



DIGITAL BOOK OF PROCEEDINGS

14TH EUROPEAN IFSA SYMPOSIUM
FARMING SYSTEMS FACING CLIMATE CHANGE
AND RESOURCE CHALLENGES

8 – 14 APRIL, 2022, UNIVERSITY OF ÉVORA, PORTUGAL

All rights reserved. Authors are responsible for contents. Please do not reproduce.

SUPPORTING AGRICULTURAL AND AGRI-FOOD INNOVATIONS FOR STAPLE FOOD PRODUCTION IN CAMEROON: PLURALISM OF ORGANIZATIONS, DUPLICITY AND DISCONTINUITY OF SERVICES

Rodrigue Kamga^a, Guillaume Hensel Fongang Fouepe^a, Syndhia Mathé^{bcd}, Sarah Crestin-Billet^e, Ludovic Temple^f, Andrea Knierim^e

^a University of Dschang, Dschang, Cameroon

^b INNOVATION, Univ Montpellier, CIRAD, INRA, Montpellier SupAgro, Montpellier, France

^c CIRAD, UMR INNOVATION, Yaoundé, Cameroun

^d International Institute of Tropical Agriculture (IITA), Yaoundé, Cameroun

^e University of Hohenheim, Stuttgart, Germany

^f CIRAD, UMR Innovation, Montpellier, France

Abstract

The innovation systems approach is an analytical framework that is increasingly used to address agricultural innovation support services (ISSs). In the staple food production sector of Cameroon, a plurality of innovation support service providers (ISPs) co-exist, but ISSs are largely delivered within the framework of agricultural and rural development projects or programs. This paper aims to assess the impact of such governance mode on ISS delivery. Using a mixed research approach, empirical data have been collected focusing on the cassava innovation sub-sector in Southern region of Cameroon. ISPs at the local, regional and national levels (n=11) were first identified through literature review. Semi-structured questionnaires were administered to this first sample in order to create an ISP and projects database. A second semi-structured questionnaire was then administered to an enlarged group of ISP respondents (n=27) in order to characterize ISPs and ISSs, as well as to identify and measure the interactions among ISPs. Results indicate that public international and national ISPs dominate the system (high number of projects, ISSs and interactions with other ISPs), and that this leads to duplicity of certain types of services. The private sector and Farmer-Based Organizations (FBOs) are also present and offer rather complementary ISSs, but their number is comparatively lower. The lack of intermediary services to coordinate the overall ISS system, the rather low density level of ISP interactions and their informal quality give the impression of a fragmented ISS system. But, the interactions among ISPs are actually essentially very uneven. Although international public ISPs already interact well with FBOs, partnership strategies towards national public ISPs still need to be implemented. In turn, national public ISPs should also strengthen their links with these FBOs. Overall, ISSs delivered by national and international public ISPs, as well as by the FBO umbrella organization (PROPAC) are mainly funded on project bases, which raises the risk of service discontinuity. Multi-actor partnerships and innovative mixed funding strategies need to be supported to improve the efficacy and the quality of ISSs delivery.

Introduction

Agriculture is the backbone of Cameroon's productive sector representing 22.8% of the Gross National Product and employing 65% of the country's active population. Agriculture contributes to the national food security and sovereignty, to foreign exchange earnings and produces raw materials for the industrial sector (Mouafor et al., 2016).

In Cameroon, staple crop production employs more than 50% of the active population and contributes about 64% of the agricultural GDP (République du Cameroun, 2010). Staple crops include a wide variety of agricultural products: roots and tubers (cassava, cocoyam, potato, yam, etc.), cereals (maize, paddy rice, millet and sorghum, etc.), oilseeds (groundnuts, cotton seed, etc.), fruits and vegetables such as bananas, plantains, pineapples, papaya, but also sausages, avocados, dried vegetables, spices, leafy vegetables, ornamental plants and flowers, etc. (Kidd et al., 2000; Achancho, 2013). Staple crops are less demanding in terms of investment in inputs than export crops, as such, staple crops ensure food security through self-consumption, the supply of local markets and the generation of income for agricultural households and mainly women (Mouafor et al., 2016). Despite this diversity of products and its contribution to the country's food and nutritional security, agricultural yields remain low compared

to their agronomic potential (Kwa & Temple, 2019). Production techniques remain very manual, using few inputs except for some very intensive forms of production such as banana production for exports. The perishability of products and the failure of infrastructural logistics also generate heavy post-harvest losses. Other constraints include weak organization of actors within the food chains, embryonic processing and marketing (FAO, 2018; Ebela, 2017).

The importance of staple food for Cameroon has been taken into account in agricultural and food policies (Ebela, 2017; Fongang, 2008). In particular, the Food Crop Development Mission (MIDEVIV) created in 1981 as part of a national plan entrusted by the State mainly aimed at supporting the production and marketing, as well as the supply of improved seeds to farmers. This orientation has been reaffirmed in the context of the New Agricultural Policy, formulated after the economic crisis that led the State to withdraw from some of its providential functions. The formulation of the Development Strategy of the Rural Sector in 2006 and its revision within the framework of the Strategic Document for Growth and Employment in 2010, which continue to structure the current agricultural policy guidelines take into account the food production sector, but remain quite generic and focused on productivity objectives. Moreover, the recent public policies in support to agricultural innovations (Ntsama, 2009) remain guided by the development model of the 1960s and 1970s Green Revolution in Asia, that is, that of high capital-intensive, input-intensive and highly productive agriculture (Bayiha et al., 2019). This is however in contradiction with the international guidelines, such as the renewed MDGs edited by the Food and Agriculture Organization (FAO, 2020; Dury et al., 2019) which encourage a renewal of conventional agricultural intensification policies by integrating sustainability aspects such as environmental resource management and social inclusion in order to reduce unequal access to food resources.

