Innovation systems and scaling

A summary synthesis of SIMLESA Project, 2010 – 2019

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Abstract

A scaling strategy informed by years of scaling research and implemented through Agricultural Innovation Platforms (AIP), participatory research and partnerships and a competitive grant scheme (CGS) ensured wider reach (over 5 million farmers) and support for an estimated >10% adoption. The efficiency of electronic-based scaling; TV, radio and mobile were not fully evaluated due to time and resource limitations. TV and radio were effective in reaching millions, with a <10% adoption based on partner estimates. Participatory methods, especially interactive plot-based learning were estimated to result in about 20% adoption, but with a low mode and median reach of 30,000. Successful AIP had an average active membership of <100, yet, through investments, diversification, service delivery they facilitated equitable sustainable intensification (SI) among an average of >2000 households. AIPs did not reach hundreds of thousands, but rather, their investments ensured that farmers had quality access to SIMLESA portfolios and received support to utilise them. AIP-based scaling led to multiple co-benefits and spill-overs at scale, and resulted in wider social (incl. gender) inclusivity. During its last two years (2017 and 2018), SIMLESA organised a research-guided CGS. The CGS main purpose was to accelerate the handover of SIMLESA concept and portfolios from research to development (sustainability). New forms of partnerships were established among tens of organisations, and the SIMLESA approach, portfolios and equitable benefits were undergoing institutionalisation. That institutionalisation process need fuller support; research, national and donor investments and policy.

Introduction

The Sustainable Intensification of Maize and Legume Systems for Food Security in Eastern and Southern Africa (SIMLESA) program (www.simlesa.cimmyt.org; CIMMYT 2015) employed adaptive research (e.g. van de Fliert *et al*., 2010) since 2010. Sets of SI portfolios (technologies, practices, knowledge, materials, methods and concepts) were generated as illustrated in preceding sections. Under SIMLESA, several conservation agriculture (CA-) based (e.g. Thierfelder *et al*., 2015; FAO 2009) sustainable intensification (SI) *portfolios* were tested and improved for numerous contexts. These options include zero, reduced or minimum tillage, retention of adequate levels of crop residues on the soil surface or/and legume cover, practice multipurpose cropping systems especially rotation and intercropping, seed systems. Special emphasis was on efficient use of production resources – fertiliser, equipment, labour, etc. guided by smallholder immediate term social and economic targets (Kassam *et al*., 2009; Wall 2006). Research on SI benefits focused on five themes i) economic analyses ii) agronomic trials iii) seed iv) innovation systems, incl. scaling v) equity, especially addressing gender as a cross cutting theme (e.g. Kassie *et al*., 2015; Thierfelder *et al*., 2016).

Scaling research in SIMLESA was a *transdisciplinary* connection between Sustainable Intensification (SI) research and impact at scale (IIRR 1998; Uvin and Miller 1994). In SIMLESA Phase I and II Agricultural Innovation Platforms (AIP) were the primary pathway to impact. The reliance on AIP was advised by the need for inclusive and holistic extension. It is known that investment in extension yields 80% annual rates of return. However, only 15% of the world's extension agents are women, only about 5% of women farmers benefit from direct extension services (G-FRAS 2012). Besides, extension–farmer

ratio is about 1:2000 in sub-Saharan Africa (Duo and Bruening 2007). By relying on Innovation Systems approach, SIMLESA sought to go beyond reaching households, to increase program benefits and impact (see also IIRR 2000; Proctor 2003) and achieve social equity through policy, investments and better institutions.

SIMLESA had three (3) specific targets which were to be achieved by 2023 in the focus nations, namely:

i). Improvement in maize and legume productivity by 30%;
ii). Reduction in downside risks by 30%; and
iii). Benefit >650,000 farm households by 2023.

SIMLESA lasted 9 years, from 2010 to 2018. It was divided into two main phases, Phase 1 – 2010 to 2014 and Phase II – 2014 to 2018. It had a one year extension – June 2018 to June 2019. Funding for the program was from the Australian Government, through Australian Centre for International Agricultural Research (ACIAR). The program was managed by the International Maize and Wheat Improvement Center (CIMMYT), in partnership with national agriculture research systems (NARS).

SIMLESA Objectives

Objective 1: To characterise maize-legume production and input and output value chain systems and impact pathways, and identify broad systemic constraints and options for field testing;
Objective 2: To test and develop productive, resilient and sustainable smallholder maize-legume cropping systems and innovation systems for local scaling out;
Objective 3: To increase the range of maize-legume varieties available for smallholders through accelerated breeding, regional testing and release, and availabilities of performance data;
Objective 4: To support the development of local and regional innovation systems and scaling-out modalities;
Objective 5: To build capacity to increase efficiency of agriculture research, today and in the future.

SIMLESA Participating Countries

SIMLESA program was implemented in five countries in Eastern and Southern Africa, namely:

i). Ethiopia
ii). Kenya
iii). Tanzania
iv). Malawi
v). Mozambique

A limited set of activities were undertaken in three spill-over countries of Uganda Rwanda and Botswana. South Sudan was one of the spill-over nations, but due to instability in the country, the programme suspended its operations there. The Map of Africa in Fig 1 shows the focus and spill-over nations.

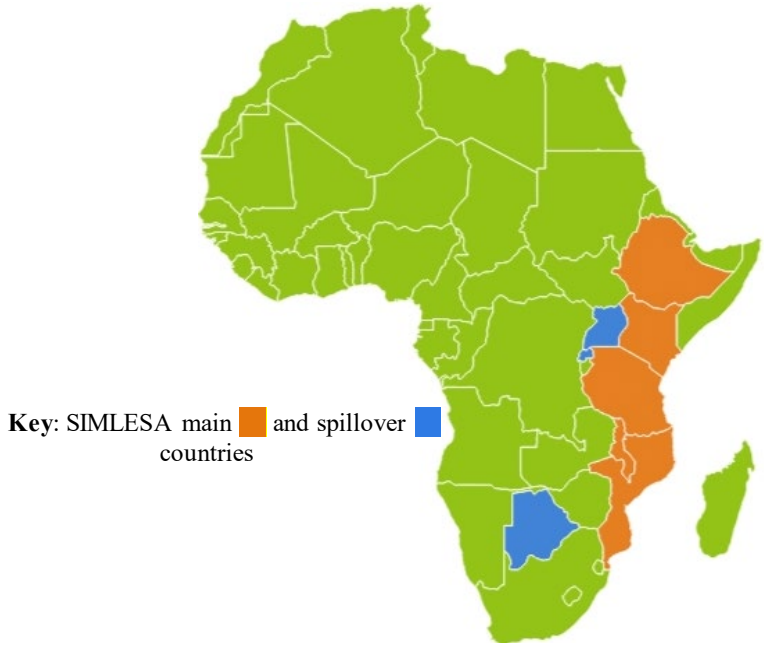

Fig. 1 Map of Africa showing the SIMLESA focus and spill-over countries

SIMLESA was founded on the premise that the African continent has a preponderance of small size farms. According to the Alliance for a Green Revolution in Africa (AGRA), Africa has approximately 51 million farms, 80% of which are less than two hectares in size (AGRA 2017). Improving the productivity, profitability and resilience of these smallholders should be the focus of research and development, feasibility studies, and scaling of agricultural portfolios (practices, technologies, innovations, knowledge).

Definition of scaling

Scaling is the systematic process of sharing, disseminating and applying of practices, technologies and innovations to attain greater impact and benefits to a society or designated target groups. It involves expansion, replication and collaboration to bring extra actors and geographical locations.

In SIMLESA, it specifically referred to the process of *widespread learning and achievement of Sustainable Intensification (SI) benefits* quickly, equitably, lastingly and at affordable cost.

The salient features of SIMLESA scaling were:

i). Quality planning that shaped outputs, outcomes and impact which guided implementation, monitoring, evaluation and learning.

ii). Grounding on systems approach; entailed integration of several technical and organisational elements.

iii). Stimulation of autonomous and spontaneous use of designated practices, technologies and innovations.

iv). Entrenchment of continuous learning and improvements. Monitoring, evaluation and learning were integral elements of scaling, with feedbacks being the basis of evidence-based information and knowledge used in learning and effecting corrective actions.

v). Supporting long term engagement in dissemination and promoting application of practices, technologies and innovations. This was through *institutionalisation*.

