Vol. 17(2), pp. 310-315, February, 2021
DOI: 10.5897/AJAR2020.14899
Article Number: CDAB57B66084
ISSN: 1991-637X
Copyright ©2021
Author(s) retain the copyright of this article
http://www.academicjournals.org/AJAR

African Journal of Agricultural Research

Full Length Research Paper

Perception and adoption of new agricultural technologies in a Northern Inland Mozambique

Matías Javier Hargreaves M[1], Antonio Hargreaves B.[2] and José Luis Riveros F.*[3]

[1]Escuela de postgrado, Facultad de Agronomía e Ingeniería Forestal, Pontificia Universidad Católica de Chile.
[2]Escuela de Agronomía, Universidad Mayor, Santiago, Chile.
[3]Departamento de Ciencias Animales, Facultad de Agronomía e Ingeniería Forestal, Pontificia Universidad Católica de Chile.

Received 7 April, 2020; Accepted 5 January, 2021

The debate on the factors constraining the adoption of agricultural technologies in Southern African countries is still open. This paper assesses the perception and the level of adoption of a set of agricultural technologies by the key actors in a Northern Inland Mozambique. These key actors formed two groups: (1) Technicians, who are the local government officials and are responsible for the adoption of agricultural technologies in the area; (2) Extension farmers, who are local farmers, and leaders in different communities of the area; they work together with the technicians to prove new technologies and to promote them within the local farmer's communities. The data was collected through surveys with 10 technicians (20% women) and 8 extension farmers (37.5% women), assessing their perception of the adoption of agricultural technologies in Chitima, Mozambique between 2012 and 2017. Results show that technicians declare seed varieties as the easily adopted technology by the farmers, but the extension farmers declared that they do not care about the type of technology as long as it increases the crop yield and the income. This reflects a misunderstanding between technicians and extension farmers that could be constraining the adoption of agricultural technologies in Chitima.

Key words: Agriculture, local farmers, Mozambique, technology adoption.

INTRODUCTION

Which factors are determining the adoption of agricultural technology? Several authors saw in their research that the perception given by farmers about agricultural technologies could be key to a successful adoption, and in the opposite case, when perceptions are ignored, the analysis turn out to be less conclusive (Kivlin and Fliegel, 1967, 1966; O'Mara, 1980). Therefore, for a wider comprehension of an adoption of technology process, cognitive, emotional, and contextual concerns must be considered as a first step (Straub, 2017).

Since the 'green revolution', the adoption rate of agricultural technologies in sub-Saharan Africa has been much lower than in other parts of the world (e.g Asia, Latin America) (Mkandawire and Matlosa, 1993; World Bank, 2007; Gollin et al., 2018) due to several factors such as a top-down approach to the community (Davis, 2008), and a lack of understanding of cultural issues (Kitoko-Nsiku, 2008; Evani et al., 2016). In order to address these issues, direct observational studies could be a way to gather real necessities directly from the local community. This methodology implies the direct participation of a researcher in the daily affairs of the community, which could generate distrust in a community (Schutz, 1999).

*Corresponding author. E-mail: jlriverosf@uc.cl.

Author(s) agree that this article remain permanently open access under the terms of the Creative Commons Attribution License 4.0 International License

In Mozambique, the adoption rate of agricultural technologies in the early post-colonial period was low, which led to a difficult agricultural productive scenario (Hanlon, 1984). After Mozambican independence in 1975, the government built state farms, which were large pieces of land managed by the government to feed as many people as possible. So the government imported several technologies (that is, tractors, harvesters) to improve the yield of the state farms, but the problem was that the workers did not know how to maintain or repair the machinery, so the adoption rate was low (Hanlon, 1984). Currently in Mozambique, the vast majority of the actors engaged to the agriculture business are small farmers, and they usually follow a leader within a community, who is the one communicating with the government officials (Ministry of Agriculture and Rural Development, 2007). The adoption of agricultural technologies process in Mozambique has been historically government-led (Ministry of Agriculture and Rural Development, 2007), with no farmer's participation (Hanlon, 1984). This sets the need for direct observation in order to gather the perception of the community about the factors constraining an adoption of agricultural technology (Michener, 1998; Bartels et al., 2013; Van Meensel et al., 2012). In the process of assessing perception, language is key (Kitoko-Nsiku, 2008; Evani et al., 2016). Mozambique has 20 Bantu languages and 99% of its population speak at least one of them; 6% declare Portuguese as a mother tongue and a 39% as a second one (Patel et al., 2008). This article evaluates the perception and the level of adoption of a set of agricultural technologies by the key actors in a Northern Inland Mozambique.