Agricultural innovations in Cameroon have traditionally followed a “diffusionist” scheme in which innovations - mostly technical such as new varieties, cultural practices and technical itineraries - originate from national public research organizations and are then disseminated to farmers by agricultural extension services through producer organizations (IRAD, 2013). The disengagement of the state from its public functions between 1980 and 2000 has however stimulated the emergence of a myriad of new actors (private organizations, international and national NGOs, NGO networks, inter-professional organizations, farmer organizations (FO) and their grouping). Through specific development projects and programs, these providers are engaged in a wide range of activities such as: distribution of seeds and improved seedlings to farmers, agricultural marketing, rural animation, organization of farmers involved in agricultural chains, technical experimentation, supply of other agricultural inputs, technical advice, agricultural financing, etc. (Temple et al., 2019). These activities can be defined as innovation support services (ISSs). *"An innovation support service is intangible, and involves one or more suppliers and one or more beneficiaries in activities in which they interact to address a more or less explicit request arising from a problematic situation and formulated by the beneficiaries and to co-produce the services aimed at solving the problem. Interactions aim to achieve one or more beneficiary objectives based on the desire to strengthen an innovation process, i.e. to promote technical and social design, enable ownership and use of innovations, facilitate access to resources, help transform the environment and build capacity for innovation"* (Mathé et al., 2016). The consolidation of farmer organizations has received a particular attention from the State that wishes to precisely invest in projects/programs aiming at consolidating farmer organizations and improve food security (Ntsama, 2009).

However, despite the implementation of these strategies and the emergence of projects/programs to increase the quantities produced of certain food crops (cassava, maize and plantain), it must be noted that the volume of the main food crops has remained almost stagnant (Achancho, 2013) or that at least production per agricultural input has slightly increased. This raises questions about the effectiveness of projects/programs as a means of intervention in support to agricultural and agri-food innovations. Project and program-based development interventions can allow a diversity of actors to join forces and thereby contribute to build farmers' individual and collective problem solving and innovation capacities

(Nagel, 1997). There are however also many examples of partnerships within the framework of projects which have failed to promote and disseminate innovations, in some cases due to a lack of linkages with some local organizations and market actors (Hall, 2006), due to strong network failure blocking the access to external knowledge (Mofakkarul et al., 2013) or due to loose relationships between the actors of a network (Magala et al., 2019), leading to “missed opportunities for collaboration and a limited recombination of knowledge and resources” (Hermans et al., 2015). Projects/programs also constitute a clear risk to the continuity of service provision due to their short time span as it has been observed in other contexts (Martínez-Cruz et al., 2019; Kidd et al., 2000; Faure et al., 2013).

Taking the cassava crop as an illustration of the staple food sub-sector in Cameroon, this paper aims to assess the importance of public project/programs as a mode of ISS delivery. It shall characterize and allow a comparison of the innovation support providers (types of organizations, types of delivered ISS, types of supported innovations and types of funding arrangements) and finally examine their linkages (density of interactions and nature of their relationship). We define “innovation support service provider” (ISP) as any actor (individual or corporate) who offers one or more innovation support services to another actor across the innovation process.

Research methodology

ISPs identification (Phase 1)

The study was conducted within the framework of the SERVinnov project (<https://umr-innovation.cirad.fr/projets/servinnov>). The Southern region of Cameroon is one of the main staple crop production lowlands area and was thus selected to analyse its Cassava innovation sub-system. Based on a literature review (including grey literature in French), a first sample of 11 ISPs active at the local, regional and national levels were identified (Table 1). A semi-structured questionnaire and face-to-face interviews with these ISPs were then conducted in order to obtain a general understanding of the sub-sector and to identify new ISPs. The interview guide was divided into five sub-sections: overview of cassava’s food chain in Cameroon, agricultural innovations developed in this food chain, ISPs engaged, innovation support system and main constraints encountered by ISPs. The interviews took place in the Southern, Central and Littoral Regions from April 26, 2019 to June 08, 2019.

ISPs and ISSs characterization (Phase 2)

Using the answers from the first phase of data collection and using a snowball sampling technique, a larger sample of ISPs was formed. In total, 27 semi-structured interviews were conducted with representatives from 14 organizations and 5 individuals which we classified into the informal sector, as they supply ISSs outside of any formal institution. These individuals are economic actors who have develop some expertise about cassava. All of them are present and active in the Southern region of Cameroon (Table 1). The questionnaire focused on the ISP typology, the offered ISSs, the main beneficiaries of these services, the funding mechanisms and the interactions of the ISP with other ISPs of the subsystem.

Table 1. Number of conducted interviews among innovation support service providers (ISPs) for each study phase

ISP types	Interviewed ISPs	Phase 1: ISPs identification	Phase 2: ISP and ISS characterisation
National public organizations	MINADER (DRCQ)	2	8
	MINEPAT	1	1
	IRAD	1	1
	IMPM		1
	Agricultural chambers		2

International public organizations	IITA	1	1
	CTA		1
	PRASAC	1	1
Private enterprises	CRIFAT		1
	Rural Investment Credit		1
	People's Finances		1
Farmer-based organizations (FBOs)	PROPAC		1
	CNOP-CAM	1	1
	PIP-CV	1	1
Informal sector	Individuals	3	5
Total		11	27

Interview data analysis

Transcriptions and coding of the qualitative information for the two study phases were done without the use of any software. Quantitative data were processed in EXCEL 2013.

ISPs mapping

A social network analysis of the identified ISPs was conducted with the mean of an actor matrix (Biggs & Matsaert, 2004). When constructing the actor matrix, emphasis was placed on the presence or absence of interactions between ISPs. In this study, interactions between ISPs are defined as any type of contact, formal or informal, between two or more ISPs leading to exchange of information, activities, access to inputs or trade related to cassava. The matrix also included the nature of the linkages: informal collaboration (informal interactions between two or more providers), partnership (interactions between two or more providers which are formalized by a contract), and coopetition (collaborative work among potentially competing ISPs in a way that benefits both of them). This matrix was then used to manually draw the ISP mapping. This was done using EXCEL 2013 from Microsoft Office.

Measure of ISP interactions

Using the actor matrix and based on a methodology from Borgatti et al. (2009), we were able to calculate:

Degree of connection

To have information on the weight of each ISP in the network, we calculated the degree of connection of each ISP. According to Mercklé (2004), the degree of connection of an actor is an indicator of its integration or, on the contrary, of its isolation in the entire network, or an indicator of its centrality. An actor's degree of connection is indicated by the number of non-zero entries (numerical sum) that are recorded in an actor's row or column of an actor matrix, in other words, it is its total number of linkages to other ISPs.

Percentage of interactions

To know the total number of interactions per ISP within the system, we calculated the percentage of interactions between ISPs.

$N_i = ((n \times n) - n) / 2$, where N_i : maximum number of possible interactions and n : number of ISPs. The totality of the 15 ISPs was used to calculate the maximum number of possible interactions between ISPs in the cassava innovation subsystem.

Density of network

To know the number of ISPs who are actually linked to others within the system, we calculated the density (D) of the ISP network.