SIMLESA scaling had three dimensions:

1. The vertical dimension of scaling involved ***institutionalisation*** of practices, innovations and technologies through creation of functional institutions: gaining local and national government support; and building human capital. This is qualitative scaling.
2. Horizontal dimension involved increase in the number of beneficiaries of SI portfolios (practices, technologies, knowledge and innovations); it involved coverage of more people, communities and geographical locations. These numeric changes refer to quantitative scaling.
3. Functional aspect entailed integration of additional features to the original portfolios. For instance, CA had different variants based on contexts, such as permanent basins, use of fertiliser, adoption of basis mechanisation. These additional features required field research and piloting.

Approaches to scaling in SIMLESA

1. Participatory scaling research (2010-2016)

Table 1. Scaling SIMLESA technologies and options

Method	Main mechanisms	Level, main partner	Social inclusion	Role of SIMLESA
Field extension	Field days, exchange visits, farm visits, collective action	Household, village *Public extension*	Understand local cultures, prioritisation of women and youth	Equity research, provision of portfolios
Not for profit	Demonstrations, field days, fairs, collective action, marketing, local trainings	Farmer groups *NGO, CBO*	Pro-poor business approaches/ skills	Capacity development, markets research
Agricultural Innovation Platforms (AIP)	Business approaches, value chains, participatory testing/ marketing	Local/ District *Platform* – numerous partners	Spill-overs, co-benefits Adaptive research, "next generation" skills Inclusive value chains	Mentoring, institutionalisation investments, cross site learning
Private sector engagement	Seed packaging, bulking, marketing	Local, district *Companies, CBOs*	Appropriate packaging/ pricing, reliance on agro-dealer networks, inclusion of farmer groups	Capacity development, markets research, new varieties
	Seed promotions (incl. seed strips)	Local, district Companies, CBOs		
	Radio, TV	District, national *Media companies*	Use of common language, simple English, pictorial or illustrational illustrations	Content provision, M&E, capacity development
	Print (e.g. brochure)	District, national NARS, NGOs		
	ICT – mobile sms (internet based)	District, national *QAAFI*	Participatory content development (applicable)	
	Internet	International *CIMMYT/ACIAR*	Inclusive materials on websites	
Policy process	Round tables, high level engagements	National, regional *Ministries of agric. ASARECA*	Multidisciplinary (policy gaps, awareness, implementation mechanisms)	Evidence - *Scientific trials, Research-led PVS,* refereed publications
	Briefs	National (+ International) *CIMMYT-led*	Trans-disciplinary	
Social networks	Group approach	Community *CBOs*	Open, and common among women, youth	Documentation

Note: Adoption has been reported under SIMLESA Objective 1.

i) Business approaches to scaling SI

SIMLESA and allied projects (especially ACIAR funded SRAs in Uganda and Rwanda) show that it is complex to integrate participatory processes with entrepreneurship for scaling in sustainable intensification (SI). There was already an active participatory process involving smallholders, private sector, local businesses, government extension, etc. in all countries. However, case studies in Uganda show the private sector involvement in scaling for crop intensification needs to move beyond supply-demand needs.

Table 2. Selected mentions of business-based scaling in SIMLESA

SIMLESA achievements	Countries	Difficulties
Small enterprises – spontaneous community-based service provision: e.g. small mechanisation business, incl. herbicide spraying, shelling	Ethiopia (FACASI related), Tanzania, Kenya, Mozambique	*i).* Poor extension skills in businesses, mechanisation *ii).* Cost of equipment *iii).* Weak markets, limited potential of private sector involvement (esp. maize based systems) *iv).* Lack of kick-start subsidy for small enterprises *v).* Linkages to seasonal capital from MFIs
Research-business partnerships – e.g. insurance provision (Kilimo Salama), Banking (complemented by ACIAR SRA)	Kenya, Rwanda, Uganda	*vi).* Low interest among private sector to support smallholders due to perceived low returns *vii).* Social science skills in mobilisation/ organisation for context-relevant business shortage. Rural-appropriate businesses ventures must for instance ensure social equity
Partnership with agro-businesses (seed companies, agro-dealers, cooperatives/CBOs, machinery dealers	All countries	*viii).* Low volume of produce/ economies of scale *ix).* Pitch collaboration at the correct level AIP– district/ region *x).* Weak AIP/collective action on business, esp. too much focus on field technologies rather than agro-business *xi).* Late focus on business innovation – under CGS
Capacity building in business management, marketing, agribusiness (also supported by FACASI)	Ethiopia, Kenya, Tanzania	*xii).* Effective but need post training coaching and mentoring skills + broker to facilitate linkages *xiii).* There are systemic deficiencies related to poor policy, or lack of policy instruments and focused investments
Capacity building of AIP business facilitators (supported by ACIAR-funded SRA)	Kenya, Rwanda, Uganda	*xiv).* Challenge to find appropriate (sustainable alliances among) facilitators in AIP-bases business brokerage. SIMLESA built an alliance around AIP, which needs further investments to institutionalise (in anchor organisations)
Partnerships among extension and businesses	All countries	*xv).* Packages for a proven CA based technologies available, but not well linked with business start-ups *xvi).* Influencing regional/ federal level bureaus (in Ethiopia) was achieved. But actual partnerships not instituted due to weak private sector
Strengthening regional/ national platforms	Highly achieved in all countries except Ethiopia	*xvii).* Interest of NGO and private sector partners to participate was high. However, local/ Woreda private sector systems (outside of Addis Ababa) were not well entrenched (Ethiopia) or unsupported with public investments. Rwandan AIP-based support systems were more organised (Misiko *et al*. 2016)

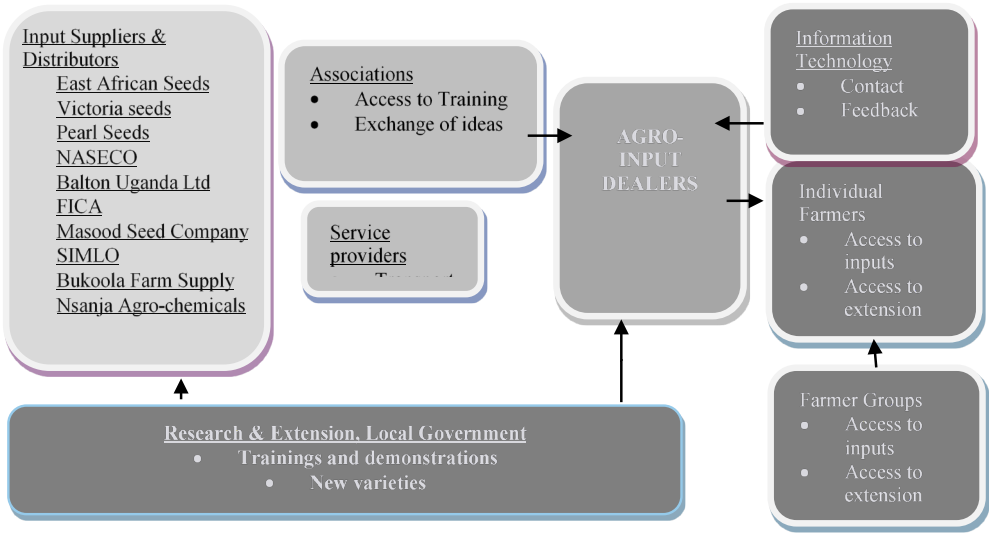

Fig. 2 Generalised agro-input dealer-farmer Business Model – case studies from Uganda (Misiko *et al*. 2016b)

ii) Going forward

SIMLESA recommends that new sets of skills combinations among key scaling actors be developed. This process requires a mentoring process for input of skills that are neither available locally nor in one organisation. It requires years of interactive learning, backstopping and alliance building, based on SIMLESA lessons. There is need for the creation of a learning alliance among professionals with complementary skills including in agribusiness, AIP and scaling. This alliance is key to nurture applied models of participatory entrepreneurship for enhancing private sector-led scaling, and guide their application.

2. Agricultural Innovation Platform (AIP) (2012-2019)

i) Nature and process of AIP

SIMLESA led a programme of AIP development (Table 3) that resulted in social equity (Table 3b), adaptive capacity, investments – through identification and pursuing of business niches, marketing, credit access, processing (broad-based value addition).