MATERIALS AND METHODS

The research took place in Chitima (15°43'57.91''S; 32°46'07.37''E), CahoraBassa district, Tete province, Mozambique. The climate is dry-tropics, with 600 mm of rainfall (INE, 2009). Every methodology and activities were conducted within a direct observation approach based on Michener (1998), Bartels et al. (2013) and Van Meensel et al. (2012). First, an open meeting was conducted with the Government Agriculture Office's staff in order to determine who are the key actors in Chitima that should be interviewed in technology adoption matters. We opted for two types of key actors: technicians and extension farmers. Technicians are the workers of the Government Agriculture Office and are the responsible for every technology adoption process related to agriculture in Chitima area; they operate directly with the second key actor, the extension farmers, who are local farmers who have common characteristics such as community leadership and high level of technology adoption; and their operational role is to prove every agriculture technology provided by the technicians, and if it works, extension farmers promote it within their communities. To survey these two key actors, a 7 open and 6 closed question questionnaires were designed in Portuguese for technicians and a 7 open and 6 closed open question questionnaires for extension farmers, and in this case a Portuguese-Nyungwe (local language) interpreter was used. Both questionnaires were designed to last 10 to 12 min. The survey addressed the perception of the key actors on the adoption of agricultural technologies in the area between 2012 and 2017. Every interviewee signed an Informed Consent. Qualitative data collection was conducted according to Nigatu (2009): (1) sampling: open ended questionnaires; (2) tools: observation and interactive interviews. Quantitative data collection was conducted through closed questionnaires. The questionnaires were transcribed word by word, and the qualitative and quantitative data were organized in summaries. Analysis method was deductive approach for qualitative data; measures of central tendency were mean, median, and mode; and measures of variability like standard deviation for quantitative data was used.

RESULTS AND DISCUSSION

All the staff of the Government Agriculture Office were surveyed, numbering ten technicians (two women) and all the extension farmers for Chitima area, numbering eight (three women).

Although 100% of the technicians claimed that they are the main link between agricultural technology and extension farmers, results showed that 100% of the technician received training out of Tete province, and only 40% declared to be a *Nyungwe* native speaker, which could be leading to less satisfactory professional understanding between the two groups. All the technicians spoke Portuguese language fluently (as a second language), which might appear useful since Portuguese is the official language in Mozambique, but according to Patel et al. (2008), only 39% of the population have spoken Portuguese sufficiency. This situation confirms the importance to address perceptions of each group separately.

Results of the surveys showed that interviews lasted 20.5±2 min with the technicians and 22±2 min with the extension farmers, this is, 10±2 min above the calculated time.

The overall gap could be due to field work issues such as daily life interruptions, introductions and greetings, invitations to eat and/or drink; or due to operational limitation factors such as the quality of the interpreter, and the uncertainty associated with answering open question.

The time gap between the technicians and the extension farmers' interviews may presumably be due to a single factor, the need for an interpreter, which could delay the interviewing process. The aforementioned must be taken into consideration when calculating data collection sessions, since it can have a significant impact on the schedule of a research of this nature.

In terms of gender, technicians and extension farmers groups were made up mostly of men (80% of the technicians and 62.5% of the extension farmers), with only a 20 to 37.5% of women overall land ownership. Although this percentage is above the world average for land ownership by women (15%), neighbour countries like Malawi show almost a 50% of women land ownership (FAO, 2018). Anyhow, global and/or local data show that women are still significantly disadvantaged relative to men with regard to their land rights (FAO, 2018). On the

