Innovation systems proposition with actors and their role. Road Map for Large-Scale Adoption of Conservation Agriculture (CA) in Bolivia

COMPONENT 2: Development of a delivery system/participatory farmer-led extension system for accelerating of adoption

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March, 2019

Abstract

Scaling innovations to improve the sustainability of farming systems in a region requires understanding of the main scaling ingredients, particularly the ones acting as the bottlenecks and opportunities. For that, "The Scaling Scan" is a useful tool that can identify the strengths and weaknesses of a scaling ambition. The main results of this report are:

Key finding 1: The scaling ambition for the CLCA project can be set as: "By 2022 CIMMYT facilitates scaling partners in Bolivia to have 500 (at least 50% women and 30% youth (below 35 years)) small crop-livestock farmers in drylands adopt one or more CLCA technologies to sustainably increase production and enhance climate resilience".

Key finding 2: In collaboration, systematic platforms for exchange/collaboration on quinoa or llama does not exist.

Key finding 3: In leadership and awareness, leadership to coordinate efforts to reverse land degradation are scattered and not properly recognized.

Key finding 4: In awareness and demand:

- The levels of awareness vary by place and by type of producer but there is a general recognition of their relevance of the need for alternatives for sustainable CLCA …. although there are not many active alternative actions.
- There is interest in sustainable practices such as: Recovery of native plants; Fertilizing the soil with llama manure; Use of organic pesticides; Proper techniques for water recovery; Proper techniques for frost protection; improved Fallow areas; Crop rotation; Efficient sowing of wind breakes according to wind directions; Appropriate mechanization practices.
- For the producers and community authorities, there are specific demands for information, training, dialogue and coordination of activities. For consumers, it is required to tell the story of *Quinoa Real* and its coexistence with camelids and the ecosystems of the Altiplano to add value at national and international level.

Further, the steps to be taken are: (i) to validate scaling implementation plan with stakeholders (scaling workshop July 2019); (ii) to nurture iterative feedback and update of the scaling road map; and, (iii) Development and follow-up of critical scaling ingredients.

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Road Map for Large-Scale Adoption of Conservation Agriculture (CA) in Bolivia

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I. Introduction

The Activity 2.1.1. Road Map for Large-Scale Adoption of Conservation Agriculture (CA) in Bolivia is part of the *Component 2: Development of a delivery system/participatory farmer-led extension system to accelerate adoption*. This component deals with the articulation of the innovation system model and a knowledge management (KM) strategy to ensure the design, development, and use of an effective delivery system for locally adapted CLCA[1] systems and practices. Innovation systems are social systems as they deal with a multiplicity of actors coming together to prioritize challenges, and to jointly uncover opportunities for mutually beneficial outcomes through resolution of these challenges.

I.I. Problem definition

The CLCA project focuses on the continued and growing challenges of food security, climate change, and land and natural resource degradation encountered by mixed smallholder farmers in dry areas of Bolivia. Mixed crop-livestock smallholder farmers need to balance incomes, soil fertility and biomass from their livestock and their farm. Especially in dry areas, these systems are threatened by climate change, land degradation and water scarcity (FAO, 2017; IPCC, 2014).

The harsh environment of the highlands of Bolivia do not allow many crops or animals to survive. The traditional llama-quinoa system that consisted of about 10% land for quinoa and 90% grazing land for llamas has been the only agricultural system that did well. Llamas were used for meat (transport, savings, rituals), and little bit of wool, and the quinoa as a staple crop. With rising demand for quinoa from high-income countries and the introduction of mechanization in the region over the last two decades , Bolivia succeeded in scaling production to unprecedented levels mainly based on area expansion (compensating yield decreases) with some authors estimating a 300% increase in area dedicated to Quinoa.

Sophisticated marketing strategies, business incentives, subsidies and trade regulations were brought to another level to keep up with demand and maintain a significant global market share from Bolivia, notably profiting the niche of certified organic quinoa "*Real*" (as opposed to Peru that actually produces more Quinoa but non-organic). However, in the process, farmers converted land from grazing to quinoa, reduced fallow rotations (from 10 to 2 or 3 years) and got rid of their llamas, to squeeze out as much quinoa as possible from the land and concentrate available labour on quinoa production. With additional income, more machines were bought to expand production even more. This led to massive soil degradation and low yields.

Currently, the Quinoa boom seems to be reaching an end, and it might not be a happy end. With low yields and their resources degraded, farmers are starting to see a decline on quinoa price (as it is starting

[1] Conservation agriculture in crop-livestock systems

to be produced elsewhere – US, France, Australia and of course Peru and Chile). In 2013, markets were paying about 1900 Bolivianos (+/-220 EUR) per quintal (48.5 kg), in 2017 they were paying less than one-third, 600 Bolivianos (+/-75 EUR). Consequently, millions of livelihoods are threatened by poverty, hunger, resource degradation and forced migration. This is a classic case of seeking maximum scale, while ignoring what the optimal, or responsible, scale should have been.

The Bolivian government wants to maintain the niche market of organic quinoa production from Bolivia. IFAD and FAO supported projects to promote more sustainable cultivation of quinoa and to promote the return of llama production for improved rural livelihoods in the cultivation systems (e.g. ProCamelidos, and predecessor programs).

I.II. Methodology

Conservation Agriculture (CA) comprises of the practical application of three interlinked principles, namely: no or minimum mechanical soil disturbance, biomass mulch soil cover and crop species diversification, in conjunction with other complementary good agricultural practices of integrated crop and production management (Kassam et al. 2018). CA in this way facilitates good agronomy, such as timely operations, and improves overall land husbandry for rain-fed and irrigated production. If the three principles are applied separately, they do not constitute a CA system. Complemented by other known good practices, including the use of quality seeds, and integrated pest, nutrient, weed and water management, etc., CA is a base for sustainable agricultural production intensification.