Table 3a. Number of active AIP established under SIMLESA (June 2018)

Country	Name of the AIP	AIP Totals	District (level)	No. members	Year est.	Level (Fig 3)
Ethiopia	Shalla	**18**	Oromia	26	2013	2
	Adamitulu-Jido				2013	2
	Kombolcha				2013	1
	Dugda				2013	1
	East Badewacho		SNNP	60	2013	1
	Hawassa Zuria				2013	1
	Meskan				2013	2
	Bako Tibe		Oromia	40	2013	2
	Wayu Tuqa				2013	2
	Gobu Sayo				2013	2
	Guanga		Amhara	35	2013	2
	Pawe		Benishegula-Gumuz		2013	2
	Boricha		SNNP	30	2013	2
	Loka-Abaya				2013	1
	Halaba				2013	2
	Jabi-Tehnan		Amhara	45	2013	2
	South Achefer				2013	1
	Gursum		Somali	55	2013	1

	Jigjiga	**2**			2013	1
	Membership total			**291**		
Uganda	Nakasongola	**2**	Central Uganda	**40**	2015	1
Malawi	Mitundu AIP	**6**	Lilongwe	146	2010	3
	Chamama AIP		Kasungu	83	2012	2
	Msipe AIP		Ntcheu	52	2013	2
	Tembwe AIP		Salima	152	2012	2
	Kapiri AIP		Mchinji	60	2012	1
	Livirivi AIP		Balaka	45	2013	1
	Membership total			**538**		
Tanzania	Rhotia	10	Karatu	40	2011	3
	Bashay		Karatu	35	2011	2
	Masqaroda		Mbulu	30	2011	2
	Bargish Uwa		Mbulu	20	2011	2
	Mageuzi		Kilosa	18	2014	2
	Kwimage		Gairo	22	2012	2
	Dodoma Isanga		Kilosa	17	2014	2
	Vitonga		Mvomero	21	2014	2
	Mshikamano		Mvomero	20	2014	2
	Mkombozi		Mvomero	10	2014	2
	Membership total			**233**		

Table 3b. Number of active AIP established under SIMLESA (June 2018) – Gender disaggregated

Country	**Name of the AIP**	**AIP Totals**	**District (level)**	**No. members**		**Year est.**	**Level (Fig 3)**
				Men	Women		
Kenya	BUSOFIP (Bungoma)	**9**	Bungoma	19	10	2012	3
	Bumula AIP		Bungoma	15	7	2012	2
	Boro AIP		Siaya	9	12	2012	3
	Karemo AIP		Siaya	8	7	2012	2
	Kyeni		Embu	4	14	2011	4
	Mariani		Tharaka-Nithi	7	18	2011	4
	Geeto		Meru	4	11	2011	2
	Nkogwe		Meru	3	15	2014	2
	Kathuri		Embu	4	20	2014	2
Rwanda	Mareba	**5**	Bugesera	33	14	2012	1
	Twishakirumuti-Gashora		Bugesera	12	13	2012	2
	Twegerane-Runda		Kamonyi	20	29	2012	1
	Kayenzi		Kamonyi	21	30	2012	1
	Kabeza-Cyuve		Musanze	5	7	2015	1
Mozambique	UCAMA AIP	**6**	Macate/ Sussudenga	8	16	2013	4
	ISPM		Vanduzi	8	14	2012	2
	ADEM		Nhamatanda	14	10	2012	1
	Total Land Care		Angonia	15	33	2012	2
	IDEAA –CA		Macate	7	11	2012	1
	AGRIMERC AIP		Sussundenga, Marera, Gondola	48	10	2013	4
			Gender Totals	264	301		
			Percentage	47%	53%		

Note: membership in AIP at level 3 comprised of farmer groups. Each group had approx. 20 farmers average

A total of 58 AIPs (Table 3) were active in June 2018, playing a critical role in SI. Case studies among more advanced AIP in mid-2019 show two of them (Rhotia – Tanzania and Kieni – Kenya) had a combined membership of about 100 men and women. Their commercially focused activities *i)* increased produce market access, mitigated transaction costs and leveraged better and stable prices for smallholders *ii)* improved nutrition among

the vulnerable *iii)* attracted credit/ banking services closer to their membership and other farmers *iv)* provided affordable and secure produce transport *v)* facilitated equitable sharing of proceeds and influence *vi)* aided responsible management of common pool natural resources including land, water and new germplasm – especially pigeon pea at Rhotia *vii)* Kieni AIP attracted insurance and poultry investments that benefitted thousands beyond its membership *viii)* Rhotia AIP created new international market channel for pigeon pea smallholders, and helped to commercialise an otherwise subsistence pattern of production. It significantly lowered transaction costs, including for non-AIP membership in the local district.

Case study research showed that AIP were not a quick fix to SI problems, but rather a medium to long term sustainability mechanism aimed to generate equity and spill-overs. AIP takes time to take off. Fig 3 is an illustration of the development of AIP over years.

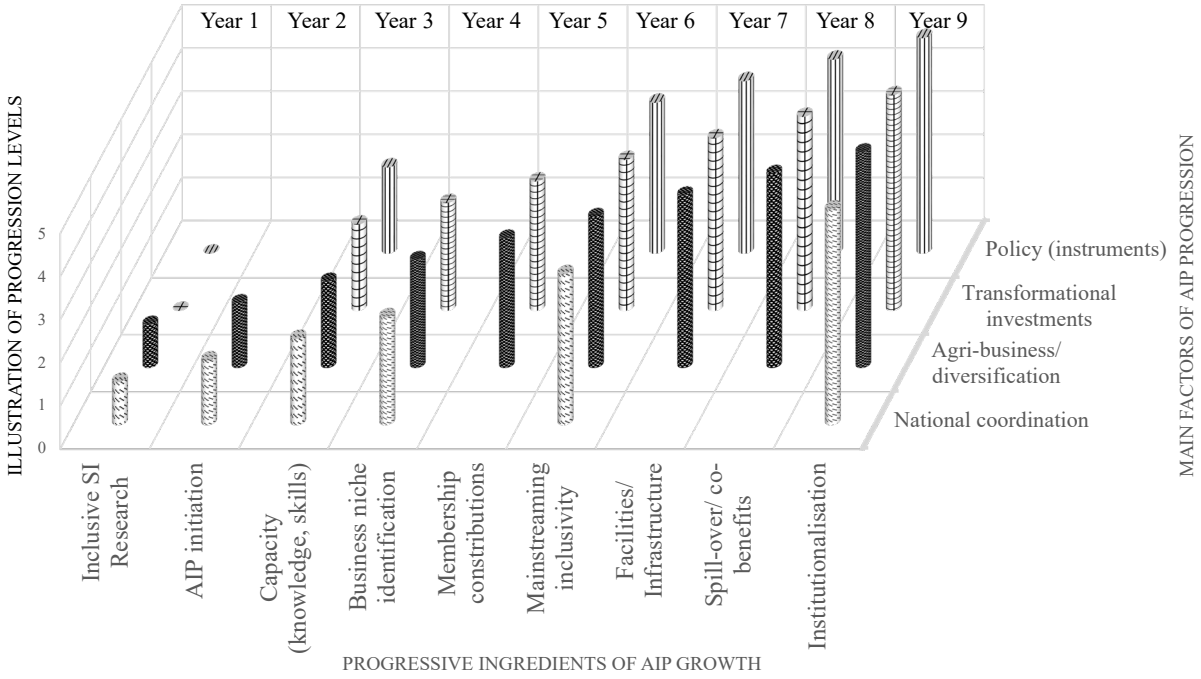

Fig. 3 An illustration of AIP development

ii) AIP evolution

The initial years of all AIP were dependent on donor, government and few private funds input. Stage 1 was all about 'farm productivity', focused around research. During stage two, more non-research input became available due to better organisation, visibility, enhanced group collateral related to addition and initial investments through collective-action. Stage three was sustainability phase, with more gender equity in benefits sharing being realised. At stage four, AIPs had mastered how to engage multiple partners, especially for business. Stage 5 was characterised by strong leadership based on business skills. Business and infrastructural assets were more central, and resulted in permanence of benefits (esp. income). Examples in this stage were non-SIMLESA AIPs in Rwanda, namely KIAI, Gataraga and especially Mudende, which employed many AIP membership as waged workers in their investments. These workers were selected based on skills.

Stage in AIP evolution was possible with progressive policy, its wider awareness among AIP actors and attendant policy instruments. More successful AIP members grasped public policy requirements on gender and applied them. They exploited policy instruments timely, because they had strong partnerships with an anchor organisation (RAB for the Rwanda case). AIP

studies show that functional government agencies were pivotal in communication of policy on gender in language farmers understand. The role of RAB is an example of how sub-Saharan Africa national institutes can anchor AIP processes that result in sustenance of benefits generation.