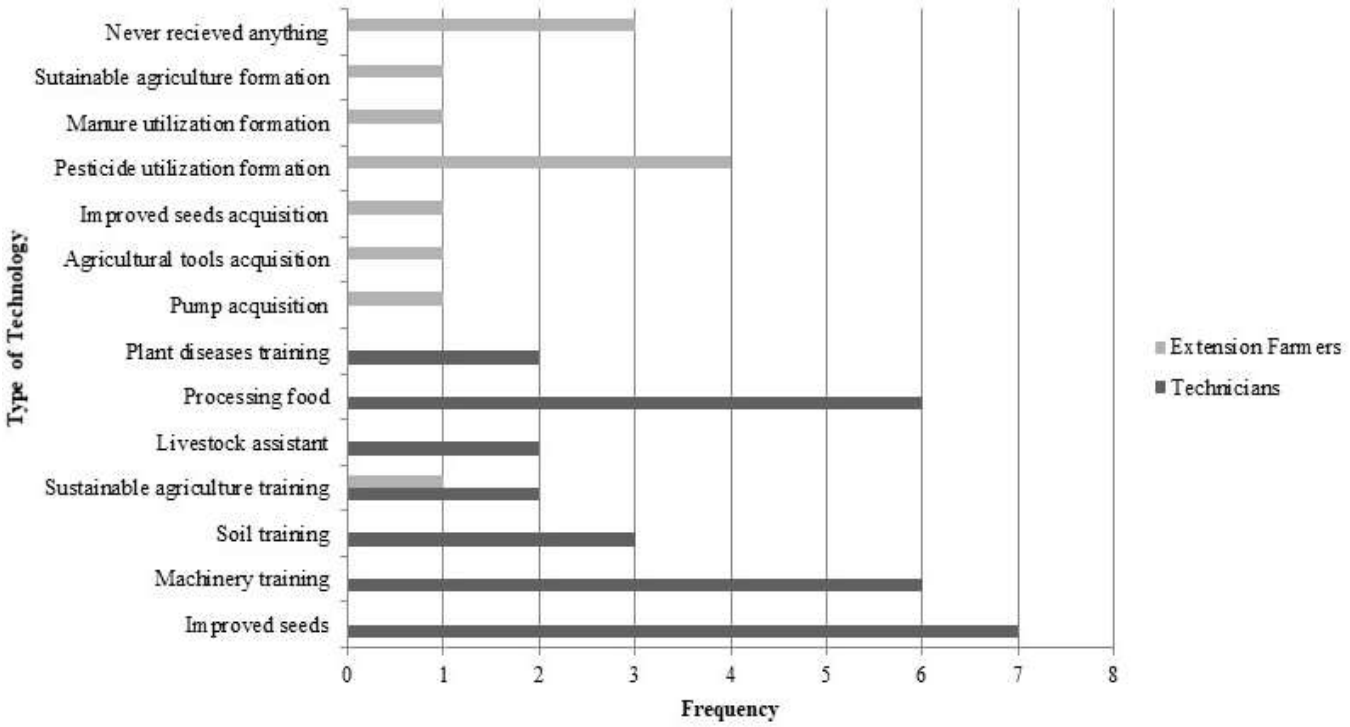

Figure 1. Frequency of types of technology delivered to Chitima from 2012 to 2017 according to technicians and extension farmers.

other hand, Arnfred (2011) argue that women are key to rural development in Southern African countries, and they have been taking leadership positions in agriculture (Hanlon, 1984; FAO, 2018). Further local studies should be conducted regarding gender inequality in agriculture, since it might be a significant constraint to development, and therefore to adoption of technology.

In terms of technology, 100% of the technicians declare that after Mozambican's independence (1975), agricultural technology in Chitima was provided by the government, and this operation was progressively passing into the hands of international aid organizations (that is, FAO, Hellen Keller Foundation, US AID, World Vision International) until present times (2017). This could be related to the civil war in Mozambique (1977 - 1992) in which most of the government functions were paralyzed (Newitt, 1995).

According to 100% of the technicians (Figure 1), the set of agricultural technologies provided for Chitima between 2012 and 2017 were (a) improved seeds (that is, bean, tomato, maize), (b) machinery training (that is, Water pumps), (c) sustainable agriculture and soil training (that is, planting techniques, waste management); (d) food processing techniques (that is, maize flour techniques, healthy cooking techniques) and (e) livestock assistant (that is, food supplements). Then, when asked for the factors determining the adoption of these technologies, 70% of technicians assured that an agricultural technology will be adopted if it helps with the droughts (Figure 2). Chitima has a rainy season from December to April and then a dry period from May to November; normally, the local farmers who do not have an irrigation system harvest their crops at the beginning of the dry season, and then the gardens remain unproductive until the next rainy season. Additionally, the incidence of long droughts in Southern Africa has been increasing since 2000 due to various factors, including climate change (Boko et al., 2007), in fact, Salinger et al. (2005) and Boko et al. (2007) showed that agriculture in Africa is highly dependent on weather conditions, and Jones and Thornton (2003) explain that crop yields in East Africa will decrease in 15% by 2050 due to global warming. Therefore, technicians declare that helping farmers to reduce the unproductive season with technology, will improve the adoption rate. On the other hand, extension farmers declared that they were provided with the following set of agricultural, in order of frequency: (a) Pesticides utilization (that is, spraying techniques, 50%), (b) sustainable agriculture training (that is, planting techniques, 12.5%), (c) improved seeds (12.5%), and (d) water pump (12.5%). Additionally, 62.2% of the extension farmers said that the most important factor to adopt an agricultural technology is yield improvement (that is, 'bigger plants'). In fact, the majority of agricultural technologies provided by international aid organizations to Africa focused in yield improvement (Davis, 2008). But results showed differences between the information given by the two groups. First, the set of agricultural

