Irrigated agricultural production and adaptation to climate change in the Argentinean Pampas: An analysis from a socio-theoretical perspective

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Abstract—In the temperate agriculture of Argentina there has been a profound restructuring in the activity as a result of globalization processes. The use of land brought along an expansion of agriculture and the ending of the livestock production, which had to be relocated in marginal areas of the country. These changes have been accompanied with climate variations associated with Climate Change and the incorporation of new capital intensive technologies. Our study in the Río Segundo department, situated in the border of the pampas region in the province of Córdoba, is an area characterized by water shortage. Here, the above mentioned changes came along with the adoption of sprinkler irrigation with groundwater for specialized production of extensive crops (soya). In the present work we analyze from a socio-cultural perspective, whether the adoption of irrigation is an adaptation strategy to the dynamics of climate, or to social and economic logics resulting from the installation of a new model of agriculture, for a particular group of farmers. To fulfill this purpose we gathered primary information obtained in semi-structured interviews performed during field works. Our results show that irrigation systems have been incorporated as a way to cope with the historical natural restrictions of the area for crop production. However, its adoption is more an economic strategy to improve the position of farmers in the social space, rather than a way of adapting to local variations in climate related to Climate Change that, on the contrary, has revealed a tendency to humidity increase, as far as farmer’s perception is concerned and recent studies have shown.

Keywords—adaptation, Argentinean Pampas, irrigated agriculture, social theory.

I. INTRODUCTION

THE present work analyzes some of the causes related to the incorporation of sprinkler irrigation by a group of extensive crop farmers from a socio-cultural perspective in a marginal zone of the Argentinean Pampas. We tried to observe whether the incorporation of such technology corresponds to an adaptation to climate dynamics or social and economic logics resulting from adapting a new agricultural model. For this purpose, we have gathered primary information obtained through semi-structured interviews performed during two field works in August and October 2008 in the Department of Río Segundo and Córdoba Capital City; secondary data was obtained from Agricultural National Census -CNA- and specific bibliography.

II. HISTORICAL CONTEXT

There is a period of sustained expansion of agricultural production from the 1970s and until 1985 in the Pampas region [1]. As well as a dramatic increase in crop yield derived from the technological changes introduced as from the 50s and later in the 60s when the “tractorization” of the pampas farming was completed.

Production increase was intensified in the 80s, exports grew bigger and agriculture got specialized in five basic crops – wheat, maize, sorghum, soya and sunflower – with the consequent displacement of other alternative crops [1]. [2]. This specialization in addition to the increase in terms of land devoted to agriculture is a process that has been called agriculturization of the production in the Pampas [1], [2]. The raise in yield results in the increase of land productivity and labor employed by the sector that starts to acquire higher qualifications [2].

All these changes in the agrarian structure –where a higher concentration of production in a minor amount of larger cultivations is observed- also the land usage patterns can be understood as some of the signs related to intensified capitalist development in the agriculture of the pampas resulting from globalization processes. Agriculturization of the humid Pampas, with soya as the main crop, is part of a phenomenon that some authors call the “Forage Revolution” [3]. In this context, Argentina becomes part of the new division in the international production of food, as the producer of grains for animal consumption and accordingly, devoting land mainly to oilseeds, particularly soya (51% of cultivated area) [4]. As a result of this, in the last years our country turned into the third world forage exporter [3] and 46% of the exports of oilseeds correspond to cattle feed [4].

III. CASE STUDY

The department of Río Segundo is located in the center of the province of Córdoba in an area considered
“marginal” to the humid Pampa, mainly because of its water shortage since it historically does not reach the 800mm annual rainfall (See Fig. 1).

Fig. 1 Map of the Department of Río Segundo, Córdoba, and Río Segundo river basin.

If we take into consideration data from CAN carried out in 1988 and 2002\(^4\) we can observe that processes of agriculturization and production concentration also occurred in Río Segundo. These processes had a particular impact on this department that used to be part of the milk basin with a mixed exploitation regime that also constituted the “peanut center” in Argentina [5]. During the 90s the agriculturization process becomes even more evident with the intensification of the specialization in wheat, soya and maize crops\(^3\), to which most of the farmers devote their labor. These changes occurred because of the adoption of innovative technologies that resulted from a favorable international economic context [6].

The productive change in this department was the result of introduction of irrigation systems complementary to the usage of underground water, direct sowing and crop rotation\(^4\), which permitted the introduction of new productions that contributed to modify the farmers’ profile in the area. The agricultural reconversion process started early, by the end of the 70s but was even more intense in the 90s when the first irrigation equipments were installed.

