Essay

Communication of climate change and generation of adaptive capacities among farmers in the sub-humid tropics

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Abstract

This essay analyzes the importance of the communication of climate change in a specific local context, emphasizing the semantics used by the mass media influenced by a scientific-technical discourse. It also reflects on the opportunities to make said communication effective and convert climate change in a topic of social communication. The foregoing essentially required a documentary review of the role of the mass media in the communication of climate change and the principles of Luhmannian theory, as well as the use of previously generated information through a survey and in-depth interviews. The results show that the understanding of the meaning of climate change and its impacts on agriculture in the medium and long term requires considering semantics as a collective construction used in communicative operations by producers and their families in the local context, this will enable the generation of adaptive capacities and therefore, the design and implementation of proactive actions for the adaptation of agriculture in the Mexican subhumid tropics to climate change.

Keywords: adaptation, agriculture, semantics.

Reception date: June 2019
Acceptance date: August 2019

Climate change is a phenomenon that in approximately two and a half decades of its inclusion as a topic in the mainstream media seems to have become a leading and recurring theme among the population, which should be influenced the attitude and behavior of the same (González, 2012). In the continuum of reality, the foregoing would be expressed in a series of mitigation and adaptation actions to this phenomenon (Weingart *et al*., 2000). In other words, the population should have a general knowledge of its effects on their daily lives and on the development of their productive activities leading them to greater commitment and participation to deal with the real effects.

Potential and unexpected of this phenomenon, especially in the medium and long term (O'Neill *et al*., 2013). In contrast, recent research focused particularly on the communication of climate change from the mass media shows that this phenomenon has ceased to be relevant for the population, evidence of this is the lack of proposals or actions to counteract its impacts. (Newig, 2011) they mention that this fact is related to the scientific controversy among climatologists concerned about the phenomenon versus climate skeptics, a situation that has generated uncertainty and questions among the population about its real existence.

Thus, it went from a discourse where climate change was posed as the omnipresent goal of humanity, to be subsequently a problem of normal and routine political regulation, reducing the perception of its danger and urgent need to establish strategies to face its impacts (Weingart, 2000). In regions of Europe and North America, climate change is still a topic under debate, which underlies uncertainty and controversy (Wibeck, 2013).

In Mexico, studies on climate change communication are considered emergent, particularly the understanding of the role that television and radio play as the main means of communication by making information available quickly to a large audience (González, 2012). In this regard, ENDUTIH (2019) states that, 2018; 95.4% of Mexican households had digital television, in contrast to 52.9% of households with internet access via fixed or mobile connection. This survey also revealed that the use of the internet is an urban phenomenon, since 73.1% of the total population in the cities are users of this service, while in rural areas it is only 40.6%.

Both television and the internet are media that have registered an impressive development in recent years due to a series of technological inventions that established new dimensions for the distribution of communication (Osorio, 2011). The above is an important issue since much of what we know about this phenomenon has been through them. This requires a deep reflection of the motives and goals of the communication, how the messages are constructed and how they should be, in what context and if they really are understood (Wibeck, 2013; Leombruni, 2015).

So far, the findings of the research work in other latitudes indicate that communication strategies on climate change have failed and we face an apparently indifferent audience (Ockwell *et al*., 2009). Therefore, research is needed to generate knowledge particularly in relation to the strengthening of adaptive capacities (Adger *et al*., 2005).

Knowledge that could eventually be incorporated into the design of communication strategies from public and private sector institutions that have a real interest in contributing to the efforts aimed at the development of population capacities. Particularly of farmers, to establish practices that help them mitigate and adapt to climate change in the medium and long term. Consequently, this document aims to elucidate the role played by the media and the semantics used in its discourse in the perception of climate change among farmers in part of the Mexican sub-humid tropics; also, to reflect on the opportunities to make such communication effective to make climate change a topic of social communication and conditions of possibility are provided to generate adaptive capacities among farmers for this phenomenon.

Climate change and the media: a first approach

Climate change is a daily issue in the media, which reports on scientific advances, disagreements between the international community and institutional response policies (González, 2012). However, its communication has been characterized by a standardized discourse that was promoted from the scientific field, a discourse with a common semantics that facilitated the exchange of knowledge, fostering a greater understanding among researchers around the world (McNaught *et al*., 2014).