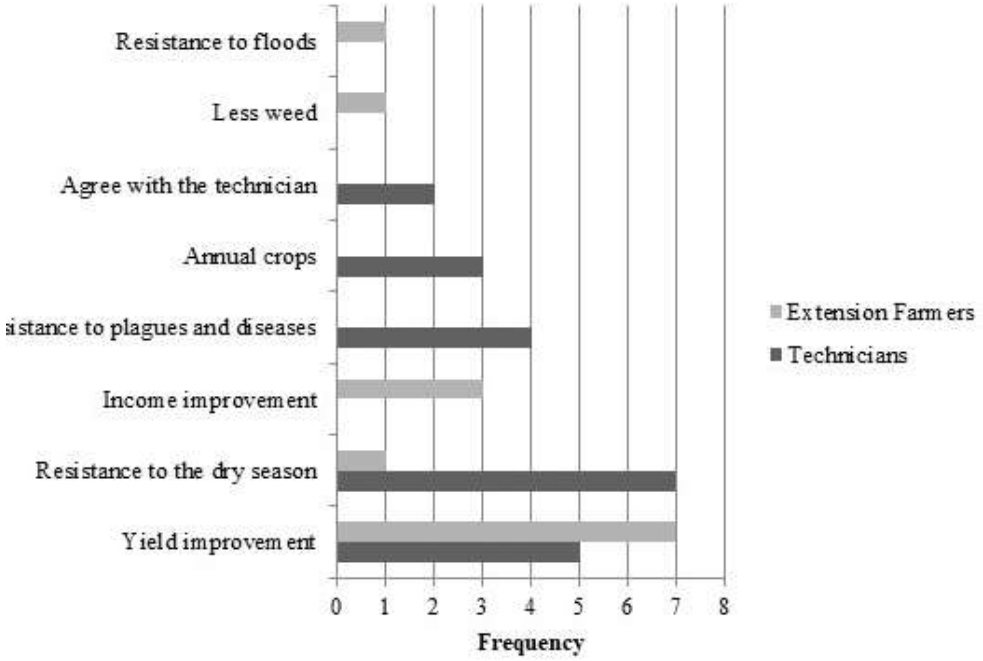

Figure 2. Frequency of the most important factors to achieve technology adoption, according to technicians and extension farmers.

technologies is different, which could reflect that some technologies are not being provided to the extension farmers, in fact, 37.5% of the extension farmers said that they never received anything from the technicians. Second, the main factor determining the adoption of an agricultural technology is resistance to the dry season, according to 70% of the technicians; but to 88% of the extension farmers is yield improvement. This difference between the perceptions of both groups could lead to misunderstanding since a technology that improves resistance to the dry season might be affecting yield improvement too, but surveys show that when extension farmers declare yield improvement, they refer mainly to individual plant size, in detriment of other yield indicators (that is, production per hectare, production in the dry season). Yield improvement tends to be a wider concept than resistance to the dry season, for yield might be improved as a consequence of some technologies that give resistance to the dry season, but also as a consequence of other types of technology (that is, fertilizers, improved seeds) that do not necessarily increase the resistance to the dry season. This situation could lead to a complete different approach when providing agricultural technology to Chitima.

Technicians and extension farmers match in one type of technology (Figure 1), sustainable agriculture training, which could be seen as an opportunity of adoption, since authors like Brown et al. (2017) showed that Southern Africa seems to be heading to cleaner options; and particularly Mozambique is one of the most promising in politics for sustainable mobility (Hartley et al., 2019).

