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What (science for) adaptation to climate change in Colombian agriculture? A commentary on "A way forward on adaptation to climate change in Colombian agriculture: perspectives towards 2050" by J. Ramirez-Villegas, M. Salazar, A. Jarvis, C. E. Navarro-Valcines.

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Abstract

Climate change is putting Colombian agriculture under significant stress and, if no adaptation is made, the latter will be severely impacted during the next decades. Ramirez-Villegas et al. (2012) set out a government-led, top-down, techno-scientific proposal for a way forward by which Colombian agriculture could adapt to climate change. However, this proposal largely overlooks the root causes of vulnerability of Colombian agriculture, and of smallholders in particular. I discuss some of the hidden assumptions underpinning this proposal and of the arguments employed by Ramirez-Villegas et al., based on existing literature on Colombian agriculture and the wider scientific debate on adaptation to climate change. While technical measures may play an important role in the adaptation of Colombian agriculture to climate change, I question whether the actions listed in the proposal alone and specifically for smallholders, truly represent priority issues. I suggest that by i) looking at vulnerability before adaptation, ii) contextualising climate change as one of multiple exposures, and iii) truly putting smallholders at the centre of adaptation, i.e. to learn *about* and *with* them, different and perhaps more urgent priorities for action can be identified. Ultimately, I argue that what is at stake is not only a list of adaptation measures but, more importantly, the scientific approach from which priorities for action are identified. In this respect, I propose that transformative rather than technical fix adaptation represents a better approach for Colombian agriculture and smallholders in particular, in the face of climate change.

Keywords

Vulnerability, Adaptation, Climate change, Agriculture, Smallholders, Colombia

1 Introduction

Several recent studies have shown that climate change is putting Colombian agriculture under significant stress and that it is expected to do so increasingly over coming decades (e.g., Pabon 2003, Bradley et al. 2006, Ruiz 2010). The expected effects of climate change vary significantly because of the high diversity of pedoclimatic conditions and farming systems that are typical of Colombia. Nevertheless, there is agreement that overall, the potential threats to agricultural production outweigh the opportunities (e.g. Zhao et al. 2005, Cline 2007, Pisco 2010) and that if no adaptation is made, Colombian agriculture will be severely impacted by climate change during the next decades (Ramirez-Villegas et al. 2012).

Agriculture is a key sector of the Colombian economy in terms of contribution to national wealth, food security and employment (Pisco 2010, Ramirez-Villegas et al. 2012). Therefore, it is strategic and urgent for Colombian agriculture to respond promptly to climate change. However, the Colombian government has tended to prioritise other climate-related challenges, such as biodiversity conservation and disaster management (Lau et al. 2011). Ramirez-Villegas et al. (2012) noted that despite growing evidence about the impact of climate change in Colombia, there are still serious gaps in knowledge concerning those measures that could be implemented as part of national, regional and sectorial adaptation plans.

Against this backdrop, Ramirez-Villegas et al. (2012) set out a proposal for a way forward by which Colombian agriculture could adapt to climate change. They identify, in essence, four priorities for action:

1. Information production in the form of, e.g., crop- and region-based climate change impact assessments, in order to select and prioritise adaptation options and information accessibility, e.g., through inter-institutional, free-access databases.
2. Technological development and economic measures. Research, development, validation and transfer of technologies, crop management and development of subsidies and insurance schemes to support farmers.
3. Institutional restructuring and inter-institutional networks. Improved coordination among institutions (e.g., ministries, governmental and non-governmental agencies responsible for specific sectors, regions, or crops) to improve data availability, access to international funds and the efficiency and effectiveness in spending the available funds and implementing the adaptation measures.
4. Prioritisation of smallholders' adaptation. Smallholders rely on a lower level of technological development and therefore, are expected to be less capable of adapting to climate change.

