

**ECONOMIC, ECOLOGICAL AND DEMOGRAPHIC
IMPLICATIONS ON THE BIOLOGICAL LIVING
STANDARD WITHIN THE MEDITERRANEAN
AGRARIAN SOCIETY: THE ANTHROPOMETRIC
EVIDENCE IN THE VEGA OF GRANADA (1850-
1936)**

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Centre d'Estudis Demogràfics

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CÁMARA, Antonio D. - **Implicacions econòmiques, ecològiques i demogràfiques del nivell de vida biològic d'una societat agrària mediterrània: l'evidència antropomètrica de La Vega de Granada (1850-1936)**

Resum: L'objectiu d'aquest treball es analitzar l'evolució de la salut i de l'estat nutricional de la població durant la primera etapa del procés de modernització a l'Espanya rural, entre mitjans del dinou i el primer terç del segle vint. Per aquest propòsit, s'utilitzen dades demogràfiques i antropomètriques considerant les implicacions dels canvis socioeconòmics i ecològics dins les estratègies reproductives de les llars camperoles. Es tracta en especial atenció, l'*input* nutricional basat en l'alimentació, així com als aspectes socials que existeixen darrera de les tendències en el nivell de vida biològic. Tot plegat s'il·lustra mitjançant un estudi de cas en el sud d'Espanya.

Paraules clau: Nivell de vida, història antropomètrica, població i recursos, segles XIX i XX, Espanya.

CÁMARA, Antonio D. - **Implicaciones económicas, ecológicas y demográficas del nivel de vida biológico de una sociedad agraria mediterranea: la evidencia antropométrica de La Vega de Granada (1850-1936)**

Resumen: El objetivo de este trabajo es analizar la evolución de la salud y el estado nutricional de la población durante la primera fase del proceso de modernización en la España rural entre mediados del siglo XIX y el primer tercio del siglo XX. A tal efecto se utilizan datos demográficos y antropométricos considerando las implicaciones de los cambios socioeconómicos y ecológicos en las estrategias reproductivas de los hogares campesinos. Se presta una atención especial al *input* nutricional basado en la alimentación así como a los aspectos sociales que existen detrás de las tendencias en el nivel de vida biológico. Todo ello se ilustra mediante un estudio de caso en el sur de España.

Palabras clave: Nivel de vida, historia antropométrica, población y recursos, siglos XIX y XX, España.

CÁMARA, Antonio D. - **Economic, ecological and demographic implications on the biological living standard within the mediterranean agrarian society: the anthropometric evidence in the vega of granada (1850-1936)**

Abstract: This essay aims to deal with the evolution of health and nutritional status during the first stage of the modernization process in rural Spain that usually is set between the middle of the nineteenth century and the first third of the twentieth century. For this purpose some demographic and anthropometric data are analyzed regarding the implication of socio-economic and ecological shifts on peasant households reproductive strategies. Special attention is paid to the *nutritional input* (feeding) as well as to the social aspects existing behind the trends in biological living standard through a case study in the South of Spain.

Key words: Living standard, anthropometric history, population and resources. 19th and 20th century, Spain.

CÁMARA, Antonio D. – **Implications économiques, écologiques et démographiques du niveau de vie biologique d'une société agraire méditerranéenne: l'évidence anthropométrique de La Vega de Granada (1850-1936)**

Résumé: L'objectif de ce travail est d'analyser l'évolution de la santé et de l'état nutritionnel de la population pendant la première étape du procès de modernisation dans l'Espagne rurale, entre la moitié du XIX^{ème} siècle et le 1^{er} tiers du XX^{ème} siècle. Pour cela, on utilise les données démographiques et anthropométriques en considérant les implications des changements socioéconomiques et écologiques sur les stratégies reproductives des foyers paysans. Il s'agit de porter une attention spéciale, à l'*input* nutritionnel (alimentation), ainsi qu'à d'autres aspects sociaux qui existent derrière les tendances du niveau de vie biologique. Tout cela est illustré moyennant une étude de cas dans le sud de l'Espagne.

Mots clés : Niveau de vie, historique anthropométrique, population et , 19^{ème} et 20^{ème} siècle, Espagne.

ECONOMIC, ECOLOGICAL AND DEMOGRAPHIC IMPLICATIONS ON THE BIOLOGICAL LIVING STANDARD WITHIN THE MEDITERRANEAN AGRARIAN SOCIETY: THE ANTHROPOMETRIC EVIDENCE IN THE VEGA OF GRANADA (1850-1936)

Antonio D. Cámara

1. Introduction

1.1. Approaching the living standard in the rural society

Along the eighteenth and nineteenth centuries, a number of European regions attended a process of economic and demographic growth with different timing and intensity. Over such a process, the improvement of the population living conditions did not follow a uniform tendency either in the whole continent or among all social classes. In particular, the security in the food supply and a suitable collective nutritional status were not reached and widespread until the first third of the twentieth century if not later. For historians, these aspects have traditionally been central issues of study mainly focused on the urban world and the working classes whereas it is still known relatively little about rural population during the transition to the industrial society (which is to neglect the living conditions of the 65 per cent of Western European population by the end of the nineteenth century.)

In some urban regions, the social and environmental disruptions caused by the spurt of industry created a somewhat idyllic image about the countryside life and “the world that had been lost”. Such a world was supposed to have been uninvolved in prices fluctuations and well supplied with food. The peasantry was associated to a self-sufficient society where an abundant feeding was guaranteed by generous fields and forests. As a consequence, a not despicable part of the rejection to the modernity, identified with cities and industries, caused that the hardness of the rural life was not rightly perceived.

Today it is well-known that the peasant communities were not such an idyllic spaces, either before or within the modern society. Although some studies show that the rural remoteness meant an advantage from the biological point of view in contexts of dense and rapid industrialization (i.e. Shay, 1994) this was not the case for the overall rural society. Being relevant these comments, the main constraint to rightly approach the evolution of rural living conditions in the past has been the well-being concept itself.

