms of guiding technological and innovative interventions on business opportunities and development, policy guidance, and strengthening of multi-stakeholder engagements or participation.

- 10 Encourage early one-on-one meetings with stakeholders to promote understanding and lobby for active support of technology scaling by policy makers and local leaders.
- 11 Ensure participatory monitoring and evaluation, and learning and sharing of experience.

C Use of value chain approach for scaling technologies

Use of the value chain development will ensure that the key actors at each value point are sensitised and empowered to be able to receive good returns to their investment of money, time, and energy. Value chain analyses for the commodities of focus in the country should be undertaken. For example, innovation platforms in a district or local government area can be segmented based on value chain as in DONATA Project (Figure 9)

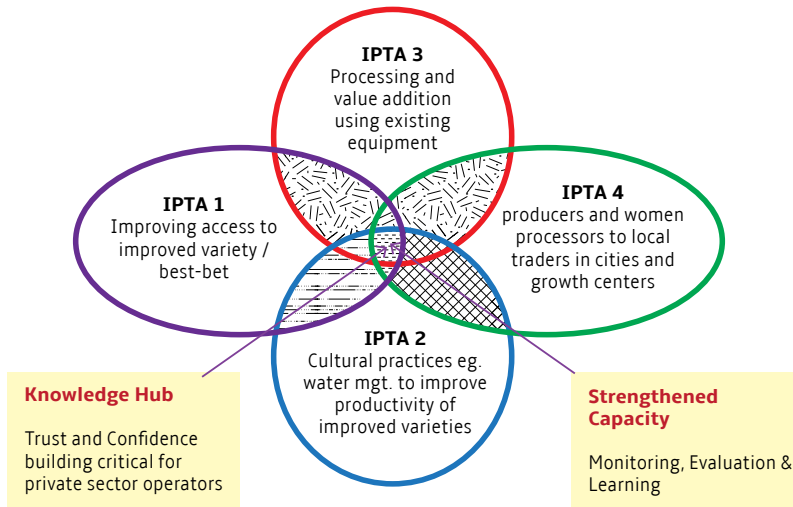


Figure 10: Innovation platform for technology adoption -Value Chain (CORAF, 2009).

Value addition and product development from the selected crops is one way to extend shelf-life and preserve the produce as well as ensure availability of the crop produce/product to a wide variety of consumers. Increased and sustainable consumption of the produce/products would drive sustainable production of the crops to guarantee steady income and better livelihood for the producers and other actors along the commodity value chain. This describes the situation whereby a commodity is processed as raw material for production of a variety of marketable products. The products usually cost more than the unprocessed raw material and usually have longer shelf lives. The existence of such processing facilities provides opportunities for farmers to sell all their surplus produce. This outlet for raw

materials thus acts as an incentive for the farmers to produce more surplus for more income to themselves. This influences farmers to adopt such technologies as they will want to produce more of such productive and marketable technologies.

The following activities will be carried out:

- 1** Survey the potential for value addition and development of products in the selected commodities within the country.
- 2** Determine market requirements for the produce and the potential for value adding as well as processing of the produce.
- 3** Develop relevant value chain product bases for the selected commodities and their acceptability in the available markets.
- 4** Prepare feasibility studies for the development of the various identified potential products.
- 5** Determine the types of processing equipment required for the development of products.

D Facilitating emergence of agribusinesses for scaling of technologies

The existence of agribusinesses, which purchase quantities of produce especially those that process agricultural produce to add value to it, means that a greater market for farm produce is available; the market acts as an incentive to farmers to produce more. This is precisely what is needed to achieve transformation. It has been demonstrated the world over that the existence of agribusinesses provides important stimuli for agriculture sector development. The idea is that once these factors begin to come into play, the process of uptake and scaling up of new technologies and innovations will be accelerated.

The facilitation of agribusiness incubator calls for support for value addition and product development in assisting to identify potential agribusinesses associated with the produce of the selected commodities. It also facilitates access to technical and financial support services required to enable the available potential to be translated into viable business enterprises; the enterprises will also serve as a source of employment generation for the teaming unemployed youths in each of the countries in Africa.