Ramirez-Villegas et al. (2012) outline what could be described as a government-led, techno-scientific approach to adaptation. In this commentary, I discuss some of the hidden assumptions

underpinning this proposal and of the arguments employed by Ramirez-Villegas et al., based on existing literature on Colombian agriculture and the wider scientific debate on adaptation to climate change. While technical measures may play an important role in the adaptation of Colombian agriculture to climate change, I question whether the focuses listed in the proposal alone and specifically for smallholders, truly represent priority issues. I suggest the need for a reconsideration of the techno-scientific approach to the challenge of climate change and discuss its implications for researching climate change adaptation and vulnerability in Colombia.

2 Technical-fix versus transformative adaptation

Ramirez-Villegas et al. (2012) approach the challenge of responding to climate change through informational, technological (e.g., technical support, new crop varieties, crop management) and economic (e.g., subsidies, insurance schemes) measures. This is a top-down, technical-fix approach (Giddings et al. 2002, Robinson 2004), which defines adaptation to climate change as a problem of a technical nature, i.e., one that can be solved by intervening through technical measures (these being technological or economic) to re-establish the balance between human and environmental systems, which climate change threatens to disrupt, e.g., as measured in terms of crop production. As noted by Giddings et al. (2002), technical solutions are attractive because they can be introduced relatively quickly and they do not require fundamental reconsideration of the characteristics and relationships between the human and environmental systems. The implicit aim of such an approach is to maintain the functional persistence of farming systems in a changing environment, i.e., their resilience (Pelling 2011).

By framing the effort of responding to climate change as adaptation, rather than vulnerability reduction, Ramirez-Villegas et al. (2012) inevitably shift the focus from the causes of vulnerability (i.e., “why” adaptation is needed) to the response to climate change (i.e., “how” to adapt) (Ribot 2011). As noted by Ribot (2011) and O´Brien et al. (2007), such a shift is much more than semantics. It places the risk within the hazard (i.e., climate), naturalising adaptation as a natural response to a stimulus and thus, drawing attention away from the social causes of vulnerability, the socially differentiated risks to which populations need to adapt and from the attribution of responsibility for this state of vulnerability (Pelling 2011, Ribot 2011). Not surprisingly, Ramirez-Villegas et al.’s analysis largely overlooks the root causes of Colombian agriculture’s vulnerability but “actions labelled adaptation should be based on deep knowledge of vulnerability” (Ribot 2011:1161). While exposure and sensitivity of different regions and crops to climate change are detailed, no comparable level of analysis is reached with respect to why farmers and particularly smallholders are considered vulnerable to climate change, except for a mention of their low technological development. In fact, several studies have illustrated how under certain socio-

ecological conditions peasants show a high adaptive capacity to economic, social and environmental stresses (Forero 2002, Forero 2003, Torres 2002, De los Rios and Almeida 2010, Perez et al. 2010, Corrales 2011). As documented by these studies, adaptation does not need to take a technological form but instead, can consist of socio-economic strategies (e.g., temporary migration) and social rules of cooperation, reciprocity, risk sharing, labour and resource access and allocation. Furthermore, the definition of vulnerability adopted by Ramirez-Villegas et al. (2012), i.e., "the susceptibility of the agriculture sector to the biophysical and hence, economic impacts of climate-related issues", in contrast to the more commonly referred Intergovernmental Panel on Climate Change (IPCC) definition (IPCC 2007) excludes the reference to adaptive capacity and thus, justifies the small consideration given to this vulnerability component. In summary, assuming that the policy goal in the face of climate change is one of maintaining the functional persistence of existing farming systems through adaptation measures that are technical in nature, leaves us at best with the doubt of what exactly it is that makes Colombian farmers and in particular smallholders, unable to adapt to climate change and whether technical measures are the most effective way to address such causes.