Summarizing, results of the surveys conducted in Chitima to assess the perception of technicians and extension farmers about adoption of agricultural technologies show different answers, including different set of agricultural technologies, and different conditions to adopt a technology, which could be constraining adoption. This could be due to several factors, such as language barriers between technicians and extension farmers, cultural hierarchy, gender disadvantages and different productive objectives between the two groups. First, 80% of the technicians declared that an effective communication with extension farmers is ‘non-essential’ for an adoption of agricultural technologies, even when authors like Kogut and Zanter (1992), Nahapiet and Ghoshal (1998), Hedlund (1999) and Rwanda Podium (2017) argued that language barriers affect adoption of technology in Africa. However, field observations determined that cultural hierarchy in Chitima would allow technicians to be above extension farmers in a decision-making chain, which could have been hindering the survey with the extension farmers, but further studies in this matter are required to make it a conclusive factor. Third, gender discrimination could be a factor constraining adoption within a patriarchal society, since authors like Arnfred (2011) and FAO (2018) declare women in agriculture as the key actors for household development and identification of real necessities. Fourth, extension farmers and technicians in Chitima seem to chase different objectives. When asked, 100% of the

technicians said that they needed to achieve government goals (that is, number of visits to extension farmers, a high adoption rate), while 87.5% of the extension farmers want to improve yield. This situation could contribute to fulfill the gap in perceptions between technicians and extension farmers.

The debate on the factors constraining an adoption of agricultural technologies in many Southern African countries is still open (Kapfudzaruwa et al., 2017), registered adoption for cook stoves in 14 African countries, and they discovered that most of the rejections occurred in rural areas because they could not afford it. Parkinson (2009) identified severe disagreements between farmers and technicians in Uganda; extension systems were not consistent with farmer's perspectives. In Ghana, farmers did not want to use manure to enhance soil since they found it 'old fashioned' (Kiff et al., 1997).

Results in this study lead to a complex scenario; the adoption of agricultural technologies shows to have local specific constraints.

However, international experiences show to have some similarities in the factors needed to lead an effective adoption of agricultural technology. Graves et al. (2004) and Burgess et al. (2019) concluded that no technology will suit all farmers, and therefore every agricultural technology development should operate within the existing biophysical, social, economic and cultural contexts. In other words, a technology should have better adoption rate if it improves farmer's livelihoods and well-being (Birner et al., 2006).

Further studies are needed in Chitima area in order to address and delve deeper in the effect of language barriers, cultural hierarchy, gender, and rural goals in the adoption of an agricultural technology; and in how agricultural technology should address biophysical, social, economic and cultural contexts to develop a suitable technology that effectively improves the well-being of a community.

CONFLICT OF INTERESTS

The authors have not declared any conflict of interests.

REFERENCES

Arnfred A (2011). Sexuality and gender politics in Mozambique: rethinking gender in Africa. Boydell and Brewer Ltd. PO Box 9 Woodbridge, Suffolk IP12 3DF (GB):309 pp.

Bartels W, Furman C, Diehl D, Royce F, Dourte D, Ortiz B, Zierden D, Irani T, Fraisse C., Jones J (2013). Warming up to climate change: a participatory approach to engaging with agricultural stakeholders in the Southeast US. Regional Environmental Change 13:45-55.

Birner R, Davis K, Pender J, Nkonya E, Anandajayasekeram P, Ekboir J, Mbabu A, Spielman D, Horna D, Benin S, Kisamba-Mugerwa W (2006). From best practice to best fit: a framework for designing and analyzing agricultural advisory services.ISNAR Discussion Paper N°5. Washington DC: IFPRI.

Boko M, Niang I, Vogel C, Githeko A, Medany M, Osman-Elasha B, Tabo R, Yanda P (2007). Africa in climate change. In Parry, M.L. et al (Eds.) 2007 Impacts, adaption and vulnerability.Contribution of working Group II to the fourth Assesment Report of the Intergovernmental Panel on Climate Change. Cambridge University Press pp. 433-467.

Brown B, Llewellyn R, Nuberg I (2017). Why do information gaps persist in African smallholder agriculture? Perspectives from farmers lacking exposure to conservation agriculture. The Journal of Agricultural Education and Extension 24:191-208.

Burgess P, Harris J, Graves A, Deeks L (2019). Regenerative Agriculture: Identifying the Impact; Enabling the Potential. Report for SYSTEMIQ. 17 May 2019. Bedfordshire, UK: Cranfield University.

Davis K (2008). Extension in Sub-Saharan Africa: overview and assessment of past and current models, and future prospects. Journal of International Agricultural and Extension Education 15:15-28.

Evani T, Atanga L, Nforbi E, Biola E, Helen N, Balinga S (2016). Language, intercultural communication and development: a psycholinguistics analysis of conflicting paradigms in Sub-Saharan African sustainable development dilemma. International Journal of Linguistics and Communication 4:104-111.

Food and Agriculture Organization (FAO) (2018). The gender gap in land rights. Food and Agriculture Organization of the United Nations. Available in http://www.fao.org/3/I8796EN/i8796en.pdf.