Thus, the knowledge generated strengthened and allowed to position the theory of anthropogenic climate change as the dominant paradigm (IPCC, 2013), this progress contrasts with the perception and understanding of the phenomenon at the local level in several regions of the world (Sterman, 2011; McNaught *et al*., 2014). That is, there is empirical evidence that allows inferring the existence of a rickety understanding of climate change in part of society (Leombruni, 2015).

This can be associated with the use of concepts that are not part of the semantics used in the communicative operations of people living in certain regions/localities. This is because semantics like language are not invented by someone in particular, but rather, it is a construction group of the community of speakers (Lavid, 2003; Rahman, 2013).

A community of speakers that proposes from one generation to another, inter-generationally a certain semantics that is reinterpreted, critically assuming and re-adapting to the new conditions. This should be a point of debate between decision makers and their communication strategies not only at the central level, but also in the different administration structures that, in the case of Mexico, refer to the state and municipal levels of such so that this helps decision makers understand vulnerability and risk at the local level as mentioned and act accordingly, in strategies to develop adaptive capacities among members of society.

Under this context, it is proposed that so far the communication of climate change from the media has not considered the different audiences related to characteristics such as: age, sex, school level, productive activity, cultural context and neither, the semantics that underlie its communication (Buys *et al*., 2012; Schweizer *et al*., 2013; Wibeck 2014; Leombruni, 2015).

This makes it possible, for example, to generate different meanings for those who are dedicated to science, politics, education, agriculture, or for those who live in cities or rural areas. This happens because there is no semantic translation of the climate change discourse in the local language (Lata and Nunn, 2012; Rahman, 2013). These different audiences must be considered in any communicative strategy, its omission has resulted: indifference, skepticism and invisibility of the phenomenon (Wibeck 2013; Leombruni, 2015). In the case of indifference to climate change, this is derived from a perception of normality among the population that generates and strengthens a kind of social anomie in terms of the commitment to participate in actions aimed at its adaptation and/or mitigation (González, 2012). As for his skepticism, an example of this are the findings of which show that, in the United States of America, 75% of Democrats believed in the existence of solid evidence of global warming, compared to 35% of Republicans and 53% of independents, perception related to their ideological-economic position (Maeseele and Pepermans, 2017).

Regarding the invisibility of climate change, O'Neill *et al*. (2013), explains that people frequently perceive it as distant in terms of their daily experience, or believe that climate variations are temporary and it will return to normal conditions in the future. This idea has been reinforced when the mass media associate the presence of climate change with catastrophic events that occur in a distant space and time in particular: melting of polar ice caps, extreme droughts in Sub-Saharan Africa, etc. (Nielsen and Reenberg, 2010; Newig, 2011).

In this regard, it is important to recognize that climate change is not an easy topic to address since its own complexity hinders its understanding in society (Nerlich *et al*., 2010; Raymond and Spoehr, 2013; Caglea and Tillery, 2015), as well as, to identify the limits of human perception and communication errors by climate scientists (Moser and Dilling, 2004). Additionally, it is recommended that the communication of climate change in the media should consider both quantitative and qualitative information, the latter referring to the cultural and social implications that this phenomenon has in local contexts (Newig, 2011).

This is a great challenge for mass media communicators, who should not fall into the simplification of the phenomenon despite the complexity that is inherent (O'Neill *et al*., 2013) since there is a possibility that misunderstandings in the audience may have a negative impact on efforts to generate adaptive capacities in society for mitigation and adaptation.

Thus, in the last five years, climate change communication has become an emerging research topic that seeks to make it a more understandable topic (Newig, 2011). Authors like Eskjær (2012); Eaking *et al*. (2014); Fernández-Llamazares *et al*. (2015); they demonstrate the need to understand why the coverage that the media dedicated to climate change is decreasing, what are the reasons why the audience, particularly in western countries, is losing interest in its effects and is less interested in learn about it. This is nodal, since it can become a limit for the achievement of public commitment and support to deal with the impacts of this phenomenon (Wibeck, 2013).

Media, perception of climate change and agriculture: preliminary findings in the Mexican subhumid tropics

The communication of climate change from the media should consider that it is a global phenomenon with differentiated local effects (Casanova-Pérez *et al*., 2016), so it requires an understanding of the phenomenon and the characteristics of the local/regional context, so that the messages are appropriate and significant (Leal-Filho, 2009; McNaught *et al*., 2014). Above all, when it comes to a region where its inhabitants have agriculture as their main productive activity and have built a particular semantics that express a way of describing the world and a specific way in which agricultural producers communicate, which is fundamentally verbal and is performed face to face (Altieri and Nicholls, 2008; Howe *et al*., 2013; McNaught *et al*., 2014).