While specific studies on Colombian farmers' vulnerability to climate change are scarce, a significant body of scholarship has investigated the unresolved agrarian question that structurally characterises Colombian agriculture. Among the most significant features there are: a highly concentrated land distribution, precarious land rights, a static social hierarchy that hinders upward social mobility, malfunctioning institutions, the lack of infrastructure and services, the presence of political elites that has limited the full development of an open democratic life, land use conflicts and sustainability crises (Etter and Villa 2000, Fajardo 2002, Forero 2002, Leon and Rodriguez 2002, Perez and Perez 2002, Sánchez 2002, Borras 2003, Forero 2003, Forero and Ezpeleta 2007, Mesias 2009, Forero 2010, Salgado 2010, UNDP 2011). Peasants and smallholders, together with women, indigenous and Afro-Colombian communities, are the social categories that have suffered the most from the structural crisis of Colombian agriculture, as indicated by their comparatively low levels of human security (UNDP 2011). Despite their fundamental contribution to economic wealth, national food security, agricultural export and to the social and cultural life of the country (Forero 2010, Salgado 2010), peasants and the value of peasant economies have historically lacked social, economic and political recognition (Perez and Perez 2002, Sánchez 2002, Forero 2003, UNDP 2011). This has contributed to their marginalisation, lack of political representation and of access to key resources (e.g., land, water), financial support and credit (Forero 2003, UNDP 2011), which are root causes of the low technological development of smallholders.

Thus, the evidence outlined here suggests that Colombian peasants' vulnerability is significantly

interconnected to the low levels of human security that characterise many rural areas in the country and is deeply rooted in social and political structures, social values and institutional settings. Human security is "something that is achieved when and where individuals and communities have the options necessary to end, mitigate, or adapt to threats to their human, environmental, and social rights; have the capacity and freedom to exercise these options; and actively participate in pursuing these options" (GECHS 1999) and is known to be associated with adaptive capacity (Barnett 2003, GECHS 1999). A technical-fix approach alone, such as that put forward by Ramirez-Villegas et al. (2012), hardly tackles any of these structural, deeply rooted social causes of vulnerability. On the contrary, it is possible to hypothesise that this very social and political configuration could undermine the effect, or act as barriers to, the implementation of technical measures. For example, social recognition is a prerequisite for the targeting of subsidies or insurance schemes to smallholders and peasants (e.g. Forero 2010). Similarly, well-functioning institutions are a prerequisite for the effective and efficient implementation of any technological or economic adaptation measure (e.g. Borras 2003).

I suggest that adopting a transformative rather than technical-fix approach to adaptation would help to prioritise the measures that tackle the deep, structural causes of limited adaptive capacity and high vulnerability, rather than end-point, palliative technical measures. The concept of transformational adaptation has been increasingly used in literature on climate change adaptation, although with different interpretations (O'Brien 2011, Pelling, 2011, Ribot 2011). It helps to understand adaptation as a process of social-ecological change rather than a spot technical intervention. Transformation entails a radical (rather than incremental) change, i.e., one that involves the core elements or defining system characteristics (e.g., function, structure). Therefore, a transformation is configured as a change *of*, rather than *in* a system. A transformed system would be one that has modified its core elements, such as values, worldviews, economic, political and institutional configurations and is not only able to respond or adapt to climate change but is able to redirect its development pathway to eliminate the root causes of vulnerability (Pelling 2011). Thus, the policy goal for transformational adaptation is not the maintenance of a system but the reconfiguration of the structures of development, achieved through a radical change of the overarching political and economic regime and social structures (Pelling 2011).

In effect, the calls for transformative rural policies trace back in Colombia at least six decades to the milestone work of Orlando Fals-Borda among peasants in the Colombian Andes (Fals-Borda 1955). More recently, the United Nations Development Programme (UNDP) (UNDP 2011) outlined a "transformative rural reform" built around the pillars of poverty reduction, the end of rural conflict, human security, land access and institutional and human development. Together with other recent insightful analyses of Colombian rural and peasant communities (e.g., Forero 2003), this UNDP

report could represent a basis for a debate around the principles and priorities of a different way forward in vulnerability reduction and increased adaptive capacity of Colombian smallholders in the face of climate change.

3 Contextualising agricultural adaptation to climate change in Colombia

Ramirez-Villegas et al. (2012) discuss agricultural adaptation to climate change in Colombia in isolation from its wider social, economic and political context. The adoption of this particular perspective inevitably leads to the proposal of sectorial measures and to the identification of sectorial-related organisations and institutions as key stakeholders for adaptation development and implementation.