Gollin D, Hansen C, Wingender A (2018). "Two Blades of Grass: the Impact of the Green Revolution." Working paper.

Graves A, Matthews R, Waldie K (2004). Low external input technologies for livelihood improvement in subsistence agriculture. Advances in Agronomy 82:473-555.

Hanlon J (1984). Mozambique: the revolution under fire. Zed Books Ltd., 57 Caledonian Road, London N1 9BU: 294 pp.

Hartley F, Van Seventer D, Tostão E, Arndt C (2019). Economic impacts of developing a biofuel industry in Mozambique. Development Southern Africa 36:233-249.

Hedlund G (1999). The Multinational Corporation as a Nearly Recomposable System (NRS). Management International Review 39(1):5-44.

INE (2009). Instituto Nacional de Estatística. Governo de Moçambique. Available in http://www.ine.gov.mz/.

Jones P, Thornton P (2003). The potential impacts on climate change on maize production in Africa and Latin America in 2055. Global Environmental Change 13:51-59.

Kapfudzaruwa F, Fay J, Hart T (2017). Improved cookstoves in Africa: explaining adoption patterns. Development Southern Africa 34:548-563.

Kiff E, Chan MK, Jackson D (1997). Integrated Food Crop Systems Project, Ghana: 12 Development and Promotion of Improved Techniques of Water and Soil Fertility Management 13 for the Sustainable Production of Crops on Land in the Humid Forest Belt. (Inception Report). 14 Report No. R6789 AO683. Natural Resources Institute, London.

Kitoko-Nsiku E (2008). Dogs' Languages or People's Languages? The Return of Bantu Languages to Primary Schools in Mozambique. The Journal of Agricultural Education and Extension 8:258-282.

Kivlin J, Fliegel F (1966). Attributes of innovations as factors in diffusion. American Journal of Sociology 72:235-248.

Kivlin J, Fliegel F (1967). Differential perceptions of innovations and rate of adoption. Rural Sociology 32(1):78-91.

Kogut B, Zander U (1992). Knowledge of the Firm, Combinative Capabilities, and the Replication of Technology. Organization Science 3(3):383-397.

Michener V (1998). The participatory approach: contradiction and co-option in Burkina Faso. World Development 26:2105-2118.

Ministry of Agriculture and Rural Development (2007). RCBP (Rural Capacity Building Project). Draft Project Implementation Manual.

Mkandawire R, Matlosa K (1993). Food policy and agriculture in southern Africa. Food and Agriculture Organization of the United Nations.In AGRIS since 1997. SAPES: 250 p.

Nahapiet J, Ghoshal S (1998). Social capital, intellectual capital, and the organization advantage. Academy of Management Review 23(2):242-266.

Nigatu T (2009). Qualitative data analysis.African Medical and Research Foundation. Available in https://es.slideshare.net/tilahunigatu/qualitative-data-analysis-11895136.
Newitt M. (1995). A history of Mozambique. Hurst and Company Ltd. 41 Great Russell Street LondonWC1B 3 PL: 679 p.
O'Mara G (1980). The micro-economics of technique adoption by small-holding Mexican farmers.World Bank Development Research Center, Washington DC.
Parkinson S (2009). When Farmers Don't Want Ownership: Reflections on Demand-driven Extension in Sub-Saharan Africa.The Journal of Agricultural Education and Extension 15:417-429.
Patel S, Chambo G, Tembe F (2008). Bilingual education in Mozambique: nowadays situation. Eduardo Mondlane University 20 p.
Rwanda Podium (2017). AFRICA: language barriers hurt African investments. Available in http://www.rwanda-podium.org/index.php/analyses-critiques/383-africa-language-barriers-hurt-african-investments.
Salinger J, Sivakumar V, Motha R (2005). Increasing climate variability and change: reducing the vulnerability of agriculture and forestry. https://www.springer.com/gp/book/9781402033544
Schutz A (1999). El forastero: ensayo de psicología social. Estudios sobre teoría social. Buenos Aires, Argentina. Amorrortu Editores.
Straub E (2017). Understanding technology adoption: theory and future directions for informal learning. Review of Educational Research 79:625-649.
Van Meensel J, Lawers L, Kempen I, Dessein J , Van Huylenbroeck G (2012). Effect of participatory approach on the successful development of agricultural decision systems: the case of pigs2win. Decision Support Systems 54:164-172.
World Bank (2007). World Development Report 2008: Agriculture for Development. Washington DC: The World Bank.