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Blaming It on the Weather: The Role of "Inclement" Rainfall in Society-Nature Relations in Liberal Costa Rica (1860-1940)

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This article seeks to shed light on some of the many possible interactions between changes in rainfall regime, one of the climatic factors with the greatest bearing on the history of human society, and the economic and socio-environmental dynamics of Costa Rica. While Costa Rica was developing into a Nation-State and defining its role as an agricultural exporter in the global market, new liaisons with the biophysical environment were being developed, guided by the irresistible ideology of "progress". Significantly, this time period largely coincides with of current process of institutionalization of science in Costa Rica, and the State's urgent need to understand the specific features of the country's rainfall regime in connection with its efforts of expansion and diversification of commercial farming, given the indisputable impact of precipitations on the agricultural sector and infrastructure development, both pivotal elements of the liberal economic project. Parting from this contextual base, the article seeks to analyze the operative capacity of this "modern", "scientific", and "macroeconomic" vision of rainfall and its effects, the unequal and socially differentiated character of institutional response in the face of floods and other "disasters", as well as the concomitant "culpability" discourse placing the blame for these disasters on Nature as a means to justify the priority given to "national" infrastructure over the needs and wishes of many citizens. We will also briefly look at promising themes for future research, such as the relationship between climate and property value, as well as the impact of rainfall on the performance of the agro-export model, the economic basis of liberal Costa Rica.

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Blaming it on the Weather: The Role of "Inclement" Rainfall in Society-Nature Relations in Liberal Costa Rica (1860-1940)[1]

he socio-economic, environmental and psychological impact of climate on human beings has been the object of research from the most diverse perspectives. Climate, however, is far from being a static phenomenon, or one susceptible of analysing the strictly Braudelian long term. From global glaciations to local events such as tornados, climate has definitely affected the way in which human beings have structured their societies. As with other dimensions

of the natural world, mankind has sought to "dominate", control,[2] and even exploit climate, moving from the perspective of Western rationality, painstakingly constructed during the so-called scientific, energetic, intellectual, and, lastly, industrial "revolutions".[3]

Societies primarily devoted to agricultural activities are highly dependent on climatic phenomena, particularly those of cyclical nature such as, in Central America, El Niño and La Niña, as well as localized and specific meteorological phenomena. Unanticipated variations in rainfall regimes, for example, have a deep effect on the yield of various seasonal crops. Other phenomena not only affect productive farming, but also have major social and demographic consequences. This is especially true of catastrophic events such as floods, hurricanes, and storms,[4] which are the ultimate cause of dis-

[1] This work is part of the Research Project VI-805-A8-192 "Climate in Costa Rican History: trajectory and perceptions (1860-1940)" of the Program on Social Studies of Science, Techniques, and Environment (Spanish acronym PESCTyMA) (VI-805-A4-906) of the Geophysical Research Center of the University of Costa Rica. Our sincere appreciation to Dr. Jorge Amador for his valuable comments and observations, and especially for his determination in carrying on this project, as well as promoting social studies of science, techniques, and the environment in from a multi-, trans-, and interdisciplinary perspective, essential for building bridges between different scientific "cultures" traditionally kept apart by an inexplicable academic ostracism. We also wish to thank Licda. Flora Solano for her altruistic collaboration and inputs, particularly as regards meteorological data for the first years of the period analyzed. Our appreciation also goes to Dr. John Soluri for his ever valuable suggestions and appreciations. To Francisco Delgado Jiménez, our sincere thanks for the revision of the statistical data. It is understood that this work's limitations are entirely the responsibility of the authors.

[2] A recent interesting work on the ways in which different social groups have tried to control climate throughout the history of mankind is J. Fleming, *Fixing the Sky: The Checkered History of Weather and Climate Control*, Columbia University Press, New York 2010.

[3] For an interesting analysis of the transition from the Society-Nature relations of the Ancient Regime or pre-Modern era to those dominated by the material, secular, progressive, and rational perspective inherent to Western modernity, where Nature's value depended on its capability to satisfy human material needs, see D. Worster, "La riqueza de la naturaleza", in id., *Transformaciones de la Tierra. Ensayos de historia ambiental*, EUNED, San José, C.R. 2006, pp. 137-172.

[4] As in Cuba following the devastating hurricanes of 1842, 1844, and 1846,

asters which are, however, socially constructed. On the other hand, the manner in which different groups and individuals perceive climate and climate change is historical and thus, an object of historical research. Here diverse factors come into play, ranging from knowledge and conceptions of climate to human dependence on climate for production, or merely for survival.

We have found historical studies on climate to be firmly rooted in the environmental historical tradition. Indeed, ever since its beginnings environmental history, which today boasts a well-established academic tradition[5] in a variety of historiographic contexts, has regarded climate as a conditioning factor in the economic and social development of human beings.

In the historiographic literature on the influence of climate on different aspects of human activity, the renowned works of the French historians of the *Annales*[6] School stand out. These studies highlight

when a good part of the coffee producers decided to plant sugar cane, which, though equally vulnerable to hurricanes, could be replanted much faster. Working conditions and social relations at sugar cane plantations were notoriously harsher for the island's slave workforce, and contributed to a significant increase in slave mortality. See S.W. Miller, *An Environmental History of Latin America*, Cambridge University Press, New York 2007, p. 122.

[5] For example, American environmental history formally appeared on the academic scene almost 40 years ago. Some of its prominent authors, such as William Cronnon, Alfred Crosby, and Donald Worster stand out as the pioneers of this historiographic field, although they had outstanding forerunners, particularly as regards frontier historiography, in authors such as Frederick Jackson Turner and James Malin. Several reviews and analyses on the development of environmental history as a secondary field of historiographic study can be found in Worster, *Transformaciones de la Tierra* cit. J. O'Connor, "¿Qué es la historia ambiental? ¿Para qué historia ambiental?", in id., *Causas Naturales. Ensayos de marxismo ecológico*, Siglo XXI, México 2001. P. Camus, "Perspectiva de la Historia Ambiental: Orígenes, definiciones y problemáticas", in *Pensamiento Crítico, Revista Electrónica de Historia*, 1, 2001, on the web: *www.pensamientocritico.cl/index.php?inc=resumen&mrev=1&IDREV=1*. A. Florez-Malagón, "El campo de la historia ambiental y las perspectivas para su desarrollo en Colombia", on the web: http://www.javeriana.edu.co/cursos/aflores/AMBlib.htm.

[6] In the context of the thematic and methodological expansion carried forth by the most prominent members of the Annales School, many of them are con-

the socio-economic impact of climate in a perspective seeking to expand the methodological and thematic horizons of history's field of study.[7] However, in spite of the importance of their contribution, these valuable initial efforts were vitiated by a one-sided and even anthropocentric approach, since they usually gave little attention to the obverse side of the coin, viz., the influence of human societies on the climate through time.

Braudel, one of the most prominent authors of this historiographic movement, directly addressed the subject of climate from a historical perspective. In his famous study *Mediterranean*,[8] this author describes the history of the relations between human beings and the environment as slow-moving.[9] Another notable author is Le Roy Ladurie, who

sidered pioneers in measuring the extent of the interactions and interdependence between human societies and the natural world. Among the greatest works in this field are Lucien Febvre's *Le terre et l'évolutionhumaine*, published in 1922, Braudel's outstanding work *Mediterranean*, as well as Le Roy Ladurie's studies on the impact of climate change on human societies, which are closely related to the subject of the present article. For a contextual analysis of these and other contributions by the Annales School to environmental history, see Camus, *Perspectiva de la Historia Ambiental* cit., pp. 7-10.

[7] We agree with Julio Aróstegui's argument that the theoretical contribution of the Annales to historiography was indeed scarce; however, in research themes, methods, and techniques its principal exponents generated an impact that exceeded by far the historiographic scope of French historiography. See J. Aróstegui, *La investigación histórica: teoría y método*, Crítica, Barcelona 1995, p. 106.

[8] F. Braudel, *El Mediterráneo y el Mundo Mediterráneo en la época de Felipe II*, 1. ed. in Spanish, Fondo de Cultura Económica, Mexico 1953.

[9] Braudel compares this deep, slow-moving history with the gradually unfolding history of political and economic structures, on the one hand, and the fast-moving history of events, on the other, which historians must learn to mistrust, since these events are only the "crests of foam that the tides of history carry on their strong backs"; in order to understand the past, one must hence dive beneath those tides. This multidimensional, tripartite analysis of historical phenomena is, in our opinion, one of his most valuable contributions. See P. Burke, *La Revolución Historiográfica Francesa. La escuela de los Annales 1929-1984*, Editorial Gedisa S.A., Barcelona 1996, pp. 39-40. We find Braudel's conceptualization of evident historiographical significance. On the one hand, he systematizes the long-term approach and stresses the need for historians to transcend not only events, but also political and economic structures, which implies looking beyond national boundaries. At

in his *Times of Feast, Times of Famine: A History of Climate Since the Year 1000*, gave an undeniable contribution to the comparative history of long-term climate changes and their impact on agriculture.[10]

More recently, climate has been analyzed by historians from other points of departure, as in the case of the economic-ecological historical and agro-ecological approaches of authors such as José Manuel Naredo and Manuel González de Molina, who point out how agro-climatic characteristics have become environment-conditioning factors for the cropping pattern of traditional organic-based agriculture.[11] In the specific case of traditional Spanish agriculture, the authors explain that towards the end of the *Ancient Regime*[12] this type of agriculture was ecologically limited by its dependence on rain as a source of energy, particularly in dry or xeric areas, that is, in the greater part of the country. It is worth stressing that the limitations generated by dependence on edaphoclimatic conditions likewise assured a high degree of ecological sustainability compared to "modern" agriculture – although this does not necessarily mean that traditional agricultural systems did not transform the environment. The modernization of agriculture went hand in hand with an increasing reliance on external energetic inputs to boost productivity. The ecological impact was massive, as the transition was accomplished from "an agricultural sector that originally operated with great physical independence, replacing labor, soil fertility, and cattle feed internally, and generating a marketable surplus with little dependence on external production

the same time, and obviously in connection with the above, Braudel challenges the linearity of historical time, as well as its Newtonian-based cumulative character.

[10] Ibid., p. 64.

[11] M. González de Molina, "Condicionamientos ambientales del crecimiento agrario español (Siglos XIX y XX)", in *El pozo de todos los males: sobre el atraso en la agricultura española contemporánea*, J. Pujol, J.A. Pujol (eds), Crítica, Barcelona 2001, pp. 43-94. J. Naredo, "La modernización de la agricultura Española y sus repercusiones ecológicas", in *Naturaleza transformada, estudios de historia ambiental en España*, M. González de Molina, J. Martínez Alier (eds), Icaria editorial, Barcelona 2000, pp. 55-85.

[12] González de Molina, *Condicionamientos ambientales del crecimiento* cit., pp. 54-55.

means" to a sector that "increases productivity at the cost of large-scale dependence on external production means", as well as on the "overexploitation of water and soil resources and the simplification of the ecosystems in which it develops".[13] As clearly expounded by the above authors, in traditional agricultural systems climate had been a primary environmental conditioning factor. The way in which various communities "liberated" themselves from this dependence often ended up transforming climate itself, to a point where the very survival of the human species was placed at risk. On the other hand, the capitalist view of traditional agriculture as outdated and, due to the supposed indolence of those who practiced it, is not historically substantiated. Actually, it is local agro-climatic features that "determined in good measure the cropping pattern and the schedule of the main agricultural tasks, and not routine or ignorance or inertia, as has been alleged regarding traditional agriculture".[14]

Turning to Latin American climate history, it seems to us that historiographic literature has chiefly focused on three fundamental lines of research, although these often intersect or overlap. We could term the first of these the "historiography of disasters". The numerous historians who have embraced this perspective strive to demonstrate the socially constructed character of so-called "natural" disasters, as well as how the human and social impact of natural phenomena falls unequally on the population, affecting far more the underprivileged at the social, economic and environmental level. It is these groups that have the largest share of personal suffering and material loss in catastrophes such as earthquakes and hurricanes.[15] Several authors regard this line of research as highly promising, especially as a means to go beyond the Nature-Culture dichotomy in Latin American environmental history studies.[16]

[13] Naredo, *La modernización de la agricultura* cit., p. 67.

[14] González de Molina, *Condicionamientos ambientales del crecimiento* cit., p. 53.

[15] A detailed overview of much of the academic production in the field of Latin American environmental history can be found in M. Carey, "Latin American Environmental History: Current Trends, Interdisciplinary Insights and Future Directions, in *Environmental History,* 14, 2, 2009, particularly in pp. 235-237.

[16] Ibid., p. 235.

A second group of historical studies on climate in Latin America focus on the relationship between climate – or individual climatic events – and the construction or consolidation of the modern Latin American nation-states. These works highlight the response of states and institutions to specific local climatic events or local edaphoclimatic conditions, highlighting the complex relations between political and economic powers, geopolitics, modern science, and traditional cultures, as well as other aspects of the intricate cultural pattern of climate-society relations.[17]

Finally, a third line of research sets forth perceptions and social representations of climate in Latin America. The majority of works adopting this approach present in-depth analyses of how chroniclers, travelers, explorers, and other individuals from the North Atlantic region "imagined" the tropical climate and its ecological characteristics in the course of history. Under the heavy burden of Eurocentrism and the consequent idealization of their home countries' temperate climate, these individuals developed a series of representations contrasting "noxious" climates, inadequate for human life, as found especially in the warm zones of Latin America, with the region's "healthy" climates, found in areas endowed with a climate more like their own.[18] This dichotomic classification, clearly rooted in geographical determinism, played a central role in racist "theories" about the inferiority of the American people vs. the superiority of the European civilization and race. Working in a similar perspective, other historical works have analyzed the deploying of a "disaster discourse" by Latin American elites in order to legitimate their political projects.[19]

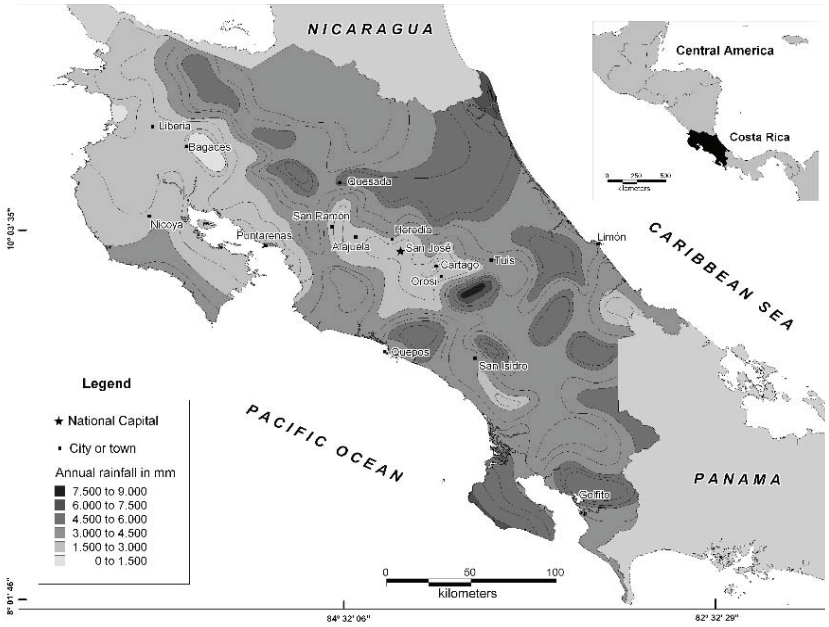
Given that the present study seeks to provide an all encompassing view of the relationship between climate and society in Costa Rican history, while inviting other scholars to investigate more in

[17] Ibid., pp. 236-237.