Tillage, as a soil management concept was questioned for the first time in the 1930s, when the dustbowls devastated wide areas of the mid-west United States. Only in the 1960s did no-tillage enter into farming practice in the USA. In the early 1970s and as the result of uncontrollable erosion problems in the southern states, no-tillage reached Brazil, where farmers together with scientists transformed the technology into the system which today is called CA. Yet it took another 20 years before CA reached significant adoption levels (See Figure 1).

During this time, farm equipment and agronomic practices in no-tillage systems were improved and developed to optimize the performance of crops, machinery and field operations. During the 1990s, this development increasingly attracted attention from farmers and researchers in Europe, Asia, Africa and Australia, and from development and international research organizations such as FAO, World Bank, IFAD, GIZ, NORAD, CIRAD, ACIAR and the CGIAR system. Study tours to Brazil for farmers and policymakers, and regional workshops, development and research projects were organized in different parts of the world. In 2015/16, CA cropland was about 180 M ha (12.5% of global cropland), while in Australia this is 80-90% (Bellotti and Rochecouste, 2014).

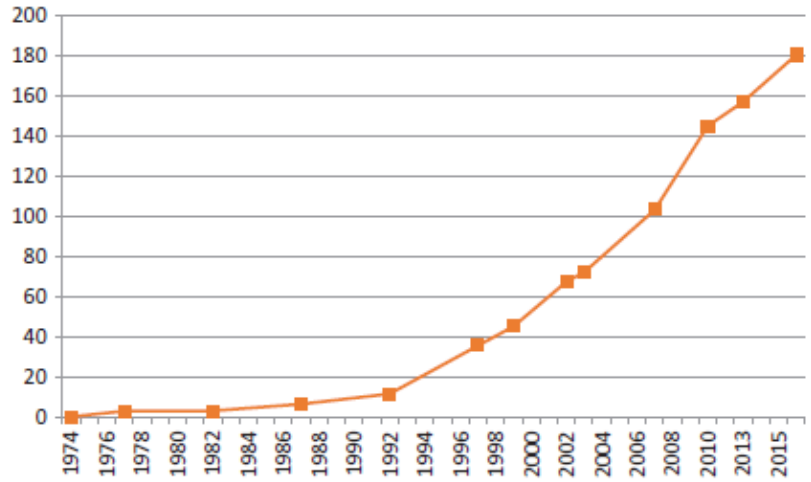

Figure 1. Global uptake of CA in Mha of cropland, note: 180 Mha =12.5 % of global cropland (from Kassam et al., 2018)

CIMMYT is one of the leading institutes for R&D on CA for smallholder farmers (Baudron et al., 2012; Jat et al., 2018). Adoption is much lower in low income countries than in high income countries due to lack of awareness, know-how, inadequate policies, unavailability of machinery and equipment and lack of suitable management strategies (Andersson and D'Souza, 2014). In areas where people mix livestock with crop production, a major challenge for CA is the competing needs for biomass for fodder and mulching for soil improvements. An IFAD supported grant with ICARDA on Integrated Crop-Livestock Conservation Agriculture (CLCA) systems has just been completed in Tunisia, Algeria and Tajikistan.

It was found that CLCA systems can be profitable if proper strategies for incorporation of forage crops and balanced management of biomass are developed and applied (adjusted to local specificities of farming and agro-ecological systems). The current CLCA project builds on this to expand to dryland areas in Latin America, expand the partnerships and link stronger to ongoing IFAD development projects.

I.III. Environment for scaling in the Bolivian Altiplano

The road map focuses on the region of the Altiplano Central and South of Bolivia. The gradient north south has a decreasing rainfall (800mm-300mm) and increasing importance of Llama. There is a cold desert climate (3800-4600m altitude) with temperatures up to -15°C in the winter and annual average temperatures between 4 and 8°C. The rainfall occurs between November and March with a range of 200 to 800mm/year. Frosts occur throughout the year and hail by the end of the rainy period causing serious damage to the few crops and native grasslands in the area. The conditions include low water availability, high winds (16-30 km/h), soil salinity, high solar radiation and low nitrogen soils in Altiplano Sur. This region is origin and main area of Quinoa *Real* (Royal Quinoa), which it's characterized with large grain, better price and preferred for export. There is a low population density, low access to services and, there are problems llama production: poor pasture management, water and animal health.

II. The Scaling Ambition

The scaling mechanism relies a lot on having the public and private sector drive the scaling process. First, this is conducive for sustainability beyond the project, and second, practically; CIMMYT has a limited time input for this project. The approach is more strategic than focused on pushing for field level adoption. The emphasis lies on reaching a transformation/ system change in the way quinoa is produced rather than the project directly working with farmers and counting their adoption (numeric approach to scaling). The Scaling Scan (https://www.cimmyt.org/scaling-scan-a-simple-tool-for-big-impact/) is used with a group of key stakeholders to get a joint-understanding of what scaling means in their context, and to identify bottlenecks and opportunities. This was done as part of a reconnaissance mission (11-14 June 2018) to meet key stakeholders, do field visits and get an impression of gaps.

Step 1 of the Scaling Scan is to develop a scaling ambition to get a clear idea of what impact would look like, who is involved, and why it is important.