For example, the production of Mamera from sorghum will promote more production of sorghum and this can generate employment for youth in the industry as shown in Box 4

BOX 4: Example of emergence of agri-business from an innovation platform in Uganda

One other major success of agri-business emanating from IP that is good to show case is the production of **Mamera**. This is a product in which Bubare IP partnered with HUNTEX Industries (owned by a private partner and a member of the IP). It is already a registered brand name and is gazetted by the Government of Uganda (GOU). The brand name is associated with the good-quality Bushera (fermented sorghum porridge) in Kabale District and has attracted big market demands for the sorghum products in Kabale and beyond. This trademark, Mamera, is expected to be used for a number of products that will be produced by Bubaare sorghum IP, including malted sorghum flour (a ready-to-use flour for home or urban small-scale Bushera makers). Bushera quality parameters were developed by the incubation centre of Makerere University Food Science and Technology Department (MAK-FST). Source: Tukahirwa et al (2013)



Figure 11: The process of hot filling of Mamera Source: Tukahirwa et al. (2013)

Another example of how the agri-business is driving scaling of technology is found in the Gambia where production and introduction of branded Gambian rice is being produced and packaged into the Gambia market as shown in Figure 11. Many farmers are now going into rice production as a result of this initiative.



Figure 12: Jahally, Gambia rice IP processed product

The following strategic activities will be carried out:

- 1 Run training workshop on potential agribusinesses for actors on the innovation platforms to enhance their entrepreneurial skills and assist their decision value to invest.
- 2 Ascertain and promote entrepreneurship for product development from the selected crop produce and determine the infrastructure requirements to make this happen.
- 3 Link and establish collaboration with the private sector for agribusiness incubation development in the processing, packaging, and marketing of produce/products to enhance utilisation and further increases in production of the selected commodities.
- 4 Establish systems and networks for information and knowledge exchange and to link growth poles for a more harmonised agricultural, business, and social transformation.
- 5 Collaborate with financial institutions on the IPs such as the miro-finance and outside in support of potential agro-enterprises.
- 6 Develop modalities for collaboration with business information providers.
- 7 Facilitate protection of property right for the products.

D Facilitation of capacity building

Capacity building at all levels is the key to technology adoption, use, scaling, and impact creation. The specific technical knowledge and skills required will depend on the sector or commodity focus of the innovation platform. Knowledge and skills about market functioning and value chain analysis would be needed if a value chain approach is used. For horizontal scaling, focus on adaptive up-take of technologies will require skills and experience around participatory approaches, collective action, and extension methodologies. Capacities for vertical scaling activities will require advocacy skills for policy dialogue and for making linkages with those decision makers who can affect the policy and institutional change required for further up-scaling. Strengthening the knowledge management capacities of farmer organisations can provide a bridge for multi-directional knowledge flows within and across different levels of partnerships (McEwan, 2009). Successful scaling up programmes need organisations with the institutional and human capacity to deliver on the scaling up mandate. Institutions lacking the capacity to operate the larger programmes can be serious obstacles to scaling up. Two problems are involved in this, an unwillingness of organisations to carry through the required change needed to create the capacity for scaling up, and lack of skills, systems, and manpower to manage the increased programme especially within a country.

The following strategic activities will be carried out:

- 1** Identify capacity needs in the new stakeholders who will use the technologies before scaling of the technologies and innovations.
- 2** Design a capacity building programme to address the identified skill gaps for resource persons.
- 3** Build capacity for resource team with advocacy skills, facilitation skills, training, monitoring and evaluation, gender issues and strategic management. Those who will facilitate like extension staff, researchers, NGOs and CBO staff will need to be trained.
- 4** Identify capacity building needs for scaling in IPs for piloting and scaling.
- 5** Undertake an inventory of potential partners, specifically farmer organisations and their capacity needs for scaling.
- 6** Train stakeholders in application of scaling methodologies and approaches.
- 7** Each country can request for copies of “A Resource Manual for Training in Integrated Agricultural Research for Development (IAR4D) in Innovation Platforms” by Fatunbi et al. (2015). This manual is useful as it covers a wide range of skill development activities on using innovation platforms for technology adoption and scaling.

E Creation of awareness and advocacy for scaling of technologies

The importance of awareness for scaling technology cannot be overemphasised especially within a country. This is because to adopt and scale any technology, the stakeholders must be aware of the technology, for both vertical and horizontal scaling require advocacy. In fact, the positive impacts of bottom-up technologies are not well known in many countries. Therefore, there is a need for strong advocacy towards governments, extension services, development agencies, and the private sector. It is only through advocacy that the mind shift can take place among farmers, extension personnel, government officials, researchers, and others involved in agriculture. Such advocacy lends legitimacy to the technology transfer process and increases adoption by farmers and farmer organisations. Figure 12 shows an example of how a field day may be used to promote awareness of technologies and innovations among stakeholders and policy makers.