However, it is widely acknowledged that climate change often corresponds with other phenomena to pose a potential threat to local rural communities ("double (or multiple) exposure") (O'Brien and Leichenko 2000). Farmers need to respond, not only to climate change but also to other socio-ecological phenomena, whereby there might be synergies, or trade-offs between the actions taken in response to the different simultaneous pressures. One such phenomenon is that of globalisation, whereby farmers need to adapt to the combined pressures of climate change and international markets simultaneously. The free trade agreement (Tratado de Libre Comercio - TLC) between Colombia and the United States of America that recently came into effect configures an almost prototypical situation of double exposure for Colombian farmers, big producers and smallholders alike. Although precise estimates on the TLC's effects on Colombian agriculture are yet to be produced (Torres 2010), it is clear that the challenges for the sector are potentially very significant, especially for some products (e.g., poultry and pork meat, beans and several cereals) that are exposed to competition from USA producers (Garay et al. 2010). It is apparent that such a substantial change of the Colombian agricultural market needs to be factored in when discussing climate change adaptation. The economic performance of agricultural units in the national and international markets will largely determine the level of resources that the sector will be able to invest in order to sustain the costs of climate change adaptation. In addition, the TLC sets institutional and normative structures that appear inconsistent with some of the economic measures proposed by Ramirez-Villegas et al. (2012). In particular, the TLC requires the progressive cancellation of tariffs and support schemes to Colombian agricultural producers (Garay et al. 2010), which at best reduces the scope for the use of subsidies as climate change adaptation measures. Therefore, the relevance of the TLC for adaptation to climate change in Colombia is double: as a determinant of adaptive capacity (i.e., financial resources to respond to climate change effects) on the one hand and on the other, as a constraint to the development and implementation of specific technical adaptation measures.

A second highly important contextual factor that is not considered in Ramirez-Villegas et al.'s (2012) analysis is violent conflict. Decades of pervasive and persistent violent conflict has not only claimed its toll of human lives, including those of farmers but resulted in the forced displacement of hundreds of thousands of households, the disruption of rural communities' social fabric and deprivation of access to land and rights to its use and thus, contributing to rural poverty (UNDP 2003, Comisión 2009, Ganzáles 2009, Forero 2010, UNDP 2011). Together with the legacy of distrust that the conflict has left in many areas, the disruption of rural communities is a central cause of the decline in social capital, a key component of adaptive capacity (Adger 2003) and of the low level of farmer organisation observed in Colombia compared with other Latin American countries. Often, in violation of the most basic human rights, violent conflict has also favoured land accumulation, reinforced social inequalities and contributed to institutional inefficiency and ineffectiveness in providing basic services to rural communities (Perez and Perez 2002, UNDP 2011). Smallholders and peasant are among those who suffer most from violent conflict (Comisión 2009, Forero 2010, UNDP 2003, 2011). Therefore, as for the TLC, the relevance of violent conflict for adaptation to climate change in Colombia can be interpreted from a double perspective. Firstly, it contributes to and exacerbates the sources of vulnerability already mentioned with respect to the agrarian crisis. Secondly, it acts as a constraint to the development and implementation of specific technical adaptation measures. For example, response strategies in the context of conflict and insecurity are usually short-term (i.e., coping) rather than long-term (i.e., adaptation). Planning and forward thinking, which are prerequisites for the perception of long-term climate change risks and for the implementation of adaptation measures, are hardly possible in the context of poverty, conflict, insecurity and emergency (Banerjee and Duflo 2011).

In summary, framing agricultural adaptation in Colombia in its historical, social, political and economic context helps uncover a wider set of multiple exposures and therefore, to reconsider the prioritisation of adaptation measures in Colombian agriculture in the face of trade-offs and constraints. For example, do the technologies and new management practices proposed to confront climate change also help compete in liberalised markets, or there are trade-offs between adaptation to climate change and to the TLC? Importantly, it also suggests that agricultural adaptation to climate change should not be the exclusive responsibility of agriculture or environmental related organisations (ministries, agencies, extension services, agricultural research institutions) but requires the cooperation and coordination of a much broader set of institutional and non-institutional political, social and economic actors.