Table 1: Scaling Scan step 1: defining your scaling ambition

I want to scale…	Response
What? *Considerations:* - Is it a technical, process or organizational innovation? - Do you need to scale all components of the technology/practice? Or is there one central component that should be scaled? - Is there enough evidence from the pilot phase to go to scale?	My **innovation:** … - There is not a lot of experience with Conservation Agriculture for Quinoa- Llama systems, hence it is important first to get an overview of the current status. - It is clear though that there is not crop enough residues available, tillage is used as a way to "harvest" water and not much scope for diversification due to hard environmental conditions. - Little knowledge globally on the integration of CA and livestock, their synergies and trade offs - Table 2 below summarizes findings on the CA technology per CA principle to come up with a locally adapted CA technology.
For whom? *Considerations:* - System change and sustainability are achieved by people; therefore we prefer to target people (households, organizations, etc.) rather than hectares or other indicators. - Are you targeting end-users, consumers and/or intermediaries? - What specific type of population are you targeting (hhs, indiv., businesses, rich/poor, women/men, age group, etc.)	My **target group** is…. - IFAD and CIMMYT are mandated to target poor vulnerable population, here small (<50 ha quinoa and/or up to 200 herd size) crop-livestock farmers. - Project objective: target at least 50% women and 30% youth (below 35 years) - Research needed: Llama herding seems to be more of youth/women job. Quinoa more of a men's activity
How much? *Considerations:* - Maximum: What is the size of the potential target group?	**Size** of the target group aimed for…. - Target set by IFAD for entire CLCA project: Tunisia+ Algeria+ Bolivia + Honduras: 3000 small crop-livestock farmers (>50% women and 30% youth (<35yr) - IFAD set target for Bolivia at 500 households

I want to scale…	Response
- Minimum: What is the current adoption rate of the innovation (up to piloting stage)? - What is a realistic target?	- Pro-Camélidos will benefit 30,000 families (47% of target population) in 1,500 communities in 37 municipalities - Focus CIMMYT more on sustainable system change and learning than on numbers - Maximum number of small quinoa-llama farmers in Altiplano Central and Sur estimated at 30,000 families
Where? *Considerations:* - What boundaries are you considering? Geographic/ agro-ecological zone/ water catchment/ etc.? - Are you looking at geographic expansion or more/different target population in the same geography?	My **intervention area** is… - Should overlap with Pro-Camelidos intervention area: 37 municipalities in la Paz, Oruro and Potosi department - Rainfed areas of Altiplano central and sur – initial focus on 3 communities: Quipaquipani (central), Chita and Chacala (Sur)
By whom? *Considerations:* - Does the organization/people that piloted the solution have the required experience and skills to lead the scaling process? - Who is most interested and best suited and motivated to provide leadership in reaching the scaling ambition (think beyond the project)?	The **leading organization** for scaling is/are…. - Since CIMMYT will test and introduce a new way of doing CA the leadership for this will be with CIMMYT who subcontracts local collaborators to conduct research - CIMMYT role will change to a partnership broker and catalyst for change by intervening strategically at all levels. - IFAD and FAO are providing high level advocacy for more sustainable production practices. - In the course of the project it should be determined who has the most interest and is best suited to take the leadership on scaling CLCA.
When? *Considerations:* - What is a realistic timeline for achieving your scaling ambition? - How long can you lead the scaling? Does the leadership for scaling need to be done in phases and handed over at some time?	The **time** to reach the desired scale is…. April 2018-June 2022 (4 years)
Why? *Considerations:* - What is the larger development outcome you aim to contribute to? Defining this is important to enable collaboration with those contributing to the same overarching development goal.	The **system change** we contribute to is…. Goal: to sustainably increase production and enhance the resilience of smallholder crop-livestock production systems to climate variability in drylands in Bolivia.

Table 2: Findings from the field vis-a-vis the principles of Conservation Agriculture (CA)

CA principle	Challenge encountered	Promote in the CLCA project (*italic and green indicates new practices introduced by CIMMYT*, black indicates practices that have already been proven in Bolivia)
1: No or minimal mechanical soil disturbance	- Poor mechanization practices (too often, too deep, along slope, use of wrong attachments, etc.) - Uprooting of Quinoa at harvest - Short fallows do not allow soil health recovery	- *Introduce smart and more appropriate mechanization practices (no/shallow ploughing, strip/zero tillage)* - *Direct seeding of quinoa and associated crops into untilled soil* - Cut quinoa instead of uprooting - Rotations and improved fallow management that provide feed for Llama
2: Maintenance of a permanent biomass soil mulch cover on the ground surface	- Clean harvest and no fallow - No wind barriers and no water harvesting	Quinoa has little biomass, need to intercrop with biomass crops - *Relay sowing of lupines, or lupines mix with leguminous, brassicas and cereals* - Wind barriers with forage species - *Forage banks in strips* - Improved fallow
3: Diversification of crop species	- Monocropping of Quinoa Real	- *Relay cropping lupines (wild → fodder/cover crop, cultivated → human consumption) in quinoa* - Intercrop bushes (tola, qawachi & lampaya) or perennial grasses (eg. pasto paja (Stipa ichu), Pasto lloron (Eragrostis curvula) Alcar (Agropyron elongatum)).
Complementary GAP	- Uncertain and limited rainfall - Degrades soils, soil erosion, high wind velocity, wind erosion in southern altiplano (sandy soils), - Frost damage - Pest and diseases -	- Improved manure application (at sowing instead of at tillage, or application in strips) - *Bio inoculants such as free living N-fixing bacteria (eg. Azotobactor, Azospirilium) and P_solubulizing bacteria (Psuedomonas or Bacillus), symbiotic N fixation for legumes such as Rhizobium and Trichoderma in quinoa → CIMMYT introduces new germplasm of alternate crops for improved fallow* - Planting perpendicular to slope and/or dominating wind direction

A sub-step in the Scaling Scan is to do a responsibility check. After all, people can be affected by an innovation that fails to produce its intended impacts or unintentionally produces negative side-effects. The following Table should be regularly reviewed over the course of the project.

