

**REVIEW****Open Access**

Exploring the impact of farmer-led research supported by civil society organisations

Ann Waters-Bayer¹, Patti Kristjanson^{2*}, Chesha Wettasinha¹, Laurens van Veldhuizen¹, Gabriela Quiroga¹, Kees Swaans¹ and Boru Douthwaite³

Abstract

This paper asks: What have been the impacts of farmer- or community-led (informal) processes of research and development in agriculture and natural resource management in terms of food security, ecological sustainability, economic empowerment, gender relations, local capacity to innovate and influence on formal agricultural research and development institutions? An innovative conceptual framework was applied to a diverse set of farmer-led research initiatives in countries in Africa, Asia and Latin America to explore approaches, outcomes and impacts of informal agricultural research and development (ARD) facilitated by civil society organisations. Findings include the following: locally appropriate technical innovations emerging from these processes are readily taken up by other farmers; the most common channels of dissemination are farmer to farmer through informal networks and spaces created for farmer-researchers and other farmers to meet and exchange, such as innovation fairs; livelihood impacts are broad and substantial; local capacity to innovate is strengthened and institutionalisation through the formal sector has been limited. Lessons are drawn for future partnerships in promoting and supporting farmer-led research involving formal and informal ARD actors working with smallholder communities.

Keywords: Agricultural research, Farmer-led processes, Impact, Civil society organisations, Innovation, Institutionalisation

Introduction

Many of the efforts to transform scientific knowledge into sustainable agriculture and natural resource management have brought only limited benefits to smallholder farmers, including fishers, livestock keepers and other resource users [1-3]. Donors, policymakers and civil society organisations (CSOs) have been urging the formal agricultural research and development (ARD) sector to make its research more relevant for smallholders [4]. This has led to an examination of the principles, tools and approaches that enhance the likelihood that the knowledge being generated by ARD leads to actions - not only through greater innovativeness among smallholders but also through changes in policies, strategies and institutions - that help alleviate poverty in a sustainable way [5-7]. A major lesson is that a shift to user-driven research and co-production of solutions is

needed, but how best to do this effectively and efficiently, and support the institutional changes that need to happen in order to embrace learning approaches, remains a challenge for most ARD organisations [8].

Several formal research institutions are seeking ways to engage more directly with smallholders and supporting organisations in the field so as to achieve this aim [9,10]. These institutions are also open to learn from examples of ARD driven and co-managed by smallholders and facilitated by CSOs outside of the formal ARD sector, in what could be called 'informal' ARD. Two international CGIAR consortium research programmes joined forces with ProInnova (Promoting Local Innovation)^a to explore the experiences, outcomes and impacts of such 'informal' ARD approaches, in particular, farmer- or community-led processes of research and development in agriculture and natural resource management (referred to in short as 'farmer-led research'). These are i) the programme on Aquatic Agricultural Systems, which seeks to embed its research in development processes and, in so doing,

* Correspondence: p.kristjanson@cgiar.org

²World Agroforestry Centre (ICRAF), United Nations Avenue, Gigiri, POB 30677 Nairobi, Kenya

Full list of author information is available at the end of the article

strengthen the system's capacity to innovate [11] and ii) the programme on Climate Change, Agriculture and Food Security, which seeks to translate knowledge into action for change through social learning processes [12].

This paper synthesises the main findings about the impacts of a wide range of farmer-led research initiatives in terms of food security, ecological sustainability, economic empowerment, gender relations, local capacity to innovate and influence on ARD institutions. It then draws lessons for future partnerships between formal and informal ARD actors who are seeking common goals in serving smallholder communities. More details are found in Wettasinha *et al.* [13].

The definitions used in the review were as follows: 'innovation' is the process of developing locally new and better ways of doing things; 'innovations' are the new ways of doing things (in terms of technology or socio-economic organisation or institutions, such as new marketing or local financing procedures or changes in gender roles) that emerge from this process; 'farmer-led research' is a process in which farmers together with other support agents (for example, formal researchers, extensionists) investigate possible ways to improve the livelihoods of local people in the realm of agriculture and natural resource management.

Methods

A desk study was designed to identify good examples of CSO-facilitated 'informal' ARD, examine the kind of impacts that they reportedly produced and draw lessons

for work in both formal and informal ARD. A parallel study of farmer-led research facilitated by formal ARD actors had been planned by the CGIAR partners but could not be carried out because of insufficient funding. As information on the process and outcomes of informal ARD initiatives rarely appears in double-refereed scientific journals, the initial sources were mainly project reports and articles for development practitioners and any available reports on project evaluations and impact assessments. In most cases, it was not possible to acquire internal monitoring and evaluation reports made by project staff.