4 The role of farmers in adaptation to climate change in Colombia

Ramirez-Villegas et al.'s (2012) proposal foresees a marginal role for farmers in adaptation to

climate change. It does not exclude the involvement of stakeholders and farmers in the formulation of adaptation projects, e.g., in workshops “to elicit feedback regarding strategies and conclusions” but considers farmers mostly as “recipients” of adaptation in a technology development and transfer process, which is led by expert knowledge and structures (i.e., agencies, agricultural research centres and extension services).

In so doing, Ramirez-Villegas et al. (2012) implicitly adopt a prescriptive decision model that presumes, rather than tries to understand farmers’ adaptive actions (Risbey et al. 1999, Krandikar and Risbey 2000) and farmers are expected to respond in an economically rational way, i.e., to adopt the technical solutions proposed by experts. However, there is abundant evidence in the literature that farmers do not necessarily behave like rational economic actors (e.g., Krandikar and Risbey 2000, Feola and Binder 2010). Therefore, effective policies need to be based on a sound understanding of farmers’ actions, which includes the way rational expectations, values, social norms, feelings, habits and contextual factors produce and reproduce actions that are adaptive to the social, as well as to the natural environment, as perceived by the farmer (Feola and Binder 2010). Therefore, to understand farmers’ adaptive, or mal-adaptive, farming practices requires the understanding of “the decision-making processes into which adaptations to climate change can be integrated” (Smit and Wandel 2006:285). This approach differs from the socio-economic assessment of the type proposed by Ramirez-Villegas et al. (2012), in that its “aim is not to score adaptations or measure relative vulnerabilities, or to quantify impacts or estimate effects of assumed adaptations. Rather, the focus is to document the ways in which the system or community experiences changing conditions and the processes of decision-making in this system (or that influence the system) that may accommodate adaptations or provide means of improving adaptive capacity” (Smit and Wandel 2006:285).

Furthermore, the lack of consideration of the farmers risks contributing to the imposition of adaptation measures rather than their co-development and thus, creating the basis for policy failure and most importantly, reproducing the lack of recognition that is at the root of Colombian peasants’ vulnerability. Research has shown that farmers’ and technical experts’ visions can differ and that this gap can result in policy failure, when policies do not address the needs identified by the target communities themselves and are not based on a solid understanding of the social context in which they are implemented (e.g., Schoell and Binder 2009a, 2009b). Bottom-up, participatory approaches have been shown to be a fruitful way to overcome such barriers in agricultural development. There are many examples of successful participation in Colombia and in Latin America from which lessons for agricultural adaptation could be learned (e.g., Braun and Hocdé 2000, Perry 2004). They can be led by farmers, integrative of novel technologies with ancient wisdom and experiential knowledge and able to consider systemically social as well as environmental dynamics, instead of

separating them (Pretty 1995, WI 2011). In contrast to the technology transfer proposed by Ramirez-Villegas et al. (2012), the aim is to empower farmers to identify vulnerabilities, formulate and pursue responses and to share the risks and responsibilities of adaptation. Indeed, the "essential factor in strengthening farmer innovation capacity is not technology per se but rather the construction of social processes that support experimentation and learning" (Braun and Hocdé 2000:51). Therefore, bottom-up participatory processes are arenas for social learning in which not only, e.g., new technologies or management practices are introduced but where a change in understanding occurs through social interactions within social units or communities of practice (Pretty 1995, Braun and Hocdé 2000, Reed et al. 2010).

In summary, uncovering the causes of vulnerability entails learning *about* farmers' actions and practices and *with* farmers in trans-disciplinary processes of knowledge co-production. The latter are no silver bullet and by no means an easy or short path to take. To scale-up local, small-scale participation processes might prove to be a further challenge. However, the process by which adaptation measures are developed matters. A top-down, techno-scientific approach contributes to reproducing and reinforcing the lack of social recognition and voice that is among the root causes of Colombian peasants' low adaptive capacity and vulnerability. A bottom-up participatory approach would not only constitute a first essential step towards a better understanding of vulnerability but also, would in itself tackle those vulnerability factors and thus, directly play a transformative role.