Table 3. Responsibility check of scaling CLCA

	Potential **negative** side effects
A. Social responsibility	
Gender and age equality: - Do women, men, young and elder people equally benefit from and have access to resources and opportunities?	- Research needed: Llama herding seems to be more of youth/women job. Quinoa more of a men's activity. - Research needed: gender/youth study on impacts equality - Target of 50% women is probably too high- 30% would already be great. - FAO is setting up a quinoa/llama project focusing on youth employment- to collaborate with in 2019
Inclusiveness: - Are certain groups (based on ethnicity, religion, economic status, with disabilities, etc.) be excluded from any or all benefits? - Are those affected by the technology included in decisions about the scaling pathway and whether or not the intended impacts constitute success?	- How to define "small crop-livestock farmers "? Who is part, who is not? - How to connect to target population, make sure we work needs-based and whether or not the result at scale is also appealing to them. - Does the target population really want to go back to having more llamas and less quinoa? What social changes have taken place that prevent them from re-adopting a balanced llama-quinoa system? - There are some farmers (as the ones we saw) that are starting to rebuild their herd as they see less profit from quinoa, degradation of the soils and possible new opportunities with llama (there will be support from government as well) or at least ensure some regular income and food
Power equity: - Who are the winners, and who are the losers, when the new innovation is adopted at a large scale? - If the project provides exclusive advantages or power to certain players (e.g. monopoly to a certain service provider), how can this be justified?	- Focus on marginal farmers, but will learn from large farmers (Andean Valley Co., farmer cooperatives, etc) - Competition with international market for quinoa through an organic niche - Are we working with input/ service providers that may get a monopoly?
Resilience: - Is it possible for the target group to easily reverse adoption if not satisfied with the results, or is the project displacing alternatives? - What is the cost of failure, and who will bear it?	- Yes, reversible, easy not to adopt CA and get rid of intercrop plants, ground cover. - Cost of failure, rather low- CA involves subtle changes to current practices
B. Environmental responsibility	
Use of resources: - Will the scaling of the project affect the availability of important natural resources, such as water and land?	Yes, in positive sense, more productive use of land, labor and energy. A major indicator of success is resource conservation.
Quality of resources: - Will the scaling of the project change the quality of important natural resources, such as water, biodiversity and land?	Yes, increase biodiversity (multiple crops, strips, etc)

Climate change: - Will the scaling of the project worsen climate change by increasing CO_2 and other gases in the atmosphere?	No, more sensible use of machinery, more carbon sequestration in soil, more productive use of biomass

Draft Scaling Ambition: By 2022 CIMMYT facilitates scaling partners in Bolivia to have 500 (at least 50% women and 30% youth (below 35 years)) small crop-livestock farmers in drylands adopt one or more CLCA technologies to sustainably increase production and enhance climate resilience.

Step 2 of the Scaling Scan is to check the status of 10 scaling ingredients that are required for successful scaling. A rapid scan was done with representatives of INIAF, FAO, FIDA, PROINPA, CPTS and two universities (UMS and AUTF).

The participants of the kick-off workshop scored each ingredient with 1 (poor environment to support scaling) to 5 (good enabling environment to support scaling). The result is shown in Figure 2. It can be seen that there is low confidence that the policies are conducive to scaling, and that there is no clarity on who manages and coordinates a transformation to a better future.

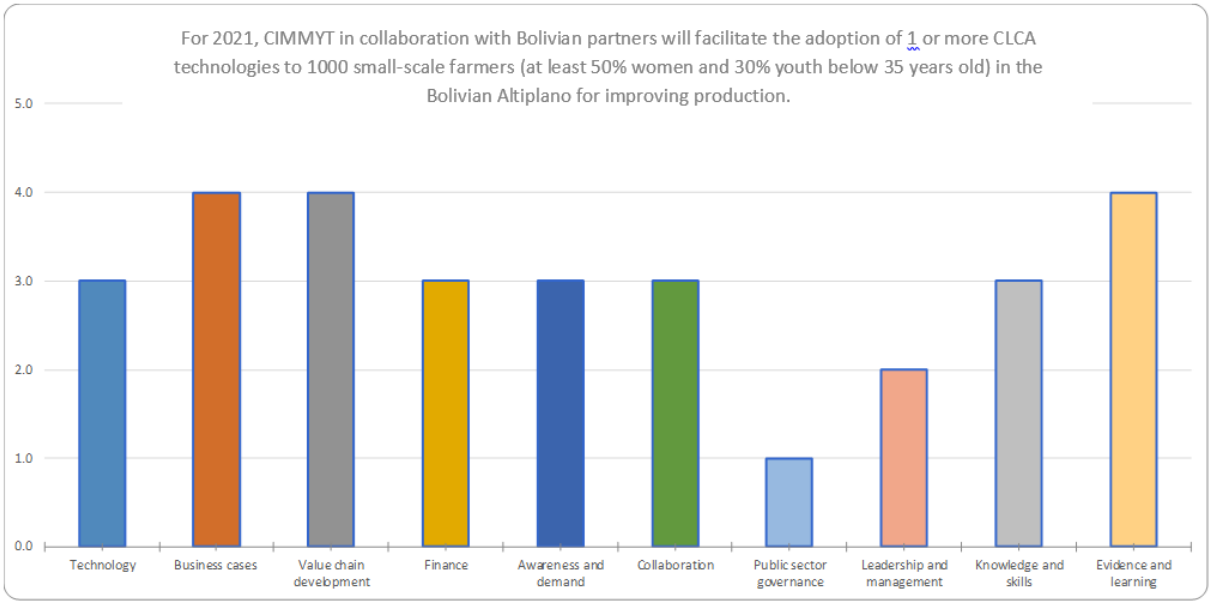

Figure 2: Results of a rapid scan by 15 participants to quantify the status of the enabling environment for scaling CLCA in Bolivia

It should be noted that this was a very rapid scan and there was little time to go deep into the meaning of each ingredient. It is planned to do a scaling workshop in the next trimester to come up with a more representative overview.

The Scaling Scan is useful to identify bottlenecks and opportunities for scaling and to set priorities for project implementation (Table 4).

Table 4. Rapid assessment of the scaling ingredients of CLCA in Bolivia.