$D = \lambda / (N(N-1)/2)$ where λ : total number of linkages and N is the number of ISPs in the network.

Results

The results of the data collection and data analysis are presented hereafter. First of all, a general characterisation of ISPs (governance type, administrative scale of activity) is provided. Secondly, the ISSs are characterised in terms of their type of service and level of importance for the ISPs, as well as in terms of their main funding source (project- or non-project-funded). The different funding arrangements for each type of ISS are then also provided. Finally, the mapping and measure of the interactions between ISPs are presented and the nature of the collaboration arrangements is identified.

ISPs characterization

The cassava innovation system is characterized by the existence of a plurality of ISPs (

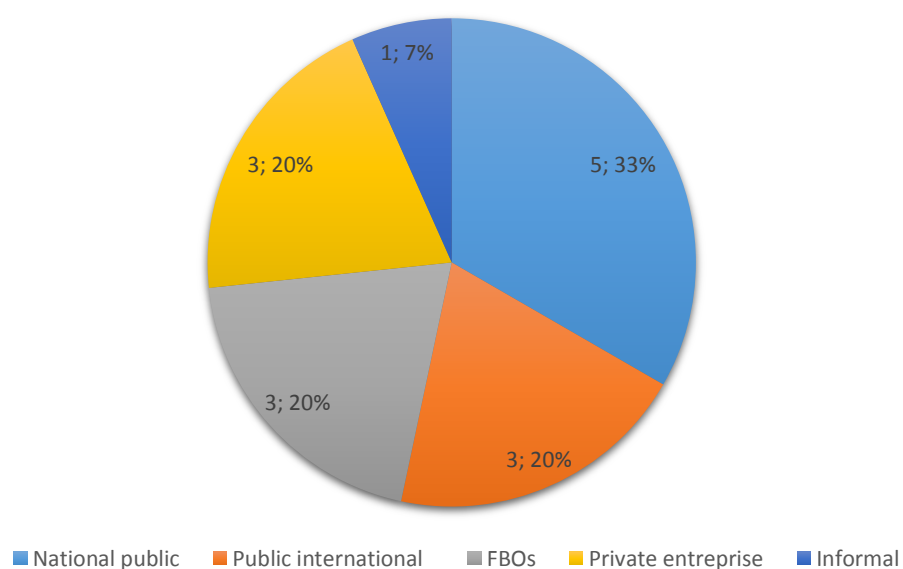


Figure 1). On the basis of their status, objectives and source of funding, they can be classified into five categories: national public, international public, Farmer-Based Organization (FBOs), private enterprises, and informal (independent individuals). Based on our investigation, the most numerous ISPs in the cassava sector are national public organizations (MINADER, MINEPAT, IRAD, IMPM, and the Chamber of Agriculture). International public organizations (IITA, CTA, PRASAC), FBOs (PROPAC, PIP-CV, CNOP-CAM) and private enterprises (CRIFAT, Rural investment credit and People's finances) each count three organizations and the informal sector counts one individual.

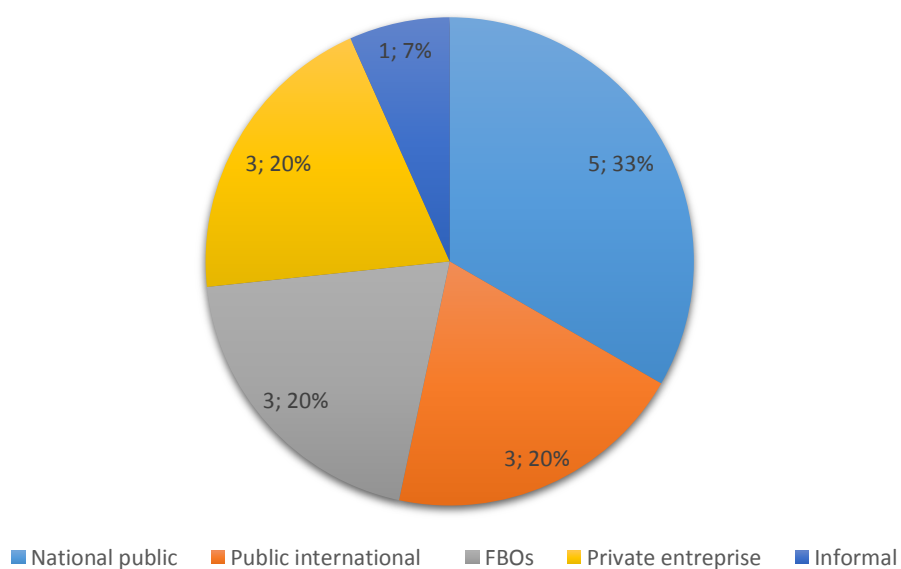


Figure 1. Distribution (absolute numbers) of innovation support service providers (ISPs) types in the cassava subsector in the Southern region of Cameroon

ISSs characterization

Seven categories of innovation support services (ISSs) have been identified within the cassava innovation subsystem

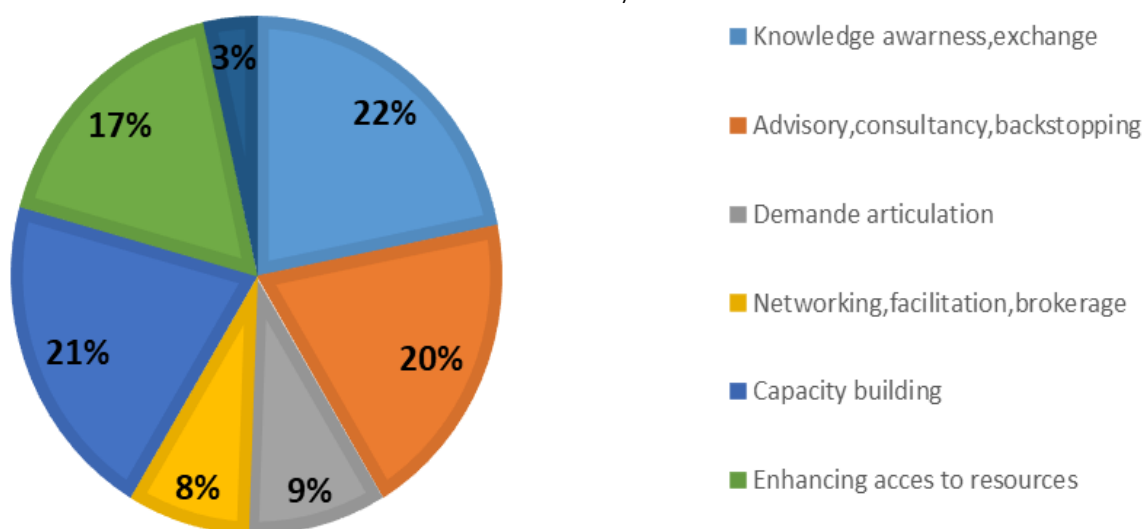


Figure 2). Knowledge awareness and exchange (22%) is the main provided service followed by capacity building (21%), advisory, consultancy and backstopping (20%), enhancing access to resources (17%) and much less provided are demand articulation (9%), networking, facilitation and brokerage (8%) and institutional support for niche innovation, and scaling (3%).