5 Conclusions: what (science for) adaptation to climate change in Colombian agriculture?

I have questioned Ramirez-Villegas et al.'s (2012) priorities for action and proposed an alternative perspective on Colombian agriculture in the face of climate change. Given the pace and scale of climate change and the state of vulnerability, in particular of smallholders in Colombia, Ramirez-Villegas et al.'s (2012) call for action and the importance of the adaptation measures proposed can be appreciated. Information, technologies, crop management practices and economic schemes are options that can significantly contribute and are indeed possibly necessary, to respond to the challenges of climate change and mitigate its negative effects on rural livelihoods. Similarly, an institutional reorganisation and a national adaptation plan to manage better the unprecedented challenges of climate change can be expected to contribute positively to a coordinated and efficient response. Nevertheless, there are reasons to believe that Colombian smallholders' vulnerability does not ultimately depend on their level of technological development but more fundamentally on low levels of human security, which are intertwined with deeply rooted social, political and economic processes, systems of value, and formal and informal institutional settings. I suggest that tackling such root causes of vulnerability forces the reconsideration of the priorities for action against climate change and that, if such root causes of vulnerability are not tackled, any technical

adaptation measure might just be palliative. In other words, tackling the root causes of vulnerability means to tackle those sources of vulnerability that are ultimately hindering farmers' adaptive capacity and, at the same time, to pave the way for more specific, technical measures that might further advance adaptation in the face of climate change.

The scale of the climate change challenge calls for novel, alternative and complementary approaches to inform much needed action towards vulnerability reduction and increased adaptive capacity.

Ultimately, what is at stake is not only the list of priorities of adaptation measures but also the scientific approach to adaptation of Colombian agriculture from which priorities for action are identified. In this respect, I have argued that transformative adaptation rather than a technical fix might represent a better approach for Colombian agriculture and smallholders in particular, in the face of climate change. Transformative adaptation focuses on vulnerability rather than on adaptation, takes a more holistic perspective (e.g., human security) rather than a technical one and does not aim to maintain existing and possibly non-desirable, agricultural systems but rather to radically change them in order to eliminate the root causes of vulnerability. Moreover, I have stressed the importance of contextualising climate change as one of many pressures on Colombian agriculture. This helps uncover the constraints, trade-offs, or synergies, that may exist between actions in response to different but simultaneous pressures and to broaden the spectrum of actors that possibly need to be involved in order to enhance farmer's adaptive capacity. To contextualise climate change also means to acknowledge, and to avoid, that technical adaptation to climate change in agriculture can have the negative side-effect of increasing vulnerability to other stresses (e.g. the TLC). Finally, I have argued for a more central role of farmers in the definition of vulnerability analysis and development of adaptation options. This can involve both learning *about* farmers (i.e., to understand their mal-adaptation decisions) and *with* them, in participatory, social learning process in which science engages with other forms of lay knowledge and in doing so, takes directly a transformative role in society.

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References

Adger, WN (2003) Social Capital, Collective Action, and Adaptation to Climate Change. Econ Geog 79:387-