Gendered access to benefits of SI depended on quality participation among women, men and youth. Generation of these benefits depends on quality leadership of AIP, harnessing of partnerships beyond original initiators and smart niche exploitation. By and large, the more mature the AIP (esp. Mudende and KIAI), the more the benefits, and more equitable they were shared among women and men. Low performing AIPs had challenges in leadership, brokerage, partnerships and niche identification. Success of AIP was not closely related to nearness to urban centres.

Complementary research supported by ACIAR through Short Research Activities show that AIP success was down to: six factors:

i). Transformational investments, esp. for infrastructure and commodity development (incl. research)
ii). Policy instruments. For instance, Rwanda government guaranteed 40% cost waiver on capital equipment purchase by AIP
iii). Strong business niche, but also diversified of business, clientele base, partnerships
iv). Strong national coordination. For instance the Rwanda Agricultural Board was instrumental in training and mentoring AIP. The role of research in supplying technologies was critical, and not peripheral
v). Strong anchoring farmer group, particularly a cooperative or business-focused CBO
vi). Advanced social inclusion. In Rwanda, it was indeed a policy requirement for social inclusion to be prioritised.

iii) AIP benefits

The transition from weak, benefactor-dependent entities, to multifunctional organisations with resourceful means to catalyse equitable rural development was slow. AIPs relied on complex set of interactive process among policy, culture, native business acumen, innovation and SI research to generate and equitably share six broad types of benefits, namely:

i). Crop related – yield increase, drought tolerant, disease/ pest tolerant, and water use efficient varieties, crop diversity
ii). Business related – higher income, market access, better agribusiness, lower input costs, capital access (e.g. credit)
iii). Infrastructural – new business building/s, new feeder road/ path, new processing centre, farmer resource centre, better produce storage
iv). Social – enhanced youth (e.g. for agribusiness) and women participation (e.g. through table banking), better nutrition (e.g. through processing), better societal or household harmony (e.g. reduced conflicts) and reduced drudgery (e.g. through commercialised food processing)
v). Environment (Fig 4) – reduced soil erosion, reduced weeds, better soil health, better water retention, and more critically, better habitat (incl. soil C and general)

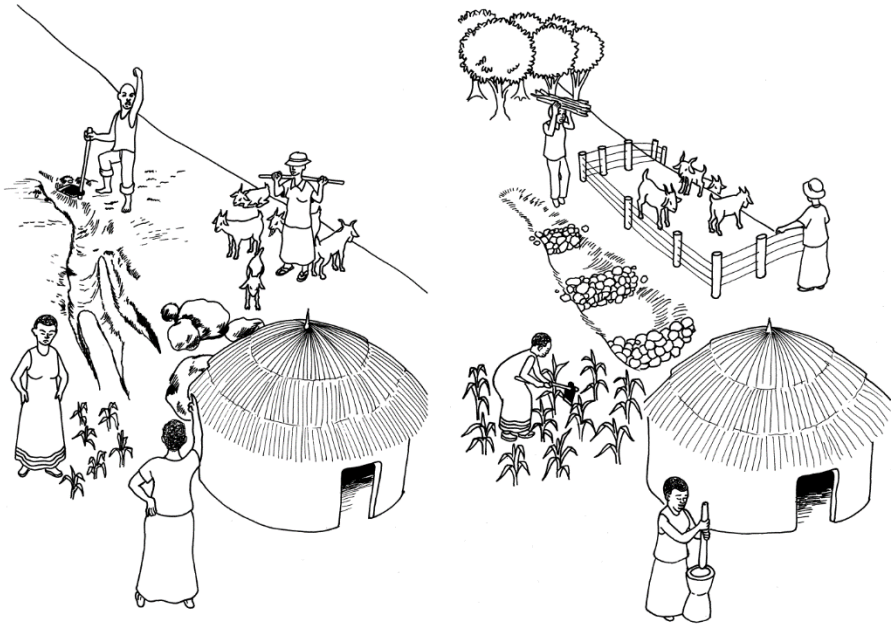

Fig. 4 AIP as a mechanism to reduce degradation at communal, landscape level

vi). Agricultural extension: AIP is an effective mechanism to combine many sources of information, whilst supporting multifunctional action. It is NOT a scaling method. AIP was an effective SIMLESA mechanism that brought many stakeholders into critical SI extension investment. Investment in extension yields 80% annual rates of return, with 40–60% being the norm (G-FRAS 2012). By diversifying extension approaches, AIP enhanced equity. Usually, 15% of the world's extension agents are women, and only 5% of women farmers benefit from extension services. In countries like Kenya, the average age of the extension staff is over 50, with few youth being incorporated. In Africa, extension – farmer ratio is about 1:2000 (Duo and Bruening 2007). SIMLESA investments show that AIP-aided scaling is critical for sustainability in these contexts; especially because it enhances social networks at local and district levels. This is critical, because 75% of smallholders in rural Africa get knowledge through ***social networks***.

iv) Mitigating AIP pitfalls

AIPs suffered from common collective action strains, such as conflicting goals or functions, tension between social and business norms. They're however more adaptive, and embrace socially and economically heterogeneous membership. Usually, social heterogeneity fosters exclusion and elite capture in market-focused systems. The AIP model as applied in Rwanda illustrates that when well managed, heterogeneity is a strength that breeds mutual interdependencies among actors. AIPs enabled much more complex linkages for multipurpose roles. On one hand, this complicated internal coordination and required extended professional facilitation. On the other hand it brought significant co-benefits that propelled take-off. AIPs require discipline in enforcement of policy, which is often lacking. Rwanda case of successful rural transformation was possible because of consistent enforcement of progressive policy instruments incl. 40% state support on capital machinery costs, along with improvements of access roads to spur investments. The government enforced equity policy, supported research infrastructure and skills for national coordination, and catalysed non-public investments along the value chain for responsible market integration.

v) Future AIP-related research investments

The preceding analysis illustrates that policy and national coordination are priority to spur both local and foreign investments to build upon SIMLESA AIP successes. There is need to institutionalise the AIP concept, through research, AIP mentoring, institutionalisation (investments).

3. The SIMLESA Competitive Grant Scheme (2016-2018)

Between 2010 and 2014, SIMLESA Phase I undertook participatory testing, agronomic and economic evaluation and validation of several agricultural sustainable intensification (SI) options in several sites (See Misiko *et al*., 2018). In 2014, Phase II was launched to scale successes of Phase I. A Competitive Grant Scheme (CGS) was designed to bring on board new partnerships for full capacity in scaling. The SIMLESA CGS had three main targets, to:

a) Scale SIMLESA research portfolios
b) Establish innovative partnerships among international, private and public research and development organisations necessary to sustain SI among smallholders
c) Draw lessons from the experience of funded projects that contribute to reduce the margins of technology transfer in Africa

i) How: process of SIMLESA Competitive Grant Scheme (CGS)

Approaches and tools of SIMLESA CGS are summarised in the illustration below (Fig 5).

Fig. 5 Steps and tools in the CGS process

Fig 5 implies a critical role of an impact assessment guide – to provide a necessary frame for assessing delivery process.

Commissioning

A critical consideration in SIMLESA was the available capacity and institutional diversity in the five countries. A non-competitive system was followed in Ethiopia. The extension system in Ethiopia is robust, and has enormous advantages of scale, funding and organisation. Non-public extension plays minor role compared to Kenya, Malawi, Mozambique and Tanzania. In the later countries, the CGS was completely open (Fig 5).

ii) Why a scaling CGS in research?

This CGS was designed to shape scaling based on SIMLESA research evidence (also see World Bank 2012). Usually, research programmes are fixated on fine tuning technologies, which takes long, more resources and often outputs are overtaken by (social, climatic, economic) events. The impact of research is as a result usually little (Waddington 1993). To mitigate this, SIMLESA innovatively meshed essentials of scaling science into a scaling strategy (Misiko *et al*., 2018) to guide a transition from research to development. A scaling strategy was critically needed to avoid SIMLESA ending with 'shelves full of technologies'. The main justification for a CGS are:

a) Application of scaling science

Table 4 is a presentation of projections of reach and adoption. And year one reach outcomes against pre-scaling projections.