Figure 13: Field Day on participatory assessment of bean germplasm at Rumangabo site (Maendeleo IP in DRC) consisting of evaluator groups, farmers, and the Provincial Minister of Agriculture. Source: Tukahirwa et al. (2013)

The following strategic activities will be carried out

- 1 Advocate for policy change among policy makers because a suitable policy environment for supporting the agriculture sector will assist in the scaling of technology.
- 2 Identify and advocate with policy makers in LGA, state and national level stakeholders who will be instrumental in allowing expansion, replication, and adaptation of technologies. There is therefore a need to advocate with district or local government leaders, traditional leaders, decision makers, extension service, and policy makers to assist in driving the process of scaling technologies.
- 3 Make realistic plans for expansion of technologies to new sites based on entry points and constraints. Start with few new sites and gain experience before expanding to other villages, state, and eventually the nation (phased introduction).

- 4** Make use of leaflets, radio, television and visits to demonstration sites of proven technologies to communicate successes of the technologies and innovations to new stakeholders for successful scaling out.
- 5** Make use of policy briefs, success stories, reports, and publications, and evaluation reports on technologies and innovations to advocate with decision makers (vertical scaling)
- 6** Conduct personal advocacy with influential people by focal persons and institutions including political leaders, ministers, LGA chairmen, and extension personnel. For example, at Dandume Local Government area of Katsina State in Nigeria, the scaling out spread from the initial five-pilot villages to all 11 villages in Dandume LGA. This was reported to be due to the support of the local government chairman.
- 7** Studies and experiences have shown that the most preferred scaling up approach by small-scale farmers, especially non-educated ones, are field days, farmer field schools, and fellow farmers. Organise visits to demonstration sites or farmers' exhibition where a governor of a state or LGA chairman will be a guest to convince stakeholders and political leaders as shown in Figure 12.
- 8** Waters-Bayer et al. (2009) indicated that farmer innovation fairs, for example, bring together farming communities with policy makers and government representatives, formal research institutions, academia, NGOs, and private sector stakeholders to learn about farmer innovation processes and identify areas for future collaboration.
- 9** Ensure support for strengthening women groups' participation in scaling of technology and innovations.
- 10** Use opportunities of national, regional, and local forums to advocate integration of scaling of technologies and innovations in LGA/District, state, county, and national agricultural development plans and policies. For example, some countries in Nigeria, Gambia, Sierra Leone, and Uganda have given direction for the use of IAR4D/IP for research activities in their countries as a national policy.

F Facilitation of market and use of ICT for technology scaling within a country

Successful private sector-driven scaling has the effect of providing markets for farm products, which in themselves act as incentives for increased farm output (Swanson, 2008). Therefore, the major thrust of this strategy is that markets, and not technology, are increasingly becoming the drivers of agricultural development in many countries.). Once farmers realise that there are available markets around them, they will want to produce more and therefore require more of the technology and many other farmers will demand for such technology.

FAO (2014) recommends increasing access to markets as a means of giving family farmers incentives to innovate. Barriers to farmers adopting innovative practices include absence of physical and marketing infrastructure, financial and risk management instruments, and secure property rights. This logic is based on the assumption that technology scaling is motivated primarily by commercial 'pull' factors, and does not consider that only relatively resource-endowed farmers may be able to respond to new market opportunities.

A good example of how market drives scaling of technologies was found in the DONATA Project in Burkina Faso. According to Adekunle et al. (2013), the Société nationale de gestion de stock de sécurité alimentaire (SONAGES), which buys maize, was a strategic partner in DONATA. The marketing manager of SONAGES confirmed that through the assistance of the DONATA project, the company had a delivery contract of 532 tonnes of maize from the IPTA in 2010 alone. Apart from SONAGES, there are many other stakeholders. They include food processors and poultry famers, who joined the platform because almost 70 percent of maize in the area goes into poultry production. Availability of such markets in the IPs stimulates demand for the technology and subsequently leads to adoption and scaling of such a technology.

In addition to market, experience from India shows that provision of market information can greatly assist farmers to choose what commodities to produce, what production technologies to apply, when to produce, and indeed for whom to produce. In other words, for smallholder farmers to change their situation and improve their livelihoods, provision of market information to them will be key to their transformation.

Therefore, to get technologies and innovations adopted and scaled by smallholder farmers, the farmers not only need to be informed about the technologies or innovations themselves, but also the market opportunities for what they produce. ICT has the potential to deliver market information to these rural farming communities. ICT is an umbrella term that includes anything, ranging from radio to satellite imagery and to mobile telephones. Their affordability has resulted in their spread and use even in rural areas. Furthermore, using ICT to facilitate knowledge sharing among disparate networks of farmers may also serve to increase exposure among policy makers, which may in turn promote institutional change at the systems level.