Thus, achieving adequate communication of climate change is essential for adaptation, since this process is primarily an act of risk management (Newig, 2011; IPCC, 2013). But what happens in a continuum of particular reality? The answer to this questioning was structured based on the information generated by a previous investigation carried out in the towns of El Limon, Angostillo, Xocotitla and Rancho Nuevo in the municipality of Paso de Ovejas, Veracruz, a region that is part of the Mexican subhumid tropic (INEGI, 2010). This research involved a survey of 135 participating producers in an age range of 20 to 80 years. The survey was conducted based on a statistical sample stratified by age and by location.

The sample was obtained from a sample framework prepared with information from the national agrarian registry, the Mexican Social Security Institute and the chairmen of the common commissioners. The data were systematized and analyzed descriptively with the Statistica 7.1 Tulsa program, OK, USA (Casanova-Pérez, 2015). The results obtained show that of the producers surveyed in these four locations, only 41.7% said they had heard about climate change. However, of these producers only 26.6% had a partial idea of the phenomenon, while 73.4% mentioned that they did not understand it.

Of those interviewed who had a partial understanding of the phenomenon, only 19.6% said that climate change could affect their agricultural work. The answers to the question of why climate change is happening allude to the fact that 'there are no trees anymore', 'there is lagoon drying', 'to deforestation and the use of (agrochemical) liquids'. These responses indicate the minimum understanding that the producers of the phenomenon have and therefore the impossibility of knowing their implications in their agricultural work, especially in the medium and long term.

This information was obtained 90% through television and 10% through television and radio. Finally, of the total of producers only 2.7% indicated having talked with their partners about it, that is, climate change is not a recurring theme in their conversations (Casanova-Pérez, 2015). Given this evidence, it is stated that, in the study area, climate change is not yet perceived by farmers as a real threat since the modification of rainfall and temperature patterns has been seen as part of natural variability.

Adaptation to this situation has been basically limited to the change in planting dates and the exchange/rental of fodder and access to water for cattle. A situation reinforced by ineffective communication and non-existent government support that has reduced the possibilities of

developing adaptive proactive strategies (Campos *et al*., 2013). In this same sense, Soares and García (2013) argue that the Mexican State and its institutions have a great challenge in terms of strengthening the adaptation capacities of the most vulnerable groups, particularly those dedicated to agricultural activity in historically marginalized areas.

To this idea, the results obtained by the survey conducted by the National Council of Science and Technology (CONACYT) and the National Institute of Statistics, Geography and Informatics (INEGI) on the public perception of science and technology in Mexico are added, where a section was destined to know the perception of the population about climate change. The results show that only 33% of the population of the urban population based in Mexico City and in the eight most important cities of the country understood the nature of the phenomenon, this reduced understanding is even lower in rural areas where agriculture has a preponderant role as a livelihood of the population.

Given these facts, it is proposed that the priority of the communication of climate change in the local context must be that it becomes a social issue and eventually becomes part of its collective memory. Concept defined by a set of memories and expectations of the communication system, that is, of the set of topics discussed in a society. This report allows farmers to have valuable, selected and updated information for contingent situations such as climate change.

This approach seen from the localities located in the Mexican sub-humid tropics means to achieve the understanding of this phenomenon by the farmers, mainly, of its impacts on their agricultural work in the coming decades and thus make decisions about it from their available resources (Boon, 2014). In this regard, he argues that communication as an understanding allows conditions of possibility to be generated that lead to reflective processes that allow action.

What are the conditions that are required for climate change to be understood? First; it is necessary to recognize that there are substantial differences between those who hold knowledge (scientists), those responsible for communicating this knowledge (communicators) and farmers. Second, make a review of the way in which this communication has been given. González (2012) states that the communication strategies of climate change in the mass media have been based fundamentally on the theory of knowledge deficit.