[18] For several outstanding works from this perspective, see A. Musset, "Lo sano y lo malsano en las ciudades españolas de América (siglos XVI-XVII)", in *Estudios sobre historia y ambiente en América I*, B. García Martínez, A. González Jácome (eds), El Colegio de México – Instituto Panamericano de Geografía e Historia, México 1999. Miller, *An Environmental History* cit., pp. 106-112.

[19] Carey, *Latin American Environmental History* cit., p. 237.

Map 1. Costa Rica: distribution of average annual rainfall (current data)



Compiled by the geographer Hubert Vargas Picado on the basis of the following source: *Distribución de la precipitación promedio anual en el territorio*, Ministerio de Agricultura y Ganadería (MAG), Undated.

depth the specific subjects broached as well as other connected ones, we addressed succinctly in some cases and in more detail in other aspects of all three of the above lines of research. Our main purpose is to come up with a preliminary explanation of some of the many possible interactions between changes in the rainfall regime – as one of the climatic factors with greatest historical bearing on human society – and the economic and socio-environmental dynamics of Costa Rica. At the time when Costa Rica was developing into a nation-state and consolidating its role as an agricultural exporter on the global market, it entered into new relations with the biophysical environment under the banner of the irresistible ideology of "progress".

Significantly, this evolution went largely hand in hand with the institutionalization of science in Costa Rica. This institutionalization depended, at least in part, on the government's urgent need to understand the specific features of the country's rainfall regime in connection with its effort to expand and diversify commercial farming, given the indisputable impact of precipitations on the agricultural sector and the infrastructure, both pivotal elements of the liberal economic project.

Starting from this contextual base, we seek to analyze the operative capacity of this "modern", "scientific", and macroeconomic vision of rainfall and its effects, the socially discriminating character of institutional response in the face of floods and other "disasters", as well as the concomitant discourse placing the blame for these disasters on Nature and, more specifically, on inclement rainfall as a means to justify the priority given to "national" infrastructure over the needs of many of the state's citizens. We will also briefly look at promising themes for future research, such as the relation between climate and property value, as well as the impact of rainfall on the performance of the agro-export model, the economic basis of liberal Costa Rica.

The context: rainfall, agriculture, and the institutionalization of science in Costa Rica

The period from 1887 to 1889 was crucial in the process of the institutionalization of science in Costa Rica. It is in those years that emblematic scientific institutions such as the National Museum (1887) and the Meteorological Observatory (1887) were established. In 1889, due to its growing multiplicity of functions, the latter became the Instituto Físico Geográfico Nacional (IFG), an indisputable paradigm of the model of scientific investigation promoted by the liberal governments during the final decades of the nineteenth century. This is a clear case of a State's active intervention in the development of science in the name of the ideology of "progress". As Ronny Viales and Patricia Clare have pointed out, this intervention was part of the liberal "scientificity regime". As in other Latin American countries, but unlike countries with a high degree of scientific and technological development, the State and transnational

companies thus became major advocates of scientific growth during the process of Latin America's insertion in the global market. Latin American scientific and technological development, where technology was conceived as a result of applied science, oscillated then between two fundamental poles: the State and the market.[20] The Costa Rican liberal state's institutionalization of science occurred in a context where the State, as an interested party in techno-scientific development according to its own idea of progress, became the guarantor of a minimum of autonomy for the emerging scientific networks and associations in the country, thus "releasing" them from the utilitarianism of a solely market-driven science. By the same token, the State was empowered to dictate – and did dictate – what kind of science was to be developed[21] on behalf of the "national interest". Hence, while casting itself as the liberator of science from coercion by market forces, the state was actually putting pressure on scientists to serve its own ends.[22] Houldmn hence come as no surprise that, as we have tried to establish in previous studies, during the course of the IFG's institutional "life" its "scientific" activities began to shift from a merely speculative approach, where science was a means of "progress" *per se*, to an utilitarian and pragmatic approach where scientific knowledge was judged by its contribution to the country's economic development.[23] At the turn of the nineteenth century, the Costa Rican coffee industry experienced a particularly adverse economic crisis as a result of international market conditions – especially the Brazilian overproduction of 1897[24] – and an outdated tra-

[20] R. Viales, P. Clare, "El Estado, lo transnacional y la construcción de comunidades científicas en la Costa Rica liberal (1870-1930). La construcción de un 'régimen de cientificidad'", in *Diálogos,* 7, 2, September 2006-February 2007, p. 146, online at: http://historia.fcs.ucr.ac.cr/dialogos.htm, p. 152.

[21] Ibid., pp. 152-153.

[22] Ibid., p. 153.

[23] A. Goebel, "Economía, ciencia, y "liberalismo": Condicionamientos económicos de la institucionalidad científica liberal en Costa Rica. Una invitación al análisis. 1887-1910", in *Diálogos Revista Electrónica de Historia*, 7, 2, September 2006-February 2007, pp. 46-94, online at: http://historia.fcs.ucr.ac.cr/dialogos.htm.

[24] C. Hall, *El café y el desarrollo histórico-geográfico de Costa Rica*, 2. Ed., Editorial Costa Rica, San José 1982, p. 42.

ditional agricultural system. The repercussions of this crisis included dwindling cropping efficiency, an increasing incidence of plagues and other diseases, and soil depletion.[25] In this dismal scenario, the importance of agricultural research and experimentation, meteorological systematization, and agricultural expansion and diversification – the latter with a view to effectively integrating the internal market[26] – became overwhelming compared to that of other responsibilities of the IFG, particularly those related to activities that did not translate into short-term economic benefits. As a matter of fact, these merely utilitarian considerations turned out to be the main cause of both the IFG's first closing in 1899 and the elimination of several of its divisions after it was reopened in 1901. By 1905, the Institute was trimmed down to only its Geographical and Meteorological departments.[27] By 1910, the Meteorological Observatory had become a division of the National Museum,[28] whereby the IFG's future was secured at least temporarily. In sum, the liberal scientific institutions, and particularly the IFG, slowly but systematically eliminated "pure" scientific research, eventually promoting almost exclusively studies aimed at expanding agricultural production.[29]

The State's interest in climate was defined by this context. Understanding climatic factors had proved essential to the expansion and diversification of agricultural production. Experimentation was mostly aimed at increasing productivity in already cultivated areas, given the

[25] M. Samper, C. Naranjo, "La innovación tecnológica de la agricultura costarricense, 1880-1920", in *Revista de Historia*, 53-54, Escuela de Historia, UNA/ Centro de Investigaciones Históricas de América Central, UCR, January-December 2006, p. 100.

[26] R.J. Viales, *Las bases de la política agraria liberal en Costa Rica. 1870-1930. Una invitación para el estudio comparativo de las políticas agrarias en América Latina*, online at: http://historia.fcs.ucr.ac.cr/articulos/p-agrari.htm.

[27] Archivo Nacional de Costa Rica (henceforth ANCR), "Informe a la Secretaría de Estado en el despacho de Fomento", prepared by A.J. Aguilar, in República de Costa Rica. *Memoria de Fomento* (1905).

[28] M. Eakin, "The Origins of Modern Science in Costa Rica: The Instituto Físico – Geográfico Nacional, 1887-1904", in *Latin American Research Review*, 34, 1, 1999, pp. 134-135.

[29] Ibid., p. 136.

difficulty and elevated costs of claiming new land for farming.

Agriculture was thus the first priority of the liberal scientific institutions. This is reflected not only by the establishing of agencies within existing institutions but also by the founding of independent agencies, all primarily oriented to the promotion and development of agriculture. The former included the Granja Nacional de Agricultura (1900), a division of the agricultural department of the IFG, which was basically an agricultural experimental station charged with introducing new crops as well as improving existing ones.[30] Among the latter was the Sociedad Nacional de Agricultura (1903), patterned after the Sociedad Agrícola de Jamaica.[31] Its fundamental object was "to promote agriculture in all its aspects".[32] It brought together small and medium cattle breeders and farmers of various crops, "including coffee as well as sugar cane, basic grains, and other 'non-export products'".[33] Other institutions devoted to the promotion and improvement of agricultural productivity included the Department of Agriculture, established in 1911, the Escuela de Peritos Agrícolas, a private initiative carried forward by Luis Cruz Meza,[34] and the Centro Nacional de Agricultura, which eventually took over the IFG's functions after the latter was shut down in June 1936.[35]

The very existence of these agencies for the promotion of agriculture, as well as the fact that one of these, the Centro Nacional de Agricultura, took over the functions of the Instituto Físico-Geográfico – including meteorological observations –,certainly leaves no doubt as to the strong connection between the collection and systematization of meteorological data and the state's commitment to agrarian change. The meteorological equipment that had once belonged to the IFG was transferred to its new home in San Pedro de Montes de Oca, from where information on climate conditions was supplied from July

[30] Goebel, *Economía, ciencia y liberalismo* cit., p. 89.

[31] Museo Nacional de Costa Rica (henceforth MNCR), *Boletín del Instituto Físico – Geográfico*, Year 3, n. 25, San José 1903, p. 3.

[32] Ibid., p. 2.

[33] Samper, Naranjo, *La innovación tecnológica* cit., p. 103.

[34] Ibid., p. 104.

[35] ANCR, Serie, Ministerio de Educación Pública, n. 003233, 1936.

1936 until mid-1943, in alternation with the Liceo de Costa Rica.[36]

This concern with a more in-depth understanding of climate conditions, and principally of the rainfall regime, on the part of both the State and the private sector, was far from being fortuitous. Costa Rican commercial agriculture can be regarded as having remained largely "traditional", in ecological and energetic terms, at least until the late nineteenth century. In the particular case of coffee, its cultivation did go through a modernization process between 1880 and 1920, involving, besides the generalized use of regulated shading, the incorporation of coffee hulls and other organic residues into the soil, and the import of guano, nitrates, and other fertilizers to make up for nutrient loss in the soil.[37] Nevertheless, the Costa Rican export agriculture still made a comparatively limited use of external energy inputs and hence remained relatively dependent on edaphoclimatic conditions; hence the State's evident concern for a systematic assessment of climatic data, particularly regarding rainfall. As Mario Samper and Carlos Naranjo rightly observe – while drawing a general balance of the modernization of the Costa Rican coffee industry and comparing it with modernization in other coffee-growing countries such as El Salvador – the first decades of the twentieth century

> "…did not witness any major innovations previously unknown to the Costa Rican coffee industry, but rather a more generalized implementation of certain

[36] Ministerio de Agricultura y Ganadería, Instituto Meteorológico Nacional, *Las series pluviométricas de Costa Rica, I. San José; Valores diarios de 1888 A 1972,* Estadísticas, San José, Costa Rica 1973, introduction without page numbering. The Liceo de Costa Rica was founded in 1887 and became one of the pillars in the liberal program of reforms, which pursued a greater centralization of education and witnessed increasing governmental involvement in education. J. Quesada, *Un siglo de educación costarricense 1814-1914,* Editorial de la Universidad de Costa Rica, San José 2005, especially pp. 29-33. The country's ruling class imposed a positivistic view of education and the country's agro-export potential. It is hence not surprising to find, in many of the high schools created under the liberal governments, agricultural research farms or other institutions oriented principally to the production of knowledge rather than its transmission. Neither it is surprising that meteorological equipment was transferred from one institution to the other, regardless of its different function, at least in theory.

[37] Samper, Naranjo, *La innovación tecnológica* cit., p. 100.

rigorous labor procedures aimed at improving the husbandry of coffee plants and their durability, in the first place to halt the drop in productivity, and secondly to increment the number of *fanegas* collected per *manzana* (0.7 hectares). Compared to the coffee-growing industry of El Salvador, at the time considered exemplary, the average productivity per area unit in Costa Rica continued to be modest, although there were marked differences in this respect among the various localities and types of productive units, with yields proving superior in farms with greater extensions and higher capitalization levels."[38]

Agro-climatic characteristics continued to strongly condition the cropping pattern and distribution in the period under study. The object of the afore mentioned institutions of agricultural research and experimentation was to "liberate" the Costa Rican agriculture from these limitations by testing new agricultural products and improving existing ones. Over time, with the meteorological systematization in place, a more accurate understanding was reached of the climatic features that still conditioned to a good degree Costa Rican agriculture as a whole.

In sum, for the greater part of our study period agriculture in Costa Rica – as in other historical-geographic contexts – was ecologically limited by its dependence on rainfall and soil nutrients as primary energy sources. Therefore, the main environmental impact of export agriculture in the period under study depended on its extensive nature and the consequent simplification of ecosystems,[39] which went

[38] Ibid., p. 106.

[39] Guillermo Castro, in analyzing the changes with the most impact in the relationship between society and Nature in Latin America, underscores that the production reorganization that accompanied the introduction and spread of crops such as, sugar, cocoa, coffee, and tobacco in the Antilles, the Venezuelan coast, and the Brazilian northeastern region, resulted in "the valorization of new areas whose ecology was radically simplified –to such degree that it sustains one single species, which grows there only because in some other place there is a strong market demand for it…". See G. Castro, *Naturaleza y Sociedad en la Historia de América Latina*, 1ª ed., Centro de Estudios Latinoamericanos (CELA), Panamá 1996, p. 164. Likewise, given the fact that vegetation represents the most important biomass at the trophic level of primary producers, the simplification of ecosystems resulting from the rearrangement of the biophysical environment has undoubtedly brought about a decline in ecosystems' energy yield, in ecological terms. This will certainly have a significant impact on human societies – particularly in the

hand in hand with the biophysical rearrangement processes required for their introduction and development. In the specific case of coffee, the washing and de-pulping processes resulted in the systematic polluting of rivers and streams with wastewater known as *aguasmieles,* which seriously affected water consumption in various places. People living along or near rivers filed numerous claims against coffee processors, who were situated at the pinnacle of the social and economic scale of the coffee industry. Pollution from coffee processing gave rise to a wide range of socio-environmental conflicts.[40]

The evolution of rainfall in San José in the context of global climatic phenomena: towards the construction of a typology

In the present section we analyze the precipitation pattern documented for San José, the capital city of Costa Rica. By comparing the available data, we will try to establish the relationship between the phenomena of El Niño and La Niña and the temporary evolution of rainfall. We will base ourselves on the periodization of these events drawn up by Ileana Mora and Jorge Amador.[41] The importance of performing this study lies in the fact that San José is the only city with available rainfall data for just about the entire period under study, a fact that bears witness to the economic and produc-

long run – both at the agro-ecological and environmental levels. For a study of energy in environmental transformations, se J.P. Deléage, C. Souchon, *La energía como tema interdisciplinario en la educación ambiental*, Programa Internacional de Educación Ambiental UNESCO-PNUMA, Serie de Educación Ambiental n. 11, Editorial Los Libros de la Catarata, Bilbao, Spain 1996, p. 15.