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\(^4\) Data from CNA _08 still under processing; that is why it is not included in this work.

\(^3\) For example, in Río Segundo, among cereals, wheat shows strong growth in the inter-census period 647%, as well as the land cultivated with maize for the second occupation 58%. In terms of oilseeds, the only growing one is soya that for the second occupation shows a dramatic growth 1760%, completing the “soyazation” process.

\(^4\) It is a biannual planned scheme that includes an agricultural campaign with maize and other with a double soya-wheat of second occupation.

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IV. THEORETICAL REFERENCES

As a starting point to think about answers to environmental changes, the definition adopted was that of adaptation as an adjustment occurred in a natural or human system as a response to current or expected climatic stimuli or their effects in a way to moderate damages or take advantage of beneficial opportunities [7], [8] (our translation). From this perspective in natural sciences, adaptation implies maintaining life even in extreme conditions. Thus, all other definitions like Scheraga and Grumbach’s understand adaptation actions as responses that enlarge the resilience of vulnerable systems in order to reduce damages produced to natural and human systems caused by climatic variability and change [9]. In this way, they recover Kates’ 1985 work that distinguishes between resilience and adaptation: “the first one refers to the capability to face and absorb an infrequent hazard of diverse magnitude, then returning to the original state. Instead, adaptation of a system is an adjustment in the long term that depends on its ability to change in form and function so as to respond to a extended hazard” [9].

From a social perspective, however, the idea of adaptation represents major difficulties since it implies a social action theory located in particular contexts. Within the bibliography, the idea of adaptation is linked to the actors, like the behavior that allows the “adaptation to the conditions” [10]. “On the other hand, political and economic changes have their impact on people insofar as they are filtered through social organizational arrangements that people have adopted as means of adaptation to their environment, unless there is great pressure, such cultural and social features change only slowly” [11]. Adaptation as actions focused on adjusting to material conditions is compatible with Bourdieu’s perspective. It provides an appropriate social theory to generate a hypothesis on the existing relation between the adoption of irrigation, climate and the introduction of technology in general. Thus, going back to the author’s concept on “adaptation” within his own: it refers to habitus adjustment to objective conditions or also to terms applied in _Algeria 60_ in relation to capitalism and modern life: “The recent transformation of Algerian society is a particular case of such socio-cultural fact: an adaptation process to capitalist economy therein observed reminds what a mere consideration on the part of advanced capitalists might forget, that is, the functioning of an economic system is related to the existence of a determined system of dispositions in relation to the world” [12] (the emphasis is ours).

Accordingly, adaptation to existing conditions within a capitalist economic and social order implies a series of dispositions to action that in Bourdieu’s theory are framed in the concept of habitus, as “long lasting systems and transposing perception, appreciation and action schemes that result from institution of the social in the bodies”, that in relation to the fields –“objective relations systems that are the result of instituting the social in the things”– generating social practices and representations, objects of sociological knowledge [13]. Then, “adaptation” to objective conditions from the social sciences is exercised also in relation to the model for development and the kind of democracy that each
society has. In this sense and recovering the actors factor, Murgida and Natzenz define adaptation as a “process of creative action where the man-subject integrates reflexively to reality constructing and transforming, in this way taking part of the developmental model that he also helps to build up.” [14, 15]

Social vulnerability defined by socio-economic conditions as a “differentiated capability”, prior to a catastrophe, is directly associated to the development [16] therefore, the existence of a connection between adaptation and vulnerability. According to Porto [17] vulnerability in the area of catastrophes is seen as property of the socio-environmental system, in relation to the degree in which it results susceptible to a certain damage consequently to such exposition. It also mean the lack of capabilities to face, recover from and accordingly to adapt in a structural way.

V. RESEARCH DEVELOPMENT

Incorporating irrigation, producers in Río Segundo could differentiate from those producing in dry lands (unirrigated), not just because they have a tool that allows a decrease in climatic hazards but also because such incorporation of technology places them in a different position within the social sphere, understanding this as a space of pluridimensional relations built on the basis of differential distribution of capital or kinds of power [18], [19]. If we consider the “irrigating” as a group of specific social actors it is possible to observe that they are farmers who represent middle stratum – in terms of the extension of their agricultural exploitations- predominant in the department. They consider themselves as medium producers and “top” producers, making clear differences in relation to other producers in the area, mainly because of the addition of technology. This perception they have of themselves can be related to what Bourdieu considers a double social structure [18], constituted by an “objective” component based on the position this kind of producer occupies in the social space and another “subjective” one.