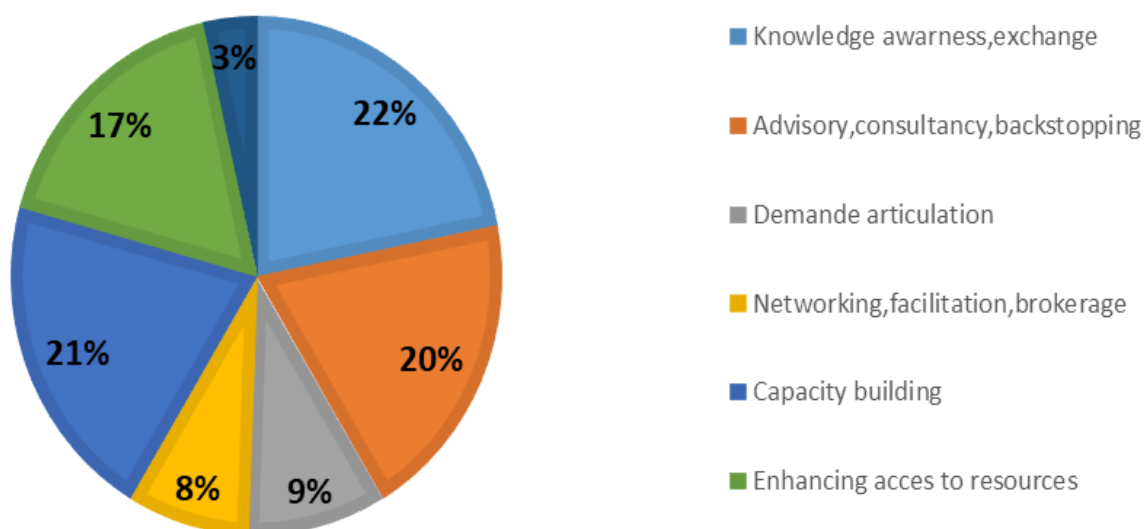


Figure 2. Distribution (%) of innovation support services (ISS) types in the cassava subsector in the Southern region of Cameroon

ISSs			KNOWL. (Knowledge awareness, exchange)	ADVIS. (advisory, consultancy, backstopping)	MARKET. (demand articulation)	NETWORK (networking, facilitation, brokerage)	TRAIN. (capacity building)	RESS. (enhancing access to resources)	INSTIT. (institutional support for niche innov., scaling)
ISPs									
Type	Name	Project							
International public	IITA		++	++	O	O	++	+	+
	CTA	Manioc 21	++	+	+	++	++	+	O
	PRASAC		++	+	++	+	++	+	O
National public	IRAD		++	++	O	O	++	+	+
	IMPM		O	O	O	O	O	++	O
	MINADER	DRCQ	++	++	O	O	+	+	++
		PIMDA	++	+	+	+	++	++	O
		PADRT	++	++	+	O	O	++	O
		APAPE	++	++	+	+	++	+	O
		PROSAPV	++	++	O	O	++	+	O
		PAPMAV-Q	++	O	O	O	O	O	O
		ACEFA	+	++	+	O	+	++	O
		AFOP	+	++	O	O	++	++	O
		PAIJA	+	++	O	O	++	++	O
	MINEPAT	Agropoles	++	+	+	+	++	++	O
	Chamb. of Agriculture	Pionnier	++	++	+	+	++	+	O
		CIP	++	+	O	O	++	O	++

Private Entr.	CRIFAT	YA-Manioc	O	++	++	O	++	+	O
	Rural inv. credit		O	O	O	O	O	++	O
	People's finances		O	O	O	O	O	++	O
FBOs	PROPAC		++	++	+	+	++	+	O
	PIP-CV		++	+	++	++	+	+	O
	CNOP-CAM		++	+	+	++	++	+	O
Inform.	Individuals		++	++	O	+	++	O	O

++: Main service provided

+: Service provided of secondary importance for the ISPs

+++: Main service provided mainly through projects/programs

+: Service provided of secondary importance for the ISPs mainly through projects/programs

O: Service not provided at all

Table 2 Innovation support services (ISSs) provided by innovation support service providers (ISPs) of the Cassava subsector in Southern Cameroon.

Depending on their type, ISPs provide specific ISSs which are either of primary (among the three ISSs that they the most actively provide) or secondary importance to them (Table 2). We further specify whether these services are provided within the framework of projects or programs and whether the share of project funding is the greatest or not in the case of ISS co-funding.

The international public organizations solely supply project-/program-based ISSs. Knowledge dissemination and training prevail (development of and training on local seed varieties, improvement of cropping practices, fight against diseases and rodents, conservation and food products processing). Recent projects (Manioc 21) however entail new types of services aimed at strengthening the entrepreneurship, Marketing, networking and financing capacities of cassava producers and their cooperatives (trainings, development and facilitate access to ICT tools, new marketing linkages and innovative financing schemes). Facilitating access to resources is a secondary activity of all the international public actors. Institutional support is only provided by IITA as an activity of secondary importance.

All the national public service providers – with the exception of IMPM and two projects of the MINADER – deliver ISSs within the framework of projects which largely remain focused on knowledge dissemination, advisory and training. The majority of the national public ISPs are also strongly involved in facilitating farmers' access to resources (e.g. Programme Agropoles from the Chamber of Agriculture, the PIMDA, PADRT, ACEFA, AFOP and PAIJA programs from the MINADER, IMPM). Marketing and networking ISSs are rather secondary activities for those who carry them out (MINADER, MINEPAT and Chamber of Agriculture). Institutional support is only a major activity of two organizations: the Chamber of Agriculture (CIP) and the MINADER (DRCQ). The latter provides, for instance, seed plots certification and the granting of approvals to seed companies.