Scholars agree in indicating that the economic development can be identified neither with the human well-being nor with a natural way that necessarily lead to it. Consequently, some traditional economic indicators have lost their exclusivity in the explanation of the phenomenon. On the contrary, it may only be approached by regarding a system of interacting variables. Particularly, the study of historical populations' living standard tends to be focused on the access to diverse economic, social and cultural resources that activate and promote some reproductive strategies (Sen, 1985; Nussbaum and Sen, 1996: 17-18; Tello 2006.)

In the case of rural society, until recent, the evolution of property and farming patterns as well as the process of agrarian growth and its associated variables (production and productivity) were the issues that preferably concerned the agrarian historians under the assumption of a positive correlation with well-being. The fact is that the economic and social efficiency do not often merge. If the latter is identified with a positive evolution of the wealth distribution and the improvement of some components of well-being (i.e. health) then the relation with the economic efficiency (measured in classic terms of growth) has been historically imperfect. If in addition the environmental variable is incorporated to the analysis, the relation usually becomes reversed. For all these reasons, dealing with living standards in traditional societies has tended to integrate the implications of economic and ecological shifts on the strategies to meet basic needs.

A second assertion has been promoted after recognizing the special characters of the rural way of life. It is widely accepted that some conventional indicators like prices and real wages led up to many problems to study an economy in which trade and market were not the main ways to access to goods and services. Not to mention the particular entailment between the reproductive strategies, the social networks and the sustainability of the ecosystems where daily rural life took and takes place (Toledo, 1993; Daly and Cobb, 1993; McNeill, 2003.) In short, there is a demand for a specific theoretical and methodological framework to cope with rural society in historical

perspective. In this sense the study of the shifts in the management of resources altogether with the classic view referring to demographic dynamics are becoming a promising area to undertake in front of the *living standard puzzle* in the past rural society.

1.2. What measures and how to measure it

In my view, *living a good life* within the pre-industrial society consisted of a sufficient level of health and nutrition allowing confronting disease with some guarantee of survival. This, as well, depended on factors like feeding, hygiene, housing and labour conditions. At least before the so-called *Pasteur era*, a good part of the results in these areas were related to the availability and management of food, fuel and raw materials. The land that was the base of subsistence and socio-economic reproduction provided all of them. For this reason the agrarian activities were not only oriented to agriculture and human feeding but also to livestock breeding, the obtention of raw materials, etc.) Consequently it was not easy to vary the proportions of territory dedicated to each use. For instance, altering the vocation of a part of the territory to increase the food production could lead to suffer from a shortage of fuel or manure. This lack of elasticity affecting territorial uses was a result of the rather limited available energy in the management of the agrarian systems.

Until the end of the nineteenth century such availability highly depended on the physical and technological constraints (climate and soil conditions, transport means, fertilization means, etc.) Definitively, the crux of the peasant society stability was the capacity to get a positive energetic balance within the local agrarian system. Lacking energy sources other than organic ones, the bulk of social production depended on the agrarian sector like the only provider of food, fuel, raw materials and mechanical energy. Due to the little possibility of human intervention on the natural cycles, the capacity to accumulate some energy was equally reduced. It derived, according to Wrigley, into the main structural feature of pre-industrial way of life: scarcity¹.

Within this kind of *organic economy* (Wrigley, 1988) the growth was possible, but dramatically limited by the land productivity (related, as well, to soil and climate

¹ For instance, the main space containing energetic stocks by this time, the forest, displayed so extensive replacement terms that its use had to mainly pursue the sustainability. This way, the energetic extraction on the part of the population had to be, consequently, very limited.

conditions.) The energetic constraints also influenced decisively the volume and flow of basic products, the income increase and, therefore, the level of subsistence consumption. Only the use of new mineral raw materials would contribute to introduce external energetic inputs, releasing the land from its role as only subsistence supplier. Therefore, both the pre-industrial way of life and the evolution of living standard were mainly the result of an *energetic dilemma* affecting the *social metabolism* (Georgescu-Roegen, 1975².)

It is extremely difficult to get information in order to construct indicators referring to a so wide range of involved variables. This is the reason why *final output* indicators offer the most realistic chance to evaluate the general implications of environmental shifts on living standard. The health area has received major attention in this sense increasing the relevance of some indicators like life expectancy and anthropometrics. In the case of stature, its strength as a proxy of biological well-being comes from its quality as a synthetic *output indicator* allowing evaluating the *nutritional status* (Floud, 1991.) This feature makes it especially valuable for agrarian historians who had to cope with serious difficulties when working with *means indicators*. A good nutrition, hygiene and access to every kind of social services preventing disease would strongly contribute to rightly reach the biological potential genetically established at birth. A deficient organic energetic balance, on the contrary, would collaborate to the retardation or interruption (temporary or definitive) of the physical growth cycle³.

The success of stature complementing some other health indicators like mortality is unquestionable. The essays that have used the evolution of height to enhance the arguments of the debate on the evolution of living standards during the transition to the modern society are countless today⁴. This work aims to contribute to that debate offering some new perspectives about the Spanish agrarian growth in terms of biological well-being.

² Siefertle (2001: 41) defines the social metabolism like a system integrated by production, consumption, technique and the dynamics of population in which energy flows between nature and society.

³ Some general aspects about the nature and qualities of the indicator may be seen, among many others, in Engerman (1997), Martorell (1985), Steckel (1995), Komlos (1998) and Eveleth & Tanner (1990.)

⁴ In Spain, they have been followed one another since the middle of the 1980s due to the abundant historical data generated by the conscription process (Pérez Moreda y Gómez Mendoza, 1985; Martínez Carrión, 1986; Quiroga, 1998; González Portilla, 2001; Martínez Carrión y Perez Castejón 2002; Cámara Hueso 2004; García Montero 2005; Puche Gil, 2005; Ramón i Muñoz, 2005; Martínez Carrión y Moreno Lázaro, 2007; Cámara Hueso, 2007.)