404
Banerjee A, Duflo E (2011) Poor Economics: A Radical Rethinking of the Way to Fight Global Poverty. PublicAffairs: New York
Barnett J (2003) Security and climate change. Glob Env Change 13:7-17
Borras SM (2003) Questioning the Market-Led Agrarian Reform: Experiences from Brazil, Colombia and South Africa. J Agr Chang 3:367-394
Bradley RS, Vuille M, Diaz HF, Vergara W (2006) Threats to Water Supplies in the Tropical Andes. Science 312:1755-1756
Braun AR, Hocdé H (2000) Farmer Participatory Research in Latin America: Four Cases. In: Stur WW, Horne PM, Hacker JB, Kerridge PC (eds.) Working with Farmers: The Key to Adoption of Forage Technologies. ACIAR Publication, Canberra
Cline WR (2007) Global Warming and Agriculture. Peterson Institute for International Economics, Washington
Comisión de seguimento a la política pública sobre desplazamiento forzado (Comisión) (2009) El reto ante la tragedia humanitarian del deplazamiento forzado: Reparar de manera integral el despojo de tierras y bienes. Consoltoría para los derechos humanos – Codhes, Bogota
Corrales E (2011) Sostenibilidad agropecuaria y sistemas de producción campesinos. Cuadernos Tierra y Justicia, ILSA, Bogota
Etter A, Villa LA (2000) Andean Forests and Farming Systems in part of the Eastern Cordillera (Colombia). Mountain Res Dev 20:236-245
De los Rios JC, Almeida J (2010) Percepciones y formas de adaptación a riesgos sociambientales en el páramo de Sonsón, Colombia. Cuad Desarro Rural 7:109-127
Fajardo D (2002) Tierra, poder politico y reformas agriaria y rural. Cuadernos Tierra y Justicia, ILSA, Bogota
Fals-Borda O (1955) Peasant Society in the Colombian Andes: A Sociological Study of Saucío. University of Florida Press, Gainesville
Feola G, Binder CR (2010) Towards an improved understanding of farmers' behaviour: the integrative agent-centred (IAC) framework. Ecol Econ 69:2323-2333
Forero J (2010) Economia campesina, pobreza, tierra y desplazamiento en Colombia. In: Forero J (ed) El campesino colombiano: entre el protagonismo economico y el desconocimiento de la sociedad. Pontificia Universidad Javeriana, Bogota
Forero J, Ezpeleta S (2007) Las brechas entre el campo y la ciudad en Colombia 1990-2003, y propuesta para reducirlas. CEPAL, Bogota.
Forero J (2002) La economia campesina colombiana 1990-2001. Cuadernos Tierra y Justicia, ILSA, Bogota
Forero J (2003) Economia campesina y sistema alimentario en Colombia: aportes para la discusion sobre seguridad alimentaria.
Ganzáles W (2009) El desplazamiento forzado y el despojo de la tierra: efectos de un modelo capitalista de producción en Boyacá. Periodo 1997 – 2007. Apuntes del CENES 47:133-154

Garay LJ, Barberi F, Cardona I (2010) Impatos del TLC con Estados Unidos sobre al economía campesina en Colombia. In: Forero J (ed) El campesino colombiano: entre el protagonismo economico y el desconocimiento de la sociedad. Pontificia Universidad Javeriana, Bogota

Giddings B, Hopwood B, O´Brien G (2002) Environment, economy and society: fitting them together into sustainable development. Sust Dev 10:187-196

GECHS (1999) Global environmental change and human security. GECHS science plan. IHDP, Bonn

Krandikar M, Risbey J (2000) Agricultural impacts of climate change: if adaptation is the answer, what is the question? Clim Chang 45:529-539

Intergovernmental Panel on Climate Change (IPCC) (2007) IPCC Fourth Assessment Report Working Group II Report Impacts, Adaptation and Vulnerability. IPCC: Geneva

Lau C. Jarvis A. Ramírez J (2011) Agricultura colombiana: Adaptación al cambio climático. CIAT Políticas en Síntesis no. 1. Centro Internacional de Agricultura Tropical (CIAT), Cali

Leon TE, Rodriguez L, (2002) Ciencia tecnología y Ambiente en la agricultura colombiana. Cuadernos Tierra y Justicia ILSA, Bogota

Mesias (2009) Relatos y contrarrelatos de los actores subalternos: el campesino organizado en la construcción de narrativas democráticas en Colombia. Cuad Desarro Rural 63:13l-162

O´Brien K, Eriksen S, Nygaard LP, Schjolden A (2007) Why different interpretations of vulnerability matter in climate change discourses. Clim Pol 7:73-88

O'Brien K (2011) Global environmental change II: From adaptation to deliberate transformation. Prog Hum Geog DOI: 10.1177/0309132511425767

O'Brien KL, Leichenko RM (2000). Double exposure: assessing the impacts of climate change within the context of economic globalization. Glob Env Chang 10:221-232

Pabon JD (2003) El cambio climático global y su manifestación en Colombia. Cuadernos de Geografia 12:111-119