From about 130 cases identified through ProInnova's various networks and a Web search, 11 cases from Africa, Asia and Latin America were selected to assess impacts of farmer-led research. The main selection criteria were led by smallholders, supported by CSOs, structured interaction of farmers with other innovation-system actors over several years and some documented evidence of impact. A relatively balanced geographic spread of cases across continents emerged but was unintended. The 11 cases used for the analysis (see Table 1) were clustered in three groups:

- i.) Cases 1 to 3, in which the farmer-led research process was initiated and borne by farmers themselves with minimal external support
- ii.) Cases 4 to 8, in which the process was initiated through external intervention of a CSO
- iii.) Cases 9 to 11, focused on integrating a farmer-led research approach into formal ARD organisations.

Table 1 Overview of 11 cases of farmer-led research analysed in the desk study

No.	Name of case	Period of CSO intervention	Country	Supporting CSO
1	Improving <i>zai</i> planting pits	1992 to 1999 (initial development and spread by farmers)	Burkina Faso	Informal group of farmer innovators
2	<i>Campesino a Campesino</i> (farmer-to-farmer)	1986 to 1989 (continued as movement)	Nicaragua	UNAG and other farmer organisations
3	Farmer-scientist partnership	1985 to present	Philippines	MASIPAG (farmer organisation)
4	Farmer experimenters	1981 to 1990	Honduras	World Neighbors (NGO)
5	Farmer participatory research	2000 to 2007	Tanzania	FARM-Africa (NGO)
6	Smallholder action research	1990 to present	Burkina Faso	Diobass (NGO)
7	Participatory innovation development	1990 to present	Mali	ProInnova-Mali (NGO-led multistakeholder platform)
8	Local agricultural research committees (CIALs)	1993 to present	Honduras	FIPAH (NGO)
9	Participatory extension approach	1991 to 1995	Zimbabwe	ITDG/Practical Action (NGO) with German bilateral support
10	Participatory technology development approach	1999 to 2007	Vietnam	Helvetas (NGO) with Swiss bilateral development
11	Institutionalising farmer participatory research	1999 to 2003 (institutionalisation phase)	Ethiopia	FARM-Africa (NGO)

The study team drew up a format for compiling the information on the outcomes and impacts of each case, which outlined four main areas of review: the main outcomes of the farmer-led research process, impact on farmers' livelihoods, whether and how local capacity to innovate was enhanced and impact on governmental and non-governmental institutions of agricultural research and development. The information in the case studies was analysed in an iterative process of synthesising, clustering, comparing, contrasting, further synthesising and then drawing out main characteristics and lessons - but remaining open to unexpected outcomes and impacts that were not in the initial format for analysis.

Results

Outcomes and impacts of farmer-led research

Types of innovations

Farmer-led research led to various types of locally appropriate innovations and adaptations. Technological innovation featured prominently in the documentation; little was reported about social or institutional innovation. Most examples were related to land reclamation or improvement, soil and water conservation, plant breeding and varietal selection, crop husbandry and crop and animal protection.

Disseminating farmer-led research results and approach

The farmer-led research results were documented mainly by the supporting CSOs, which also guided the farmers in keeping records of their trials. However, the data were often incomplete and seldom systematically analysed, as this activity was neither a strength nor a focus of the CSOs. The CSOs and farmer-researchers used the documents to inform other farmers and to share the results more widely through workshops, newsletters and magazines. The most common ways of sharing were spontaneously from farmer to farmer through informal networks and through deliberately created opportunities, such as innovation fairs, where farmer-researchers could exchange knowledge among themselves and with other farmers. Innovations that required no or few external inputs and brought obvious benefits spread quickly in these ways. NGOs seeking to integrate farmer-led research approaches into government institutions documented and shared the process and lessons from using the approach, but then included little about the findings from farmer-led research. It was striking that external evaluators often missed the point and looked for spread of technologies rather than spread of the approach.