Scaling Ingredient	What it provides to support scaling…	Bolivia
Technology/ Practice	An effective and efficient solution for the issue at stake - Relevant - Comparative advantage - Easy to adopt	- CLCA technology needs to be adapted to local conditions- prioritize understanding current status and if necessary set up new experiments with Fundación PROINPA/ UMSA. - Convincing evidence of relevance and comparative advantage exists, but not yet specifically for smallholders in Bolivia, nor on quinoa-llama systems.
Awareness and Demand	A wish and readiness for the consumer or producer to use the solution - Recognized need - Information available - Social credibility	- Research task: whether specific information on quinoa-llama systems is available/ accessible for farmers and value chain actors - Research task: Is there indeed much competition for resources in crop –livestock systems? - What is the demand for a solution at the different levels? - Level of knowledge within Bolivian value chain and internationally at extreme levels of soil degradation in production areas?
Business Cases	Attractive financial/economic propositions for users and other actors to respond to the demand - Incentives aligned - Demand-supply match	- Programs exist to support with developing business cases, however temporary nature and high production costs are killer factors. More support needed for example from PROCAMELIDOS, ACCESSOS, KOICA, PAR, GAMS, GAD - Demand for organic quinoa Real from the country of origin is higher than supply
Value Chain	Effective links between actors to pursue their business cases - Access and quality - Sector governance - Economies of scale	- No existing link between R&D camels and R&D quinoa, except for PROINPA who does research on both. - Value chain quinoa set up very professionally to serve export market. - Value chain llama very local and lost importance over last 10 years due to quinoa boom. - Poor coverage by service providers, poor interaction and articulation. Need to concentrate beneficiaries (economies of scale) through govt/ municipal support.
Finance	Effective financing options for users and other value chain actors - Affordability and accessibility - Acceptable risks	- Pro-Camelidos has a project component (3) on "Access to Financial Services" to "*design an information strategy and financial education using multimedia, modular workshops for municipal facilitators, and programme users. These activities will be coordinated with specialized entities (PROFIN, FINRURAL PRODEM, FIE, CIDRE and others) and with international cooperation institutions such as the Inter-American Development Bank (IDB) that have financial education programmes aimed at financial inclusion of different actors in the South American camelid complex……..///…. Promotion of financial services in coordination with specialized public sector entities (BDP, Banco Union) that have already developed lines of credit, guarantees and trusts for other items or chains such as quinoa. Promotion*

Scaling Ingredient	What it provides to support scaling…	Bolivia
		activities will also be coordinated with specialized entities (PROFIN, FINRURAL) that have various products and financial innovations that can be adapted to the reality of breeders, producers and entrepreneurs in the South American camelid sector" (page xv project doc)- however status is unclear at the moment. - Availability and coverage are OK, however poor compliance with rules. Need to work on investment security. - Support could come from: PROCAMELIDOS, KOICA, FAO, FIDA, BDP, SENASAG, ADUANA, MDRYT - Are consumers willing to pay more for more SUSTAINABLE organic production?
Knowledge and Skills	Capacities at individual and institutional level to use, adapt and promote the innovation - Capacity to use and promote - Capacity to scale.	- Hardly any capacity development programs on better llama/ quinoa management. Materials are poor. - Hardly any investments in cap dev, participatory research - Support should come from: INIAF, UNIVERSITIES, PROINPA, innovation networks.
Collaboration	Strategic collaboration within and beyond the sector to scale the innovation - Relevant and motivated actors - Effective networks and platforms	- No coordination between actors to promote CA (machine providers, service and training providers, extension, etc). Existing networks and platforms do not function properly. - Private sector actors (Andean Valle Co.) motivated to enhance organic and sustainable production of quinoa.
Evidence and learning	Evidence and facts underpin and help gain support for the scaling ambition - Measuring system change - Adaptive management - Leverage credibility	- Within CLCA project ICARDA set up M&E framework, but with focus on project management indicators. - Research task: Who is interested in what information? What info is missing to make drastic decisions? - Research task: identify and monitor indicators that show a system change/ transformation from unsustainable to sustainable quinoa-llama systems. - Key role of project: generate and formalize evidence about the degradation of resources, the need to integrate crop and livestock for better sustainability and on specific alternatives.
Leadership and management	Effective coordination and navigation of the scaling process - Recognition of leadership - Lobby and advocacy - Change management	- Influential people for lobby and advocacy? Who is interested in the crop livestock tension at political level? - MDRyT and MMAyI and municipalities should show more leadership. - IFAD and FAO offer opportunity to access more funds to support CLCA. - See comments Table 1 "by whom?"
Public sector governance	Government support to reach the scaling ambition - Conducive rules and regulations	- Research task: Policy support/frustration? Priority? - Research task: Government programs with similar objective?

Scaling Ingredient	What it provides to support scaling…	Bolivia
	- Gov"t support (in-kind/ co-funding) - Smart subsidies	- Research task: Subsidy program to re-introduce llamas exists (pro-camelidos)? Subsidies on quinoa? Tariffs on quinoa/lama? - No clear policies exist that support the scaling of a solution. - Sporadic initiatives by individuals. - Need for a strategic plan at national level by MDRyT.

III. Implementation Plan

This implementation plan is a proposal based on previous findings and needs to be validated with key stakeholders.

Table 5. Implementation plan proposal for scaling CLCA in Bolivia.