Table 4. Partner estimates of reach vs. application (or try outs by 2018 end)

Country	Partners	Partner estimations			No. of Districts	No. of partners	No. of Portfolios
		No. reach	No. applying	%			
Ethiopia (Public extension at Zonal level)	East Shewa Zone	72,660	21,798	30	3	4	4
	East Wollega Zone	74,180	22,254	30	3	4	4
	West Shewa Zone	53,690	16,107	30	3	4	4
	Hadiya Zone	53,140	15,942	30	3	4	4
	West Arsi Zone	73,150	21,945	30	3	4	4
	Sidama Zone	48,980	14,694	30	3	4	4
	West Gojjam Zone	48,840	14,652	30	3	4	4
Kenya	University (Egerton)	30,000	7,500	25	4	7	4
	Seed Co. (Freshco)	30,000	24,000	80	4	4	4
	Faith-based (NCCK)	30,000	9,000	30	4	7	4
	TV (Mediae)	3,000,000	300,000	10	>50	5	4
Malawi	Radio (Farm Radio Trust)	100,000	15,000	15	3	4	4
	Seed co. (MUSECO)	10,000	5,000	50	-	-	4
	Farmer Org. (NASFAM)	30,000	7,500	25	4	7	4
Mozambique	Business NGO (Agrimerc ODS)	50,000	15,000	30	5	7	4
	ICT-based (ISPM)	100,000	15,000	15	>10	4	4
	Farmer Org. (UCAMA)	30,000	9,000	30	4	5	4
Tanzania	Farmer Org. (MVIWATA)	50,961	15,288	30	4	7	4
	NGO (RECODA)	24,000	12,000	50	3	6	4
	Seed Co. (SATEC)	30,000	24,000	80	3	5	4
Totals		3,939,601	585,680	Avg. 15%			

Definitions:
Reach – farmers that were covered, and who verifiably received SIMLESA portfolios (also see Walker and Alwang 2015).
Applying – also referred to as **try outs**. Farmers using the options scaled out. **Adoption** and **impact** were studied under Objective 1, and will be fully measured in 2023 (see definitions in Walker *et al*., 2014).

Numbers in Table 4 are additional from those reported under non-CGS processes. CGS partners operated in districts different from other SIMLESA processes.

b) Stimulating demand for research knowledge through partnerships

SIMLESA followed international principles and practices of CGS to ensure CA-based research options are handed over to scaling organisations through partnerships. The key aspects of this CGS were i) competition of ideas, a key proxy for demand, and which fostered efficiency (also see FAO 2002). ii) Commissioning – grant schemes were both competitive and non-competitive (e.g. IFAD 2012) iii) incentive and disincentive (e.g. FAO 2001).

c) Competition

The main feature of the CGS is competition (e.g. NARO 2010). Table 5 shows how competitive the SIMLESA CGS was.

Table 5. Number of CGS applications and selected partners

Country	Applicants considered	Selected partners		Comments
Kenya	24 (out of 28)	4	17%	4 were irrelevant
Malawi	16	2*	13%	
Mozambique	***9*** (out of 11)	***3***	33%	2 were irrelevant
Tanzania	14	3	21%	
Total	63	12	19%	

For this CGS to be worthwhile the number of grants offered had to be much smaller than the number of units taking part in the competition (see Table 5). Ideally the number of grants offered should not exceed 20% of the number of participants (Tadjudin 2007). This CGS achieved this, and has stimulated unique partnerships (e.g. NARO 2010), based on broad-based complementarity as illustrated in Table 6.

Table 6. Range of selected partners

Type of partner	Kenya	Malawi	Mozambique	Tanzania
Farmer-based organisations	Secondary partners esp. AIP	NASFAM	UCAMA	MVIWATA
ICT	Secondary partners – QAAFIe	Sec. partner – QAAFI, FRT	ISPM, QAAFI	Secondary partner – QAAFI, CABI
NGO			AgriMerc ODS	RECODA
Media	Mediae ltd.	Farm Radio Trust (FRT)	ISPM	Secondary partner
Seed	Freshco Seed Co.	*MUSECO	Secondary partners	SATEC
University	Egerton		ISPM	Secondary partner – Sokoine University
Church organisation	NCCK			

The design of this CGS followed a thorough examination of what was possible in each country among stakeholders. This determined the:

a) budget allocation, areas of work, and possible reach
b) extent of programme that could be completed in 24 months.
c) transaction costs involved in administering the CGS per partner
d) feasibility of desired results.

d) Incentive and disincentive

Because SIMLESA options are public goods (e.g. FAO 2001), there had to be a mechanism to entice or gauge interest. This process shows partners' interest in the funds was linked to their interest in the technologies. In retrospect, the available funding per partner (Aus$23,000 – 70,000), was small in view of the reputation of applying organisations. Funding alone could not be the key driving factor among national institutes to apply but rather interest in owning an SI portfolio of SI.

e) Catalysing scaling innovation

SIMLESA demonstrated how CGS can incentivise and engage diverse innovation stakeholders (also see World Bank 2012). This CGS was a mechanism to harness wider partner comparative advantages (e.g. Table 6), and has illustrated efficiency for the (simultaneous) inclusion of many regions through many next users to reach millions.

iii) What was innovative?

Impact was realised by catalysing scaling innovation through novel funding mechanism (e.g. Mbabu and Hall 2012), and building on existing scaling initiatives. Field evaluation showed partners utilised SIMLESA knowledge to deliver services, especially to agricultural producers and also to develop capacities of their organisations. Egerton University in Kenya picked sites with high *Striga hermonthica* incidences. They integrated SIMLESA options of intercropping, crop rotation, fertility management, improved crop varieties, with push and pull (ICIPE 2015), IPM (Pretty and Bharucha 2015) and *Striga hermonthica* repelling varieties in their programme. Their core model is *integration* of participatory approaches, technologies (beyond one project), extensive farmer group networks, FM radio (transcripts) with a widely read Saturday newspaper feature called "seeds of Gold". The Mediae utilised a TV programme called *Shamba Shape up* and an ICT concept *iShamba*. Their approach illustrated agriculture as highly beneficial; using real farms and a farmer field school set up to film and clarify SIMLESA concepts. Both Egerton and Mediae had a heavy focus on benefits of SIMLESA options beyond mere descriptions.

a) Characterising *i*nnovation pathways

This CGS catalysed innovation as by applying pre-identified principles or concepts as shown in Table 7.

Table 7. Summary of SIMLESA CGS guiding principles as applied among selected partners

Guiding principle	**Mediae**	**AgriMerc**	**Recoda**	**Farm Radio**	**ISPM**	**Egerton**	**NASFAM**
Main scaling approach	*iShamba*, *Shamba Shape Up*	*Agro-dealer system*, lead farmer, Mobile platform	*RIPAT* recoda-tanzania.org/ripat	Participatory radio farmradiomw.org	*SMSs*, radio, video	Participatory, *farmer group networks*, radio, print media	Club Model, lead farmers nasfam.org/index.php/history
Motivation	TV info deals	Smallholder business	Participatory service	Radio/ ICT information deals, intermediaries		Data and policy drive	Farmer welfare, value chain
Policy linkages	Medium	High	Low	Low	High	High	High
Main capacity	Message delivery	Brokerage	Participatory	Message organisation	Content development	Testing and delivery	Delivery and advocacy
Scaling pathway	Via field, TV and mobile	Piloting, testing, and replicating	Piloting, testing, and replicating	Via field, radio and mobile	Via ICT (sms), radio and video	Participatory, media and local farmer networks	National network of farmer groups
Partnership nature	Transitory, based on knowledge needs and funding source	Wide, depend on NARS and international knowledge market	Wide, depend on NARS and international knowledge market	Transitory, based on knowledge needs and funding source	Long term, stable and less dependent on external funding	Long term, stable, national and external funding	Wide, stable, NARS, national and international knowledge market
Key (ME and) learning mechanism	Unique ME&L designed for TV and ICT, partner feedback	ME&L revolve around performance of agro-business, partner feedback, external evaluation	Flexibility for Partner feedback systems, external evaluation	Flexibility for Learning by doing, partner feedback systems, external evaluation, radio feedback	Strong ties to NARS, govt. departments, established ME&L and local partnerships	Strong documentation, reliance on extension department and policy institute/ experiences. Reliable ME&L	Est. ME&L capacity. Established feedback and learning system – farmer network
Orientation for purpose	Depends on partners with knowledge – ready	Organised, diverse funding i.e. relatively flexible and efficient in	Emphasis on partnerships (esp. research): strategies co-	Depends on partners with knowledge portfolios – open to wide	Collect and/or organise content. Not agile for	Link local context with national processes. Lessons focused. Good at site	Integrate all new work with existing smallholder programmes –

	whenever portfolios are	market related work	developed to integrate SI based development	knowledge content	distant sites that require wide coordination	characterisation before full scale operations	training a critical component for