Impacts on farmers' livelihoods

Farmer-led research reportedly led to greater food and nutrition security through higher and more dependable

yields, better storage and increased crop diversity compared to their previous practices. The greater agrobiodiversity also contributed to greater resilience to environmental risks and to pests and diseases. Farmer-led research in ecological farming techniques often led to higher household incomes compared to conventional farming techniques using external inputs, primarily because of reduced costs, and allowed farmers to accumulate savings and to invest in economic assets. Some locally developed farming techniques increased labour productivity; others demanded higher labour inputs, at least at initial stages, as was the case for the planting pits (*zai*). Most of the farmer-led research involved reduced use of chemical inputs and had a positive environmental impact. The documented impacts were mainly at household level, although some cases of stronger cohesion and joint action within communities were noted. Farmer-led experiments with introduced technologies tended to bring more benefits to medium and better-off farmers; experiments based on endogenous innovation using local resources tended to be more relevant for the poor and for women. Where women were encouraged to become experimenters, they often became more outspoken and active in the community also beyond farming activities.

Impacts on local capacity to innovate

Leeuwis *et al.* [11] describe both core and supportive capacity aspects that are needed to strengthen a system's capacity to innovate. Core capacities include the capacity of individuals and communities to continuously identify and prioritise problems and opportunities in a dynamic environment; the capacity to take risks, experiment with social and technical options, and assess the trade-offs that arise from them; the capacity to mobilise resources and form effective coalitions around promising options and visions for the future and the capacity to link with others in order to access, share and process relevant information and knowledge.

A key area of impact seen in the case studies involved farmers' ability to continue the process of innovation to address other and new challenges. Strengthening individual capacities (confidence, knowledge and skills to experiment and innovate) was a key feature mentioned in all cases. Farming peers and external ARD actors recognised men and women farmers as innovators. Many farmer-researchers became skilled facilitators and continued to support others. Local organisational capacity was strengthened within the communities as a result of farmers working and learning in groups, initially for experimentation and later for other activities, such as marketing, labour-sharing, savings and credit and lobbying for farmers' rights. Farmers became better able to identify and link up with relevant sources of information and

partners in innovation. Several cases showed that creating spaces for social learning stimulated innovation and, by the end of the CSO intervention, had enhanced local capacity to innovate, but there is little documentation on how the local innovation processes continued afterwards.

Impacts on formal and informal ARD institutions

The farmer-led research approaches led to some changes in both formal and informal ARD institutions, including government research and extension organisations at different levels, educational institutions, NGOs, community-based organisations (CBOs) and farmer organisations (FOs). In six cases, the main path for institutionalisation was through formal ARD institutions; the other five cases focused on CSOs. Institutionalisation through the formal sector was slow with limited success: although some changes in mindsets, skills and knowledge were observed among staff, no case reported significant changes in structures and working mechanisms of the organisations or in their budget allocations. NGOs, CBOs, FOs and farmer movements appear to have been more open and receptive to integrating farmer-led participatory approaches.

Discussion

From the 11 cases, several lessons can be drawn that are relevant for partnerships between formal and informal ARD actors seeking to promote farmer-led research in smallholder communities.

Supporting farmer-led research processes

Explicit attention needs to be given to not only technical but also social and institutional innovation; the latter usually accompanies technical innovation but is often overlooked [14]. Smallholders develop innovations that can be applied by others and inspire them, but many low-cost and low-risk innovations are not easily recognised by farmers and formal ARD actors. When farmers are encouraged to work in small groups, they can tackle a wide diversity of topics, responding to heterogeneous needs in the community while sharing their newly acquired knowledge with each other. The case studies show that this often leads to some forms of communication among group members that continue after the intervention ends. Farmer-led research can be facilitated by community members (often community-minded innovators) or by local staff of CSOs, who gradually strengthen the capacity of farmer-facilitators and/or farmer-researchers to continue the process. It was especially obvious from the cases in Latin America that farmer-led research activities that bring 'early wins' sustain the enthusiasm and motivation of farmers to experiment and to engage in longer-term research. This supports findings by researchers evaluating volunteer farmer-to-farmer extension approaches. They also found

peer recognition of the farmers' achievements to be a key motivating factor [15]. The case studies show that introducing new technologies without providing exact specifications gives the farmers flexibility and space to experiment and adapt to local conditions.