Private organizations, in contrast, seldom provide services through projects or programmes. Only one actor, CRIFAT provides services such as demand articulation, training and access to resources facilitation through the YA-Manioc Project. Moreover, private ISPs are not at all engaged in knowledge dissemination and institutional support. Facilitating access to resources of cassava producers is the main or the secondary activity of private ISPs.

Among FBO's main services are knowledge dissemination (all three FBOs), networking and training (two providers) and advisory (PROVAC, project-funded). The public FBOs consider advisory (PIP-CV, CNOP-CAM), Marketing (PROVAC, CNOP-CAM) and facilitation to access resources (all three) as rather secondary activities to them. Institutional support doesn't count among their activities at all. PROPAC's activities are mostly project-based; whereas the two other interviewed FBOs only fund one of their service types through project (Marketing support and training).

The interviewed individuals support innovative stakeholders with knowledge dissemination, advisory, training and to a lesser extent networking.

Several respondents report a lack of coordination among the actors and duplicity of actions. One member of an FBO ISP explains: "My structure (PIP-CV) has direct partnerships with other ISPs. As far as relationships are concerned, there is no interaction because for the moment everyone is acting on his own. Sometimes they act on the same activity but do not collaborate. An example: CTA came to train the same actors and the same way as PRASAC had already done. We do the same things with the same people and repeat ourselves over and over again." Different projects also focus on the same varietal innovations developed by IRAD and IITA such as APAPE, PADRT, Pioneer Program, PIDMA and PAPMAV-Q. Indeed, these projects/programs are all involved in the dissemination of the same improved varieties of cassava cuttings (8034 and 96/1414 developed respectively by IRAD and IITA) to women producers located in the same production areas.

ISSs			KNOWL.			ADVIS.			MARKET.			NETWORK.			TRAIN.			RESS.			INSTIT.		
ISPs																							
Type	Name	Project																					
International public	IITA		+			+									+			X			+		
	CTA	Manioc 21	+			+			+			+			+			+					
	PRASAC		+			+			+			+			+			+					
National public	IRAD		+			+									+			X			+		
	IMPM																	O					
	MINADER	DRCQ	O			*									*			O			*		
		PIMDA	X			X			X			X			X			X					
		PADRT	X			X			X									X					
		APAPE	X			X			X			X			X			X					
		PROSAPVA	+			+									X			X					
		PAPMAV-Q	+																				
		ACEFA	X			X									X			X					
		AFOP	+			+									+			X					
		PAIJA	+			+									+			X					
	MINEPAT	Programme agropole	X			X			X			X			X			X					
	Chamber of Agriculture	Programme pionnier	X			X			X			X			X			X					
		CIP	X			*									X						X		

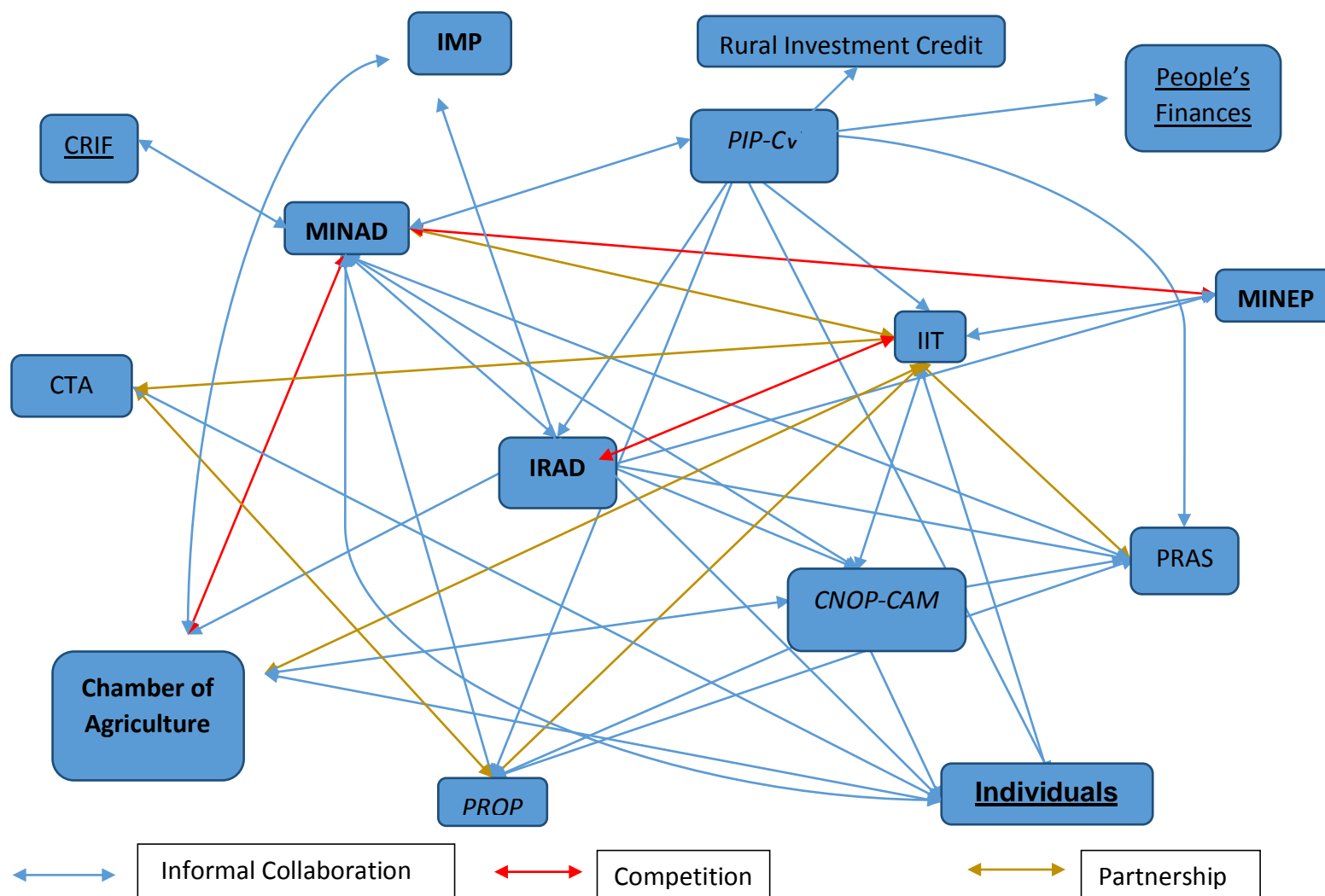
Private Entreprise	CRIFAT	YA-Manioc				*			X						X								
	Rural investissement credit																O						
	People's finances																O						
FBOs	PROPAC		+			+			+			+			+		+						
	PIP-CV		+	*	X	+	*	X	+	*	X	+	*	X	+	*	X	+	*	X			
	CNOP-CAM		+	*	X	+	*	X	+	*	X	+			+	*	X	+	*	X			
Informal	Individuals		*			*						*			+	*							