In Mexico, as in other parts of the world, this technocratic theory has been the foundation of the communication model used mostly by the mass media, which consists of three fundamental elements (sender-message-receiver). From this model, the issuer is at the beginning of the communicative process, such as the one that determines its contents and the ideas that it wants to communicate, while the recipient is at the end, as a simple receiver, receiving the message (Ibarra, 2001).

Thus, the messages are sent in a linear way from those who have the knowledge to those who lack them (Newig, 2011). This model is based on the Shannon model, which presents communication as a system of discrete transmission of messages that is organized according to a source, a message, a channel and a receiver and whose operation is linear (Pignouli, 2013). As with other models such as contextual, expert/legal and public participation (Sagastegui, 2015).

Based on the above, the communication of climate change implies going beyond the linear interpretation of the production and dissemination of information (Eakin *et al*., 2014). It is necessary to find models that consider communication based on dialogue and understanding based on a certain cultural context (Nerlich *et al*., 2010). In this regard, the principles of an alternative communication model based on the theory of autopoietic social systems (TSSA) of Niklas Luhmann are presented below.

Communication as an understanding in agriculture: alternative communication model from the Luhmannian theory

Climate change communication by itself is insufficient to motivate adaptation and mitigation actions, however, adequate communication can facilitate them (Eaking *et al*., 2014). This is because the communication of this phenomenon is part of the risk communication, the one that aims to make people informed and can make decisions based on judgments about the risks that this phenomenon implies in their safety, health and productive activity (Newig, 2011).

Therefore, one of the relevant issues is to understand the role played by the mass media in making communication about climate change likely. However, from the empirical data shown above, it is inferred that the role of the mass media in the communication of climate change, at least in the Mexican sub-humid tropics, has been limited, because its role should not only be that a farmer have heard about climate change, in other words it is not enough for a television or radio commentator to read and comment on a document, a newsletter, or give a news about the polar thaw, the effects of a drought, a tornado or a severe flood (such as phenomena associated with climate change).

An adequate communication of climate change should generate among the farmers their own conceptualization of the phenomenon. If farmers are informed in this regard, they can engage in actions, establishing changes that can facilitate the development of mitigation and adaptation strategies in the medium and long term, including those that involve changing norms and values. In that sense, it is important to ask: What are the conditions that communicators from the mass media must consider so that the producers of the Mexican sub-humid tropics understand climate change?

First, consider the semantics of stories, stories and all kinds of narratives by locals (Wolf and Moser, 2011), as well as, the conceptualizations they have about the climate and its main variables, all as a form of expression of a particular way of seeing the world, including its concerns as farmers (Baraldi, 1996; Fowler, 2008) states that semantics also underlies the traditional knowledge that society has about itself and its environment, therefore, it should be considered as a conceptual heritage of society, they are the topics on which it is communicated and the words used in it.is about concepts and ideas to use and eventually build conceptions of the world, as expressed in the Table 1.

Table 1. Semantic differentiation of rainfall in four locations of Paso de Ovejas *versus* scientific semantics.

Scientific semantics	Semantics in the local context
Torrential rains	Aguacerones, torrentales
Isolated rains	Lluvias manchoneadas
Light drizzle	Pelillo de gato
Occasional rain	Lluvias aventureras
Rain	Lluvia pausada, lluvia penetrante

Source: Casanova-Pérez (2015).

The above is a specific example of particular semantics in an agricultural society, which expresses a conception of the particular world that must be considered by communication strategists. Other aspects to consider, is that semantics evolves and that in rural societies it feeds on oral communication and is linked to people's memory (Baraldi, 1996). This is how the concept of 'lloviznas frijoleras', a hydrometeor that provided moisture to the soil for the cultivation of beans in the last four months of the year, was passed to the drizzles called 'pelillo de gato', a semantic construction that indicates light or low drizzles intensity.

That is, the communication strategies on the effects of climate change should consider the difference between these two concepts, a difference that indicates changes in the intensity of the hydrometeor in question in the area of study, the above would favor the understanding of climate change and its impacts on the behavior of the main agroclimatic and their relationship with agriculture.

Consequently, the above requires leaving aside the linear communication model based on the theory of knowledge deficit and putting forward the search for models whose approach allows understanding as the ultimate goal of climate change communication (Eakin *et al*., 2014) in which semantics play a fundamental role. That is, to overcome the traditional communication model where the issuer is at the beginning of the communicative process and is the one who determines the contents and what he wishes to communicate.