[40] G. Rojas, *Café, ambiente y sociedad en la cuenca del Río Virilla, Costa Rica (1840-1955)*, Editorial de la Universidad de Costa Rica, San José 2000. M. Ramírez, "Problemas, Protestas y Conflictos Ambientales en la Cuenca Del Río Virilla: 1850-1900", in *Diálogos*, 4, 2, November 2003 – March 2004, online at: http://historia.fcs.ucr.ac.cr/dialogos.htm; A. Montero, J. Sandí, "La contaminación de las aguas mieles en Costa Rica: un conflicto de contenido ambiental (1840-1910)", in *Diálogos*, 10, 1, February 2009 – August 2009, online at: http://historia.fcs.ucr.ac.cr/dialogos.htm

[41] J. Amador, I. Mora, "El ENOS, el IOS y la corriente en chorro de bajo nivel en el oeste del Caribe", in *Tópicos meteorológicos y oceanográficos*, 7, 1, 2000, pp. 27-39.

tive significance ascribed to the Costa Rican capital city and its surroundings. Given Costa Rica's great climatic variability – a feature it shares with the other countries of the Central American Isthmus –, the data cannot be generalized to the country as a whole. Nevertheless, our study of rainfall trends in San José over almost a century has yielded valuable information, allowing us to reconstruct historical rainfall frequency and intensity patterns for the city, as well as their connection with the presence or absence of El Niño and La Niña.

The consulted sources clearly show that the predominant feature in the evolution of rainfall in San José is its fluctuating nature. In the period under study, we observed drastic reductions and increments in the framework of a general trend towards gradual intensification (see Table 1).

In Graph 1 we have used error bars with a standard deviation to measure years that are noticeably outside the tendency range. The historical extremes of rainfall in San José were recorded in two years with a marked proximity in time. The year 1884 registered the smallest amount of rainfall, only 495 mm, while just two years later the pluviometer registered 3843 mm of rain for San José, making 1886 the year with the heaviest rainfall in the period under study.

Considering that the average rainfall for the entire period was 1787.2 mm, the following graph shows other years clearly moving away from the general trend described above. For example, the years 1863 (1119.38 mm), 1868 (1087.37 mm), 1914 (1221.20 mm), 1921 (837.80 mm), and 1930 (1093.60 mm) registered rainfall levels considerably below average, while in 1892 (2500.40 mm), 1893 (2467.40 mm), 1900 (2133.80 mm), 1919 (2355 mm), 1924 (2281.80 mm), 1931 (2313.20 mm), 1932 (2399.10 mm), and 1938 (2754.30 mm) rainfall levels were significantly above average.

Seeking relationships with El Niño and La Niña in the historical evolution of rainfall as reconstructed by Ileana Mora and Jorge Amador,[42] we observed differentiated trends which help us to better understand how these phenomena affected the rainfall regime. We can thus differentiate between "Niña years" and "Niño years", as well as years in

[42] Amador, Mora, *El ENOS, el IOS y la corriente* cit.

Table 1. Rainfall data for the city of San José 1863-1940

Year	Rainfall [mm]	Year	Rainfall [mm]	Year	Rainfall [mm]	Year	Rainfall [mm]
1863	1.119.38	**1883**	n.d.	**1903**	2.097.20	**1923**	1.317.20
1864	n.d.	**1884**	495.00	**1904**	1.627.60	**1924**	2.281.80
1865	1.746.00	**1885**	1.768.00	**1905**	1.573.40	**1925**	1.658.50
1866	1.475.74	**1886**	3.843.00	**1906**	1.766.60	**1927**	2.091.60
1867	1.273.81	**1887**	1.766.40	**1907**	1.287.10	**1928**	2.271.60
1868	1.087.37	**1888**	1.403.80	**1908**	2.127.60	**1929**	1.375.70
1869	1.423.67	**1889**	2.121.00	**1909**	1.934.30	**1930**	1.093.60
1870	1.763.73	**1890**	1.823.40	**1910**	1.594.50	**1931**	2.313.20
1871	1.997.08	**1891**	1.654.30	**1911**	1.666.70	**1932**	2.339.10
1872	1.755.39	**1892**	2.500.40	**1912**	1.700.40	**1933**	2.268.90
1873	1.292.98	**1893**	2.467.40	**1913**	1.883.30	**1934**	1.518.90
1874	1.407.16	**1894**	1.478.60	**1914**	1.221.20	**1935**	2.135.20
1875	1.360.17	**1895**	1.951.20	**1915**	2.160.80	**1936**	1.968.30
1876	n.d.	**1896**	1.641.40	**1916**	2.311.20	**1937**	2.057.20
1877	n.d.	**1897**	1.901.70	**1917**	2.245.80	**1938**	2.754.30
1878	n.d.	**1898**	1.995.40	**1918**	1.521.80	**1939**	1.533.20
1879	n.d.	**1899**	1.457.20	**1919**	2.355.00	**1940**	1.614.70
1880	n.d.	**1900**	2.133.80	**1920**	1.659.50		
1881	n.d.	**1901**	2.291.30	**1921**	837.80		
1882	n.d.	**1902**	1.402.80	**1922**	1.566.30		

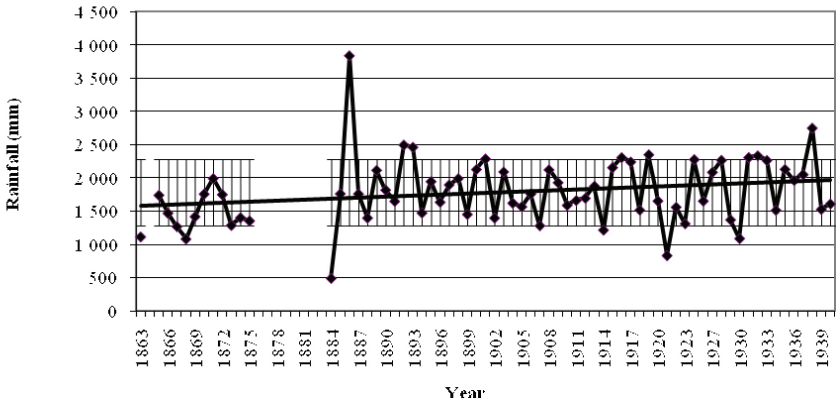
Compiled by authors from the following sources:
Ministerio de Agricultura y Ganadería, Instituto Meteorológico Nacional, "Las Series Pluviometricas de Costa Rica", I. San José; Valores Diarios de 1888 a 1972, Estadisticas, San José, Costa Rica 1973. Ministerio de Recursos Naturales, Energía y Minas, Instituto Meteorológico Nacional, Año del centenario 1888 – 1988, "Catastro de las series de precipitaciones medidas en Costa Rica", San José, Costa Rica 1988. Gaceta oficial, Oficina de estadística, data from 1863 to 1886. N d.: No data.

which such climatic events were not present at all (see Table 2).

During the years for which data about these meteorological phenomena are available in our period of study – considering that El Niño emerged as a scientific category at the end of the 1890s and did not come to the fore on the global scientific scene until the mid-1920s[43]- El Niño

[43] G.T. Cushman, "Enclave Vision: Foreign Networks in Peru and the Internationalization of El Niño Research During the 1920s", in *Proceedings of the International Commission on History of Meteorology 1.1*, 2004, p. 65.

Graph 1. Precipitation data for the city of San José (1863-1940)



Sources**:** same as Table 1. Graph by authors.

figures in a total of 20 years and La Niña in 29, while the concurrence of both events was recorded in nine years only. There were also 17 years when neither of these phenomena affected Costa Rica[44] (see Graph 2).

A first observation we consider relevant is that the yearly rainfall average for the "Niño years" (1734.34 mm), the "Niña years" (1849.09 mm), and years without either event (1917.94 mm) does not depart significantly from the general rainfall average for the entire period.

However, the precipitation extremes in the years affected by these events are obvious. The years under the influence of La Niña show the greatest fluctuations within the period, with the two rainiest years (1886 with 3843 mm and 1938 with 2754.3 mm.) and the second driest (1921 with837,8 mm.). This observation is corroborated by standard deviation calculations: in the La Niña years there is definitely a greater variability, showing a standard deviation of 567.1; El Niño years show a standard deviation of 297.2; while for the years without either event the standard deviation is 488.7.

The years under the influence of El Niño show less distinct fluctuations compared to La Niña, though with a clear tendency to be-

[44] Amador, Mora, *El ENOS, el IOS y la corriente* cit., p. 34.

Table 2. Rainfall during the years affected by El Niño or La Niña, and years without either event (1884-1940)

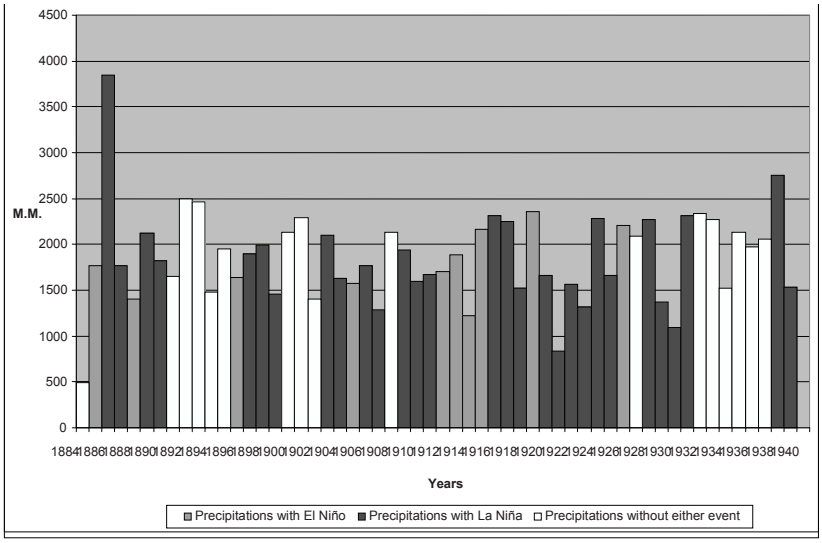
Year	Rainfall [mm]	Year	Rainfall [mm]	Year	Rainfall [mm]	Year	Rainfall [mm]
1863	1119.38	**1883**	n.d.	**1903**	2097.20	**1923**	1317.20
1864	n.d.	**1884**	495.00	**1904**	1627.60	**1924**	2281.80
1865	1746.00	**1885**	1768.00	**1905**	1573.40	**1925**	1658.50
1866	1475.74	**1886**	3843.00	**1906**	1766.60	**1927**	2091.60
1867	1273.81	**1887**	1766.40	**1907**	1287.10	**1928**	2271.60
1868	1087.37	**1888**	1403.80	**1908**	2127.60	**1929**	1375.70
1869	1423.67	**1889**	2121.00	**1909**	1934.30	**1930**	1093.60
1870	1763.73	**1890**	1823.40	**1910**	1594.50	**1931**	2313.20
1871	1997.08	**1891**	1654.30	**1911**	1666.70	**1932**	2339.10
1872	1755.39	**1892**	2500.40	**1912**	1700.40	**1933**	2268.90
1873	1292.98	**1893**	2467.40	**1913**	1883.30	**1934**	1518.90
1874	1407.16	**1894**	1478.60	**1914**	1221.20	**1935**	2135.20
1875	1360.17	**1895**	1951.20	**1915**	2160.80	**1936**	1968.30
1876	n.d.	**1896**	1641.40	**1916**	2311.20	**1937**	2057.20
1877	n.d.	**1897**	1901.70	**1917**	2245.80	**1938**	2754.30
1878	n.d.	**1898**	1995.40	**1918**	1521.80	**1939**	1533.20
1879	n.d.	**1899**	1457.20	**1919**	2355.00	**1940**	1614.70
1880	n.d.	**1900**	2133.80	**1920**	1659.50		
1881	n.d.	**1901**	2291.30	**1921**	837.80		
1882	n.d.	**1902**	1402.80	**1922**	1566.30		

Sources: same as Table1. I. Mora, J.A. Amador, "El ENOS, el IOS y la corriente en chorro de bajonivel en el oeste del Caribe", in *Tópicos Meteorológicos y Oceanográficos*, 7, 1, p. 34.

ing considerably drier than average; therefore, these years may be classified as years of "downward stability" in terms of rainfall. Finally, the years without the influence of El Niño or La Niña proved to be particularly rainy, though not too far from average. These years, we argue, show a general trend to "upward stability".

The rainfall regime of San José during this period featured extreme fluctuations, with very wet years preceded and succeeded by particularly dry ones and vice versa. It is also clear that El Niño and La Niña did significantly affect the intensity of rainfall. We therefore deem it important to pose two essential and inevitable questions: What was the social and economic impact of the above-described

Graph 2. Rainfall during the years affected by El Niño or La Niña, and years without either event (1884-1940)



Sources: same as Table 2. Graph by authors.

climatic trend? And what were the institutional and individual reactions to the consequences of a disproportionate increase or drastic diminution in rainfall? In the following section, we will suggest a number of preliminary answers to these questions by highlighting several connections between meteorological data and social phenomena, working in a historical perspective.

An overview of the economic and socio-environmental impact of rainfall in Costa Rica between 1860 and 1940

The impact on infrastructure and the governmental-institutional response

The November 28, 1906 decree passed by the Costa Rican Congress and ratified by the Executive on that same date, authorized the latter to

invest up to US$ 48,000 face value in the repair of damages caused by intense rains to several communication routes, as a supplementary contingencies item, or incidental expenses, of the Ministry of Public Works. Special emphasis was given to the reconstruction of the Barranca River Bridge; in fact, a separate article was devoted to this particular item. The Executive was authorized to spend the necessary funds, with an expense limit of 150,000 colones (over US$70,000 face value). The argument for this decision was set forth in the following terms:

> "The Commission of Public Works acknowledges, as anticipated, the Executive's Bill regarding the repair of damages and losses suffered in almost the entire country due to the severe rains of the past month of October (…) We must consider that, judging from the reports we have before us, submitted by different authorities, it is clear that none of the damages listed can be compared (due to the harm it causes to the country in general and the urgent need for its repair) to the loss of the bridge on the Barranca River, which provided passage for the railway between Esparta and Puntarenas and likewise for the national highway to Guanacaste. Damages like these should be repaired before any others that in some measure affect the interests solely at the *canton* level in each province. The lack of the bridge in question is suffered every minute by transportation and the country's commerce in general".[45]

Only two years later, on November 7, 1908, a new decree was issued. This time the Congress of Costa Rica authorized the Executive to spend the sum of 200,000 colones, over US$ 95,000 face value, in the repair of severe damages to infrastructure caused by the rains. The legislative body justified this decree as follows:

> "[The] period of stormy weather that occurred in the past month of October has caused considerable damages across the entire country, but even more so to the Pacific railway and the province of Guanacaste. Currently, a commission has been appointed to estimate the time frame and the resources needed to carry out the repair of damages, but in view of the urgency to begin such works, and of the fact that the sum required will obviously exceed the amount of two thousand colones, the Executive, as is natural, appears before the Superior Body to request funds to supplement that amount, which shall be incremented in due time if deemed necessary".[46]

[45] ANCR, Serie Congreso, N° 3224, October 1906. Highlighted portions by authors.
[46] ANCR, Serie Congreso, N° 10103, folio 3.