Work package	Responsible	Proposed Timing	Comment
1. **Locally adapt CLCA technology** using relevance, comparative advantage and ease of adoption as main criteria	CIMMYT agronomists + PROINPA and UMS	April 2018-March 2021 and further fine-tuning until 2022	Quinoa is sown in Sept-Oct, it flowers in Dec-Jan, harvest in March then fallow
2. Set up collaboration system: a. Identify stakeholders motivated to work towards a transformation of the quinoa-llama system b. Formalize collaboration and clarify roles and responsibilities c. Intensive support to coll. system and esp. partner that drives scaling	CIMMYT scaling and partnership experts + support IFAD/FAO/Pro-Camelidos + consultants to set up professional collaboration system	a. April 2018-Jan 2019 b. Feb-Mar 2019 c. April 2019-June 2022	Collaboration is key for scaling, however in many projects it is actually a collection of transactions, there are no "true" strategic alliances. CIMMYT developed some concepts to collaborate "better" that will be integrated in the project implementation
3. Apply Scaling Scan and other tools to a. get joint understanding of scaling, identify and prioritize bottlenecks and opportunities and to help navigate the scaling process. b. Re-assess and evaluate progress	CIMMYT scaling expert	a. June 2018 (rapid scan) and July 2019 b. Annually	Project leaders will use the Scaling Scan. Method: 2-3 day scaling workshops with key stakeholders.
4. Develop specific strategies to overcome the bottlenecks, and exploit the opportunities that are critical for enabling environment.	CIMMYT + project partners+ Sectoral experts/ consultants (e.g. finance, policy, marketing, advocacy)	Feb 2019- June 2022	Several assignments of subject matter specialists (non-agriculture)
5. Evidence and Learning	CIMMYT M&E expert and scaling expert+	a. Dec 2018 b. 2019-2022	

Work package	Responsible	Proposed Timing	Comment
a. Identify indicators that capture system change b. Adapt M&E system to Bolivia and system change indicators c. Monitoring	ICARDA		

An Agricultural Innovation System (AIS) has to be built putting together the different stakeholders with a common purpose in close collaboration. Research and development institutions, such as PROINPA and the Universidad Mayor de San Andres (UMSA), together with CIMMYT and other international agencies such as IFAD and FAO need to collaborate with scaling entities such as Pro-Camelidos and NGO's (e.g. ReverdeSer) in order to develop, adapt and implement alternatives for more sustainable CLCA systems. Champion farmers to test different alternatives need to be accompanied in the local adaptation of main CLCA principles and their experiences will be used as learning elements for other farmers in the communities. Scaling agents such as Pro-Camelidos but also local authorities and cooperatives or farmers organizations, such as *Asociación* Nacional de *Productores de Quinua* (ANAPQUI) need to be involved from the beginning in the development and adaptation of alternatives.

IV. Replicability

The CA technology is already replicated all over the world. The replicability of the scaling case as such depends on the willingness and capacity to replicate the process in another context, by another team. Critical processes have to approach towards:

- Local adaptation of the CA technology;
- Setting up a collaboration system that is based on an intrinsic motivation to transformation beyond the project;
- Scaling as a science and art in itself, and the application of tools that help approach scaling systematically;
- Thinking out of the box- looking for solutions outside of the comfort zone. In this case, 9 out of 10 answers on scaling agricultural innovations lie outside of the agricultural discipline;
- Focus on system change, sustainability and not on reaching a certain number within a project context. All partners should be aware of this, and the M&E system should capture this as well.
- Be transparent on lessons learned and "wrong" pathways taken.

V. Risk Assessment

- **Project management**: project steering from Mexico, low budget (300 000 USD for year 1) and hence low time input from CIMMYT staff → focus on strategic interventions, "hands-off" approach and invest in identifying good collaborators as well as a well-functioning local collaboration system.
- **Resistance of NARES, farmers and R&D partners (public and private) to the CLCA approach**→ Planning for the dissemination of the CLCA approach will be carefully undertaken, with ICARDA and CIMMYT working closely with national IFAD country programs and investment projects partners to ensure support at the national policy level. Science-based evidence and lessons' learned from the previous CLCA project in North Africa and other similar initiatives will be used as a basis for effective communication of the approach and to ensure country buy-in. Participatory approaches will be

applied early on in the project to develop and involve farmers, local extension services, and other relevant stakeholders to reduce the risk of low adoption of CLCA packages. The project team will organize a series of virtual consultations with the stakeholders listed above in order to identify clear target audience, goals, objectives, and potential risks.

- **Extension support cannot be sustained** without continuous support from external sources →the project will be strongly linked to on-going IFAD investment projects that provide strong support and strengthen existing extension services. Furthermore, the project will adopt community-based and community-driven processes with the aim to strengthen local governance (through innovation systems) over natural resources and components of the CLCA system.
- **Natural disasters and weather** disrupt the experiments and farmers activities on the field, for example leading to starvation of llama, or failed quinoa harvests.
- **Political instability** → develop an alternative implementation strategy in case of major political instability and social unrest which could occur during the period of the project implementation (although not expected in Bolivia, Nicaragua was replaced by Honduras due to political turmoil).
- **Fluctuations in market price for (organic) quinoa,** a high price might incentives farmers to squeeze the ultimate drop of fertility out of their field. A low price might disrupt the stakeholder landscape (exit of private sector) and incentivize farmers to stop producing quinoa → monitor quinoa prices, employ sector specialists to develop scenarios, potentially promote diversification of markets.

To ensure a collective understanding of risks to the project, and implications, a risk mitigation plan will be developed during the project inception phase in consultation with the relevant stakeholders. This will facilitate that any risks, that could impact on the planned cost, schedule and performance parameters of the project, are acknowledged from the start, and measures taken to track and monitor the progress, alongside appropriate mitigation actions.

Overall success probability “5” to achieve the project objective set by IFAD (500 farm households adopt CLCA). However, CIMMYT aims beyond that to provoke a sustainable system change beyond the project – probability of success is estimated at “3”.

VI. Monitoring and Evaluation

ICARDA adapts the M&E system used in the predecessor project CLCA North Africa to fit the needs of this project. The M&E system of this project should hence be compatible with the overall project M&E lead by ICARDA, as well as the M&E system of IFAD and Pro-Camelidos. Apart from indicators that show the project objectives are fulfilled, it is important for scaling to include indicators that show that the project contributes to a transformation of the way quinoa-llama systems function.