Table 7 shows that although innovation cannot be predetermined, it can be catalysed (see also Hall *et al.,* 2006).

b) Increased capacity to innovate

A latent yet fundamental function of the SIMLESA CGS was to utilise scaling research to introduce efficiency in scaling. By guiding scaling, agencies were aided to logically construct their methodologies, and therefore achieve operational efficiency. SIMLESA enabled participating organisations to broaden scaling skills, improve their scaling concepts and built new partnerships.

c) Relay progression

This CGS is a novel concept of passing the button of responsibility, in a knowledge into use relay that is seamless. A relay progression is successfully performed when those in the race understand each other, pass the button efficiently, and finish early. This is not the case in most agricultural projects. Research usually follows a monotonous process that results in research products that are unfamiliar or 'uncalled-for' among development users (World Bank 2012). This CGS is therefore a means to a) cultivate teamwork, i.e. through demand-supply partnerships, esp. because research is provisionally backstopping scaling efforts b) ensure research passes the baton i.e. bundles of research options procedurally handed over to next-users c) next-users deliver the button successfully i.e. research clients clutch the products and proficiently deliver to beneficiaries.

iv) Merits and demerits of funding scaling programmes through a CGS

The SIMLESA CGS had merits, demerits and constraints. This section provides i) indicators of performance ii) merits and demerits and iii) constraints experienced.

Table 8. Merits and demerits of the SIMLESA CGS

Merits	**Demerits**
Has brought to the fore research role on scaling. The ***role of science*** is well appreciated among non-traditional partners	***Funding was partial***; applied as pilot. Funding limited to operation costs, lack of support to core salaries and maintenance has limited wider scaling
Increased effectiveness of SIMLESA scaling expertise, by relying on competition – for better ideas, and on co-financing – for better reach. SIMLESA scientists did not have to do the actual scaling	Short nature of this scheme (like others) means ***documentation will be curtailed***, esp. upon completion unless a ***short research activity*** facility is provided for fuller lessons. ME&L only will not provide inner lessons. These also need to emanate from *emic project reflections*. This is critical for medium- to long-term research agenda and policy
Contributed to ***better capacity*** among scaling partners, for instance better knowledge on drought tolerance, CA, etc.	
Promoting a good ***platform where science meets society***, through simplification of research products for sharing as illustrated by Egerton and Mediae	No institutionalisation of processes due to ***lack of mentoring***. Like other CGS, SIMLESA has no plans for extended engagements with partners
Setting a precedent for ***target-oriented*** and demand-driven research system. There is evidence for seamless relay of research options	***Demanding*** and costly transactions from grant seeking, proposal writing and implementation, less time for scaling research
Strengthening ***linkages*** between research and scaling organisations – new type of partnerships created	Legal, financial, administrative and technical costs of setting up and ***administrating*** exist for partners
Diversification of ideas, by involving scaling organisations from outside traditional partnerships. These are indeed innovation projects, not simple	Competition means organisations (or consortia) with rich capacity for proposal development and implementation dwarfed scaling consortia of less-

extension initiatives. New concepts like *iShamba* have not been part of SIMLESA vocabulary	known local organisations. It is difficult to observe ***equity*** due to competition principle
SIMLESA avoided the temptation to issue the call before the ***scaling strategy*** and basic institutional arrangements were in place. The urge to spend money in time did not undermine this CGS purpose	Contrary to (above) preceding fact, stronger seed companies did not apply. Contracted seed partners have shown difficulty in ***timely seed multiplication*** and supply
SIMLESA CGS was an arranged market concept, where prospective partners went through merit review process, grant incentive, and rich mutual feedback and strong ***objectivity***	Dependent more on knowledge market, ***rather than needs oriented***. Small research knowledge market like Mozambique meant fewer number of competitors compared to a smaller country like Malawi (Table 5)
Increased research flexibility to focus on both competitive and commissioned grant dynamics; ***new research opportunities*** have emerged	Good proposals did not necessarily mean good opportunities for better scaling. The ***inherent confusion*** among some applying partners that a good proposal was all it takes had to be disproved through further investigations about credibility of applicants
Lessons for sustainability are being generated for providing modalities of funding ***scaling to suit niches***, by targeting diversity of needs at national level	***Prone to delays***. Because grants are limited, scaling teams were small, and any exit of key team member is disruptive to projects

v) Lessons for CGS practice

i). CGS and SIMLESA impact pathways

A competitive grant scheme should have a specific purpose that should be explained in the guidelines for submission of proposals (Tadjudin 2007). More critically, a shared ***vision*** of success must be published in a strategy before the call is made (Misiko *et al*., 2018). This vision was to contribute to at least 30% of the overall target of SIMLESA, which was to influence a minimum 650,000 households mainly in five countries by 2023. Projections in Table 4 shows the scaling partners fulfilled that vision.

ii). Transparency and consistency in carrying out policies contribute to trust

Rules set up to guide the competitive funding were carried out consistently. First, this CGS recognised the possibilities of litigation, or prospective grantees would lose interest to apply, would do it simply for grants or only weak applicants would apply. Therefore, SIMLESA maintained transparency in the selection process, and reports were filed for reference (Misiko *et al*., 2018). The TACC was very consultative, and this CGS coordinator facilitated partner engagements for openness and feedback. Each partner therefore is able to take advantage of other participating organisations (Table 5).

iii). Communication

This CGS has showed the integrity of the selection process is immensely useful for the donor, for CIMMYT, and for successful partners. Since the selection process was transparent and accountable, it can stand peer review. However, a CGS involves confidential information such as parts of contracts that may not be shared until a collective decision is reached. Notwithstanding, institutes submitting proposals received feedback notes informing of their weaknesses and/ strengths and the basis of decisions. CGS therefore is an intensive communication process (see *management tools* – Fig 5).

iv). Value for money

The total CGS budget was US$891,624, only 2% of the entire SIMLESA budget. By close of project, it had run 18% of SIMLESA's life. From a project perspective, therefore, this CGS was hugely successful because it contributed to more reach, and a large percent of adoption of (single or different combinations of) its research options.

v). Innovative space

The SIMLESA CGS shows the importance of ***creating space for innovative experiments in scaling***. The SIMLESA CGS initiated practical fit-for-purpose institutional arrangements. This proof of principle can be leveraged in wider policy debates for transformational

initiatives that: i) fulfil the need for beyond sectoral utility of agricultural funds ii) allow for institutional arrangements that are responsive to diverse development needs.

vi). Leadership and coordination are critical

Coordination is a key ingredient in the research-scaling relay. This should ideally be done by NARS. However, such capacity is not in place. There is ***need for mentoring programmes***, to prepare national capacity for informed coordination of evidence-based scaling. This CGS illustrates scaling is largely coordination dependent.

vii). Integrating scaling science with practical experience is complementary

It is key to have the right set of skills mix to support a CGS. This CGS has been a learn-by-doing research-led initiative. SIMLESA was in the end locked in a process of adaptive leadership, of ensuring partners stay on course (based on project vision), of coining partnerships and structuring support for non-research/ non-traditional stakeholders, of providing encouragement to participants to stay the course. Considerable effort went into having proposal support/ feedback. Feedback was built on two factors, one development partners have extensive hands-on experience in scaling. Two, social scientists possess in-depth analytical knowledge on scaling. Scientists' feedback therefore related CGS proposals to past similar initiatives with the aim to identify success potential. These are complementary. For instance, SIMLESA did intentionally shun technology-transfer models. This placed an extra burden on this CGS process for customised engagement of each partner in the implementation of projects to embrace innovation constantly.

viii). Innovation has boundaries in a CGS

Seed is often seen as an example of a technology simple to scale out. This scheme shows ***seed involves little room for innovation***. A company either can or cannot produce seed promptly. This aspect makes a competitive process meaningless. Large companies with capacity for immediate seed multiplication and supply did not apply. It is therefore better to commission seed production when services are urgent. Alternatively, rely on partners with established networks of seed companies.

ix). Develop factsheets on portfolios before the scaling journey

While scaling appears a straightforward endeavour, the most obvious requirement was one that was "assumed' to be in place, or which scientists were most unrehearsed for. Before any scaling journey is attempted, there is ***need for factsheets on technologies, and clear definition of options*** to be showcased. This indeed sounds obvious, yet, it was the most elusive requirement among scaling teams. It was easy to refer to varieties, to CA, yet having these as simple bundles of information to be shared in different forms and for usage among different type of users proved mysteriously awkward.

vi) Lesson for policy and institutional arrangements

There is need to develop National Agricultural Scaling Innovation Facility. This is possible through initiating discourse with governments. If this were to occur, the scheme will have succeeded in catalysing a major institutional innovation in the way agricultural services are scaled, and in the way scaling is organised to engineer agricultural innovation. A national scheme based on the SIMLESA CGS would allow governments and other stakeholders to set up funds, which are competitively given to partners with innovative ideas to achieve evidence-based scaling.