The PSTAD project built the capacity of NARS in knowledge management using ICT. Many of the countries have individual country eRAILS portals. They include Gambia, Togo, Ghana, Cote d'Ivoire, and Burkina Faso. Farmer organisations are also using the eRAILS portal to increase their visibility and share information related to their activities not only to the external world, but also to their members. This approach will be a good mechanism for disseminating information on available technologies and market information in individual countries.



Image 2: Website developed by Market Unit/Market Data Analyst Planning Services Unit, Department of Agriculture, Ministry of Agriculture, Gambia. Source: FARA, (2011)

The major activities of this strategy will include:

- 1 Determining the market needs of the IPs. The market needs of each of the IPs must be determined so as to organise and involve relevant marketing institutions in the IPs for buying produce produced.
- 2 Ascertaining the marketing channels and structures to meeting the identified needs, noting the challenges and opportunities to explore.
- 3 Promoting development of appropriate channels and structures to enhance effective marketing of the produce/products from the IPs.
- 4 Strengthening the capacity of the IPs on packaging, markets, and marketing of products and services.

- 5 Facilitating access to national and other markets suitable for the disposal of IP products.
 - 6 Facilitating establishment and proper management of product quality and standards to ensure better market share and good return to investment.
 - 7 Establishing systems for exchanging market information and management for better agricultural business flow.
 - 8 Facilitating policy improvements for better agricultural market integration across the various divides in each country.
 - 9 Developing modalities for collaboration with appropriate (ICT) institutions for dissemination of market information
 - 10 Maintaining available functioning eRAILS in each country and state levels and establishing new ones in countries where necessary.
 - 12 Agreeing on harmonised institutional policies that support open access to information in each country.
 - 13 Installing compatible systems (both hard and software) at the hub and in primary information centres.
 - 14 Using other communication channels such as fliers, booklets, radio, TV, jingles, meetings, brochures, fact sheets, and mobile phones.
-

G Generation of financial resources

Scaling of technologies will require funds but the budget for agriculture in many of the countries is small. Accordingly, there is need to mobilise funds for scaling activities.

The following activities should be carried out:

- 1 Mobilising funds for training resource team and adjusting the pace and scopes of scaling up to ensure the resource team provides adequate support;
- 2 Writing a proposal for funding of scaling up to donors and internal organisations;
- 3 Budgeting costs of scaling out as part of an annual budget in each country; Project proposals should include cost of advocacy activities. Costs of personnel should also be budgeted for in the scaling budget.

- 4 Advocating having a national budget on IP scaling up activities;
 - 5 Partner with relevant initiatives on funding to reduce cost, i.e., having economies of scale.
 - 6 Scaling of technologies requires increased investments in the agricultural sector. Therefore appropriate action through media coverage, field visits, and reports on the economic benefits of scaling of technologies should be made available to the donor communities.
 - 7 Getting the support of local leaders and policy makers can also assist in getting funds and resources for scaling as well as lead to sustainability of scaling of technologies. For example, in KKM PLS, the chairman of Bunkure Local Government in Kano State, Nigeria, was reported to have distributed motor cycles to the extension agents on the Cereal/Legume IP in order to make the extension agents function well in disseminating information and technologies to farmers.
-

H Monitoring and Evaluation

Progress and challenges should be documented. Monitoring and evaluation should help inform on the positive impacts of scaling of technologies and innovations on poverty reduction through development of an appropriate database.

The following activities should be carried out

- 1 Develop simple monitoring and evaluation indicators for tracking activities related to technology scaling up;
- 2 Use results of monitoring and evaluation to adjust the strategy as scaling-up proceeds;
- 3 Use existing service statistics for monitoring;
- 4 Conduct rapid qualitative evaluation to gain insight into the process of scaling and constraints; and
- 5 Conduct studies to evaluate outcomes and impact of the process of technology scaling.

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About FARA

The Forum for Agricultural Research in Africa (FARA) is the apex continental organization responsible for coordinating agricultural research for development (AR4D) in Africa so as to increase its efficiency and effectiveness. It serves as the entry point for agricultural research initiatives designed to have a continental reach or a sub-continental reach spanning more than one sub-region.

FARA serves as the technical arm of the African Union Commission (AUC) on matters concerning agricultural science, technology and innovation. It provides a continental forum for stakeholders in AR4D to shape the vision and agenda for the sector and to mobilize them to respond to key continent-wide development frameworks, notably the Comprehensive Africa Agriculture Development Program (CAADP) of the African Union (AU) and the New Partnership for Africa's Development (NEPAD).