2. Exploring the biological living standard in the Mediterranean rural society during the nineteenth century⁵

The nineteenth century remains as a controversial period in the Spanish history. The Spanish economic growth (particularly its delay with respect to other Western European countries) generated abundant literature and debate. It has been usual to write in terms of either *failure* when analyzing the Spanish industrialization process (Nadal, 1975) or *handicap* referring to the agrarian sector in particular (Tortella, 1992.) According to this view, between 1800 and 1900 the Spanish economy had grown little if it did. Some essays reviewed these first conclusions later.

Spain did not certainly follow the rates and stages of some other European countries during the modernization process. However, that during the central decades of the nineteenth century an economic development took place in Spain seems little questionable (Sánchez Albornoz, 1985b.) According to the more accepted opinion, the stage of highest growth would have been the second half of the century, particularly between 1860 and 1890 (Carreras, 1989: 538-539.) During this period, the Spanish GNP would have grown between 0.7 and 1.5 per cent depending on the estimates (Prados de la Escosura, 1992: 33.) These rates did not mean either a progressive convergence with other European countries or an improvement of living conditions for population. On the contrary, the central decades of the nineteenth century attended a serious deterioration of the biological living standard.

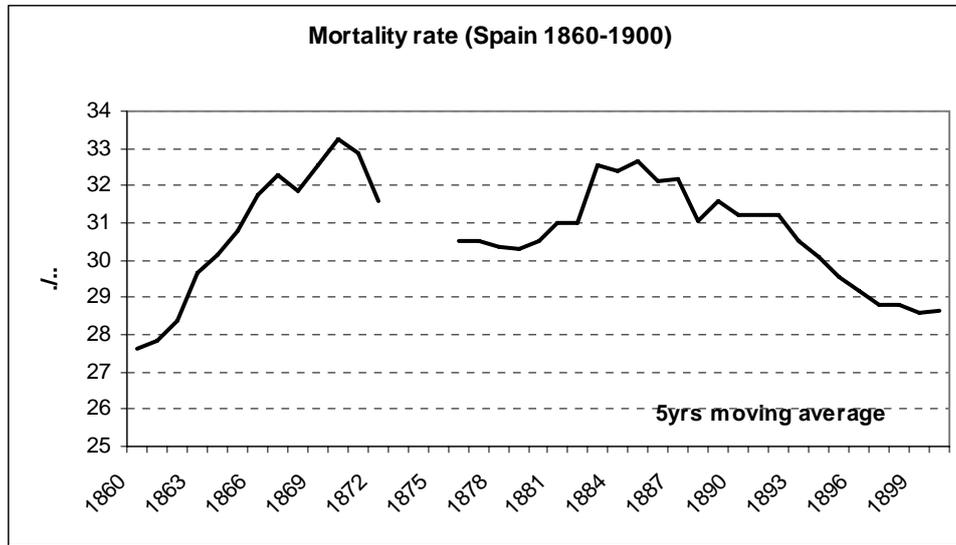
The long-term height series elaborated for different rural areas in Spain concluded a significant decline in the biological living standard during the mentioned period (Martínez Carrión y Pérez Catejón, 2002; Cámara Hueso 2004; García Montero 2005; Puche Gil, 2005; Ramón i Muñoz, 2005.) The drop in mean male height matches a general increase of mortality rates.

These facts talk about an economic growth process with *null capacity of modernization in socio-demographic terms* (Pérez Moreda, 1985.) Diverse explanations have been proposed, generally related to the effects of an increasing urbanization, the economic liberalization process and the increase of the social differentiation. In my view, in

⁵ The main data and assessments in this section follow Carreras (1989), Naredo (1971) and Sánchez Albornoz (1985.)

addition, what was happening during the central decades of the nineteenth century has to do with some previous socioeconomic and demographic shifts.

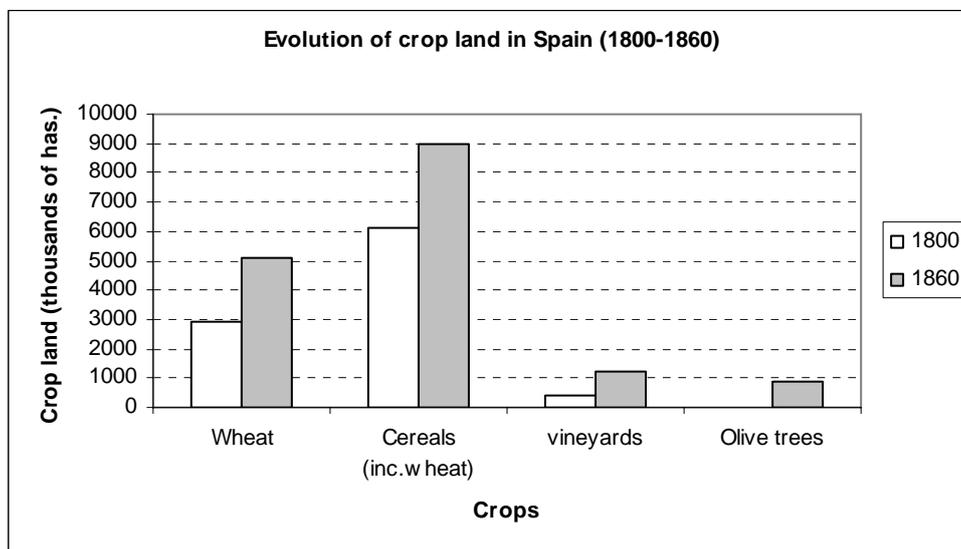
Figure 1. Mortality rate in Spain (1860-1900)



Data from Nicolau (1989)