Spreading or 'scaling out' the results of farmer-led research

As was evident from the case studies, farmer-led research often leads to site- and household-specific interventions but still gives ideas to and encourages other farmers by showing how households under similar conditions manage to address their problems. Some local innovations needing few or no external inputs spread spontaneously, but little is reported about the dissemination pathways. The results of farmer-led research in some cases were being shared through farmer-to-farmer extension, national symposia for farmer-researchers and farmer innovation fairs; similar approaches are reported by Kundhlande *et al.* [16] and Triomphe *et al.* [17]. Information is thus disseminated not only about specific farming techniques or technologies but also about the process of joint experimentation and learning. The case studies suggest that farmers and NGOs need to reflect on the pros and cons of restricting intellectual property rights to different types of locally developed technologies and what impact this could have on innovation processes. The achievements of farmer innovators should be recognised but without restricting access to their innovations by other smallholders, as future innovation 'stands on the shoulders' of prior innovation.

Spreading or 'scaling out' farmer-led research approaches

In addition to scaling out specific innovations, the case study findings suggest that efforts are needed by all involved - ranging from farmers to international research scientists - to share and scale out the approaches of stimulating and supporting farmer experimentation, so that this is done by a larger number of farmers and other ARD actors over a wider area. These cases also provide evidence that farmer-led research approaches can have long-term impact in terms of farmers' increased capacity to investigate, experiment and share knowledge. It appears to be more important to start small, gain experience and scale out gradually, and to stimulate farmers' curiosity instead of trying to perfect their research capacities. Farmer-led research can both generate and harvest social energy, so that people are willing to move beyond individual or household gains and engage in activities that benefit others in the community, a finding supported by research into agricultural innovation [18].

Institutionalising or ‘scaling up’ farmer-led research as an approach

Vertically scaling up farmer-led research (as opposed to scaling it out horizontally) involves building the capacity of different stakeholders and their organisations to apply the approach as part of their regular work. It is a complex process that requires stimulating and enabling change in individuals and, through them, change in organisations [19]. It requires broad multistakeholder alliances pursuing an agreed theory of change. The cases from Ethiopia, Vietnam and Zimbabwe revealed that, when farmer-led research is being introduced into government services, care must be taken to embed the approach so that the underlying principles of the farmer-led research approaches are embraced and practised by all staff at all levels within the organisations. This poses challenges, as learning within government organisations is often poor on account of high staff turnover and frequent administrative restructuring. There may be greater chances in embedding and sustaining farmer-led research approaches within informal-sector institutions such as CBOs, FOs and farmer networks. Where government structures and policies are not conducive, the most promising pathway for ‘institutionalising’ the ideas, principles and spirit of farmer-led research approaches is probably through less formal structures such as grassroots movements.

Gender and other equity issues

There should be a conscious and consistent effort to deal with gender and equity within farmer-led research approaches [20]. Being tagged ‘participatory’ does not necessarily mean that men and women have equal opportunity to take part in the process. When too little attention is given to gender and other socioeconomic differences in the farming community, the farmer-researchers are not likely to include very poor and marginalised community members and the research results are less likely to suit the conditions of these people. It was found, however, that endogenous innovations developed by smallholder farmers tended to be more relevant for the poor, and for women in particular, than were new technologies introduced from elsewhere. The case of the CIALs in Honduras in particular showed that gender-conscious facilitation, timely socioeconomic assessments, close observation and continuous adjustments can make the farmer-led research methodology more inclusive and can open up spaces for marginalised groups, including women, to be actively involved. Such participatory forward-looking gender-transformative approaches are now being pursued by AAS [21] and CCAFS (https://cgspace.cgiar.org/bitstream/handle/10568/45955/CCAFS_Gender_Toolbox.pdf?sequence=7).

Roles of formal ARD actors

As becomes especially obvious from the *zai* case in the West African Sahel, innovation in farming is happening without continual inputs from formal science. However, scientists can play an important role by sharing their knowledge and skills, building farmers’ capacity in certain aspects of experimentation, helping farmers understand why something works or not, documenting and sharing what farmers are doing and validating innovations in scientific terms to increase credibility in the formal ARD sector. In the case of complex experiments in CSO-facilitated farmer-led research, scientists can help farmers recognise which factors affect outcomes. Researchers can help make the analysis and documentation of the process and findings of the farmer-led research more rigorous, less biased and more comprehensive (for example, environmental, economic, nutritional and social implications and impacts), thus strengthening the policy messages of farmer groups such as MASIPAG in the Philippines or the CIALs in Latin America. Rural advisory services can link farmers with a wide range of relevant sources of information and potential partners in innovation. To the extent that farmer-led research is integrated into decentralised plans of formal ARD, it would be advisable to make a budget available to support farmers’ research. If formal researchers and advisors are to play these new roles, farmer-led research must be integrated into agricultural education and training. Here, CGIAR researchers working closely with local universities could provide important support, for example, through online courses to reach a large number of interested staff in national institutes.