FARA's vision:

Reduced poverty in Africa as a result of sustainable broad-based agricultural growth and improved livelihoods, particularly of smallholder and pastoral enterprises

FARA's mission:

Creation of broad-based improvements in agricultural productivity, competitiveness and markets through strengthening of the capacity for agricultural innovation across the continent

FARA's value proposition:

Strengthening Africa's capacity for innovation and transformation by visioning its strategic direction, integrating its capacities for change and creating an enabling policy environment

FARA's strategic direction is derived from and aligned with the Science Agenda for Agriculture in Africa (S3A), which is, in turn, designed to support the realization of the CAADP vision of shared prosperity and improved livelihoods.

FARA's programme is organized around three strategic priorities (SPs), namely:

Visioning Africa's agricultural transformation through foresight, strategic analysis and partnerships to enable Africa to determine the future of its agriculture, using proactive approaches to exploit opportunities in agribusiness, trade and markets, taking the best advantage of emerging sciences, technologies and risk mitigation practices and approaches, and harnessing the combined strengths of public and private stakeholders.

Integrating capacities for change by making different actors aware of each other's capacities and contributions, connecting institutions and matching capacity supply to demand, so as to create consolidated, high-capacity and effective African agricultural innovation systems

that can use institutional comparative advantages to mutual benefit while strengthening individual and institutional capacities.

Enabling environment for implementation, initially through evidence-based advocacy, communication and widespread stakeholder awareness and engagement to generate enabling policies and institutions, then by ensuring the stakeholder support required for the sustainable implementation of program for African agricultural innovation.

Key to these outcomes is the delivery of three important results, which respond to the strategic priorities expressed by FARA's clients. These are:

Key Result 1: Stakeholders empowered to determine how the sector should be transformed and to undertake collective actions in a gender-sensitive manner

Key Result 2: Strengthened and integrated continental capacity that responds to stakeholder demands in a gender-sensitive manner

Key Result 3: Enabling environment for increased AR4D investment and implementation of agricultural innovation systems in a gender-sensitive manner.

FARA's development partners are the African Development Bank (AfDB), the Canadian Department of Foreign Affairs, Trade and Development (DFATD), CGIAR, the Danish International Development Agency (DANIDA), the UK's Department for International Development (DFID), the European Commission (EC), the governments of the Netherlands and Italy, the Norwegian Agency for Development Cooperation (NORAD), the Australian Agency for International Development (AusAid) and the World Bank.

The Program of Accompanying Research for Innovation (PARI) brings together partners from Africa, India and Germany to contribute to sustainable agricultural growth and food and nutrition security in Africa and India. PARI offers independent scientific advice to the special initiative of the German Government “One world without hunger” (SEWOH) which, among other activities, supports the improvement of food and nutrition security and sustainable agricultural value chains by setting up Green Innovation Centers (GICs) in 12 African countries and India.

Specific goals of PARI are to promote and support the scaling of proven innovations in the agri-food sector in collaboration and partnership with all relevant actors; to support and enhance investments in the GICs through research; and thereby to contribute to the development of the agri-food sector in Africa and India through the identification, assessment and up-scaling of innovations. The core topics and thematic research priorities of the Program have been identified in accordance with the African Union’s CAADP as part of the New Partnership for Africa’s Development (NEPAD).

PARI’s collaborative work includes:

- 1** Innovation research with future-oriented impact analyses, such as:
 - modelling and mapping direct and indirect impacts of potentially promising innovations
 - developing methodologies and concepts for strategic analysis of potentials and prospects
 - institutional analysis of the GICs in the context of their national agricultural innovation systems

- 2** Identifying and stimulating technological and institutional innovations, such as:
 - screening for promising innovations from research and innovation systems (“top-down” approach)
 - soliciting innovations generated by farmers and other actors in the value chains (“bottom-up” approach)
 - scaling of innovations

- 3** Engaging with food and agriculture policy making to enhance approaches for innovation that improve food and nutrition security.

The Program is being implemented by an international, interdisciplinary consortium of three universities (ZEF / University of Bonn, University of Hohenheim, Technical University Munich), the Forum for Agricultural Research in Africa (FARA) and its network of national and regional partners in Africa, and the African Growth and Development Policy Modeling Consortium (AGRODEP) facilitated by the International Food Policy Research Institute (IFPRI, Africa Office) and research collaborators in India.



Design and Print Qualitytype Limited 0277484612



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ISBN: 978-9988-8776-1-3