4. Social inclusion

SIMLESA research identified numerous barriers in the search for social equity and gender (e.g. Doss 2001; Agrawal 1997). For instance, SIMLESA findings in Kagera Tanzania (Adam 2011) show women faced more barriers in engaging with bean traders. Women, children and the youth were quite more likely to be curtailed in participating in gainful farm

production, commercial processing and marketing. This resulted in underperformance of agriculture in ESA (see also (Doss and Morris 2001; Meinzen-Dick *et al*., 2010; Quisumbing and Pandolfelli 2010). To deal with this, SIMLESA research relied upon successful Agricultural Innovation Platforms (AIP) as effective vehicles for generation of, and equitable sharing of benefits of agricultural sustainable intensification (SI) as illustrated above. Findings from a complementary ACIAR project of FACASI and a key SRA in Rwanda show that small start-ups were hard to be initiated by women and youth. Yet, they were critical for long term benefits.

i) Selected determinants of equitable benefits generation, and sharing

a) Guided and complementary donor investments including research and skills were critical as shown in Fig 3.

b) Smart business niche identification, with gender focus – enabled wider benefits generation, minimised failure and reduced competition among farmer entities. These entities were mostly gender balanced – Table 3b.

c) AIP based trainings and mentoring process of for gender equity among national officers.

ii) Agricultural policy and practice

Gender mainstreaming and strategic interests require two elements: (i) integrating a gender perspective into the preparation, design, implementation, monitoring and evaluation of policies, regulating measures and spending programmes, and (ii) addressing the issue of representation of women and men in the given policy area (e.g. Ministry of Gender and Family Promotion 2010), with the goal of promoting equality between women and men, and combating discrimination. In addition, mainstreaming is a process that involves men and women, in collective processes that require systematic investments and mentoring of leadership to coordinate plans as illustrated through successful AIPs.

Evidence shows policy is critical to catalyse youth and gender friendly investments. However, policy needs to be operationalised through laws and supportive instruments. In Rwanda, gender is entrenched within wider policy and operationalised through strategic planning instruments. Equally crucial, there was widespread policy awareness, and firm enforcement or follow up.

5. Transdisciplinary focus in SIMLESA scaling research

Trans-disciplinary (TD) work in SIMLESA was late to mature. SIMLESA progressively embraced transdisciplinary research; investigation by different disciplines that worked jointly to create new concepts, methods, and transformational innovations that integrated and transcend discipline-specific approaches to address common SI problems (e.g. Jahn *et al*., 2012). Ideally, trans-disciplinarity should have been embraced at the onset of SIMLESA project. However, SIMLESA was a complex social organism. It comprised of people, partnerships, organisations, countries, disciplines, leadership styles, and expectations that would not be in sync with one another at the onset. It had to gradually morph (Table 9) from multi-disciplinary research, to interdisciplinary R&D, and ended as a transdisciplinary research in development (R-in-D) programme. This took enormous effort in leadership (e.g. Ramadier 2004) and individual commitment to achieve transdisciplinary teamwork.

Table 9. The evolution of team models in SIMLESA 2010 – 2018

Component (of SIMLESA)	Multidisciplinarity	Interdisciplinarity	Transdisciplinarity
	Baselines and establishment	Research for development	Scaling, research in development

	2010 – 2014	2015 – 2016	2017 – 2018
Assessment process	Assessments – discipline-focused baselines Country teams formed along disciplinary ***objectives***	Annual Review and Planning Sessions (ARPS) became more ***integrated*** across disciplines. Assessment tools linked economics with agronomic and seed processes	More robust ARPS, closely linked to ***scaling*** and ***impact*** targets. Field assessment, observing and recording, esp. in 2017 and 2018 mostly across disciplines e.g. competitive grants architecture; partnerships
Plan development	Separate plans – trials, seed – for interventions within disciplinary objectives Agricultural Innovation Platforms are initiated by agronomists as research committees	Goals cut across disciplines, were shared with the rest of the team to align research for development. Plans focused on ***portfolio*** (blends of economic, social, agronomic, germplasm) ***benefits***. Cross-cutting Qs were: What are the promising portfolios? What are their social, economic, agronomic returns? Who will benefit? How many will sustain?	Staff and partners developed plans together based on agreed targets, priorities and resources (esp. the CGS). Key Qs were How many portfolios are successfully scaled? What nature of benefits are men and women farmers deriving? How many men and women adopted? How many partners are owning SIMLESA – sustainability – e.g. investments. How are AIPs SI sustainability vehicles? How is policy [dis]enabling SIMLESA-led transformational change? Are SIMLESA SI portfolios Climate Smart – in terms of economic, agronomy, germplasm?
Plan implementation	Plans are implement – separately by discipline. However, agronomists used economic plans to lay out trials, seed plans utilised agronomy inputs/ advice, etc.	Project members largely implemented ARPS plans for which their discipline was responsible. And worked toward the next ARPS. Innovation scientist, M&E work across disciplines, strengthened AIP approach to shape R4D linkages sms, seed co., harmonised demonstrations, etc.	ARPS focus more on how team members shared SIMLESA responsibilities. Accountability moved away from SIMLESA leader, to collective objective headship – accountable for how plans were implemented by collective SIMLESA persons with the partners: CGS being flagship R-in-D task for all. SIMLESA targets delivered by value chain/ markets/ processing focused partnerships under CGS grants. AIP focus more on niche identification, spill-overs/ co-benefits. The foregoing relied on SIMLESA strong leadership in interlocking disciplines strengths

Also see http://www.njeis.org/NJFoundationsSP.pdf

Under SIMLESA, TD ideals appeared more practical with increased focus on impact (Table 9). There were disciplinary silos along objectives, and therefore the necessity to bridge gaps among parallel researches within this same project (multidisciplinarity), to extend the focus of "doing research" to "the search for impact" on marginalised communities and groups (transdisciplinarity). Scaling, especially the very unique CGS introduced a unique feature of reflection, guided by the midterm and long-term outcomes. The "evolution" into TD emanated from the formation of pathways (i.e. partnerships) that sought impact under the CGS process. Impact demanded blurring of boundaries of disciplinary methodologies. For instance, striking a balance between the extent of farmer involvement in field experiments and their engagement in piloting business models through AIP. This case example shows the necessity of knowledge linkages through research framework (e.g. Brandt *et al*., 2013). Although SIMLESA must be criticised for being an MD project for the longest, the search for impact must be carefully executed to avoid insisting on transdisciplinary research being enacted rapidly. A strong focus on impact may easily limit research capacity of a project by over-emphasising development aspects (e.g. Strengers 2012). TD can, therefore, be effective through mentoring for capacity.

6. Institutionalisaton of SIMLESA scaling concept

i) Adoption of SIMLESA concept

There has been adoption of SIMLESA model among key development initiatives and national agricultural institutions. Key donors e.g. IFAD, USAID and World Bank are applying this model. For instance, AIP is now entrenched at KALRO (Kenya), NARO (Uganda), RAB (Rwanda).

SIMLESA's approach of working with national research organisations in each country has contributed to the project's results being recognised and used by key organisations in ESA. For example in Malawi the SIMLESA technologies involving maize and legume varieties have been taken up by the IFAD funded Sustainable Agricultural Production Programme (SAPP). Similar focus is adopted by the World Bank funded Agricultural Productivity Programme for Southern Africa (APPSA). In Malawi, a CA guide building on SIMLESA's CA-based research results has been produced for current and future use by field scientists, extension and farmers. In Mozambique the SIMLESA framework has been taken up and replicated in related projects such as APPSA and others supported by AGRA. This includes AIP based market approaches. In Kenya, the Kenya Agricultural and Livestock research organisation (KALRO) has also domesticated SIMLESA manuals. In Ethiopia the government requested SIMLESA to support the development of policy briefs based on SIMLESA's findings that were used to institutionalise SIMLESA-based scaling. In Ethiopia a project funded by the Norwegian Development agency and focused on scaling CA practices is being implemented using SIMLESA CA-based portfolios. In addition, seven farmer training centres in Ethiopia have also embraced the SIMLESA portfolios. In Kenya the recently released Climate Smart Agriculture strategy (http://canafrica.com/wp-content/uploads/2017/05/) aligns well with SIMLESA's current and future initiatives.