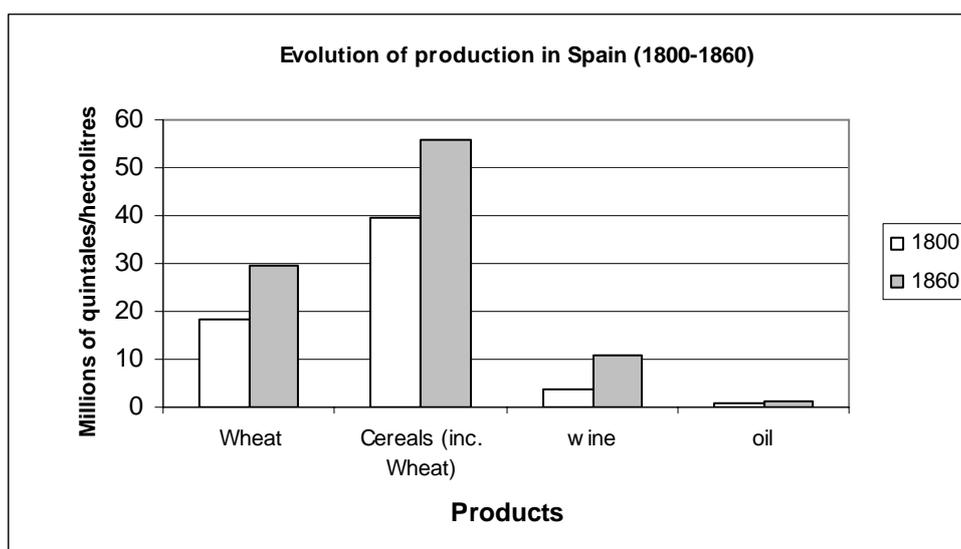
As it is well-known, Spain had attended a demographic growth process since the eighteenth century due to the reduction of the mortality crises caused by plague epidemics. Also, like in other regions of Europe, a suitable response to the increasing food needs occurred in the agrarian systems. Those where the soil and climate conditions allowed it developed new crops for livestock feeding and specialized in cash crops for human feeding. Those others under typical Mediterranean physical conditions could also experience a productive growth once the feudal and communitarian property structures were deregulated by the Enlightened and the Liberal reforms. Between 1833 and 1876, some important extensions of land previously owned by the church or the peasant communities were put up for sale. The reduction of the land prices favoured the access in the property of many peasants. The cropped area and the agrarian production increased through the new farms laboured as properties or lettings. At the same time, an important decrease of the communal spaces of pasture together with forests was happening.

Figure 2. Evolution of crop land in Spain (1800-1860)



Data from Naredo (1971:25)

Figure 3. Evolution of production in Spain (1800-1860)



Data from Naredo (1971:26)

A first outstanding consequence was a noticeable reduction of the livestock that was an important source for a suitable and nourishing diet in the traditional society and the main provider of manure. Secondly, since the vocation of the agrarian system was changing from self-consumption to commercialization, the road to a sharper social differentiation was open within the peasant communities. Finally, all these shifts implied the need to obtain some more monetary resources to pay land rents and taxes, as well as to purchase some basic products and productive inputs that previously were available thanks to the integrated use of the territory. Therefore, the new ecological scenario (in which agriculture had become greatly prevalent) have been accurately pointed out as a major determinant to explain the breakdown of the precarious stability of the subsistence peasant economy in nineteenth century-Spain (Naredo, 1971.)

As it can be observed in Figures 2 and 3, the productive increase was almost proportional to the expansion of the cropped land. Thus, the productivity levels did not substantially rise in this period. Under the conditions of an *organic energetic regime* and regarding the existent technological level, this extensive growth pattern might be exhausted by 1850 when the territories of better quality had been occupied and the limit of decreasing yields was reached. In a context of productivity stagnation and demographic growth, an imbalance between the population and the available resources could take place.

Whatever the prevalent factor considered, the peasant society arisen in Spain as a result of the process of economic liberalization displayed quite unstable bases from the reproductive point of view by the middle of the nineteenth century. Obviously, the most exposed sectors were the small owners and tenants who obtained an ideal complement of rent and diet from an integrated use of the resources.

3. A case study from the south of Spain: the *Vega* of Granada

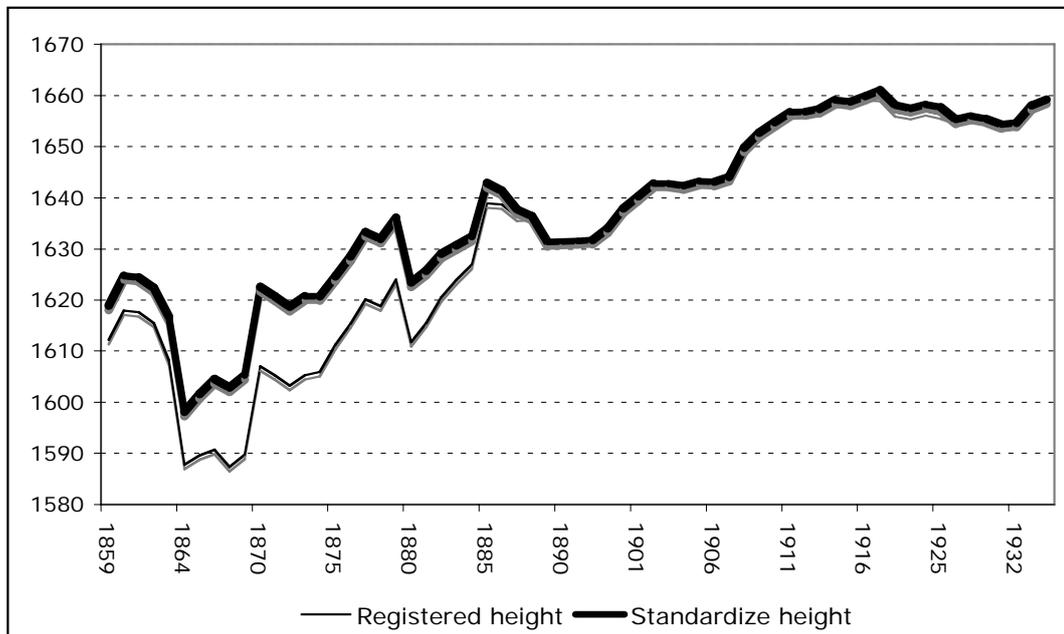
3.1. Data and methodology

Most of the data presented next are from the capital municipality of the county of *la Vega*: Santa Fe. The ecological context is approached through the shifts in the management of the local agrarian system: the progress of agricultural use, the expansion of irrigated land and the evolution in the fertilization systems. The economic aspects are

illustrated by some data on local agrarian production. The evolution of population have been reconstructed through national and local censuses (Cámara Hueso, 2007.)