Roles of CSOs

The case studies reveal the strong role CSOs play in strengthening the technical and socio-organisational skills of farmers and local support staff to enable them to interact better in farmer-led research, as well as to promote this approach. For example, the CSOs in the cases in Latin America have been successful in training paraprofessionals to take over CSO roles in supporting farmer-led research; Warburton *et al.* [22] report similar achievements in Bangladesh, Kenya and Sudan. Encouragement provided by national and local organisations of smallholder farmers can help in spreading a farmer-led research approach. The critical role of social capital (motivation, trust, networking capacity, ownership) in development is well known [23] and also emerges as a key success factor for the farmer-led research process. It is this quality that may make such approaches more successful in the CSO than the formal ARD sector. Where the political conditions allow it, FOs and NGOs can form networks and use their experiences in farmer-led

research in policy dialogue and advocacy to maintain or expand the space to continue this approach.

Roles of donors

External funding can help initiate or strengthen the farmer-led research process and is particularly important for longer-term research that brings returns only after several years. Long-term commitment of donors that recognise the value of farmer-led research helps farmers slowly but surely build up the capacity of their networks. Prevailing mechanisms for external funding are oriented to project cycle management, which can constrain the flexibility and creativity of partners in the innovation process [5]. The costs of farmer-led participatory research could be reduced in the longer term if donors would invest in capacity development so that local people can facilitate the process. Donors wanting to support the institutionalisation of farmer-led research in the formal and/or informal ARD sector should be prepared to give more time - and not necessarily higher funding levels - to achieve this.

Conclusions

The cases of farmer-led research analysed in this study show that such approaches have led to greater food and nutrition security through higher and more dependable yields than those achieved through previous practices. Farmer-led research in ecological farming techniques often led to higher household incomes than did conventional farming techniques using external inputs. Farmer-led experiments with newly introduced technologies tended to bring more benefits to medium and better-off farmers, while endogenous innovations developed by smallholder farmers tended to be more relevant for the poor and for women. Farmer-led research led to increased crop diversity, which contributed to greater resilience to environmental risk and, in most cases, involved reduced use of chemicals. This suggests that farmer-led research is important in the context of climate change adaptation and may also reduce greenhouse gas emissions. Moreover, farmer-led research can have profound, self-reinforcing and long-lasting impacts - especially on capacity to innovate - that conventional impact evaluation does not pick up.

The challenges are great, as well. Action research needs to be conducted in the midst of ongoing ARD processes led by farmers and rural communities in order to explore more deeply the impacts - both positive and negative - and understand how they come about. This kind of research could be integrated into the work of international agricultural research centres and programmes and other formal ARD actors, giving sufficient space for reflection and mutual learning with the farmers and the supporting CSOs. This is starting to

happen in the context of long-term ARD programmes [24] but is difficult to do within the typical project cycle of only 2 to 3 years. More investment is needed in research that monitors progress towards desired outcomes and that, in the longer run, assesses the impacts of interventions designed to support farmer-led research in relation to a diverse set of indicators related to aspects such as livelihoods, empowerment, nutrition and the environment, so something can be learned about sustainability as well. The lessons from this desk study and from such action research will provide guidance for better integration of 'formal' and 'informal' research in development by smallholder communities.

Endnote

^aProlinnova (Promoting Local Innovation in ecologically oriented agriculture and natural resource management) is a multistakeholder international network, facilitated by CSOs, that promotes local innovation and farmer-led participatory research and development processes (www.prolinnova.net).

Abbreviations

ARD: agricultural research and development; CBO: community-based organisation; CIAL: *Comité de investigación agrícola local* (local agricultural research committee); CSO: civil society organisation; FARM-Africa: Food and Agricultural Research Management in Africa now Farm Africa; FIPAH: *Fundación para la Investigación Participativa con Agricultores de Honduras* (Foundation for Participatory Research with Honduran Farmers); FO: farmer organisation; ITDG: Intermediate Technology Development Group, now practical action; MASIPAG: *magasaka at siyentipiko para sa pag-unlad ng agrikultura* (farmer-scientist partnership for agricultural development); NGO: non-governmental organisation; UNAG: *Unión Nacional de Agricultores y Ganaderos* (National Farmers and Cattle Ranchers Union).