The SIMLESA technology packages and work framework has also been adopted by several organisations in southern Africa such as the USAID SIMLEZA project in Zambia, IFAD SAPP project in Malawi and Tanzanian ministry of agriculture is also using SIMLESA principles in its official R&D country strategy. In the Eastern Cape province of South Africa the Agricultural Research Council is applying the SIMLESA framework. Capacity building initiatives in SIMLESA spread all the way from the farmers to technocrats within the implementing NARS institutions. Trainings were tailor-made to suit scaling skills gaps in each country and by 2018 more than 60 scaling experts were trained. This was done through CIMMYT skills, critical linkages with advanced research institutes in Australia, in the Netherlands and well recognised regional institutions such as the Agricultural Research Council.

ii) Private-sector-incorporated scaling

There is ongoing private sector adoption of SIMESA portfolios, and market-based scaling. For instance in Mozambique, SIMLESA scaling partner AGRIMERC has effectively linked scaling farmers to maize and pigeon pea markets thereby providing incentives and creating a demand for the cropping technologies. This outcome is replicated among several of the Competitive (and commissioned) Grant Scheme partners that are using and promoting SIMLESA Portfolios/ approaches across the region for smallholder income generation.

iii) Regional policy initiatives

Major institutionalisation efforts include the Policy Forum in October 2015 held at Entebbe Uganda involving Ministry of Agriculture representatives from seven countries in East and Southern Africa. This led to the Entebbe declaration of 2016 (www.cimmyt/simlesa) ratified by representatives of the seven countries. The resolutions partly focused on SIMLESA scaling approach at regional level, incl. AIP, seed sector harmonisation, trade, etc.

iv) Going forward – policy and investments

Support institutionalisation of SIMLESA portfolios and model of partnerships for rural agricultural transformation. This is possible through annual planning and budgeting based on a National Adaptive Strategic Competencies policy/ framework that facilitates customised skills (e.g. for program coordination) and approaches for agricultural transformation.

Governments and donors invest in the development of a demand driven R4D national policies that promote sustainable production systems that will drive the promotion of climate smart agriculture in Africa.

7. SIMLESA scaling strategy

SIMLESA scaling strategy (Misiko *et al*., 2018) is referred to in various sections of this synthesis report.

i). Why a scaling strategy?

SIMLESA scaling was a 'practice puzzle' consisting of several pieces that required a strategy to unite or solve. The following are a selection of the core themes of SIMLESA scaling strategy.

ii). Institutional analyses as key scaling precursor

SIMLESA carried out institutional analyses, with special focus on their capacity to anchor SI extension. SIMLESA was a NARS-based program, who worked with CIMMYT to plan, co-invest, implement, etc. It was therefore necessary to prioritise integration of institutional elements in SIMLESA scaling. However, like the nature of any other research project, integration plans were short term. Indeed, SIMLESA research shows that institutions are by far sub-Saharan Africa's most limiting factor in extension.

iii). Scaling based on available scientific evidence

SIMLESA Scaling science was derived from long term transdisciplinary researches and combined evidences from multiple countries and several projects. As explained in this synthesis therefore, SIMLESA scaling was not theoretical experimentation, but rather a process of applying scientifically tested portfolios as basis for transformational investments.

iv). Fundamentals of scaling Sustainable Intensification portfolios

Extension entails numerous elements, which all depend on context. At the onset, SIMLESA delineated terms and the context, which defined scaling scope. Among these terms and context were i) definition of the innovation to be scaled; ii) scaling approaches incl. partnerships; ***TIME*** dimension, resources, institutionalisation; and social capital. These enabled the understanding of minimum thresholds for ESA's average smallholder adoption.

v). Social equity and rights

SIMLESA scaling strategy prioritised social inclusion and sustainability. This prioritisation led to heavy preference of AIP. SIMLESA scaling defined pathways to equitable social innovation (Fig 6), barriers to equity in benefits e.g. access to SI skills for entrepreneurship.

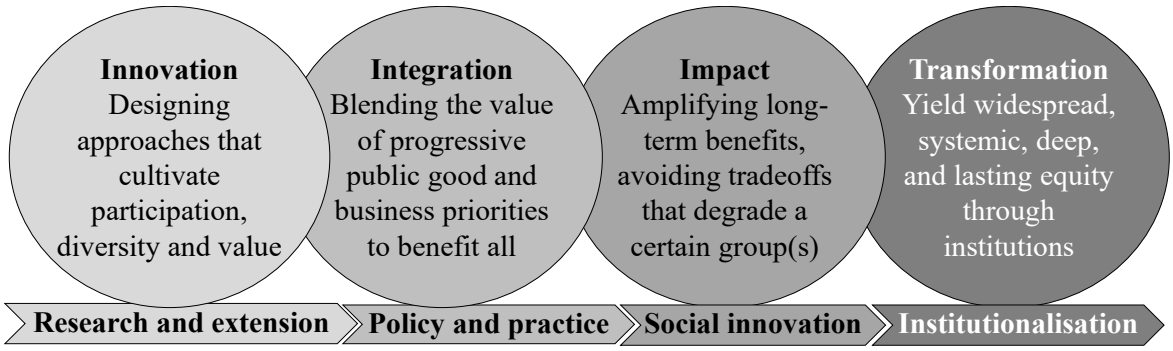

Fig. 6 Social equity as a systemic theme

vi). SIMLESA scaling philosophy

The core wisdom of SIMLESA scaling was not to seek quick success in SI adoptions. Both qualitative and quantitative aspects of scaling were integrated to minimise common compromises in Fig 7.

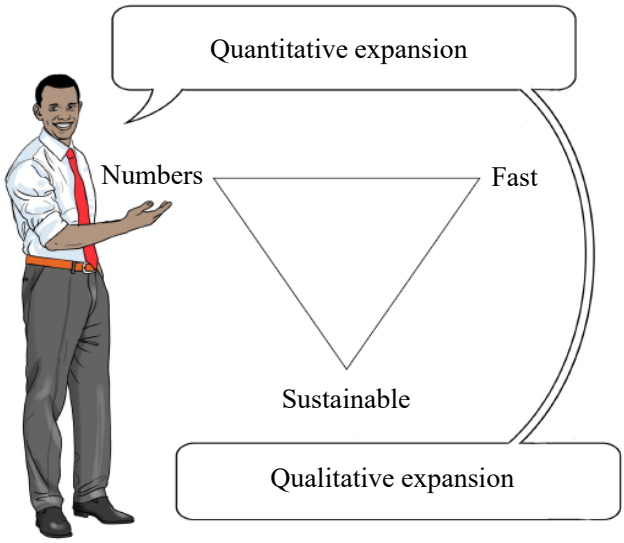

Fig. 7 The SI scaling triangle

Fig 7 shows the three common scaling beliefs; when you choose two, you often get the opposite of the other for free.

SIMLES showed that if scaling objective is "good, rapid and cheap", the result is an illusion of success. CA-based SI is progressive, and requires.

vii). Monitoring, evaluation, quality assurance and learning

MEL in scaling was complex, it entailed covering the portfolios, approaches, actors, inputs, outcomes, and a host of contextual issues that interacted over time and space. SIMLESA scaling was ***participatory***, based on clear vision, metrics and transdisciplinary standards.

Conclusion

The most important element of scaling in rural Africa is institutional support for farmers. SIMLESA shows that any scaling work must begin with an audit of institutional/ structural drivers that unlock the scaling conundrum. SIMLESA scaling was based on a strategy that among others defined: context; approaches; investments; institutionalisation; MEL; and operational choices. SIMLESA relied upon several approaches, including i) participatory partnerships among farmer entities, public, non-public and private extension to carry out field days, exchange visits, farm visits, collective group learning, seed bulking ii) Agricultural Innovation Platforms (AIP) focused on service delivery, value chains, marketing, capacity strengthening and equity iii) Social networks. iv) Media – especially radio, TV and print v) ICT – sms software designed and led by QAAFI vi) A competitive (and commissioned) Grant Scheme – critical handover mechanism, which enhanced scaling support. v) Policy – roundtables, high level meetings, and ministerial endorsements/declarations. These strategies/ approaches illustrate i) quantitative and ii) qualitative nature of scaling iii) role transdisciplinary research. There is need for future funding, especially focused on institutionalisation to entrench gains and benefits of SIMLESA scaling research/ initiative.

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