The biological indicators (mortality and stature) have been elaborated with data from the Parish Books, the Civil Register, the Local Recruitment Acts⁶ and the Province Recruitment Books. In the case of heights they have been standardized at age 21 applying a regression model to supersede the handicap of the age variations in the Spanish recruitment laws (Cámara Hueso, 2007.⁷) This way, the interpretation of trends may be exclusively done in environmental terms.

Figure 4. Height standardization at 21 Five years moving average (Santa Fe, 1857-1936)



Data: Local Recruitment Acts and Province Recruitment Books

⁶ For some detailed information on the Spanish recruitment sources see Cámara Hueso (2006) and Martínez Carrión (2001.)

⁷ The regression model was based on 600 recruitment records from Montefrío and Santa Fe (both municipalities belonging to the province of Granada, Eastern Andalusia) ranging from ages 14 to 40 between 1771 and 1837. They were excluded both heights under 1400 mm. and those ones over 1725 mm. (percentiles 10 and 90 respectively.) The results showed a strong influence of age in the stature until 19 and smoother from 19 to 21. The correlation presented little significance from age 21 onwards. Thus, a hypothetical final age of physical growth was established at 21. During the analysed period (1857-1936) the recruitment age ranged from 19 to 21. Hence, the standardization was finally applied to the heights of Santa Fe's recruits aged 19 and 20. That means that the main stage of physical growth have been completed and the estimates are presumably more accurate.

Recruitment at 21 was definitively established in Spain in 1907, which also protect the regression model from a likely change in the physical growth pattern between the nineteenth and the twentieth century. Although the model does not include a class variable (which undoubtedly influence the *growth tempo* of individuals) the results are coherent with the auxologic theory as well as with some results from scholar's previous works (Floud, 1994: 22.)

Finally a study of the height distribution allows obtaining some conclusions about the social aspects involving the trends in biological living standard in Santa Fe. The location of recruits as infants or children in local censuses get more coherence between the cohort approach applied by the anthropometric history and the distribution of health and nutrition by social class. The task of location of recruits in their infancy environment is not easy. However, once located in the local census, the conclusions obtained by the anthropometric study are surely more solid than those based on the recruits' professional status at the age of recruitment.

3.2. Basic demographic and productive characters until 1850

On the West of the town of Granada lies the Valley of Genil River that is the main tributary river of Guadalquivir (the latter crosses the South of Spain from East to West.) This extension of low-lying fertile land around Granada is known as “*Vega*” (term that will be used here referring a land usually close to a river and specially suitable for crops, instead of “valley” that has a slightly different meaning in Spanish.) The *Vega* was an ideal territory to practice the agriculture since ancient times. Although the area is affected by an extreme climate generated by the proximity of the Beticas Mountains, this handicap is compensated by a great hydrological wealth and the smoothness of the relief. Both latter elements favoured an early expansion of the irrigation reaching a special development in Muslim times.

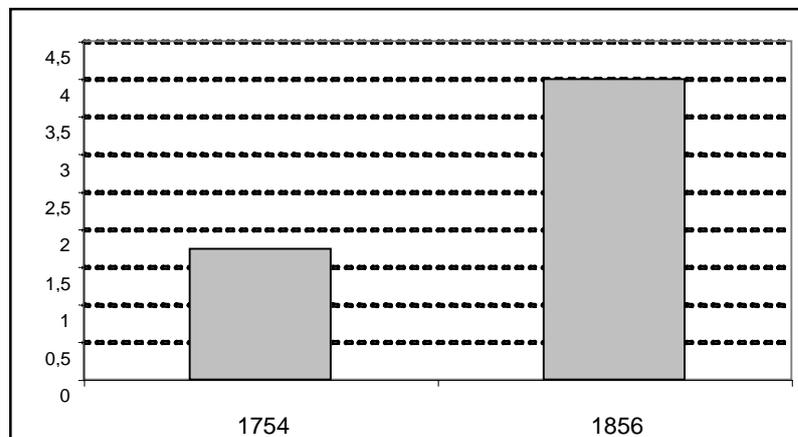
During the last years of the Christian conquest, at the end of the fifteenth century, the reign of Granada and particularly the surroundings of the capital city, became the main refuge for thousand of Muslims expelled from their old territories. The population of the *Vega* is estimated in no less than 75000 inhabitants by that time what meant an extremely high population density (Martínez Rodríguez, 1982: 66.) This circumstance altogether with the natural advantages, would have invited to practice an intensive agriculture supported by the irrigation and the application of alternative and novel crop systems.

The well-established *irrigation culture* undoubtedly favoured that some productive alternatives to the traditional *cereal system* were put into practice by the middle of the eighteenth century. For instance, an early cash-crop specialization took place through the farming of linen and hemp to satisfy the demand of some products such as sails and

rope on the part of the Spanish Navy. Anyway, the main crops were wheat and barley. Some crops oriented to self-consumption like olive trees and vineyards were also farmed.

Like in the rest of Spain, between 1750 and 1850, the agrarian system of Santa Fe experienced a general increase of the cropped land reducing meadows and pastures. What was new here with respect to the overall country was the spread of irrigation, particularly on high quality lands and farm of all sizes. It opened the possibility of intensifying the crop yields reducing the fallow lands. (Martínez Martín, 1995: 25-47.)

Figure 5. Agrarian production estimates (million of kilograms) Santa Fe, 1754-1856



Data from González de Molina y Guzmán Casado (2006: 76 y 103)

A not despicable productive increase took place between 1750 and 1850. The agrarian production doubled and the population grew in very similar proportions (from 2400 to nearly 5000 inhabitants.)