The above decrees bear witness to the extent of the damages caused by the rain in those years, as well as offering a clear picture of the government's reconstruction priorities and the "protocol" it set forth at the time for emergencies due to climatic events, in this particular case, rainfall.

It is worth recalling that the Ferrocarril al Pacífico (Pacific Railway) was one of the major projects of the Costa Rican State. The high expectations generated by its construction were primarily related to the need of the country's dominant economic groups – particularly the coffee-growing elite – to break the transportation monopoly held by the Northern Railway Company in the Caribbean.[47] The Pacific Railway was finally inaugurated in 1910.[48] It is clear that the damages to the railway, whose construction was drawing to an end, would result in delays and economic losses for the State as well as the elite. This group resented the excessive "liberalism" of the Atlantic/Caribbean railway contracts they themselves had promoted, the holders of which undoubtedly regarded the rapid conclusion of the construction of the railway as a priority. During the period analyzed, when heavy rains caused severe damages to the still under construction railway, the section between San José and Santo Domingo de San Mateo (today Orotina) had been completed and a provisional station set up. From this point, goods were transported to Puntarenas by way of a wagon road, later to be known as a "mixed route", which was far from being a viable commercial route. For this reason, exporters preferred the Atlantic alternative, although freight charges were less by the Puntarenas route.[49] It is hardly surprising then, in the light of this context and the highly strategic character of the Puntarenas route at the time, that the repairing of the road to the Pacific port of Puntarenas –presumably damaged by river flooding- was a government priority. Destruction in other parts of the country, such as Naranjo,

[47] A. Botey, "El ferrocarril al pacífico: un ente de regulación y desarrollo en crisis permanente (1880-1972)", in *Anuario de Estudios Centroamericanos*, 25, 1, San José 1999. H. Ulloa, "El ferrocarril costarricense al Pacífico: baluarte de la economía nacional (1897-1935)", in *Revista de Ciencias Sociales*, 80, San José 1998.

[48] Botey, *El ferrocarril al pacífico* cit., p. 144.

[49] Ibid., p. 144.

Palmares, and San Ramon, among others, was left purposely unattended. Meanwhile, municipal officers reported numerous damages caused by the flooding of nearby rivers and insisted on demanding economic aid from the central government.[50] It is quite clear, then, that the State considered a priority all that directly affected Costa Rican foreign trade, a position that was inherent to the liberal thought of the time, as well as reflecting specific economic interests.

It is important to point out that in 1906 Costa Rica was affected by both El Niño and La Niña, with a significant impact on its Pacific coast. In 1908, instead, neither event occurred in the country, so the heavy rains that fell that year depended on other climatic phenomena or conditions.

The strategic character attributed to roads and highways in general as arteries of a still under construction internal market[51] and a gateway for Costa Rican foreign trade was by no means novel, nor was governmental action in this regard limited to the removing of obstacles to the conclusion of the railroad. Even in earlier times it was common for municipal or government officials living in flood-prone areas to submit regular reports to the Public Works Department during the rainy season, informing on the state of roads, bridges, and passes, as well as the level of rivers prone to overflowing.

[50] ANCR, Serie Congreso, N° 3224. The reports of local and State authorities on damages in different parts of the country, assessing particularly damages to roads and bridges and their repair costs, are found in folios 5-35.

[51] R. Viales has established that Costa Rica lacked an integrated domestic market of agricultural products until after 1950. Before this date, according to agricultural production data presented by the author for the specific cases of Guanacaste and the Atlantic region, a regional product specialization prevailed and, hence, a differentiated production for the market and self-consumption. R. Viales, "La historia socioeconómica regional de Costa Rica. Una aproximación a la especialización productiva agropecuaria regional en Guanacaste. 1900-1950", in *Teoría y métodos de los estudios regionales y locales,* S. Chen, A. Malavassi, R. Viales (eds), 1 ed., Sede del Pacífico Universidad de Costa Rica/Centro de Investigaciones Históricas de América Central, Sección de impresión del SIDEIN, San José 2008, pp. 25-44. V. Hurtado, R. José, "La especialización productiva agropecuaria regional en Costa Rica. 1870-1950. Una propuesta de análisis a partir del caso de la región Atlántica", in *Revista de Historia*, 47, 2003, pp. 11-41.

In January 1867, Adalberto Johanning writing from Angostura informed the Director of Public Works about the effects of a five-day stormy weather period in his area.[52] Johanning pointed out that the level of the rivers had risen alarmingly and the water level of the Reventazon River had nearly reached the bridge planks. However, the only damage produced by the swelling of the river was the submerging of the access to the bridge, hindering the passage of carts, and repair works were already under way.[53]

In June 1869, Joaquín Vega D. submitted continuous reports to the Director of Public Works on climatic conditions in San Mateo and neighboring areas, and the state of the Barranca River and the road connecting Concepción with Chacarita. In that particular year the reports were favorable. Vega mentions continuous heavy rain and the swelling of the Barranca River, but no significant obstructions.[54]

The governmental decrees discussed above leave no doubt as to the importance placed on infrastructural damages, more than on any other loss or harm caused by floods, especially when these damages interfered with the country's connection with the world market. The government's reaction to the harmful effects of rainfall was thus directed by the "macroeconomic" evaluation of their impact. The human and social dimensions took a back seat, particularly in areas regarded as giving a minor contribution to the national economy. So, despite the various contextual nuances observable in governmental policies in the face of "disasters" caused by severe weather, it seems quite clear that according to the liberal-capitalist rationale of the nineteenth century – and a good part of the twentieth –, the impact of climatic events was not considered a social problem *per se*; rather, these events were seen as individual hindrances that each affected person should try to solve according to his or her own capacity and ingenuity. The government would deal with – or at least give priority to – infrastructural damages considered of public interest, particularly when related to the economy. The liberal governments had also

[52] ANCR, Serie Fomento, N° 4740, 1867, folio 1.
[53] ANCR, Serie Fomento, N° 4740, 1867, folio 1.
[54] ANCR, Serie Fomento, N° 4110, 1869, folios 7-7 back and 9.

established general assistance policies in which private philanthropic institutions played a significant role in addressing social problems caused by climatic events. These, however, gradually ceded this role to an increasing direct intervention of the State in a wide range of social policies.[55] The government actually expressed its intention to contribute to the reconstruction of affected areas, clarifying however that the immediate responsibility for this task fell on the local governments; the state would intervene in cases where municipal finances proved inadequate. Furthermore, the government affirmed that its contribution to the repair of roads in different parts of the country was ultimately an "action of national welfare".[56] In this regard, we must point out that the disproportion in the allotment of resources was overly evident. For example, the 1906 decree allocated 150,000 colones for the above-mentioned reconstruction of

[55] Since the 1990's, new sources and perspectives have emerged on the role of the "liberal" State in Costa Rica's social, political, and economic life. The new studies stress the notion of process and the prevalence of structural conditions and determining factors which traditional historiography had overlooked or minimized, while granting excessive importance to the social and economic reforms promulgated in Costa Rica since the 1940s. The common denominator of these studies is the reconceptualization of the role of the State in the socioeconomic development of the country: the actual forms of intervention adopted by the State departed from the ideal and idealized precepts of a liberal State *strictu sensu*, one, that is, ready to bow to the demands of the market. R. Viales, "El régimen liberal de bienestar y la institucionalización de la pobreza en Costa Rica 1870-1930", in *Pobreza e Historia en Costa Rica*. *Determinantes estructurales y representaciones sociales del siglo XVII a 1950,* R. Viales (ed.), Editorial de la Universidad de Costa Rica, San José 2005. R. Viales, "Las bases de la política agraria liberal en Costa Rica. 1870-1930. Una invitación para el estudio comparativo de las políticas agrarias en América Latina", in *Diálogos Revista Electrónica de Historia*, 2, 4, 2001, online at: http://historia.fcs.ucr.ac.cr/dialogos.htm. S. Palmer, "Adiós Laissez- Faire: la política social en Costa Rica (1880-1940)", in *Revista Historia de América*, 124, 1999, pp. 99-117. A. Goebel, "La política económica liberal y su rol en el consumo de bienes 'monopolizados'. El caso del monopolio del tabaco en Costa Rica (1880-1907)", in *Anuario de Estudios Centroamericanos*, 29, 1-2, San José 2003. A. Malavassi, *Entre la marginalidad social y los orígenes de la salud pública. Leprosos, curanderos y facultativos en el Valle Central de Costa Rica (1784-1845)*, Editorial de la Universidad de Costa Rica, San José 2003.

[56] ANCR, Serie Congreso, N° 3224, October, 1906, folio 2.

the railway bridge and the National Highway on the Barranca River, while for the repair of numerous roads in other parts of the country the sum disbursed was of 100,000 colones,[57] that is, between US$ 75,000 and US$ 50,000 current face value.

Governmental response to the effects of these meteorological events was extremely deficient and unplanned, since the government would limit itself to allocating additional funds for the "contingencies" chapter of the public works budget. The country lacked institutions expressly devoted to dealing with disasters caused by heavy rains or other natural phenomena. Special legislative committees were named *ad hoc* exclusively to assess damages caused by a particular event. This issue in itself deserves in-depth analysis in a future study. However, the government did seem concerned with finding roads and other communication routes that would be less vulnerable to the rains and thus allow uninterrupted transit of merchandise and people. To this purpose, it did not hesitate to reach out to the previously created scientific institutions, as recounted above. Not only was the IFG's program reoriented to promote and improve agriculture, particularly after its reopening in 1901, but the institute was also assigned other responsibilities, such as determining the ideal routes for transporting goods. This was a means to increase the effectiveness of direct governmental efforts to integrate the market at both the internal and external levels. The new routes should not only be shorter, but also less vulnerable to the impact of precipitations during the rainy season, since this would affect the journey's duration.

One of the state-commissioned exploration journeys organized by the IFG in search for more adequate and secure routes for people and goods was undertaken in the valley of the Río Grande de Térraba, a river in the southwestern part of the country. Between January 15 and February 23, 1891, Swiss scientist Henri Pittier, then Director of the IFG, led an expedition to the purpose of describing the local natural environment, obtaining new species for classification, and making meteorological observations, as well as offering advice and recommendations for the promotion of agriculture, the improv-

[57] ANCR, Serie Congreso, N° 3224, October, 1906, folio 39.

ing and implementing of communication routes, and other priority state issues.[58] The extensive journal kept by Pittier and his colleagues relates that one of the tasks assigned by the government was to determine whether the route along the coast through Punta Dominical could be considered an alternative to the difficult path across the Cerro de Buena Vista. Thus, following government instructions, the expeditioners traveled from San José across the Cerro, but made their return trip to the capital along the coastline. In his journal, Pittier concluded that both routes were similar in duration, and the coastline route was by no means superior to the mountain trail.[59] Pittier offered a detailed evaluation of the advantages and shortcomings of all the roads and communication routes already in use, as well as those scheduled for construction. It is important to stress that, even on the roads Pittier described as the most secure and propitious, climatic conditions, particularly rainfall, were a major limiting factor and a cause of sub-utilization and waste of the "inexhaustible" resources of a region with scant human settlement, and the consequent economic backwardness of that region compared to the "heart" of the country.

Pittier argued that neither of the existing main roadways could be considered adequate, and the construction of an alternate road was needed to allow the expansion of human settlement in the region.[60] The new road should be built "entirely on the Pacific side", without any stretches on the Atlantic side, to minimize the effects of the "inconveniences caused by the different alternation of seasons on either slope, as well as their not always having a considerable height".[61] Certainly, Pittier regarded the discrepancy in seasonal alternation between the two slopes of the mountain range, notably as regards their different precipitation patterns, as a major obstacle, which amply justified a plan to build a new road to connect the country's south with the Central Valley. In the words of the Swiss explorer:

[58] H. Pittier, "Viaje de exploración al Río Grande de Térraba". In MNCR, *Anales del Instituto Físico-Geográfico Nacional*, 1891, pp. 61-106.

[59] Ibid., p. 100.

[60] Ibid., p. 104.

[61] Ibid.

"It is well known that seasons are not equally distributed on either side of the Great Mountain Range. The five-month period from November to March, which may be considered the dry season on the Pacific side, corresponds to five months of almost continuous rainfall along the Atlantic, while the short dry spells occurring in April-May and August-September in the latter region usually correspond to the months of heaviest rainfall on the other slope.

Now, cattle are the main product of the Río Grande basin, and must reach the country's interior by way of a dirt road. By the end of the rainy season, cattle have gained the right weight and are ready to begin their journey, in December and January, that is, as soon as rivers return to normal levels and the roads are dry. To cross to the other side of the Reventazon valley at this time of the year is like falling from Charybdis into Scylla; and in spite of the little use made of the Fuentes trail, there are numerous stories of cattle getting trapped in the mud or straying off along the way from the mountains to the village of Orosi. As I said before, it should be remembered that to cross from one side of the mountain range to the other it is necessary to climb to very high altitudes."[62]

Thus, according to Pittier, the different rainfall patterns of the Atlantic and Pacific slopes and the detrimental geomorphologic characteristics of the region constituted the main hurdles for the integration of the Térraba Valley into Central Valley's economy and society, which he understood and represented as national.

As mentioned earlier, in his study on communication routes Pittier specifically indicates rainfall as a limiting factor for the viability of roads, whether extant or planned. Referring to the road between the General Valley and Santa María de Dota, Pittier points out that the rivers flowing near the Buena Vista hill could be easily crossed on foot during the dry season.[63] Comparing the advantages of the road between the General Valley and Santa María de Dota by the so-called Monge trail with the obstacles and inconveniences posed by the Fuentes trail, Pittier noted that the first option was a faster way that seldom presented difficulties, whereas the second would inevitably expose travelers to "unmerciful climate conditions in any season…".[64]

Still more dramatic is his description of the insurmountable obstacles along the Calderon Trail. What made the road totally inad-

[62] Ibid.
[63] Ibid., p. 105.
[64] Ibid.

equate as an important transit route, according to Pittier, was the fact that it was very close to the mouths of rivers which "could only be crossed at life's risk in the rainy season".[65] Likewise, the aforementioned Fuentes Trail was a major concern for Pittier, in that it partially ran "through a region with a climatic regime typical of the Atlantic region". Pittier regarded this route as clear evidence of the unfeasibility of "opening communication routes for significant transportation to the Atlantic".[66]

In sum, climatic features, particularly rainfall regimes, were a key structural factor not only in the construction and maintenance of adequate, stable communication routes for major commercial traffic, but also in the success of the infrastructural public works agenda pushed by the liberals of the nineteenth century and beyond. In this regard, we may conclude – provisionally, of course – that the state's incoherent and improvised way of dealing with "disasters" appears to contrast with its carefully planned explorations in search for adequate communication routes that would facilitate the economic and social integration of peripheral regions–regarded as idle or, at best, sub utilized –within the national project constructed in and for the Central Valley. The liberal scientific institutions – particularly the IFG – seem to have played a major role in this infrastructural development strategy.