Competing interests

The authors declare that they have no competing interests.

Authors' contributions

AW, CW, LvV, GQ and KS designed the review, carried it out and wrote the report on which this paper is based. CW coordinated the review. BD and PK contributed to the design and oversight of the review and to the analysis of the findings. AW, PK and CW drafted the manuscript of this article. All authors read and approved the final manuscript.

Authors' information

AW, CW, LvV and GQ work with ETC. Foundation, a Dutch NGO, and are facilitators of and advisors to the international network Prolinnova. KS was part of this team at the time of completing the review and now works with Oxfam as regional programme officer in Southeast Asia. PK is a senior research fellow and agricultural economist with the World Agroforestry Centre and has led poverty and knowledge to action research at ILRI and with the CGIAR Research Program on Climate Change, Agriculture and Food Security. BD leads the research team on knowledge, learning and innovation in the CGIAR Research Program on Aquatic Agricultural Systems hosted by WorldFish.

Acknowledgements

The work reported in this article was co-funded by the CGIAR Research Programs on Aquatic Agricultural Systems and on Climate Change, Agriculture and Food Security. We thank John Mayne, David Gibbon, Stephen Sherwood, Marina Apgar, Guy Faure and Danielle Barret for their comments on the methodology and draft report and two anonymous reviewers for their comments on the manuscript of this paper. The numerous persons who provided information on the 11 cases of farmer-led research analysed in the

study, and the numerous documents on these cases, are gratefully acknowledged and are listed in Wettasinha *et al.* [13].

Author details

¹ETC, Foundation, POB 64, 3830 Leusden, AB, Netherlands. ²World Agroforestry Centre (ICRAF), United Nations Avenue, Gigiri, POB 30677 Nairobi, Kenya. ³WorldFish, Jalan Batu Maung, Batu Maung, 11960 Bayan Lepas, Penang, Malaysia.