During the process of economic and demographic growth the viability of the small peasant farms was not menaced. On the one hand there was still land enough to undertake an extensive agrarian growth process avoiding an excessive farms subdivision. On the other, the improvement of the irrigation system allowed to increase the productivity levels of both large and small farms. This way, even the small peasantry might maintain the access to high quality lands through purchasing or letting,

facing the progressive privatisation and enclosure process (Gómez Oliver y González de Molina, 1983.⁸)

This rise of the agrarian production altogether with the increase in the access to the direct farming should have collaborated to improve the population's living standard through either a higher monetary income (in the case of cash crops) or a higher availability of domestic food consumption (in the case of self-sufficiency oriented crops.) Consequently, what would have been expected is a higher effectiveness confronting illness and death even though the epidemiological context did not experience significant changes. On the contrary, the process of economic growth did not favour an improvement of the community biological living standard according to the indicators of stature and mortality.

3.3. The evolution of the biological living standard

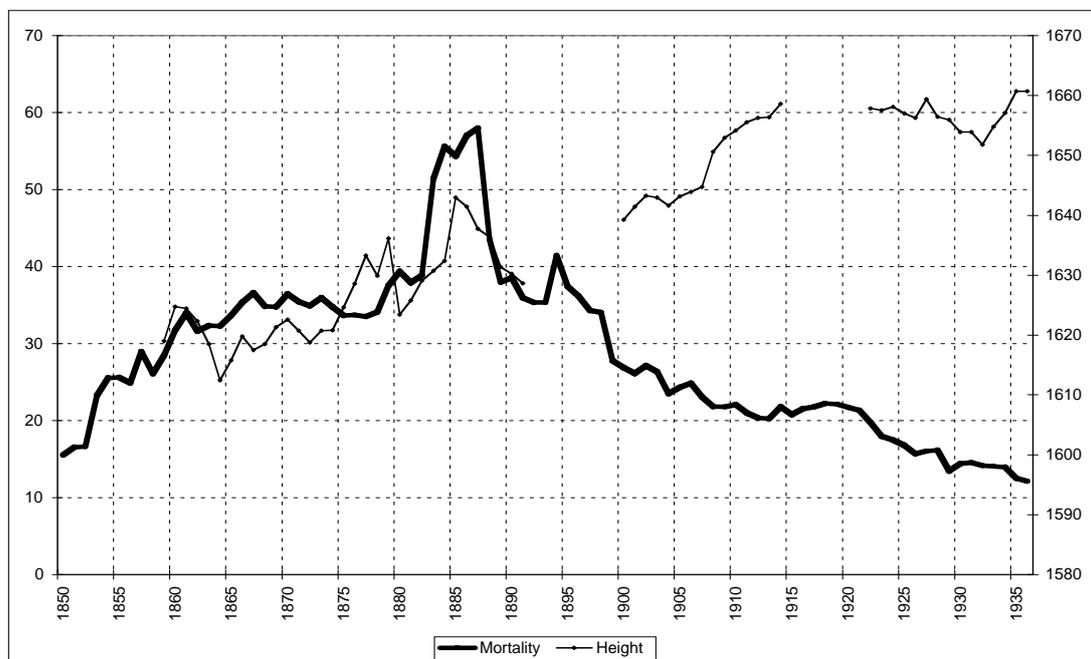
Between 1857 and 1936 the mean height of the Santa Fe's young males rose over 4 centimetres what indicates a clear improvement in the nutritional status of the population in the long term. However the gains along the period were not equally distributed but concentrated during the last decade of the nineteenth century and the first decade of the twentieth century. Between 1890 and 1915 the male mean height improved more than 3 centimetres. On the contrary, both anthropometric and mortality data indicates a worsening of the biological standard of living during the central decades of the nineteenth century during the stage of agrarian growth still under the conditions of an organic economy in Santa Fe (Figure 6.)

The tendency absolutely agrees with the Spanish series (Figure 1.) The mortality levels suffered by Santa Fe's population during the second half of the nineteenth century are nearer to a pre-modern demographic regime than to one in transition towards the modern society. The worst results must be partly explained by the incidence of serious cholera epidemics usually merging with sharp economic crises. Considering the annual anthropometric data, the most critical moments for the nutritional status of the population correspond to the principal subsistence crises occurred in Spain during the

⁸ This is an important specific character of some areas in Eastern Andalusia with respect to the Western part where *latifundios* (large properties) and *jornaleros* (casual labourers) prevailed. In any case, in the Andalusian region as a whole, the land proprietors raised from 38.4 per cent at the end of the eighteenth century to 78.8 per cent by the middle of the nineteenth century (Tedde de Lorca, 1985: 306.)

second half of the nineteenth century (Figure 7.) They were caused by both poor harvests and serious distribution failures deriving into a sharp rise of prices for the main basic products. The minimums in the annual series are detected in 1857 and 1882 matching two of these crises (Sanchez Albornoz, 1963.⁹) That is to say until the end of the nineteenth century the slight increase of mean height took place in a context of little stability of population biological living standard (the annual variations in the anthropometric series were higher than 5 centimetres in some cases.)

Figure 6. Mean height (mm.) and Crude Death Rate (per thousand). Five years moving averages Santa Fe (1850-1936)