As long as the receiver, the final recipient, is a simple receiver. What is required is that there is a real communication process, where information is more likely to be understood, must be placed in the specific reality of the recipient (Ibarra, 2001). This requires the identification of models that consider communication based on dialogue and understanding based on a certain cultural context (Nerlich *et al*., 2010). Given this context, it is interesting to elucidate the possible contributions of a communication model based on the Luhmannian theory whose main theoretical premise is communication as an understanding, which is made probable with the help of mass media facilitating its acceptance.

But how should climate change be communicated taking into account the Luhmannian theory? First, the findings found in the study area should be considered, which allow us to infer that communication about climate change, although it has been a topic repeatedly addressed by the mass media, has not guaranteed that agricultural producers in this area have understood its origin and impacts. In other words, the design of communication strategies should be considered as informed about climate change; through the media, it will not always be the same as the producer finally understood (assuming there was loss of information) and communicated to his family and other producers.

A strategy to reduce the gap between what is reported by the media and what is understood by the producers in the study area should consider the importance of using a semantics that corresponds to the audience to whom the communication strategy is directed. An example of this are the different semantic constructions in relation to the types of precipitation, which in themselves refer to changes in the distribution and intensity of rain and drizzles.

Another strategy is to associate the impacts of climate change in the study area with agricultural activity, in particular, related to income losses caused by non-optimal temperatures, decreased precipitation, intense winds and prolonged drainage. That is, communicate about the negative effects on the development of their crops and raising livestock (increased presence of pests and diseases due to high temperatures, susceptibility to crop diseases due to poor nutrition due to lack of moisture in the soil, loss of seed).

From the TSSA, the success of the communication of climate change is that it becomes a social issue, because redundancy in communicative operations produces knowledge, that knowledge is valuable knowledge that helps to make early, autonomous decisions, etc. In other words, the producer acts in many cases in a completely routine manner which can be understood as a repetition of a decision already taken. So, for it to make changes, it requires information whose prior assessment allows it to make a decision. The decisions are, therefore, the result of the thematization of a contingency (climate change).

This model that takes communication as an understanding will imply the recognition of this phenomenon and the awareness of the risks that this implies for farmers in their productive work. The results of the communication as an understanding will provide conditions of possibility for farmers to commit themselves to real actions and aimed at adapting to this phenomenon derived from autonomous strategies or supported by external agents in relation to climate change adaptation, but, above all, to a type of adaptation planned in the long term.

Likewise, they may, through citizen participation, achieve the incorporation of climate change as a central theme in development plans, considering agriculture as a vulnerable sector and responsible for food security in a region or country. In other words, forming a political agenda or using the same media to communicate their social protest, thereby achieving greater social support in other sectors of society (Solís and Salvatierra, 2013).

This is contrary to the public policies of the country that are characterized by their disarticulation (Barrasa, 2017) and the need for intersectoral and inter-institutional coordination (transversality), promoting with them strategies to boost the economy of climate change, education, training and research, as well as information and communication on this phenomenon that lead to adaptation strategies (Olmos *et al*., 2013; Soares and García, 2014).

Finally, it is necessary to reiterate that the communication of climate change to farmers through the mass media is a strategy that can contribute to the adaptation and mitigation of this phenomenon: crop management, soil management, irrigation, income diversification, etc. (Safi *et al*., 2012; Esham and Garforth, 2013), to carry it out requires the collaboration between climate scientists, researchers dedicated to social sciences, among them, communication scholars under a multi-interdisciplinary approach.

This conjugate with a state policy, a stakeholder participation among those who hold the ownership of the mass media and the strengthening of media to public service, knowledge provide conditions for the development of adaptive capacity among producers in order to deal with effects of climate change.

Conclusions

The thematization of climate change in the media is not a enough condition for it to be perceived as a problem and for agricultural producers to act in favor of its adaptation. However, if it is properly communicated (understood) it will be essential to make its impacts visible and contribute to the success in the design and implementation of productive technical strategies.

In this thematization, semantics as a collective construction plays a fundamental role, without their consideration, the existence of communicative operations between producers and their families will be limited and therefore, will impact the understanding of the meaning of climate change and its effects on Agriculture in the medium and long term. Consequently, this will reduce the generation of adaptive capacities in the face of climate change and, therefore, the design and implementation of proactive actions for the adaptation of agriculture in the Mexican subhumid tropics.

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