+ : Solely Project/Program-funding * : Solely charged to ISS beneficiaries

O : ISP-Beneficiary co-funding X : Project-Beneficiary co-funding

Abbreviations of ISS types: **KNOWL.** (Knowledge awareness and exchange), **ADVIS.** (advisory, consultancy, backstopping), **MARKET.** (demand articulation), **NETWORK.** (networking, facilitation and brokerage), **TRAIN.** (capacity building), **RESS.** (enhancing access to resources), **INSTIT.** (institutional support for niche innovation, and scaling).

Table 3. Innovation support services (ISSs) funding mechanisms of innovation support service provider (ISPs) in the Cassava subsector of Southern Cameroon.



The funding mechanisms which are used to finance ISSs differ among the various ISP types (Table 3). International public ISPs usually finance the delivered ISSs through project funds as a sole source of funding (16 counts out of 17). Most of the national public ISPs also do so (13 counts), but co-funding with the participation of ISS beneficiaries is even more commonly used (39 counts). The DRCQ, a project of the MINADER utilises alternative modes such as ISP-Beneficiary co-funding (KNOWL., RESS.) or service costs can also entirely be charged to the beneficiaries (ADVIS., TRAIN., INST.). Private enterprises use all types of mechanisms except purely project-funds. Public FBOs use three different types of funding mechanisms also within one category of ISS (co-funding by projects and beneficiaries, beneficiary-funding or project-funding). Finally, individuals' ISS charge the beneficiaries (3 counts out of 4) or benefit from project-funding (TRAIN.).

Interactions between ISPs

Nature and degree of connection

As it can be observed on the mapping of interactions (Figure 3), each of the ISPs have at least one informal collaboration with another ISP; this is the main collaboration arrangement. Formalised partnerships happen only among some of the international public ISPs (2 counts), as well as between international and national public ISPs (2 counts) or between the international public ISPs and the Public FBO PROPAC (2 counts). Relationships of coopetition happen among national public ISPs (2 counts) and among national and international public ISPs (IRAD-IITA).

The ISPs interactions mapping also shows the number of interactions of each ISP with other ISPs (Figure 3). Actors who participate in programs have a high number of connections with other ISPs: 9 and 10 connections of the MINADER and IRAD, respectively, 10 connections of the IITA. FBOs are connected to a high number of public ISPs (6-7 connections) and individuals. Only one FBO (PIP-CV) is informally connected to a private actor (the Rural Investment Credit). Private actors seem particularly weakly connected with only one client each. Percentage of interactions and density of network

Our analysis shows that only 38% of interactions (80 interactions) are maintained between ISPs of the cassava subsector, which is relatively low as compared to the maximum number of interactions that could be reached (210 interactions). This result is confirmed by the calculation of a network density indicator which is equal to 0.38, lower than that of an ideal situation (density =1). The relationships to economic actors of the value chain seems to be missing as one interviewee mentioned: "The prospects are not promising because of the lack of real and practical coordination of actions of all stakeholders in the cassava sector towards the main actors, namely farmers, processors, traders and distributors of fresh and processed cassava products" (Y1 - researcher specialized in cassava).

If all types of interactions are taken into consideration, the density of interaction of international ISPs with FBOs is high (78%), medium with national public ISPs (40%) and other international public ISPs (33%). The density of interaction of national public ISPs is high with other ISPs of the same type (70%), medium with FBOs (40%) and very low with individuals (20%) and private actors (7%). The density of interaction of private actors is the highest with FBOs (22%) and FBOs' density of connection with other FBOs is only 50%, 67% with individuals and 11% with private enterprises.

Discussion

Examining the innovation support system of the cassava sub-sector in Southern Cameroon can potentially help identify some hindering aspects to its development. This is at utmost importance

given the need to better align innovation objectives with social and environmental challenges, such as food security, rural employment, and inclusiveness.

From our empirical results, it clearly stands out that ISSs are mostly provided within the framework of public projects or programs (13 have been identified) that apparently follow a top-down approach with little coordination among them. The relative high importance of project/programs can be explained by the dominance of international and national public ISPs and by the relative low representation of other actor types. This illustrates the relative low level of privatization of agricultural extensive services as compared with other African countries (Pelon, 2019). As a result, ISSs still mostly consist in knowledge awareness and exchange, advisory and training on technical innovations (e.g. seed varieties) which originate from international and national Research and Development institutions in a top-down manner. This corresponds to the first STI policy frame described by Schot & Steinmueller (2018). Networking, demand articulation and enhancing access to resources which aim at building links and stimulating learning between elements in the systems, and enabling entrepreneurship (Schot & Steinmueller, 2018) are also well represented, but remain rather secondary activities to most of the public ISPs. In contrast, the private sector defines resource enhancement as one of its main or secondary activity. Finally, FBOs are also key actors in terms of organization of women producers and processors. The private and FBO sector thus seem to complement well the public offer, although many types of ISSs are not enough delivered or are missing (e.g. brokerage functions, institutional support).

Taking informal types of collaboration into consideration, we find that the low percentage of interactions (38%) and density of network (0.38) are similar to those of Spielman et al. (2008) obtained in Ethiopia. This result corroborates observations from other authors on the fact that there is a lack of interaction and coordination among actors of the cassava value chain (Njukwe, 2016; Meyo & Liang, 2012).

Moreover, the high degree of connection obtained by some public organizations and FBOs in the system confirms their central role. The private sector comparatively has a very limited network. This is similar to the situation reported in Costa Rica (Coq et al., 2012). More specifically, the ISPs who are involved in projects or programs are the one having the highest number of connections. Nonetheless, the overall coordination of the network is weak since duplication of interventions have been reported, particularly within the framework of projects. This lack of coordination and capacity to co-produce ISSs with beneficiaries and to align various ISSs could be due to a lack of support to social and organizational innovations (Faure et al., 2019) and to the fact that the percentage of interaction of national public ISPs with FBOs is rather low (40%). FBOs also connect poorly among themselves (50% of interactions). However, international public organizations have developed a relatively higher level of interaction with FBOs (78%) which is promising to align R&D with the needs of smallholder farmers. However, the levels of interaction of international public organizations with national public ISPs (40%) and other international ISPs (33%) could be improved in order to limit the duplication of activities and better coordinate the overall network. National public ISPs already connect well together (70%).