The struggles for official recognition of the association of irrigating producers as Consorcio de Regantes (Irrigation Consortium) rendered in a series of material advantages to such producers that are basically related to legal support and an institutional structure to exercise the right to manage irrigating water for extensive crops. A symbolic associated advantage is mainly the fact that producers acquired a formal, official organization and in this sense they were given a principle to reinforce their identity, as a particular kind of producer that is now recognized. These producers’ struggles are related to symbolic capital [13], or specific field capital, in our view, the efficiency and recognition of such efficiency. This is the area of relations of symbolic strength where the social position of farmers is at stake and within this group, that of the “irrigating producers” who do not define themselves as “top producers”. “Irrigating producers” in Río Segundo constitute a new category of social actors; mainly as from the connection they have with technology, as part of a group of strategies striving to produce with better efficiency and as a result larger yield per hectare.

These producers’ identity construction is linked to the use of irrigation, and this is so, because the possibility of disposing of water at the appropriate moment redefines ‘the activity’, together with a different management of the principal climatic variable -rainfalls-, and therefore, the “yield is different”, it is a “different reality” according to their own words.

This form of production is also associated to a particular “culture of management”, referred to the application of irrigation and the starting point of the group – in terms of positions and movement of such, together with a crop rotation system, risks in key moments of the cycle, etc.; as well as that “culture” if understood as producers’ beliefs and conceptions that enables them to decide when to irrigate, with how much water and which of the crops. This culture is based on trial-error experience from part of the farmer but also on specialized technical advice to which farmers have constant access. It corresponds to the producers’ habitus orienting them towards “the experts” for consultation, but this is also modeled as from the relations that they establish among themselves. These farmers keep close relations with the Experimental Station of the Instituto Nacional de Tecnología Agropecuaria -INTA- in Manfredi – one of the towns in the department – and several irrigating farmers also take part in CREA groups – Consorcio Regional de Experimentación Agrícola.

All these elements help to define the way they reinforce their “producers’ profile” mainly characterized by an “open attitude towards changes and technological innovations”, utilized as dialectics to give relevance to these producers among themselves. Innovative practices and permanent investment carried out by these farmers

Make sense within a frame of a mind constituted by disposition to calculus and planning, what implies the need to always “take numbers into consideration”. Experience oriented towards the maximization is what makes these producers have a close connection to calculus. Thus, the adoption of irrigation becomes a key tool for planning since it diminishes climatic risk, and therefore, the uncertainty related production yield. Lately, these dispositions contained in the “management of the field” were developed through deep changes in the objective conditions that are related to the form of production, the use of land and also to residency patterns [20]. According to Gras [21] these processes of “professionalization of the old trade” on the part of the producer include economic Management and productive exploitation base don the adoption of technology and expertise, what allows the categorization of farmers into ‘small and medium manager managers’. In this sense, the farmers groups in CREA have a central role in the creation of “management capitalist” dispositions [21].

Another aspect to be considered when trying to identify the kind of organization to which farmers respond to, is that they have a family origin. In cases where exploitation or part of it come from family inheritance, family relationships paint such exploitation with a tone of affection more related to a traditional relation to the land; that on the other hand, is not free of elements corresponding to the “capitalist spirit” that tends towards economic rationality and accumulation. In this way, the family inheritance is the most common entrance into the trade of farming, as well as into the activity
and the identity. "...you are already in the circle and you have to carry on, and the next has to continue because it is the only thing we know and want to do ...": (Irrigating farmer “P14”. Field Diary. Córdoba, October 2008).

VI. FINAL DISCUSSION AND PERCEPTION ON CLIMATE AND ADAPTATION

From a social perspective, Climatic Change (CC) is a constructed real [22] that entails a series of complexities to be observed at ethnographic scale. During the field work, we found out from farmers’ perceptions that there was no coherent image installed in relation to the existence of CC, probably because this is not a process that can be observed directly by the agents since it is manifested in a long term scale, and there are also lots of information circulating mainly promoted by the media [23].

The difficulty to observe CC phenomena in a limited temporal range justifies farmers’ perceptions more adjusted to the idea of climatic variability than change. Half the producers interviewed confirmed they do not perceive CC effects, or do not identify it as a process causing the variations observed. According to them, this could be classified as “normal”. The inevitable question that arises is: Can irrigation be a measurement for adaptation to climate change if there is no other social perception identifying it? Then, since there is a difference between irrigation and the social perception of irrigation, irrigation may be a potential tool for adaptation making productive systems less vulnerable to climate, without being perceived as such. If farmers do not incorporate irrigation reflexively as an adaptive measure to climatic change this does not mean this is not a strategy of adapting to current conditions, whether climatic or social. The climatic ones refer to historical shortage of water, a characteristic of the zone. The social ones refer to changes occurred in the production that lead the farmers to invest in order to intensify the production and increase the yield; that is associated to specific social assessment.