This concern for expanding the network of secondary and public roads deemed strategic by the nineteenth-century liberal governments was reflected in the national budget, where an item in Public Works expenditures was specifically devoted to this purpose.

Below, in Table 3, in the category "roads, paths, and bridges (maintenance and construction)", we have grouped all the budget outlays of the Public Works Department related to the construction of roads, paths, and bridges, as well as their repair and maintenance, for the period 1890-1910.

We already mentioned above that improvisation and a clear economic bias became the main features of the successive liberal governments' approach to dealing with "disasters". It should however

[65] Ibid., p. 104.
[66] Ibid.

be noted that the amounts destined to road infrastructure on the whole were outstandingly high, becoming one of the items with the greatest allocation of funds in the budget of the Ministry of Public Works. As clearly seen in Graph 3, these expenses reached a maximum of 61.18% of the total budget of the Ministry of Public Works in 1895, while the minimum was recorded at 7.89% in 1899. Expenses for the maintenance and construction of roads, paths, and bridges amounted to an average 22.68% of the total expenses budgeted by Public Works over the entire study period. One will note a general downward trend, although with marked fluctuations apparently reflecting a change in priorities for fund allocation, typical for barely institutionalized public policies. This pattern may also reflect particular economic downturns, such as the overproduction of Brazilian coffee, which exceeded world demand in 1897,[67] determining an oversupply of the market and a consequent fall in export prices.

There is also a significant overlap between the years when less funds were allocated for roads, paths and bridges, and those when the State allocated elevated sums for the construction, maintenance, and operation of the Pacific Railway. This seems to corroborate the State's high hopes for this infrastructural work, as well as explaining the downward trend in allocations for roads and paths.

Still, it seems clear that the State regarded certain roads and trails as strategic and made their maintenance an absolute priority. A qualitative analysis of the items listed under the heading "roads, trails, and bridges" confirms this. Now, this was related in good measure, we believe, to the impact of rainfall, since most of these routes were simply rudimentary trails for oxcarts running through a scarcely transformed natural environment, as evidenced in pictures of the time (see Figure 1).

Despite the limited sequential information available to help substantiate our previous statement to its full extent, let us look into several cases we may consider representative both of the strategic nature of communication routes for the State and the continuous maintenance they required.

[67] C. Hall, *El café y el desarrollo histórico-geográfico de Costa Rica*, 2. ed., Editorial Costa Rica, San José 1982, p. 42.

Table 3. Amounts allocated for roads, paths, and bridges (maintenance and construction) (pesos, 1890-1900 and colones, 1900-1910) and their percentage share in the budget of the Ministry of Public Works (1890-1910)

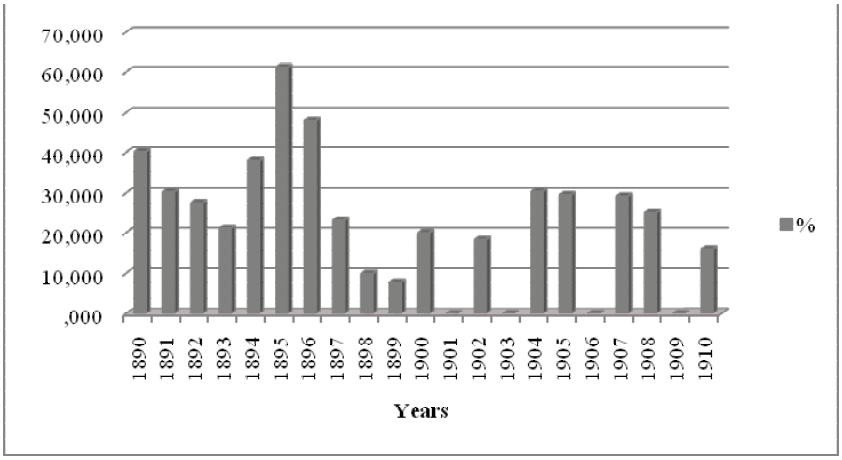
Year	Ministry of Public Works	Roads, paths, and bridges (maintenance and construction)	%
1890	358,804	144,180	40.18
1891	558,859	169,300	30.29
1892	437,244.43	121,024.75	27.68
1893	359,275.97	76,000	21.15
1894	484,818	184,000	37.95
1895	733,020	448,480	61.18
1896	959,080	461,300	48.10
1897	1,577,160	365,100	23.15
1898	1,837,580	182,440	9.93
1899	1,682,659.84	132,800	7.89
1900	932,220	186,560	20.01
1901	932,220		0.00
1902	682,100	125,000	18.33
1903	437,925		0.00
1904	516,331.4	157,000	30.41
1905	909,351.95	268,920.45	29.57
1906	1,594,412.93		0.00
1907	1,147,914.84	335,609.84	29.24
1908	976,092.66	245,482.66	25.15
1909	1,124,761.94		0.00
1910	994,909.88	160,000	16.08

Source: compiled by authors on the basis of ANCR, *Laws and decrees*, 1890-1910.

Focusing strictly on public roads, we found that the routes for which the State allocated the most funds were the road to Carrillo and the one going from Cartago into Nicaragua. These were both essential for the transportation of basic commodities and foodstuffs, particularly staple grains, beef and farm products from distant regions to the Central Valley, by now specialized in coffee production. The regional markets in the Costa Rican periphery[68] and Nicaragua faced crises whenever

[68] F. Zeledón, "La construcción de la carretera Inter-Americana en Guanacaste, estado, región y medios de comunicación 1943 y 1970", in *Guanacaste: Historia de la (Re) Construcción de una región. 1850-2007*, R. Núñez, J. Marín (eds.), 1 ed., Costa Rica, Alma Máter, San José 2009, p. 105.

Graph 3. Costa Rica: Percentage shares of maintenance construction expenses for roads, paths, and bridges in the budget of the Ministry of Public Works (1890-1910)



Source: same as Table 3. Prepared by authors.

the demand for staple products on the internal market was not met. In this context, it is hardly surprising that, in many of the years analyzed, funds in the range of 10,000 and 60,000 pesos or colones were destined to the maintenance of these roads, particularly the one into Nicaragua, which was always granted the largest budgetary allotment.[69] The funds specifically destined to the "conservation and repair" of these two roads thus accounted for a substantial part of the overall budget for the construction and maintenance of roads, paths, and bridges.

An item that is always included in government budgets between 1894 and 1902 is that of expenditures for the repair and maintenance of existing roads and the opening of new communication routes. This is crucial evidence for the case under study, in that it allows us to corroborate that important amounts were allocated for public roads; that these were hence strategic for the State; and that constant repairs or reopening of these roads were required year after year, partly due

[69] ANCR, Laws and Decrees, Years: 1890,1891, 1892,1893, 1894, 1895 and 1896.

Figure 1. Forest with coffee-filled carts

Sources: R.F. Meagher, "Holidays in Costa Rica I.- Punta Arenas to San José", in *Harper's New Monthly Magazine*, 1859, p. 18, on line at: http://ebooks.library.cornell.edu/cgi/t/text/pageviewer-idx?c=harp;cc=harp;g=moagrp;xc=1;q1=holidays%20in%20costa%20rica;rgn=full%20text;view=image;seq=28;idno=harp0020-1;node=harp0020-1%3A3;page0root,size=50

to the general climate conditions, particularly rainfall.

Table 4 shows that expenditures for the repair and construction of public roads made up a high percentage of the total allotments for roads, pathways, and bridges. Indeed, except in 1900, disbursements for the conservation and opening of public roads were always accounted for more than 50% of total expenses for roads and paths (See Graph 4).A general downward trend, matching that in allocations for roads in general, eventually set in. This, however, did not include the railroad, whose construction appears indeed to have been one of the causes of the trend, albeit only marginally.

The data shown herein corroborate what we have argued above regarding the institutional response to the need for the repair of

roads and bridges damaged by floods: independently of the State's austerity or changes in priorities, the maintenance of certain strategic communication routes did not lose its primacy in the agenda of the Costa Rican liberal governments. Rather, secondary roads were "sacrificed" through the withdrawal or reduction of the State's contribution to municipalities for repair works, except for, as we noted above, cases in which the repairs were considered of "general" – i.e., "macroeconomic" – interest. As a consequence, the downward trend in budgetary allotments for public roads was significantly less marked and irregular than that for communication routes as a whole.

Epidemics and diseases: rainfall and public health

The absence of solid institutions and policies oriented to caring for people, particularly the popular sectors, in contrast with the overwhelming economic importance accorded to the repair of infrastructure damages, is more than evident in the period under study, or at least during a good part of it. Given the inequality in modern societies between social groups as regards the allocation of natural resources and the impact arising from the transformation of the biophysical environment,[70] it should not surprise us that the poorest sectors are the most affected by hydro-meteorological phenomena.

[70] According to Joan Martínez Alier, environmental problems that fail to be solved by economic policies and technology fall disproportionately on the poor, giving rise to protests and resistance movements among social groups excluded from the ecological distribution, or with limited access to it, and whose very survival is threatened by the impossibility of providing for their basic material needs. Alier regards this form of protest, far removed from the self-conscious and organized "North Atlantic" environmentalism, as "popular ecology" or ecology of the poor. It focuses more on the solution of specific, localized socioeconomic problems rather than on future environmental impacts. See J. Martínez Alier, *El ecologismo de los pobres. Conflictos ambientales y lenguajes de valoración*, 1 ed., Icaria Antrazyt-Flacso, Barcelona 2004. A critical review of this approach from the historical field of study, highlighting the contextual nature of the conflicts, while proposing a categorical expansion of same, can be seen in M. Folchi, "Conflictos de contenido ambiental y ecologismo de los pobres: no siempre pobres, ni siempre ecologistas", in *Ecología política*, 22, 2001, pp. 79-100.

Table 4. Amounts allocated for the repair and construction of public roads (pesos, 1890-1900 and colones, 1900-1910), and their percentage share on the budget for roads, paths, and bridges (1894-1902)

Year	Roads, paths, and bridges (maintenance and construction)	Repair and construction of public roads	%
1894	184000	100000	54,35
1895	448480	350000	78,04
1896	461300	340000	73,70
1897	365100	240000	65,74
1898	182440	100000	54,81
1899	132800	50000	37,65
1900	186560	50000	26,80
1901	0	0	0,00
1902	125000	83000	66,40

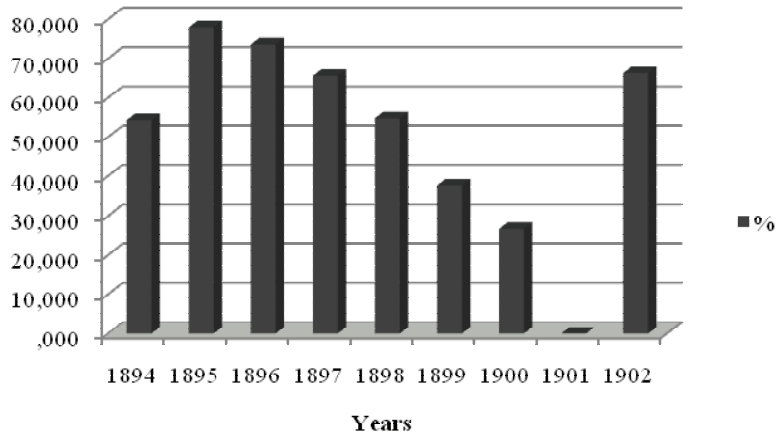
Compiled by the authors. Source of data**:** ANCR, *Laws and decrees*, 1894-1902.

This is reflected in a communiqué sent by Víctor Guardia of the Guanacaste Governor's Office to the Minister of the Interior in October 1893. Guardia stated that, due to the intense rains that had been affecting the entire Province, multiple cases of "fever and dysentery" had developed, to the point that half of the inhabitants were ill.[71] He further pointed out that many were dying because they were too poor to pay for costly medicines, as well as for lack of medical attention, since the physician contracted by the Municipality of Liberia as village doctor had become ill himself, and, furthermore, his contract was to expire by the end of October.[72] Confronted with such a dismal situation, Guardia requested the Government to assign a permanent doctor to the city of Liberia as a "humanitarian measure", and two more physicians to take care of the other cantons until the end of November, when he hoped the epidemics would retreat, presumably because of the ceasing of rainfall and the coming of the dry season.

Guardia's communiqué associates the spreading of diseases with inclement rainfall, and thus blames Nature for the endemic prob-

[71] ANCR, Serie Policía, N° 14929, 1893, folio 1.
[72] ANCR, Serie Policía, N° 14929, 1893, folio 1.

Graph 4. Costa Rica: Percentage shares of repair and construction expenses of public roads in the budgets for the maintenance and construction of roads, paths, and bridges (1894-1902)



Data source**:** same as Table 4. Graph by authors.

lems of the Guanacaste people. This idea of an unkind Nature attempting against human life was typical of a modern, progressive and distinctly anthropocentric vision of the natural world, according to which Nature should be incorporated in the market as the only way to confer a certain value to it, and should be at people's service and under their control. Thus, if the biophysical environment "attempted" against society – as in the case of an escalation of disease presumably due to rainfall and so-called "natural disasters" – this implied, according to the rationale of "progress", that Nature was transgressing the rules by which it should be governed, "rebelling" against the control people are entitled to exercise on Nature by virtue of their rights and responsibilities towards it.

It is clear, however, that rainfall *per se* could not be held entirely responsible for the abovementioned disease outbreaks. Guardia's reference to dysentery, in particular, leaves no doubt as to the fact that

[73] Francisco Comín offers an approach to the general rationale, performance, and historical construction of a welfare State. According to this author, in the wel-

a good part of these were ultimately caused by inexistent or inadequate basic sanitary measures in fast-growing urban areas. This situation, added to socio-spatial segregation – one of the major forms of social exclusion and ecological limitation, which forces large groups of underprivileged families to settle in areas ill-suited for human habitation – may be considered the key factors in the significant rise in diseases reported by Guardia. Moreover, it is quite obvious that the State's negligible efforts to promote public health policies or establishing institutions with a scope going beyond the liberal handout approach[73] had a greater impact on the population's health than rainfall, however severe. Nonetheless, if someone was to be held accountable for the human drama caused by these disease outbreaks, it would have to be Nature's implacable "fury", and not the inconsistencies of the prevailing economic model, as we can clearly infer from Guardia's communication, if we consider not only his explicit arguments but also the tacit implications.

In spite of all the above, there is no doubt as to the effect of rainfall not only on people's health but on other aspects of their daily lives as well. We can certainly say, without lapsing into environmental determinism, that the tropical climate posed a series of challenges, particularly for Europeans and their descendants (who fared a lot better in the temperate regions of the North Atlantic). This is corroborated by detailed studies by several authors who have highlighted the interactions between diseases, geopolitics, demography, and culture in various countries of tropical America.[74]

fare or residual State, characteristic of the *ancient regime* and inherited by the Nineteenth Century liberal governments, "access to benefits occurred only after the poverty of the recipient was proved". Historically, the welfare State was characterized by "proportionate social services to indigents who before benefiting from them had to prove that their income was scant and that they were on the verge of misery". See F. Comín, *Historia de la Hacienda pública, 1. Europa*, Crítica, Barcelona 1996, p. 121. Despite the generalizing intention of the author based on the study of several Western European countries, we are aware of the caution demanded in the application of these general concepts to specific local realities, particularly in Latin America.