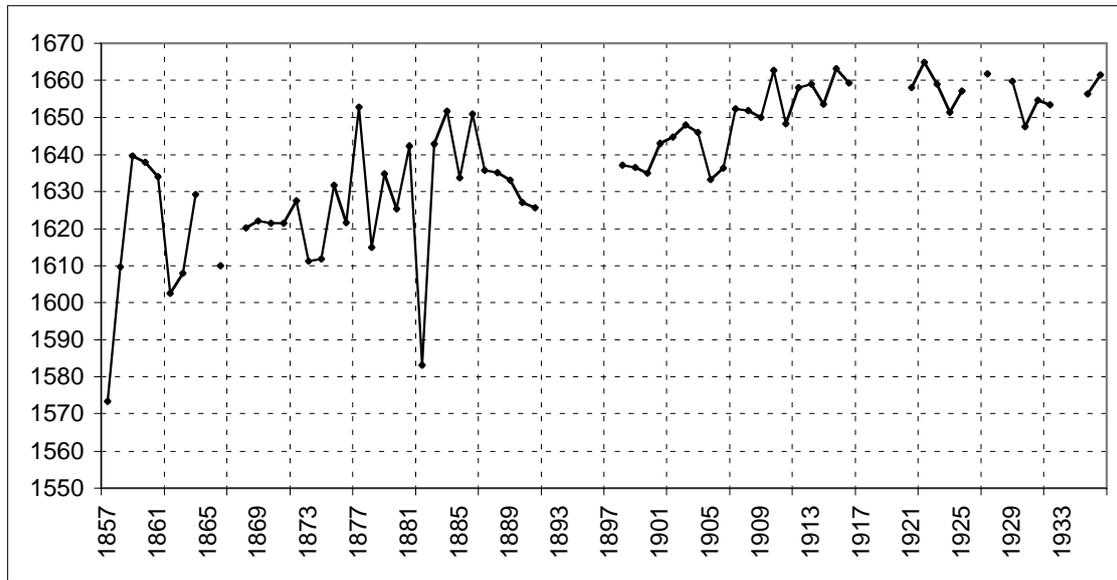


Heights: Provincial Council Historical Archive (Recruitment Books of the province of Granada, 1877-1921) and Local Historical Archive of Santa Fe (Local recruitment books, 1922-1957)

Mortality: Santa Fe Parish Archive (Deceased books, 1850-1900); Civil Register of Santa Fe (Deceased books, 1900-1936); Local Historical Archive (Local Census, 1850-1936)

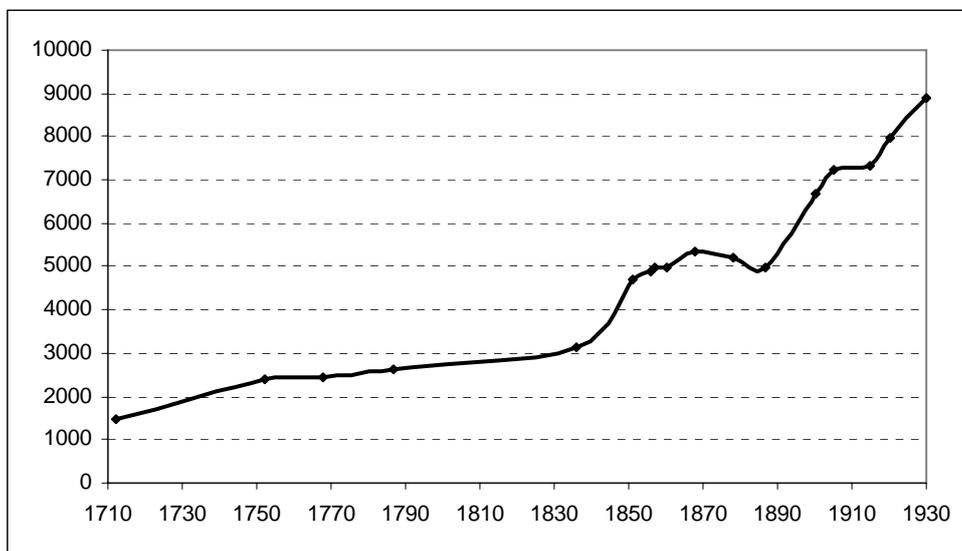
⁹ The anthropometric data for 1867-68 have not been included due to the low number of valid cases (ten.) Nevertheless, note that another sharp annual drop happened matching the economic crisis that year.

Figure 7. Annual evolution of male mean height (birth year and mm.) Santa Fe, 1857-1936



Data: Local Recruitment Acts and Province Recruitment Books

Figure 8. Evolution of population in Santa Fe (1712-1930)



Data: Censo de Campoflorido (1712) Catastro de Ensenada (1752), Censo de Floridablanca (1787) and Local Census for the rest of dates

The point is that those crises are not enough to understand the deep biological deterioration cycle clearly drawn by the middle of the nineteenth century. In my opinion, like in the Spanish case, some demographic implications were surely behind the intensity of the drop in the biological living standard.

As shown in Figure 8 the local population goes off matching the reduction of subsistence means as a consequence of the culmination of the liberal policy (enclosure, privatization and taxation on basic subsistence products.) This causal convergence would have implied that the monetary gains provided by the local productive system failed in meeting the collective nutritional needs.

Note for instance the severe reduction of the domestic livestock oriented to self-consumption, particularly goats and pigs (major providers of meat and milk and consequently, caloric stock sources for peasant households.) It was decreasing in favour of the labour livestock to cope with the rising force needs associated to the agricultural specialization process (González de Molina, 2001: 113.)

Table 1. Evolution in the composition of the livestock (heads and heads *per capita*) Santa Fe, 1752-1913

	1752	1856	1860	1876	1904	1913
Mules	51	131	140	97	150	240
Horses and colts	118	141	173	38	83	77
Asses	25	14	23	11	23	6
Cattle	79	44	86	87	101	181
Sheeps	1413	250*	1000	1025	1000	939
Goats	298	47	51	31	51	1035
Pigs	625	-	200	10*	200	-
	per capita					
Mules	0,021	0,027	0,029	0,019	0,021	0,033
Horses and colts	0,049	0,029	0,036	0,007	0,012	0,011
Asses	0,010	0,003	0,005	0,002	0,003	0,001
Cattle	0,033	0,009	0,018	0,017	0,014	0,025
Sheeps	0,593	0,051	0,208	0,200	0,140	0,128
Goats	0,125	0,010	0,011	0,006	0,007	0,141
Pigs	0,262		0,042	0,002	0,028	

Livestock: 1752 y 1876 (Cámara Hueso, 2007); rest of references (González de Molina and Guzmán Casado, 2006: 260, 107, 133 y 266.)

Population: Local and National Censuses (intercensal populations from Cámara Hueso, 2007.)