According to farmers’ perceptions, climatic risk is one of the aspects that define the agricultural activity, and as such, the agricultural producers’ identity. When incorporating irrigation, farmers in Río Segundo are socially different from other farmers within the same department because technology places them in a different position in the social space [18]. The idea of “chance” closely related to the agricultural production [20], entails producers to refer to the activity as “gambling”, a category that is associated to uncertainty that governs this economic sub-field that is the agricultural production, where profits a farmer can obtain after a campaign depends on many factors that he does not control, such as national tax policies or international market prices, factors shared with other economic fields; but in this sub-field there is also the added uncertainty that is proper to an activity conditioned by biological processes that depend on climate and other natural conditions.

Recent changes in the agricultural model have brought together certain in the farmers’ perceptions. In terms of climate, they perceive an increase in rainfall, or actually, more humidity available in the soil. Some of them associate this to a direct increase in the rainfall and others to the use of direct sowing of land that when generating the coverage of land, it retains humidity and diminishes the evaporation process by solar radiation and wind effects. In this sense, producers consider that the change in the use of land by changing from cattle to agriculture based on direct sowing may affect the local climate dynamics. The intention to establish meteorological stations that some producers have, is added to the logias of incorporating innovative Technologies, such as irrigation, for a better control of natural processes. At the same time, these technological changes are linked also to transformations in terms of exploitation management changes oriented towards a better performance. This ‘efficiency’ is pursued through actions that imply measuring, calculating and planning productive variables, where climatic variables are also included. That is why these technological and managerial changes have originated changes in perception of the climate, something that has been also observed by other authors; for an example see Barsky et al. [23].

These managerial changes looking for efficiency show in fact, the transformation of the habitus of the agricultural producer that begins to see himself as a “top farmer”. It is the system of dispositions that permits the observation of climatic events in terms of risk, and the assessment of the magnitude of hazard/damage they represent. In this way, climate assessment and perception on the part of irrigating producers are influenced objectively not only by climatic events they may observe and in many cases, suffer; but they are closely related to productive transformations in terms of land use, as by the incorporation of technology that redefine the activity. We believe this relation between transformations in the course of the field and the farmers’ habitus can be explained by the above mentioned double social structuring.

As already mentioned, irrigation can be a potential tool to adapt to climate change making productive Systems less vulnerable to climate. However, the farmers do not incorporate irrigation as a measure to adapt to climatic change, but to climatic conditions that they experiment as historical. In fact, the raise in rainfall as a result moving of isohyets associated to Climatic Change would distort the usage of irrigation in the area.

For this reason, in the present production context, the practice of incorporating irrigation is more clearly related to a strategy oriented to production efficiency and the rendering of maximum profits. “If each of the moments in the sequence of ordered and oriented actions that constitute the objective strategies may appear as determined by the anticipation of the future and particularly its own consequences –justifying the term strategy- is the result of practices that the habitus generates and are led by past production conditions of their originating principle beforehand adapted to objective conditions if and only if such conditions where the habitus function have remained identical –or similar– to conditions in which this habitus has been constituted since the perfect and immediate adjustment of objective conditions when fulfilled offers a more complete illusion of the end or what is the same: an auto-regulated mechanism” [24].

Therefore, for these farmers adaptation implies having
dispositions to be more “organized and tidy”, “accounting for figures”, calculating and planning, projecting future profits on the base of present production costs, expected yield and international grain prices since “if you want to be successful you have to plan ahead”. Irrigation increases the possibilities of precision within agricultural production and the habitus directs the permanent operations the farmers have to carry out when trying to obtain the highest yield per hectare, with lower costs; that is to say, to become more competitive, more production maximizing the land factor by intensifying production by means of the incorporation of technology.

Irrigation permits a better planning, better management of precise time for sowing, decrease in climatic risk and stabilization of a high level of yield. However, being more efficient implies knowing when to irrigate, how much water to use and which crops, because irrigation increases costs and may diminish the profits. In this sense, it might increase farmers’ economic vulnerability, if we consider the current uncertainty in terms of agricultural policies and the international market. The incorporation of calculus necessary to carry on the practice of productive maximization does not account for climatic changes but the transformations in objective conditions of the agriculture in the Pampas – expressed in the formation of a particular habitus – resulting from this new agricultural model that tends to production concentration and increasing intensive capital. That is, playing in “the big leagues” as the irrigating farmers say, becomes a necessity, a condition to continue with this activity.

REFERENCES