[74] Some of the most outstanding works in this field, to mention only a few, are: Miller, *An Environmental History* cit., p. 112-119. J.R. McNeill, "Ecology, Epi-

Climatic differences can make for different relations between Society and Nature, not only from one region of the world to another, but also within single countries with remarkable climatic dissimilarities between high-altitude areas and coastal plains. Costa Rica is a case in point. A report issued in the canton of Liberia in 1910, addressed to the Chief of the Technical Section of the Ministry of Education, related the various ways in which rain had affected the Guanacaste communities.[75] This vividly descriptive document paints a far from ideal picture of the relations between Society and Nature in Guanacaste:

> "From mid-September to mid-November, on occasions, the rainy season becomes so severe that rains fall constantly and intensely, causing even small streams, usually dry in the dry season, to turn into dangerous threatening torrents; the paths in rural communities that connect the scattered homes with the central place are muddy and nearly impassable; the roads in some villages become flooded; malaria and other diseases spread alarmingly, particularly among school children, due in part to their having to return home from school in the heavy rain; school attendance diminishes considerably almost daily, as can be imagined, to the extent that some schools are practically vacant".[76]

Thus, according to this document, the floods generated by the continuous rains negatively affected the everyday life of the Guanacaste communities, notably by undermining mobility and, hence, social cohesion, and by causing a decline in school achievement and attendance. The latter problem was of major concern for the official, the main purpose of whose report was to propose to the Government – given the distinctive character of the precipitation regime in Gua-

demics, and Empires: Environmental Change and Geopolitics of Tropical America, 1600-1825", in *Environment and History*, 5, 1999, pp. 175-184. P. Sutter, "El control de los zancudos en Panamá: los entomólogos y el cambio ambiental durante la construcción del Canal", in *HistoriaCrítica*, 30, 2005, pp. 67-90, online at: http://historiacritica.uniandes.edu.co/view.php/285/1.php. For an in-depth study of the history of malaria world-wide, see J.L.A. Webb Jr., *Humanity's Burden: A Global History of Malaria*, Cambridge University Press, New York 2009.

[75] ANCR, Serie Educación, N° 10599, 1910, folios 1-4.

[76] ANCR, Serie, Educación, N° 10599, 1910, folios 1-2.

nacaste, and as a preventive measure against disease outbreaks among students and their consequent low achievement – that a special school agenda be drawn up for this province taking account of its climatic features to minimize the impact of rainfall on the Guanacaste student population.[77] The official proposed that achievement tests be scheduled between August 15 and September 15. His proposal envisaged two vacation periods: one at the end of the school year, from September 15 to November 15, and another mid-term one from March 1 to 15.[78] He went on to affirm that these periods were "extremely necessary for teachers and students, who may not have had the chance to travel to the countryside or the interior of the Republic, and may now have a chance to do so".[79] He likewise explained that in Guanacaste March was a month of extremely high temperatures, which affected both the students' and the teachers' performance.[80]

It seems quite clear, in the examined documents, that the sociohistorical subjects who authored them attributed a negative connotation to extreme climatic conditions. They beg for greater intervention by the State for the solution of various social issues associated with climatic factors. These representations are based on the social construction of a dichotomic perception of climate and its relationship with human societies, contrasting "healthy" regions with "unhealthy" ones in the case of Costa Rica and Central America, the central highlands and the coastal plains, respectively.[81] We should not overlook the fact that, especially in the eighteenth century, when

[77] ANCR, Serie, Educación, N° 10599, year 1910, folios 2-3.

[78] ANCR, Serie, Educación, N° 10599, year 1910, folio 3.

[79] ANCR, Serie, Educación, N° 10599, year 1910, folio 3.

[80] ANCR, Serie, Educación, N° 10599, year 1910, folio 3.

[81] Alain Musset goes into an in-depth analysis of perceptions of the environment in Spanish colonial cities, clearly showing that what is considered a "healthy" or "noxious" natural and social environment is a social and historical construction associated with a variety of factors. These include, in the case of Europeans in tropical regions, the idealization of the European historic-geographic background, as well as the use of this idealization to justify – especially in the case of Spaniards – the "success or failure of their urban settlements". As regards climate, the author confers to it a decisive role in the territorial organization of the conquered regions, as "they

Europeans disseminated their racist ideas throughout Latin America, a good part of these were clearly based on geographical determinism. There circulated at the time a series of pseudoscience theories according to which tropical climate not only "produced" inferior human beings, but was also capable of degenerating, both physically and psychologically, even the white people who were at the top of the racial pyramid they themselves had erected.[82] In this context, it is hardly to be doubted that the Chief of the Technical Section of the Ministry of Education regarded rainfall not only as a constant reminder of the inconveniences of a tropical climate, but also as a public health issue impacting various aspects of social life, especially among the subordinate classes in the so-called "warm lands".[83]

Rainfall and property value

Obviously, flooding during the severe rainy seasons of Costa Rica did not affect only public infrastructure. Toward the end of the nine-

would search, on the one hand, for places to build their cities that were more conform to the model they had inherited from their past, and, on the other, for places with a more similar climate to the European, regarded as the world's best and healthiest". See Musset, *Lo sano y lo malsano* cit. A. Goebel, "Obstáculos y oportunidades para el "progreso". Las representaciones de la naturaleza costarricense como "recurso natural" y los condicionantes de su apropiación y aprovechamiento: el caso de los exploradores extranjeros (1850-1905)", in *Geonaturalia. Geografía e Historia Natural: hacia una historia comparada: estudio a través de Argantina, México, Costa Rica y Paraguay 2007*, C. Lértora (ed.) 1 ed., FEPAI, Buenos Aires 2008, pp. 273-311.

[82] Miller, *An Environmental History* cit., pp. 106-112.

[83] According to Koppen's classification. In general terms, such classification, when applied to the Costa Rican environment, groups the country's climatic regions into three categories, as follows:

Cold lands (Microthermal): mean annual temperatures below 10° C corresponding approximately to altitudes above 2000 m.

Temperate lands (Mesothermal): mean temperatures between 22° and 10° C. Lying between 2000 and 800 m.s.l. on the Pacific Slope and between 2000 and 600 on the Atlantic Slope. Warm or hot lands (Megathermal): mean temperatures above 22° C. Located between 800-600 m.s.l. and sea level, depending on which slope they lie on. See Dirección General de Estadística y Censos (DGEC), *Atlas Estadístico de Costa Rica*, 1950, pp. 12-13 and 34-37.

teenth century, when private property became consolidated in the country as the predominant form of land ownership, rainfall and its consequences undermined property value due to the impact on crops and damages to farming equipment and basic infrastructure that served a crucial function in a predominantly agricultural country.

In 1899, Jenaro Bonilla Aguilar, owner of the farm "La Dominica", had just sold a portion of land and a bridge over the Turrialba River to the Municipality of Paraíso. In a note addressed to the town councilor, Bonilla related that the heavy rains, which he defined as extraordinary and unprecedented, had washed away the bridge in question, "thus causing the loss of valuable hard work performed by capable and interested individuals".[84] His main concern was that time would wipe away all traces of the event, "which today bear witness to the enormous amount of water that caused the bridge's destruction", and that the municipality would hence refuse to pay, or deduct the bridge's cost from the agreed price.[85] His concern was such that he summoned witnesses to testify on the extraordinary character of the rains, as well as the sturdiness of the bridge he had built.[86] The witnesses were to answer the following questions, recorded in a note addressed to the municipality:

a) As long-settled neighbors of Turrialba, can you attest that never before has it rained uninterruptedly in this town for such a long period of time as during the past days, when the bridge that once stood on my farm "La Dominica", which I had sold to the Municipality of Paraíso, was destroyed?

b) Is it true that the river's current was so strong and abundant that everyone was terrified, to such a point that there was concern for the lives of the people living close to the banks of the Turrialba River, while the neighbors of the Bajo ó Guayabal were preparing to move to a safer place?

c) Is it true that fish were found dead at the river's edge?[87]

Bonilla expressed his interest in having "experts examine the ex-

[84] ANCR, Serie, Juzgado Civil de Cartago, N° 1022, 1899.
[85] ANCR, Serie, Juzgado Civil de Cartago, N° 1022, 1899.
[86] ANCR, Serie, Juzgado Civil de Cartago, N° 1022, 1899.
[87] ANCR, Serie, Juzgado Civil de Cartago, N° 1022, 1899.

isting marks, signs, and debris" to corroborate the exceptional nature of the precipitations that had destroyed the bridge. The witnesses answered the questions affirmatively, despite the municipality's reservations as to whether the railway bridge, located where the river waters were more abundant, had been actually built to withstand the battering of the river's current.[88] One of the experts, Manuel León Brenes, also supported the petitioner's argument after making a trip to the site with witnesses and experts:

> On the appointed day I arrived at the farm "La Dominica", owned by Jenaro Bonilla, in his company and in that of Mr. Santiago Jiménez and the expert Agustín Iglesias.
> I recognized the place where the bridge referred to in this statement once stood, since I was familiar with the bridge while it still belonged to Mr. Bonilla, and I found that the traces of the swell – which will remain for many years – proved it to have been extraordinary and, to my judgment, so severe that, regardless of the bridge's location or sturdiness, its destruction would have been inevitable. To support my opinion, in addition to what I have already alleged above, there is evidence all alongside the Turrialba river… of enormous piles of regular-sized rocks, uprooted trees, and gravel, in such amounts that in certain places the river changed its course, particularly where the bastion that disappeared once stood, which probably dragged the bridge along…[89]

Bonilla's report suggests several hypotheses regarding the socio-economic impact of the floods, as well as a few possible social uses of climatic events. On the one hand, it is clear that the damages caused by precipitations did impact property value, because it reduced its productive potential, and for other reasons as well. On the other, we must consider the possibility of owners exaggerating or even making up damages to their farms as a legal ruse – involving the submission of a formal statement backed by witnesses – to conceal a lack of basic infrastructure, their scant investment in factors of production, or the "natural disadvantages" of their farmlands.

We have found evidence for the importance attributed by topographers and experts to climatic conditions when evaluating property. For example, on the real estate map of lot Nº 10, a second-rate

[88] ANCR, Serie, Juzgado Civil de Cartago, N° 1022, 1899.
[89] ANCR, Serie, Juzgado Civil de Cartago, N° 1022, 1899.

lot in Santa Clara owned by General Tomás Guardia, the property's principal qualities were highlighted. Among these, it was noted that although the terrain was "somewhat uneven", it had "good water" and enjoyed a "mild climate".[90]

Another undated document -we know it is subsequent to 1880 as reference is made to a July 20 decree from that year-mentions the principal features of a lot situated in Santa Clara, such as its good quality and its being endowed with "good water" and a "good climate".[91] Likewise, towards the end of the nineteenth century, other real estate maps evidenced the importance of climate as a factor in the estimation of property value. In none of the sources we consulted did we find a negative evaluation of the prevailing climate in the area where the property was located.[92] Some of the maps actually overstated the benevolence of climate, as is the case of the map for lot Nº 23 in the "First-Rate Atlantic Second Division", drawn up in 1880, where the expert emphasizes the abundance of the spot's vegetation, its "good water", and its wonderful climate.[93]

The inclusion of "climate" as a criterion for property appraisal leaves no doubt as to its relevance for the real estate market in the nineteenth century and later. Though rainfall is not directly mentioned, it seems reasonable to believe that within what was considered a "good" or "mild" climate there would have been no room for abundant rainfall, which would have jeopardized the "normal" course of productive activities or caused inconvenience to owners. Properties located in particularly rainy areas risked losing part of their market value, unless an expert highlighted the "goodness" of the area's climate. It should be noted that the maps described above are of land located in particularly rainy and warm areas, such as the Santa Clara plains or the Caribbean lowlands of Costa Rica.

Now, if the overall climatic conditions, particularly as regards precipitation, had a bearing on property value because of their ef-

[90] ANCR, Fondo 01, Sección 00, Serie aa, N° 7597. Though undated, this map shows contextual elements that probably situates it around 1880.

[91] ANCR, Fondo 01, Sección 00, Serie aa, N° 7844.

[92] ANCR, Fondo 01, Sección 00, Serie aa, Numbers: 7796, 7818, 7819.

[93] ANCR, Fondo 01, Sección 00, Serie aa, N° 7818.

fect on production, the following question is worth posing: What relationship – if any – was there between the rainfall regime and the yields of the country's chief export products, namely coffee and bananas? In the following section we will try to give some preliminary answers to this complicated question, which undoubtedly deserves to be researched more in-depth in the future.

Rainfall, coffee, and bananas: an approach to the relationship between precipitations and the development of agro-export

As mentioned above, precipitations and soil were the two key agro-ecological factors in agricultural production. The impact of precipitations on production, however, is hard to define. We have nevertheless attempted to trace correlations between trends in rainfall and exports of coffee and banana, the flagship products of Costa Rican agrarian capitalism, especially as regards export volume.

Before starting our analysis, a word about the scope and limitations of a correlative study of these variables. Circumscribing our study to precipitation records for the city of San José one certainly introduces a sharp bias in our calculations. However, given the relatively even distribution of rainfall in the Central Valley, and the fact that this was the center of coffee production for most of the period under study and beyond, we believe that the general trend in the correlation between the two variables would hardly vary if we extended our sample to include a broader area.

It should also be noted that the amount of coffee exported did not represent the total national production, since part of it was destined to the domestic market, including self-consumption, particularly during the early years of our study period. The greater part of the coffee crop, at any rate, was directed to the external market. Coffee was indeed Costa Rica's prime national product, and as such played a key role in the country's early and definitive entry into the international market.[94] Thus, given this strong orientation of the coffee-growing economy as a whole towards the export market, we

[94] H. Pérez, "Crecimiento agroexportador y regímenes políticos en Centro-

believe that even coffee exports alone can provide an adequate image of the rainfall-production relations.

Table 5 shows the non-existence of a relation between coffee exports and rainfall in the period 1893-1940, on the basis of precipitations registered at the San José meteorological station. This can be confirmed by calculating the correlation factor, which is a mere 0.1669. The key factor gives us even more eloquent proof, since its value is 0.0278: this means that the variable "precipitations in San José" has an explanatory capacity of just 2% for the trend of coffee exports in the period under study.

In other words, the increase or decrease in precipitation levels had very little influence on the amount of coffee exported (see Graph 5). It was a wide range of other factors that defined the course of the Costa Rican coffee exports as a whole, such as worldwide market conditions, diseases, changes in technical and agricultural methods for extending the productive life of coffee plants and improving agro-ecological cycles,[95] modifications in the consumption patterns of the main importing countries, diversification of the production structure, and changes in the criteria for assessing coffee bean quality.[96] This does not mean that in particular years the effects of extreme rainfall or the lack of it – as we shall see later on – did not affect the country's chief export products or other activities in the primary sector. Our analysis clearly shows, however, that a major influence of the rainfall regime on decreases or increases in coffee exports during the period under scrutiny was the exception and not the rule. Costa

américa. Un ensayo de historia comparada", in *Tierra, café y sociedad*, H. Pérez, M. Samper (eds), Flacso, Costa Rica 1994, p. 40.