Pelling M (2011) Adaptation to climate change. Routledge, Oxford

Perez E, Perez M (2002) El sector rural en Colombia y su crisis actual. Cuad Desarro Rural 48:35-58

Perez C, Nicklin C, Dangles O, Vanek S, Sherwood S, Halloy S, Garret K, Forbes G (2010) Climate Change in the High Andes: Implications and Adaptation Strategies for Small-scale Farmers. Int J Env Cult Econ Soc Sust 6:71-88

Perry S (2004) Innovación con pequeños agricultures, el caso del a Corporación para el Desarrollo Participativo y Sostenible del los Pequeños Agricultures en Colombia. In: CEPAL, Innovación participative: experiencias con pequeños productores agrícolas en seis países de América Latina. Serie Desarrollo Productivo No. 159, CEPAL, Santiago de Chile

Pisco (2010) Colombia: Estado de Situación frente a la Agricultura, Seguridad Alimentaria y Gestión de Recursos Hídricos destinados a la agricultura y el Cambio Climático. Internationale Weiterbildung und Entwicklung, Bonn

Pretty JN (1995) Participatory learning for sustainable agriculture. World Dev 23:1247-1263

Ramirez-Villegas J, Salzar M, Jarvis A, Navarro-Racines E (2012), A way forward on adaptation to climate

change in Colombian agriculture: perspectives towards 2050. Clim Chang DOI 10.1007/s10584-012-0500-y

Reed MS, Evely AC, Cundill G, Fazey I, Glass J, Laing A, Newig J, Parrish B, Prell C, Raymond C, Stringer LC (2010) What is Social Learning? Ecol Soc 15:r1. [online] URL: http://www.ecologyandsociety.org/vol15/iss4/resp1/

Ribot J (2011) Vulnerability before adaptation: Toward transformative climate action. Glob Env Chang 27:1160-1162

Risbey J, Krandikar M, Dowlatabadi H, Graetz D (1999) Scale, context and decision making in agricultural adaptation to climate variability and change. Mitig Adap Strat Glob Chang 4:137-165

Ruiz JF (2010) Cambio climático en temperatura, precipitacion y humedad relative para Colombia usando modelos meteorológicos de alta resolucion (panorama 2011-2100). IDEAM-Meteo 005-2010, Technical note, IDEAM

Robinson J (2004) Squaring the circle? Some thoughts on the idea of sustainable development. Ecol Econ 48:369-384

Salgado C (2010) Procesos de desvalorización del campesinado y antidemocracia en el campo colombiano. In: Forero J (ed) El campesino colombiano: entre el protagonismo economico y el desconocimiento de la sociedad. Pontificia Universidad Javeriana, Bogota

Sánchez J (2002) La crisis structural y el sector rural. Cuadernos Tierra y Justicia, ILSA, Bogota

Schoell R, Binder CR (2009a) System Perspectives of Experts and Farmers Regarding the Role of Livelihood Assets in Risk Perception: Results from the Structured Mental Model Approach. Risk Anal 29:205-222

Schoell R, Binder CR (2009b) Comparing system visions of farmers and experts. Futures 41:631-649

Smit B, Wandel J (2006) Adaptation, adaptive capacity and vulnerability. Glob Env Chang 16:282-292

Torres LE (2002) Autoconsumo y reciprocidad entre los campesinos andinos: caso Fómeque. Cuad Desarro Rural 48:79-98

Torres R (2010) Comentarios. In: Forero J (ed) El campesino colombiano: entre el protagonismo economico y el desconocimiento de la sociedad. Pontificia Universidad Javeriana, Bogota

United Nations Development Programme (UNDP) (2011) Colombia rural. Razones para la esperanza. National Report on Human Development, UNDP, Bogota

Worldwatch Institute (WI) (2011) State of the World 2011. Innovations that Nourish the Planet. Earthscan, London

Zhao Y, Wang C, Wang S, Tibig LV (2005) Impacts of Present and Future Climate Variability on Agriculture and Forestry in the Humid and Sub-humid Tropics. Clim Chang 70: 73-116