Received: 14 November 2014 Accepted: 12 February 2015

Published online: 06 March 2015

References

- International Council for Science. Initiative on Science and Technology for Sustainability, Third World Academy of Sciences. Science and technology for sustainable development, ICSU Series on Science for Sustainable Development, vol. 9. Paris: ICSU; 2002.
- Cash DW, Clark WC, Alcock F, Dickson NM, Eckley N, Guston DH, et al. Knowledge systems for sustainable development. *Proc Natl Acad Sci U S A*. 2003;100:8086–91.
- Jayne TS, Mather D, Mghenyi E. Principal challenges confronting smallholder agriculture in sub-Saharan Africa. *World Dev*. 2010;38(10):1384–98.
- McNie EC. Reconciling the supply of scientific information with user demands: an analysis of the problem and review of the literature. *Environ Sci Policy*. 2007;10(1):17–38.
- Kristjanson P, Reid R, Dickson N, Clark WC, Romney D, Puskur R, et al. Linking international agricultural research knowledge with action for sustainable development. *Proc Natl Acad Sci U S A*. 2009;9(13):5047–52.
- Reid RS, Nkedianye D, Said MY, Kaelo D, Neselle M, Makui O, et al. Evolution of models to support community and policy action with science: balancing pastoral livelihoods and wildlife conservation in savannas of East Africa. *Proc Natl Acad Sci USA*. 2009. doi:10.1073/pnas.0900313106.
- Clark WC, Tomich TP, van Noordwijk M, Guston D, Catacutan D, Dickson NM, McNie E. Boundary work for sustainable development: natural resource management at the Consultative Group on International Agricultural Research (CGIAR). *Proc Natl Acad Sci U S A*. 2011. doi:10.1073/pnas.0900231108.
- Kristjanson P, Harvey B, Van Epp M, Thornton PK. Social learning and sustainable development. *Nat Climate Change*. 2014;4:5–7.
- Vermeulen SJ, Aggarwal PK, Ainslie A, Angelone C, Campbell BM, Challinor AJ, et al. Options for support to agriculture and food security under climate change. *Environ Sci Policy*. 2012;15:136–44.
- Douthwaite B, Kamp K, Longley C, Kruijssen F, Puskur R, Chiuta T, et al. Using Theory of Change to Achieve Impact in AAS. Penang, Malaysia: CGIAR Research Program on Aquatic Agricultural Systems (AAS) Working Paper; 2013. Available at: <http://aas.cgiar.org/publications/using-theory-change-achieve-impact-aas#VQCHTmacwIE>.
- Leeuwis C, Schut M, Waters-Bayer A, Mur R, Atta-Krah K, Douthwaite B. Capacity to Innovate from a System CGIAR Research Program Perspective. Penang, Malaysia: CGIAR Research Program on Aquatic Agricultural Systems (AAS) Program Brief AAS-2014-29. 2014.
- Shaw A, Kristjanson P. Catalysing Learning for Development and Climate Change. An Exploration of Social Learning and Social Differentiation in CGIAR, CCAFS Working Paper no. 43. Copenhagen, Denmark: CGIAR Research Program on Climate Change, Agriculture and Food Security (CCAFS); 2013.
- Wettasinha C, Waters-Bayer A, van Veldhuizen L, Quiroga G, Swaans K. Study on Impacts of Farmer-led Research Supported by Civil Society Organizations, Working Paper AAS-2014. Penang: AAS/Prolinnova/CCAFS; 2014.
- Meinzen-Dick R, Bernier Q, Haglund E. The Six 'ins' of Climate-Smart Agriculture: Inclusive Institutions for Information, Innovation, Investment and Insurance, CAPRI working paper 114. Washington, DC: IFPRI; 2013. Available at: <http://www.capri.cgiar.org/pdf/capriwp114.pdf>.
- Kiptot E, Franzel S. Voluntarism as an investment in human, social and financial capital: evidence from a farmer-to-farmer extension program in Kenya. *Agric Human Values*. 2014;31(2):231–43. doi:10.1007/s10460-013-9463-5.
- Kundhlande G, Franzel S, Simpson B, Gausi E. Farmer-to-Farmer Extension Approach in Malawi: a Survey of Organizations Using the Approach, ICRAF working paper 183. Nairobi: World Agroforestry Centre; 2014. <http://www.worldagroforestry.org/downloads/publications/pdfs/WP14391.PDF>.
- Triomphe B, Waters-Bayer A, Klerkx L, Schut M, Cullen B, Kamau G, et al. Innovation in smallholder farming in Africa: recent advances and recommendations. In: Proceedings of the International Workshop on Agricultural Innovation Systems in Africa (AISA), 29–31 May 2013. Nairobi, Kenya. Montpellier: CIRAD; 2014. p. 229.
- Biggs S. Building on the positive: an actor innovation systems approach to finding and promoting pro-poor natural resources institutional and technical innovations. *Int J Agric Resour Governance Ecol*. 2007;6(2):144–64.
- Ejigu J, Waters-Bayer A. Unlocking Farmers' Potential: Institutionalising Farmer Participatory Research and Extension in Southern Ethiopia, Project experiences series 2. London: FARM–Africa; 2005. p. 46.
- Twyman J, Green M, Bernier Q, Kristjanson P, Russo S, Tall A, et al. Adaptation Actions in Africa: Evidence That Gender Matters, CCAFS working paper 83. Copenhagen, Denmark: CGIAR Research Program on Climate Change, Agriculture and Food Security (CCAFS); 2014. Available at: <http://ccaafs.cgiar.org/publications/adaptation-actions-africa-evidence-gender-matters#VMAnUcawIE>.
- Morgan M. Measuring Gender Transformative Change, Program brief: AAS-2014-41. Penang, Malaysia: CGIAR Research Program on Aquatic Agricultural Systems; 2014.
- Warburton H, Blake R, Coupe S, Pasteur K, Phillips E. Bridging the gap between resource-poor farmers and extension services: the role of community based extension systems. In: Proceedings of the CTA International Conference on Innovations in Extension and Advisory Services: Linking Knowledge to Policy and Action for Food and Livelihoods. Wageningen, The Netherlands: CTA; 2013.
- Krishna A. Active Social Capital: Tracing the Roots of Development and Democracy. New York: Columbia University Press; 2002. p. 259.
- Shaw A, Kristjanson P. A catalyst toward sustainability? Exploring social learning and social differentiation approaches with the agricultural poor. *Sustainability*. 2014;6(5):2685–717. <http://www.mdpi.com/2071-1050/6/5/2685>.

Submit your next manuscript to BioMed Central and take full advantage of:

- Convenient online submission
- Thorough peer review
- No space constraints or color figure charges
- Immediate publication on acceptance
- Inclusion in PubMed, CAS, Scopus and Google Scholar
- Research which is freely available for redistribution

Submit your manuscript at
www.biomedcentral.com/submit