[95] C. Naranjo, *La modernización de la caficultura costarricense 1890-1950*, Thesis (Magister Scientiae), Programa de Posgrado en Historia, Universidad de Costa Rica, 1997. Samper, Naranjo, *La innovación tecnológica* cit., particularly pp. 100-106.

[96] Naranjo, *La modernización de la caficultura,* cit. M. Samper, "Construcción histórica de la calidad y la competitividad", in *La cadena de producción y comercialización del café: perspectiva histórica y comparada*, M. Samper, P. Sfez (eds), Instituto Panamericano de Geografía e Historia, San José 2001. A. Montero, R. Viales, "Una aproximación a la construcción histórica de la calidad del café y el banano en Costa Rica 1890-1950", Proyecto de Investigación del Centro de Investigaciones Históricas de América Central (CIHAC), 2008 (unpublished).

Table 5. Coffee exports and precipitations in San José (1893-1940)

Year	Coffee exports (Kilos)	Precipitations in San José [m.m]	Year	Coffee exports (Kilos)	Precipitations in San José [m.m]
1893	11,442,041	2467.4	**1918**	11,451,719	1521.8
1894	10,776,763	1478.6	**1919**	13,963,473	2355.0
1895	11,089,523	1951.2	**1920**	13,998,150	1659.5
1896	11,715,801	1641.4	**1921**	13,336,381	837.8
1897	13,871,363	1901.7	**1922**	18,616,803	1566.3
1898	19,486,125	1995.4	**1923**	11,088,400	1317.2
1899	15,366,671	1457.2	**1924**	18,210,760	2281.8
1900	16,100,905	2133.8	**1925**	15,352,863	1658.5
1901	16,574,025	2291.3	**1926**	18,249,045	2205.8
1902	13,749,100	1402.8	**1927**	16,153,980	2091.6
1903	17,332,613	2097.2	**1928**	18,841,798	2271.6
1904	12,578,425	1627.6	**1929**	19,676,115	1375.7
1905	18,047,539	1573.4	**1930**	23,536,645	1093.6
1906	13,774,258	1766.6	**1931**	23,014,687	2313.2
1907	17,325,531	1287.1	**1932**	18,499,038	2339.1
1908	8,977,531	2127.6	**1933**	27,777,939	2268.9
1909	12,030,104	1934.3	**1934**	19,062,662	1518.9
1910	14,396,926	1594.5	**1935**	24,238,534	2135.2
1911	12,641,156	1666.7	**1936**	21,326,158	1968.3
1912	12,237,875	1700.4	**1937**	7,305,482	2057.2
1913	13,019,059	1883.3	**1938**	24,981,132	2754.3
1914	17,717,068	1221.2	**1939**	20,244,531	1533.2
1915	12,206,357	2160.8	**1940**	18704132	1614.7
1916	16,843,782	2311.2			
1917	12,267,203	2245.8			

Chart compiled by authors. Sources**:** Ministerio de Agricultura y Ganadería, Instituto Meteorológico Nacional, "Las Series Pluviometricas de Costa Rica", I. San José; Valores Diarios de 1888 a 1972, Estadisticas, San José, Costa Rica 1973. Ministerio de Recursos Naturales, Energía y Minas, Instituto Meteorológico Nacional, Año del centenario 1888 – 1988, "Catastro de las series de precipitaciones medidas en Costa Rica", San José, Costa Rica 1988. Dirección General de Estadística y Censos (DGEC), Anuario Estadístico, Year 1934, Volume 38, San José, Imprenta Nacional, 1935. DGEC, Anuarios Estadísticos, 1935-1940.

Rica's precipitation levels, even with their apparent inter-annual variations, seem to always have been suitable – indeed, even ideal – for coffee production. Our analysis indicates that no given quantity of rainfall can be correlated with "optimal" export levels.

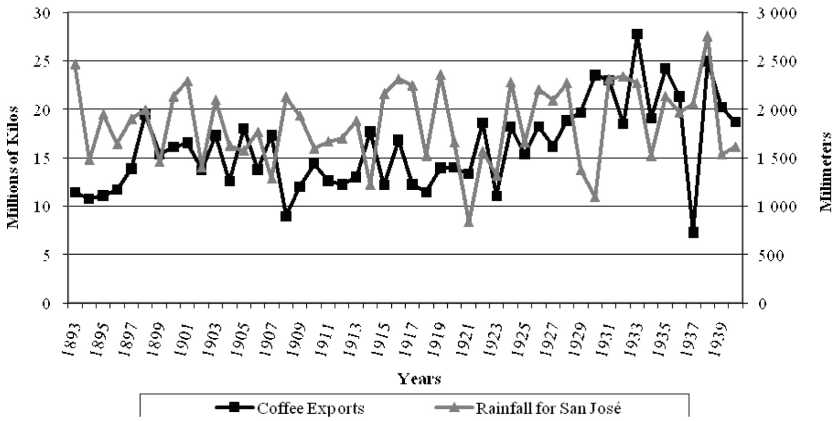
We obtained similar results in our correlation of trends in precipitations and banana exports. However, we must caution the reader that the same observations about scope and limitations apply as in the case of coffee. Additionally, since the Atlantic/Caribbean region was by far the country's major banana producer in the period under study, the use of meteorological data recorded for San José would insert an even greater bias in our results. We hence decided to compare the number of bunches exported with the precipitation records compiled at the Freeman Station, the oldest station where records were kept of precipitations in the Caribbean region, or at least in part of it. This meant, however, trimming down the period analyzed from 1905 to 1934, since from 1935 onward bananas were no longer tallied in bunches, but weighed in kilograms for export purposes. Thus, to prevent any distortions that could arise from calculations of the average weight per bunch, we omitted the last five years of our study period.

Like we said, the results do not differ much from those reached in the case of coffee exports. The relation between the variables continues to be noticeably weak. It is, however, nevertheless distinctly stronger than in the case of coffee, as can be seen in Chart Nº 6 below. The correlation factor shows a value of 0.3901, while the key factor stands at 0.1522. In other words, although the relation is still weak, the rainfall trend recorded at the Freeman station as an independent variable has an explanatory power of 15% for the trend in banana exports for the period 1905-1934. Moving from the premise that historical phenomena are intrinsically multi-causal, this is quite noteworthy.

The fact that precipitations had a greater impact on banana exports is not surprising, particularly when we consider that both climate change and the spread of the Panama disease became the main agro-ecological determinants in the decline of banana production in the Costa Rican Caribbean region, as Ronny Viales has shown.[97]

[97] R. Viales, "La coyuntura bananera, los productos "complementarios" y la

Graph 5. Coffee exports in kilos and average rainfall for San José in m.m. (1893-1940)



Graph by authors. Source**:** same as for Table 5.

Several examples given by this author for specific years show the impact of hydro-meteorological events on banana production. In 1912 alone, 292,561banana bunches were reported lost as a result of severe rainfall and floods, as well as the spread of the Panama disease over 1500 hectares of land. In 1913, 149,773 banana bunches and 54,645 cacao trees were lost to flooding and "hurricanes" alone.[98] Thus, in the Caribbean banana plantations appear to have been more vulnerable than coffee to variations in precipitation levels and their consequences, particularly floods. Differently than in the case of coffee, the Caribbean rainfall regime appears to have been not *always* suitable for banana cultivation. A closer look at certain years in our study confirms this impression, as do the reports of company officials, discussed by Viales, on the impact of "hurricanes" and floods on banana plantations. So, for example, when in 1909 E. Hitchcock,

dinámica productiva empresarial para la exportación de la United Fruit Company en el caribe costarricense 1883-1934", in *Revista de Historia*, 44, 2001, pp. 90-94.

[98] Ibid., p. 91.

Table 6. Banana exports in bunches and precipitations recorded at the Freeman Cuncas Pacuare and Madre de Dios Station (1905-1934)

Year	Banana bunches exported	Precipitations Freeman Station [m,m]	Year	Banana bunches exported	Precipitations Freeman Station [m,m]
1905	7,283,000	3810.1	1920	8,652,473	3431.6
1906	8,872,729	3365.6	1921	8,318,851	2644.1
1907	10,166,551	3390.9	1922	7,171,619	4516.1
1908	10,074,599	3792.3	1923	7,454,114	4175.7
1909	9,365,690	3952.3	1924	8,087,201	2524.7
1910	9,097,285	4457.7	1925	8,348,972	3002.2
1911	9,309,586	4020.7	1926	8,560,910	2494.1
1912	10,647,702	3662.6	1927	7,869,175	3683.0
1913	11,170,812	4285.1	1928	7,323,481	3754.2
1914	10,162,912	5118.1	1929	6,112,170	2773.6
1915	9,521,648	3406.1	1930	5,834,045	3020.0
1916	10,058,738	2821.9	1931	5,079,944	2534.8
1917	8,689,515	3459.5	1932	4,313,379	3383.4
1918	7,129,655	3490.1	1933	4,293,383	2692.5
1919	7,270,624	3672.9	1934	3,210,169	3195.2

Chart by authors. Sources: Chart compiled by authors. Sources**:** Ministerio de Agricultura y Ganadería, Instituto Meteorológico Nacional, "Las Series Pluviometricas de Costa Rica", I. San José; Valores Diarios de 1888 a 1972, Estadisticas, San José, Costa Rica 1973. Ministerio de Recursos Naturales, Energía y Minas, Instituto Meteorológico Nacional, Año del centenario 1888 – 1988, "Catastro de lasseries de precipitaciones medidas en Costa Rica", San José, Costa Rica 1988. Dirección General de Estadística y Censos (DGEC), Anuario Estadístico, Year 1934, Volume 38, San José, Imprenta Nacional, 1935. Viales, Ronny. "La coyunturabananera, los productos "complementarios" y la dinámica productiva empresarial para la exportación de la United Fruit Company en el Caribe costarricense. 1883-1934", in *Revista de Historia*, 44, EUNA/EUCR, July – December 2001, pp. 75-78.

administrator of the UFCo, began reporting on cutbacks in banana crops caused by floods and the Panama disease, the annual average rainfall registered at the Freeman Station had been increasing continuously during the last three years, from 1907 (3390.9 mm.) to 1910 (4457.7mm). The last year was the third highest in precipita-

tion levels for the period under study(see Graph 6.).The setback in production is clearly reflected in banana exports, which fell from 10,166,551bunches in 1907 to 9,097,285 in 1910.

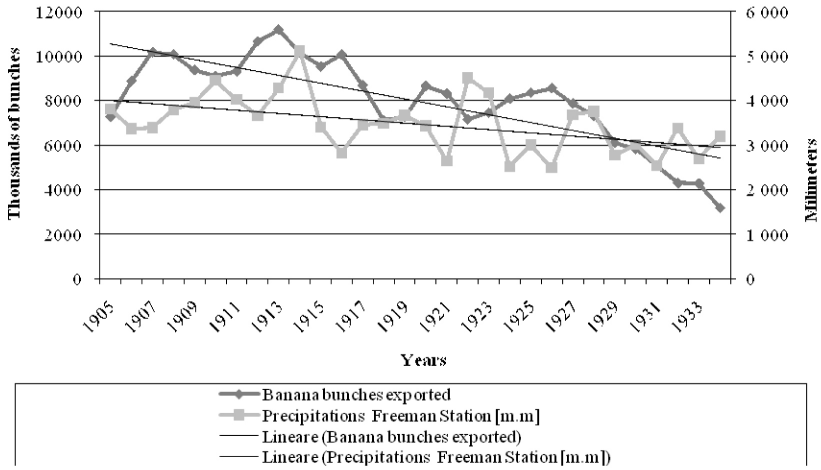
Despite the above-mentioned reported loss in 1912 of 292,561 bunches to hurricanes, floods, and the Panama disease, the precipitation levels registered at the Freeman Station were relatively low (3662.6 mm) and exportation was on the rebound. This confirms that precipitation levels were only one of many factors affecting agro-export dynamics, just as the Freeman registries cannot be considered representative of the entire Caribbean region. Only two years later, in 1914, peak precipitation levels for the entire period were documented, with 5118.1 mm of rainfall, while banana exports dropped from their historical maximum in 1913, with 11,170,812 bunches, to 9,521,648 in 1915; that is, a reduction of slightly over one and a half million bunches.

With this contextual analysis of several agro-ecological factors whose impact on banana production and exports seems indisputable, we have tried to prove that despite the weak relation between rainfall and banana exports, extreme rainfall and its consequences, such as floods, appears to have been largely responsible for the decline in banana production and marketing in several of the years analyzed, while similar levels of rainfall seem to have had only a minor impact in other years. Other factors, such as a reduction in cultivated areas, land productivity, competition from other production areas,[99] and the inflation affecting the United States economy from 1914 onward[100] were regarded as the main causes of the downward spiral suffered by the banana economy in the Costa Rican Caribbean until 1938, when banana production was officially relocated to the country's South Pacific district.[101]

Thus, given that 1914 witnessed the greatest impact of rainfall on banana production, we decided to take a closer look at how rainfall in that year influenced the Costa Rican economy as a whole.

[99] Ibid., pp. 89-90.
[100] Ibid., pp. 84-90.
[101] Ibid., p. 89.

Graph 6. Banana exports in bunches and average rainfall at the Freeman Cuencas Pacuare and Madre de Dios Station, in m.m. (1905-1934)



Graph by authors. Source: same as for Table 6.

We thought such an investigation would be especially interesting considering that climatic aspects in particular – and environmental transformations in general – as explanatory factors for socio-economic dynamics have not received adequate consideration in Costa Rican and Central American historiography. We shall therefore give a brief overview of the relationship between rainfall, the economic trend, and governmental and institutional response during this particular year, when these factors seem to have all contributed to are cession of the Costa Rican economy, especially in the export sector.

Rainfall, war, and recession: the exceptional year of 1914

The year 1914 witnessed a significant decrease in the growth rate of the Costa Rican economy, particularly as regards some of its chief export products. Banana cultivation, as we have seen, suffered from

the effects of the Panama disease.[102] Cacao exports were also seriously affected by a drop in the European demand, since in 1911 the cacao surplus had been higher than in any previous year.[103] Furthermore, these cyclical variations in export trends occurred in the context of a general contraction of the world trade as major countries cut their imports of "desserts" (non-strategic raw materials)[104] during the First World War.[105] The cyclical character of such downturns in Costa Rican exports, on the one hand, and the aforementioned global economic situation, on the other, overshadowed the importance of the impact on the export supply of the intense rains that affected the country precisely in 1914. Juan Rafael Quesada pointed out in this regard that the severe floods and hurricanes registered that year caused the destruction of a large part of the cacao plantations of the United Fruit Company,[106] which definitely affected the country's economy, since at the time cacao ranked third among Costa Rican export products, surpassing even timber, which had held this position since the late nineteenth century.[107] As illustrated in the previous section, banana exports declined coincidentally with the high precipitation levels registered at the Freeman Station in 1914.

Thus, climatic conditions appear to have been historically an influential factor in yield losses of commercial crops, along with other internal and external constraints. It is noteworthy that the year

[102] Ibid. J. Soluri, "Consumo de masas, biodiversidad y fitomejoramiento del banano de exportación, 1920-1980", in *Revista de Historia*, 44, 2001, particularly in p. 38.