Characterizing the nature of these linkages, we also show that most of the interactions are taking place informally.

One limitation of our study, is that it doesn't show the direction and whether the linkages are impacting or not. It might indeed well be the case that some linkages are ordinary with no implications for the innovation process (Biggs & Matsuert, 2004). As a result, it is hard, for instance, to draw conclusions on the role and true influence of FBOs on innovation processes. Given the technological nature of the supported innovations and the apparent dissatisfaction of FBO representatives about the services they receive through projects, we suppose that the relationship between FBOs and public ISPs gives little space for co-construction of ISSs. Our findings on the funding arrangements pursued by each ISP (Table 3) usefully highlight the fact

that FBOs have recourse to diverse funding modes – except PROPAC a public umbrella organization for FBOs. This can thus give FBOs a certain degree of autonomy (Coq et al., 2012).

A second limitation of our study is that our sampling of ISPs has been formed thanks to interviews with ISPs at the national level (MINADER, extension services and research institutions). This might explain why no other forms of civil society organizations (e.g. NGOs and “Economic Interest Groups”) active in the cassava sector were identified. Another reason given by Temple et al. (2017) could be that the relationships between intermediaries and research institutes in Cameroon are rather interpersonal. A more exhaustive ISP mapping should thus be undertaken by the mean of a structured questionnaire sent to a greater diversity of ISPs.

Conclusion

Our study clearly shows that the cassava innovation system of the Southern region of Cameroon is strongly based on ISPs from the public sector, that comprise the so-called mainstream institutions and their projects/programs-funded ISSs. As a consequence, the traditional agricultural extension services that support technical innovations are largely represented in the system. The civil society and private sectors complement the ISSs offer to a certain degree and make use of some alternative funding mechanisms, but there are not many of them. ISSs are mostly dependent on projects funding which can cause some discontinuity of ISS, although FBOs are able to diversify their funding modes. The network of actors is not very dense, but some ISPs (national and international public organizations, FBOs) are strongly linked to a large diversity of other actor types, especially through projects and through informal collaborations. The lack of coordination among actors is felt by FBOs due to the duplicity of ISSs they benefit from. This can be explained by the low percentage of interaction of national public ISPs with them, as well as by the low level of brokerage services in the system.

To address current social and environmental challenges the capacities of the existing organizations need to be reinforced and their coordination improved, especially the one representing farmers’ interests. Indeed, our study also highlights the mismatch between FBOs’ demand and ISSs offer. This risk which is related to the inability of some project settings to support participatory approaches has already been mentioned in other projects (Klerkx et al., 2017; Coq et al., 2012).

To avoid this, in particular, and as the recent innovation policy framing on socio-technological change suggests, FBOs and other grassroots organizations should become part of multi-actor networks within which they could discuss, experiment niche innovations and collectively learn with other types of actors (Faure et al., 2019; Lowe et al., 2019; Schot & Steinmueller, 2018; Knierim et al., 2017). Some organizations need to develop brokerage and facilitation services, especially to support and facilitate informal and flexible networks or temporary associations of actors at the initial phase of innovations and to more formally structure them at a later stage (Klerkx & Leeuwis, 2009). Such settings also imply searching for some innovative types of funding arrangements which could include the development of some ISSs by FBOs for their members. Ideally, the ISS costs should be shared among different types of actors using mixed funding modes in order to ensure their quality and durability (Nettle et al., 2017; Coq et al., 2012).

References

- Achancho, V. (2013). Revue et analyse des stratégies nationales d'investissements et des politiques agricoles en Afrique du Centre: Cas du Cameroun. In FAO/FIDA (Ed.), *Reconstruire le potentiel alimentaire de l'Afrique de l'Ouest* (A. Elbehri). FAO/FIDA.
- Bayiha, G. D. L. P., Temple, L., Mathe, S., & Nesme, T. (2019). Typologie et perspective d'évolution de l'agriculture biologique au Cameroun. *Cahiers Agricultures*, 28(3), 1–8. Retrieved from <https://cgspace.cgiar.org/bitstream/handle/10568/101461/U19ArtBayihaTypologieInthomNodev.pdf?sequence=1&isAllowed=y>
- Biggs, S., & Matsuert, H. (2004). Strengthening poverty reduction programmes using an actor-oriented approach: examples from natural resources innovation systems. *Agricultural Research and Extension Network*, (134).
- Borgatti, S. P., Mehra, A., Brass, D. J., & Labianca, G. (2009). Network analysis in the social sciences. *Science*, 323(5916), 892–895.
- Coq, J.-F. Le, Faure, G., & Saenz, F. (2012). Les organisations de producteurs dans le système de services agricoles au Costa Rica. *Économie Rurale*, (330–331), 175–190. <https://doi.org/10.4000/economierurale.3564>
- Dury, S., Bendjebbar, P., Hainzelin, E., Giordano, T., & Bricas, N. (2019). *Food systems at risk. New trends and challenges*. Rome, Montpellier, Brussels: FAO.
- Ebela, A. P. (2017). *Le vivrier marchand dans la lutte contre la pauvreté des ménages en milieu rural: le cas du département de la Mvila dans le sud du Cameroun*.
- FAO. (2018). *Étude diagnostique de la réduction des pertes après récolte de trois cultures Manioc, tomate, Pomme de terre - Rapport de synthèse: Cameroun*. Rome.
- FAO. (2020). Sustainable Development Goals. Retrieved February 13, 2020, from <http://www.fao.org/sustainable-development-goals/mdg/en/>
- Faure, G., Knierim, A., Koutsouris, A., Ndah, H. T., Audouin, S., Zarokosta, E., ... Faure, G. (2019). How to Strengthen Innovation Support Services in Agriculture with Regard to Multi-Stakeholder Approaches. *Journal of Innovation Economics & Management*, 28(1), 145–169. <https://doi.org/10.3917/jie.028.0145>
- Faure, G., Penot, E., Rakotondravelo, J. C., Ramahatoraka, H. A., Dugué, P., & Toillier, A. (2013). Which Advisory System to Support Innovation in Conservation Agriculture? The Case of Madagascar's Lake Alaotra. *Journal of Agricultural Education and Extension*, 19(3), 257–270. <https://doi.org/10.1080/1389224X.2013.782169>
- Fongang Fouepe, G. H. (2009). *Les mutations du secteur agricole bamiléké (Cameroun) étudiées à travers ses acteurs*: Institut des Sciences et Industries du Vivant et de l'Environnement (AgroParis Tech), France.
- Hall, A. (2006). Capacity development for agricultural biotechnology in developing countries: an innovation systems view of what it is and how to develop it. *Journal of International Development*, 17(5), 611–630.
- Hermans, F., Klerkx, L., & Roep, D. (2015). Structural Conditions for Collaboration and Learning in Innovation Networks: Using an Innovation System Performance Lens to Analyse Agricultural Knowledge Systems. *Journal of Agricultural Education and Extension*, 21(1), 35–54. <https://doi.org/10.1080/1389224X.2014.991113>
- IRAD. (2013). *Augmentation de la productivité du manioc et diffusion des semences améliorées*.
- Kidd, A. D., Lamers, J. P. A., Ficarella, P. P., & Hoffmann, V. (2000). Privatising agricultural extension: Caveat emptor. *Journal of Rural Studies*, 16(1), 95–102. [https://doi.org/10.1016/S0743-0167\(99\)00040-6](https://doi.org/10.1016/S0743-0167(99)00040-6)
- Klerkx, L., & Leeuwis, C. (2009). Establishment and embedding of innovation brokers at different innovation system levels: Insights from the Dutch agricultural sector. *Technological Forecasting and Social Change*, 76(6), 849–860. <https://doi.org/10.1016/j.techfore.2008.10.001>