VII. Learnings

- Competition for biomass between mulching for CA and livestock feed is commonly mentioned as a bottleneck for farmers to adopt CA in crop-livestock systems. ICARDA challenged this in the first phase of the CLCA project in Tunisia, Algeria and Tajakistan and found that it is not necessarily always the case. This project could potentially add important knowledge to the existing CA literature.
- The scaling case explicitly moves away from defining success in scaling as a function of a certain amount of farmers adopting a practice. It focusses much more on a sustainable system change, potentially going far beyond any measurable numbers. Many lessons can be learned on the implications for project design, implementation and evaluation of such projects.

- The scaling case aims to “scratch where it is itching” and therefore it will start with a systematic assessment of bottlenecks for scaling using the Scaling Scan tool. This approach harbors interesting lessons for any project that is set up as a sectoral project. In addition, many lessons learned are expected on the use of the Scaling Scan tool that can feed into an improved version.
- Strategic identification of collaborators with a view to scale within and beyond the project rather than the common approach to have local actors support the project leader achieve its objectives.
- The definition and implementation of the scaling pathway is an experiment in itself and will be approached as such. Potential lessons learned on “mistakes” will be communicated in a transparent way.

VIII. Progresses of critical ingredients

During the first year, four scaling ingredients have been critical: technology; awareness and demand; collaboration; and leadership and management. The ingredient of technology has been assed particularly on the reports of Component 1 while, the other three are considered mainly in the activities of Component 2.

VIII.I. Collaboration, and leadership and management

In October 2018, a field visit was conducted where 17 stakeholders were interviewed. The interviewees were : Andean Valley Corporation, Bolivian Chamber of Royal Quinoa and Organic Products Exporters, Centro Iternacional de la Quinoa, Centro de Promociones de Tecnologías Sostenibles, FAO, FINRURAL, Fundación PROFIN, ReverdeSer, INIAG, MDRyT, Procamélidos, Fundación PROINPA, and TIMTAA.

Based on stakeholder interviews the following challenges and opportunities for the quinoa-llama systems in Bolivia were identified according to the scaling ingredients (Jacobs, Ubels, & Woltering, 2018).

Table 6. Challenges and opportunities of the quinoa-llama system in Bolivia.

Scaling ingredient	Challenges	Opportunities
Technology/practice- *An effective and efficient solution for the issue at stake*	- Quinoa mines nutrients, and without fertility management, quality of grains go down. - Monocropping and weaker plants led to high incidence of pests. - Extensive pasture of llamas and climate change caused drying up of *bofedales* (wetlands) and water stress. - Narrow focus on technology transfer of quinoa varieties and machinery with insufficient capacity development.	- High cultural value quinoa and llama, and hardly any agricultural alternatives in Altiplano. - Integration quinoa with llamas desirable because camelids' manure is the best (available, organic, quality) source of fertilization. - The improvement of current systems vs alternative solution (e.g. "Ayamaya"- extensive and intensive cultivation of quinoa in non-arable land under investigation by CABOLQUI and CPTS).
Awareness/demand- *A wish and readiness for the consumer or producer to use the solution*	- Organizations in La Paz seem aware about land degradation challenge and express need to address it. - Awareness about, and need to, address land degradation from population in Altiplano needs to be investigated. - Awareness about, and need for, conservation agriculture as a technological solution needs to be investigated. - High demand expected from China; uncertainty of pathways to foster fair trade, organic and quality principles.	- High and rising int. demand for Quinoa Real because its versatility essence (organic, gluten free, vegan/ vegetarian source of protein), likely that customers in US/Europe will pay more for sustainable & smallholder produced quinoa. - Llama was seen as poor-mans-food, now becoming mainstreamed. - Communication campaigns on land degradation could be effective in Bolivia.
Business cases- *Attractive financial/ economic propositions for users and other actors to respond to the demand*	- Smallholder farmers: Not enough evidence on quinoa-llama systems relevance as economic/sustainable driver in Altiplano; strong urban-rural migration and off-farm/alternative incomes. - Smallholder farmers: yield and quality decrease of quinoa. - Service providers (e.g. machinery) don't target smallholder (<50 ha) farmers. - Strong international competition and national challenges to meet demand. - Exporters: Fewer customers appreciate quality and mismatch price-quality. - Bolivia is ranked 152 among 190 economies in the ease of doing business.	- Smallholder farmers: subsistence, established marketing channels because of quinoa boom, high cultural value quinoa-llama. - Service providers: high potential for improvement of production through better support (awareness, training, coaching, etc). - Bolivia has "Origin denomination of quinoa" and a good reputation for organic quinoa. - China market opens to Bolivia.
Value chain- *Effective links between actors to pursue their business cases*	- Smallholders: Difficult access to affordable services. - Processing/export companies provide services such as training, certification, input provision, processing, etc. on a limited scale; little/no involvement of specialized service providers or institutions mandated to provide that support (govt extension).	- Effective links between smallholders and processing/ export companies exist. - Differentiation for Bolivian Royal Quinoa can be exploited further by catching higher prices for quinoa certified for sustainable practices (https://www.soilassociation.org/certification/) or social