[103] J.R. Quesada, "Comercialización y Movimiento Coyuntural del cacao", in *Revista de Historia*, 6, 1978, pp. 94-95.

[104] According to the classification of raw materials carried out by the economics historian Victor Bulmer-Thomas. V. Bulmer- Thomas, "Las economías latinoamericanas, 1929-1939", in *Historia de América Latina. T. 11. Economía y sociedad desde 1930,* L. Bethel (ed.), Crítica, Grijalbo Mondadori, Barcelona 1997. p. 6.

[105] Quesada, *Comercialización y Movimiento* cit., p. 95.

[106] Ibid.

[107] Dirección General de Estadística y Censos (DGEC), *Anuario Estadístico*, Year 1934, Vol. 38, Imprenta Nacional, San José 1935, pp. 41-45. DGEC, *Resúmenes Estadísticos*, Years 1883-1910, pp. 5-10. DGEC, *Anuarios Estadísticos*, Years 1935-1955. Quesada, *Comercialización y Movimiento* cit., pp. 69-110.

1914 also witnessed the phenomenon of El Niño. Although San José only registered 1221.20 mm of rain, the Caribbean Slope saw high rainfall levels, according to data compiled at the Freeman Station, which was located, significantly, in the Caribbean region, more specifically in the Pacuare River basin. As we observed earlier on, the institutionalization of science in Costa Rica – as in other Latin American countries – during the liberal period was largely driven by the interests of the State and transnational companies[108] as part of a general trend to incorporate scientific knowledge into the economic networks of global capitalism.[109]

According to the data gathered by the Station, compiled in Table 7, 1914 was the rainiest year in the period 1905-1940, with 5118.1 mm. of rain. This is in sharp contrast with the trend recorded at San José. This data thus highlights enormous differences in precipitation levels between districts, since the average rainfall at the Station for the entire period 1905-1914 (3,485.46 mm) was double the mean at San José for the period 1863-1940, which was 1,7872 mm (See Graph 7).

In sum, as the above data clearly show, 1914 was a particularly rainy year for the Costa Rican Caribbean, which undoubtedly triggered floods causing severe economic and social impacts. The destruction of cacao and banana plantations further aggravated the crisis determined by the decrease in the growth rate of the Costa Rican economy. In the context of a cyclical downturn of global economy, and more specifically of foreign trade, this situation affected not only raw-material supplying countries and districts, in different ways, but leading capitalist nations as well.[110]

The impact of the profuse rainfall of 1914, however, was by no means limited to commercial crops. Floods caused considerable damages to infrastructure, especially roads and bridges, leaving many neighborhoods isolated. There were many reports of damages and requests for economic aid sent to the central government by local authorities in

[108] Viales, Clare, *El Estado, lo transnacional* cit.

[109] On the impact of El Niño, see Cushman, *Enclave Vision* cit.

[110] X. Tafunell, "La economía internacional en los años de entreguerras (1914-1945)", in *Historia Económica Mundial. Siglos X-XX*, F. Comín, M. Hernández, E. Llopis (eds), Crítica, Barcelona 2005, particularly in pp. 287-295.

different parts of the country, particularly the Caribbean region.

For example, the Chief Police Officer in Boruca requested equipment for the repairing of the roads there, which for years had not had any maintenance at all, due to "the lack of equipment", complaining moreover that this was used as an excuse by "those negligent Indians" to dodge work.[111] After several letters, the government finally replied granting the requested equipment. The reply specifies that the official letter of May 28, 1914 to the Chief Police Officer referred to the need to carry out "serious repair works on the roads that had been obstructed due to the rains".[112]

Likewise, damages were reported "to the bridges on the rivers Las Playas, 'Turrialba', Aquiares, and Guayabito". Given the seriousness of these damages, the Municipality of Alvarado approved an urgent measure to disburse the sum of one hundred colones for the building of temporary bridges, while invoking the government's aid "for restoring the way through the Fuentes road, the only access route to Santa Cruz, where its inhabitants are totally isolated".[113] In his turn, the Minister of Public Works, Alberto Echandi, in Official Letter 510 of September 7, 1914, addressed to the Secretary of State at the Governor's Office, communicated the Public Treasury's approval of "pecuniary relief" for the Municipality of the Canton of Alvarado in an amount equal to that granted by the Municipality - that is, 100 colones - to repair the damages caused to the aforementioned road.[114] That same year, Official Letter 422 dated September 18, 1914, addressed to the Secretary of State at the Governor's Office, informed of a communication from the Chief Police Agent of Sarapiqui requesting "food provisions for the crew working on bridges and roads".[115] In response to this request, the government allocated the sum of 118.15 colones "to cover the expenses of the commission sent to Sarapiqui on account of the floods that occurred in that locality".[116]

[111] ANCR, Series, Gobernación, N° 45544, May-October, 1914.
[112] ANCR, Serie, Gobernación, N° 45544, May-October, 1914.
[113] ANCR, Serie, Gobernación, N° 45544, May-October, 1914.
[114] ANCR, Serie, Gobernación, N° 45544, May-October, 1914.
[115] ANCR, Serie, Gobernación, N° 45544, May-October, 1914.
[116] ANCR, Serie, Gobernación, N° 45544, May-October, 1914.

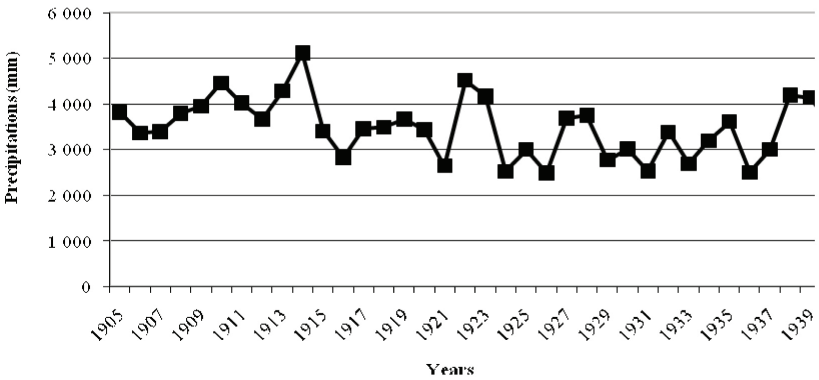
Table 7. Precipitations registered at the Freeman Cuencas Pacuare and Madre de Dios Station 1905-1940

Year	Precipitations [mm]	Year	Precipitations [mm]
1905	3810.1	1923	4175.7
1906	3365.6	1924	2524.7
1907	3390.9	1925	3002.2
1908	3792.3	1926	2494.1
1909	3952.3	1927	3683.0
1910	4457.7	1928	3754.2
1911	4020.7	1929	2773.6
1912	3662.6	1930	3020.0
1913	4285.1	1931	2534.8
1914	5118.1	1932	3383.4
1915	3406.1	1933	2692.5
1916	2821.9	1934	3195.2
1917	3459.5	1935	3614.3
1918	3490.1	1936	2504.5
1919	3672.9	1937	3002.4
1920	3431.6	1938	4188.4
1921	2644.1	1939	4135.8
1922	4516.1	1940	3500.1

Chart compiled by authors. Sources**:** Ministerio de Agricultura y Ganadería, Instituto Meteorológico Nacional, "Las Series Pluviometricas de Costa Rica", I. San José; Valores Diarios de 1888 a 1972, Estadisticas, San José, Costa Rica 1973. Ministerio de Recursos Naturales, Energía y Minas, Instituto Meteorológico Nacional, Año del centenario 1888 – 1988, "Catastro de las series de precipitaciones medidas en Costa Rica", San José, Costa Rica 1988.

One common trait in governmental responses to the requests for economic aid coming from all over the country was its reluctance to provide funding for the repair of flood damage. Constant allusions were

Graph 7. Precipitation registered at the Freeman Cueucas Pacuare and Madre de Dios Station 1905-1940 (mm)



Graph by authors. Source: same as for Table 7.

made to the precarious state of the government's finances and the economic difficulties it was encountering due to the "European conflict".

In sum, 1914 was clearly an unfavorable year in socio-economic terms, given the confluence of the effects of an external economic downturn and high precipitation levels, which caused, among other problems, the closing down of many roads as well as floods in much of the country, as can be inferred from the reviewed data. From a socio-environmental perspective, the severe damage caused by flooding, particularly to roads and paths relatively distant from the Central Valley, does seem to indicate that in several of the country's regions during the first decade of the Twentieth Century the infrastructure was largely inadequate. This issue undoubtedly deserves separate investigation.

Conclusions

Climatic factors, as integral elements of the natural world, undoubtedly weigh on various aspects of the development of human societies, which in their turn have historically constructed specific ways to relate to their climatic environment. Adaptation, assimila-

tion, and control are the fundamental strategies implemented by social groups in different spatial-temporal contexts, whether to deal with Nature as their "partner" or fight it as their "enemy". This is also true in the case of human beings' relationship with rainfall.

Though brief and evidently susceptible of empirical expansion as well as deeper methodological and conceptual analysis, this work seeks to provide a preliminary view of the relationship between different social groups and precipitations as an integral part of the environment in a "progress-oriented" Costa Rica, and of how hydrological cycles affected local society in the period under study.

First of all, it should be noted that, especially toward the end of the nineteenth century, knowledge of the rate and intensity of rainfall acquired a particularly strategic value for the State and its inseparable associates, the transnational companies. The dependence of coffee and bananas – the "flagship products" of the Costa Rican agro-export model – on rainfall as a source of energy, and the strategic character acquired by agricultural expansion and diversification during this period, may be considered the main propellants of the institutionalization of science in Costa Rica, where systematization of meteorological data was to play a central role.

In spite of the asymmetry between the abundant meteorological data for the capital city and the dispersed and fragmented information available for other areas of the country, we have found our reconstruction of the existing series extremely valuable as a document of rainfall trends in the period under study. As to the correlation between precipitations and the La Niña and El Niño climatic events, we have been able to pinpoint the years affected by these phenomena and their influence on the Costa Rican rainfall regime, especially as regards the capital city. Although in general there were no evident fluctuations in average rainfall in connection with these events, a more detailed study of precipitation patterns seems to prove that throughout the period both El Niño and La Niña caused rainfall levels to reach their highest or lowest peaks, while the years without Niños or Niñas were particularly rainy and noticeably stable.

Rainfall was unquestionably abundant during the period under study. This had various economic and social consequences. The gov-

ernment was often called upon to deal with the floods that frequently occurred in the country and continue to do so today. In doing so, the Costa Rican liberal governments seem to have followed the same precepts of "order and progress" that informed their politics and economic policies. The preeminence accorded to reconstruction of basic infrastructure required for the transportation of the chief export products as well as the imports that constituted the basis of government revenues, damaged by "inclement" rainfall, leaves no doubt as to the State's "macroeconomic" priorities. Although governmental response to natural "disasters" appears to have been usually improvised, this seems to contrast with the Costa Rican government's ongoing engagement in the search for new roads and routes, especially towards the end of the nineteenth century, to draw peripheral regions into the economic orbit of the Central Valley. To this end, the government did not hesitate to enlist the aid of newly created liberal scientific institutions – especially the IFG – whose very existence gradually came to depend on the contribution of each to the national economy. Thus, the explorations conducted by the IFG were no longer limited to expanding the botanical, meteorological or socio-cultural knowledge of the most distant areas of the country; rather, they had visibly pragmatic objectives generally associated with the government's need for information on the amount of resources and exploitation possibilities in these areas. One of these objectives was the finding of suitable routes to connect the explored regions with the Central Valley. In the criteria set down by the IFG officials, particularly by Henri Pittier, rainfall regimes were regarded as a major factor in assessments of the viability of roads or footpaths for the circulation of goods and people.

Due to the evident interest of the Costa Rican governments in a more dynamic "national economy" – understood as that reflecting the interests of the economic and political elites of the Central Valley –, rural roads, housing, and the social needs of various communities – especially those further away from the "center", not only geographically, but also socially and economically – held a marginal position in the improvised agenda of disaster relief of the Costa Rican State. This, at least, is what the sources we consulted suggest.

The scarce assistance given to the country's rural communities in facing the frequent floods is reflected in the requests for relief addressed to the central government by municipal and other local and state officials. These letters describing the difficulties experienced by these communities during the rainy season shed light on the specific character of Nature-Society relations at the local and regional level. Entire communities flooded, diseases, school attendance issues, all seem to have been a regular part of the daily life of numerous rural neighborhoods. Their representatives would clamor, on the one hand, for government aid and the institutionalization of policies to attenuate the "evils" caused by rain; on the other, they insisted on blaming these evils almost exclusively on the rain. Thus, these officials show wholesale acceptance of the principles of liberal "progress", while suffering the socio-environmental consequences of the application of those very same principles.

However, it does appear that rainfall, like other climatic factors, had an influence on property value. The sources we consulted seem to indicate that there were frequent damages to the productive infrastructure of farms and plantations, although we were unable to fully prove this working hypothesis. We have also suggested the possibility that farm owners used the legal instruments at hand to prove that any damages they suffered had been caused by exceptionally intense rainfall, to move the attention away from their scant investment in basic infrastructure on their farms. There also seems to have been a trend to over-evaluate estates with obvious natural disadvantages from a strictly economic point of view. The inclusion of local climatic features in the real estate maps of many properties, usually described in very positive terms, even in warm and humid areas far from the ideal climate of the Central Valley, seems to indicate regular recourse to this strategy.

Despite the undeniable impact of rainfall on the country's socio-economic dynamics in the period under study, a first investigation of the relation between Costa Rica's prime export crops, coffee and bananas, and precipitations seems to indicate that *statistically* variations in rainfall levels had little relation with the market trends of these products. Nevertheless, the relation between rainfall and the

number of banana bunches exported appears to be noticeably stronger than that between rainfall and coffee exports. Indeed, increased precipitation levels seem to have been decisive for the decline of banana production and marketing in some years of the study, while in others factors such as global raw material market conditions, U.S.A. inflation, land productivity, a reduction in cultivated areas, and the UFCo's own strategies aimed at artificially boosting the price of the fruit played a more significant role, particularly during the two final decades of our period.

It seems quite clear that in 1914 rainfall had a greater impact on the agro-export economy as a whole that in other years. We were fortunate enough to find qualitative data on the effects of rainfall on infrastructure as well as precipitation data for the Caribbean district for this year. The unusually severe rainfall had an undeniable impact on at least two of the country's chief export products: cacao and bananas. Apparently, the Costa Rican economy, which had already begun to feel the negative effects of the economic downturn caused by World War I, suffered the impact of precipitations not only directly in terms of diminished crop yields, but also indirectly through the damages suffered by basic infrastructure – especially roads and bridges – essential for transporting the produce to the ports for exportation, mainly to the European and U.S. markets. In sum, the available data suggests that, among the causes usually cited to explain the collapse of the Costa Rican economy at the beginning of World War I, we should also include environmental factors. Still, further studies are needed on the influence of climatic factors on the historical evolution of the Costa Rican economy if we wish to gain a better understanding of the interaction between economic systems and the natural world in this country.