- Klerkx, L., Seuneke, P., de Wolf, P., & Rossing, W. A. H. (2017). Replication and translation of co-innovation: The influence of institutional context in large international participatory research projects. *Land Use Policy*, 61, 276–292. <https://doi.org/10.1016/j.landusepol.2016.11.027>
- Knierim, A., Labarthe, P., Laurent, C., Prager, K., Kania, J., Madureira, L., & Ndah, T. H. (2017). Pluralism of agricultural advisory service providers – Facts and insights from Europe. *Journal of Rural Studies*, 55, 45–58. <https://doi.org/10.1016/j.jrurstud.2017.07.018>
- Kwa, M., & Temple, L. (2019). *Le bananier plantain. Enjeux socio-économiques et techniques, expériences en Afrique intertropicale* (Éditions Q). CTA, Presses agronomiques de Gembloux.
- Lowe, P., Phillipson, J., Proctor, A., & Gkartzios, M. (2019). Expertise in rural development : A conceptual and empirical analysis. *World Development*, 116, 28–37. <https://doi.org/10.1016/j.worlddev.2018.12.005>
- Magala, D. B., Najjingo Mangheni, M., & Miiro, R. F. (2019). Actor social networks as knowledge sharing mechanisms in multi-stakeholder processes: a case of coffee innovation platforms of Uganda. *Journal of Agricultural Education and Extension*, 25(4), 323–336. <https://doi.org/10.1080/1389224X.2019.1629971>
- Martínez-Cruz, T. E., Almekinders, C. J. M., & Camacho-Villa, T. C. (2019). Collaborative research on Conservation Agriculture in Bajío, Mexico: continuities and discontinuities of partnerships. *International Journal of Agricultural Sustainability*, 17(3), 243–256. <https://doi.org/10.1080/14735903.2019.1625593>
- Mathé, S., Faure, G., Knierim, A., Koutsouris, A., Ndah, T. H., Temple, L., ... Zarokosta, E. (2016). *Typology of innovation support services, WP1 AgriSpin, deliverable 1.4*. Montpellier.
- Mercklé, P. (2004). *Sociologie des réseaux* (Repères :). Paris.
- Meyo, E. S. M., & Liang, D. (2012). Gap Analysis of Cassava Sector in Cameroon. *Proceedings of World Academy of Science, Engineering and Technology* 6, (11), 2792–2799. World Academy of Science, Engineering and Technology (WASET).
- Mofakkarul Islam, M., Renwick, A., Lamprinopoulou, C., & Klerkx, L. (2013). Innovation in livestock genetic improvement. *EuroChoices*, 12(1), 42–47.
- Mouafor, B. I., Temegne, N. C., Ngome, A. F., & Malaa, D. (2016). Farmer's Adoption of Improved Cassava Varieties in the Humid Forest Agro-ecological Zone of Cameroon. *Greener Journal of Agricultural Sciences*, 6(10), 276–284.
- Nagel, U. W. (1997). *Alternative approaches to organizing extension*.
- Nettle, R., Klerkx, L., Faure, G., Koutsouris, A., Nettle, R., Klerkx, L., ... Governance, A. K. (2017). *Governance dynamics and the quest for coordination in pluralistic agricultural advisory systems*. 8622. <https://doi.org/10.1080/1389224X.2017.1320638>
- Njukwe, E. (2016). *Farmer participation in Research-for-Development to enhance cassava production in Cameroon*. Shoukadoh Book Sellers.
- Ntsama Etoundi, S. M. (2009). *L'adoption des innovations en agriculture: cas des variétés améliorées de maïs au Cameroun* (University of Yaounde II). Retrieved from https://papers.ssrn.com/sol3/papers.cfm?abstract_id=1383263
- Pelon, V. (2019). *Bulletin de synthèse Souveraineté Alimentaire No.29 - Vers la relance du conseil agricole en Afrique ?* Retrieved from www.inter-reseaux.org
- République du Cameroun. (2010). *Stratégie de développement de la filière manioc au Cameroun 2010-2015*. Yaoundé.
- Schot, J., & Steinmueller, W. E. (2018). *Three frames for innovation policy : R & D , systems of innovation and transformative change*. 47(July), 1554–1567. <https://doi.org/10.1016/j.respol.2018.08.011>
- Spielman, D. J., Davis, K., Negash, M., & Ayele, G. (2008). Rural innovation systems and networks: findings from a study of Ethiopian smallholders. In *IFPRI Discussion Paper 00759*. Washington, DC.

Temple, L., Machicou Ndzesop, N., Fongang Fouepe, G. H., Ndoumbe Nkeng, M., & Mathé, S. (2019). Système national de recherche et d'innovation en afrique: Le cas du cameroun. *Innovations, 0*, pages art14_I à art14_XXVI. <https://doi.org/10.3917/inno.pr1.0014>