Scaling ingredient	Challenges	Opportunities
	- No quinoa value chain platform exists that unites private and public sector actors. - Organic value chain is threatened by pollution of non-organically produced quinoa.	responsibility (https://www.iso.org/iso-26000-social-responsibility.html). - Increase in demand for vegan, vegetarians, gluten free, organic, high protein, etc products.
Finance- *Effective financing options for users and other value chain actors*	- Exists only individual financial products (quinoa or llama). - Credits or other financial products are generally not attractive for producers. - Quinoa production is risky (weather) and perceived as a risky investment. - Generally, farmers not organized in associations.	- Suppliers provide credits directly to farmers. - Producer organizations have the opportunity to create their own finance institutions. - All banks and finance institutions are obliged to offer financial literacy trainings.
Knowledge and skills- *Capacities at individual and institutional level*	- Limited investment in research and lack of extension services; Farmers don't have the knowledge about sustainable practices. - Private sector unmotivated to support farmer training in appropriate practices because market does not pay significantly more for better quality and healthy production.	- Suppliers provide extension services or buyers (exporters). - High potential for better performance through capacity enhancement. - Camelids conference organized by ProCamelidos in Nov 2018.
Collaboration- *Strategic collaboration within and beyond the sector*	- Need for cross-sectoral collaboration and cross-commodity (llama-quinoa) expressed by almost all stakeholders. - No systematic platforms for exchange on quinoa nor llama exists - Relative high distrust between private and public sector.	- Enthusiasm of different stakeholders in cross-sectoral approach, territorial management – rural development. - High potential for improvements when platform for collaboration/exchange is moderated/ facilitated.
Evidence and Learning- *Evidence and facts underpin and help gain support*	- Inefficient data management. - Management of the knowledge is complex/difficult. - Documentation on lessons learned, or status, of quinoa/llama in Altiplano not available.	- High potential for improvements if different data sets are put together. - Interest in knowledge exchange platforms (where local knowledge is also recognized).
Leadership and Management- *Effective coordination and navigation*	- Leadership to coordinate efforts to reverse land degradation scattered and not recognized. - Maximum export vs sustainable land management and livelihoods. - Conflict sensitive (public vs private sector).	- MDRyT dept of planning recognizes their leadership role for public sector. - CABOLQUI unites many processing/export companies (private sector).
Public Sector Governance- *Government support*	- Low attractive export tariffs. - High incidences of smuggling and other illegal activities in border areas (incl. Alitplano). - Overlapping mandates among organizations.	- Big national program to support reintegration of camelids (ProCamelidos). - Good marketing and international positioning in the quinoa market. - Willingness to tackle land degradation.

VIII.II. Awareness and demand

Based on the previous findings, a particular study was developed to increase the understanding of the level of awareness and demand (A&D) of/for improved crop livestock systems in the South-Central Bolivian Altiplano. The study included a full report in Spanish, an executive communication strategy and a video. The full report of 114 pages has a methodology based on analysis of bibliographic, documentary, and field data from November 2018 to January 2019 (Annex I). The fieldwork included structured and semi-structured interviews to producers, intermediaries and public and private institutions, and the data was analyzed through qualitative indicators defined by the research team (pages 71-74 and pages 83-86 of the full report). The report describes the characteristics of the region (land, territory, social, and household organization), as well as, the value chains for llama and quinoa. Moreover, it identified key finding on awareness and demand, identified as a critical ingredient for the scaling process of the CLCA project (Table 7).

Table 7. Summarized findings of the study to understand the level of A&D of/for improved crop livestock systems.

Research question	Key findings
1. *What is the level of awareness of different stakeholders about the problems, and potential solutions, associated with the unsustainable cultivation practices in llama-quinoa systems?*	The unsustainable production practices identified by the stakeholders were: • Extensive quinoa crop land area; • Use of the disc plow and its effects on the reduction of soil yield; • Use of chemical pesticides; • Insufficient rest of the land; • Monoculture of quinoa; • Lack of knowledge about frost protection techniques; • Lack of knowledge about techniques for water recovery; • Quinoa crops in places with little wind protection and decrease in camelid livestock. The levels of awareness vary by place and by type of producer but there is a general recognition of their relevance although there are not many active alternative actions.
2. *What is the level of demand ((no) interest, willingness to pay, risks, etc.) of different stakeholders for the CLCA, or another solution?*	There is interest in sustainable practices such as: Recovery of native grasses (medium to high demand level); Fertilizing the soil with llama manure (high demand level); Use of organic pesticides (high demand level); Proper techniques for water recovery (high demand level); Proper techniques for frost protection (medium to high demand level); Fallow areas (medium to high demand level); Crop rotation (medium to high demand level); Efficient sowing according to wind directions (medium to high demand level); Appropriate mechanization practices (medium to high demand level).
3. *What other information is required to develop a communication strategy*	For the producers and community authorities, there are specific demands for information, training, dialogue and coordination of activities. For consumers, it is required to tell the story of Quinoa Real and its coexistence with camelids and the ecosystems of the Altiplano to add value at national and international level (Note: this last group was not included in the research).

IX. Conclusions and steps further

Scaling innovations to improve the sustainability of farming systems in a region requires understanding of the main scaling ingredients, particularly the ones that act as bottlenecks and opportunities. For that, "The Scaling Scan" is a useful tool that can identify the strengths and weaknesses of a scaling ambition. The main results of this report are:

Key finding 1: The scaling ambition for the CLCA project is: "By 2022 CIMMYT facilitates scaling partners in Bolivia to have 500 (at least 50% women and 30% youth (below 35 years)) small crop-livestock farmers in drylands adopt one or more CLCA technologies to sustainably increase production and enhance climate resilience".

Key finding 2: In collaboration, systematic platforms for exchange/collaboration on quinoa or llama does not exist.

Key finding 3: In leadership and awareness, leadership to coordinate efforts to reverse land degradation are scattered and not properly recognized.

Key finding 4: In awareness and demand:

- The levels of awareness vary by place and by type of producer but there is a general recognition of their relevance although there are not many active alternative actions.
- There is interest in sustainable practices such as: Recovery of native plants; Fertilizing the soil with llama manure; Use of organic pesticides; Proper techniques for water recovery; Proper techniques for frost protection; Fallow areas; Crop rotation; Efficient sowing according to wind directions; Appropriate mechanization practices.
- For the producers and community authorities, there are specific demands for information, training, dialogue and coordination of activities. For consumers, it is required to tell the story of Quinoa Real and its coexistence with camelids and the ecosystems of the Altiplano to add value at national and international level.

Further, the steps to be taken are: (i) validate scaling implementation plan with stakeholders (scaling workshop july 2019); (ii) iterative feedback and update of the scaling road map; and, (iii) development and follow-up of critical scaling ingredients.

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