(*) Livestock is likely to be underestimated

Domestic livestock enlightened

This shift affected the access to nutrients since many small peasant and casual labourers' households did not have monetary resources enough to acquire them in markets. Consequently the change in the agrarian system vocation (from self-

consumption towards market demands) altogether with the demographic growth would have prevailed as main determinants to limit a sustained progress in the community nutritional status. A recent work supports the hypothesis of the structural crisis of mid nineteenth century since the first anthropometric data for previous period are being released (Cámara Hueso, 2007.) These data evidence that the generational physical growth occurred at the end of the nineteenth century would probably have compensated a previous decline trend.

Table 2. Mean height of soldier-declared male Santa Fe, 1777-1866

Birth cohort	Valid cases	Mean height
1777-97	12	1683
1798-1818	29	1685
1845-65	64	1678
1856-66	166	1674

Data: Province Recruitment Books. Heights reaching 1625 mm. at least¹⁰

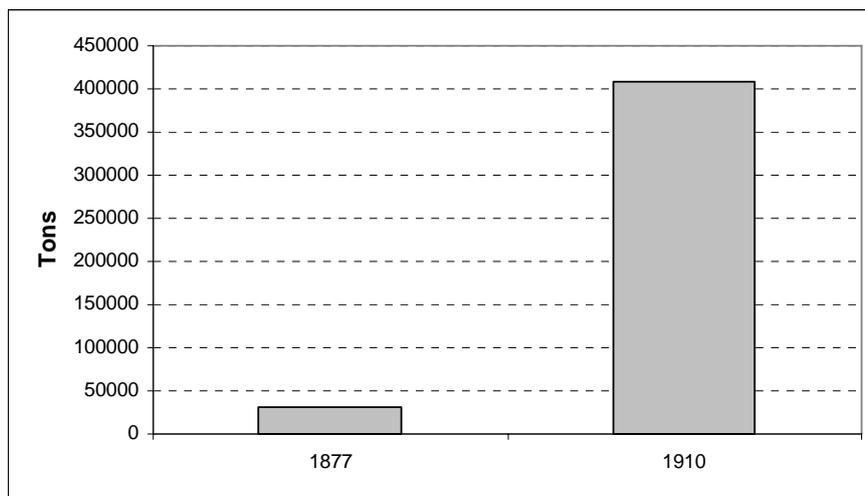
It must be noticed that establishing a constant minimum of 1625 mm. implies that a good part of heights belongs to the two highest quartiles of the height distribution. Regarding that the principal loses of communitarian mean height took place within the lowest quartiles, it means that the decline might be much more intense than what is shown in Table 2 between the end of the eighteenth century and the central decades of the nineteenth century.

As it is clearly perceived through the biological indicators, the twentieth century opened a new panorama for the health and nutritional status of the population (Figure 6.) The fact is likely to be related to the improvement of the conditions of hygiene as well as to some advances in the medical field. Nevertheless, in addition, it has to be connected with the improvement in the nutritional status of the population through the benefits reported by some more satisfactory levels of caloric and protein intake. In my opinion,

¹⁰ 1625 mm. was the minimum height required to be enrolled during the eighteenth century.

this last factor was favoured by the rise in productivity of the agrarian systems when some alternatives to the organic regeneration of nutrients began to be available. The development and the improvements in the means of transport and the drop in their costs allowed the import of mineral fertilizers like nitrates coming from Peru or Chile. Later, the phosphates will also be introduced as the alternative to the difficult natural regeneration of nitrogen (McNeill, 203: 51-52.)

Figure 9. Import of chemical fertilizers Spain (1877-1910)

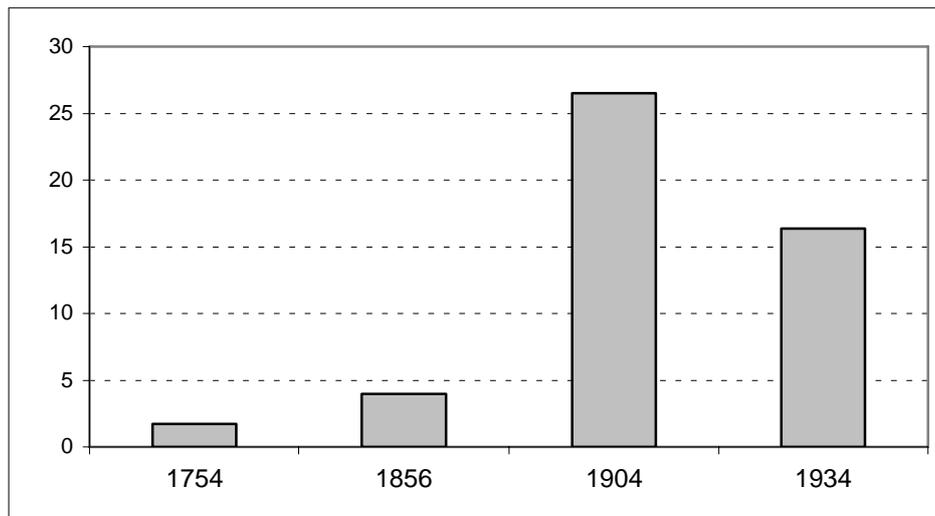


Data from Plaza Prieto, cit. in Naredo (1971: 32)

In Italy, the consumption of chemical fertilizers experienced a very similar trajectory during the two first decades of the twentieth century (Galassi and Cohen, 1992: 149-150.)

In Santa Fe a sustained productive increase was taking place since the middle of the eighteenth century (Figure 10.) In addition since the middle of the nineteenth century some alternative fertilizers, like guano, were being applied in the *Vega* of Granada. However, the outcomes were quite modest until the end of the nineteenth century when a productive revolution took place thanks to the impressive magnitude reached by the chemical fertilizers. The new crops developed under the new energetic conditions were the sugar beet and the tobacco. Both of them successively reach unprecedented productivity levels within the local productive system.

Figure 10. Agrarian production estimates (million of kilograms) Santa Fe, 1754-1934



Data from González de Molina y Guzmán Casado (2006)

The sugar beet meant an alternative in face of the generalized fall of the prices of traditional agrarian products¹¹. During the first decade of the twentieth century the crop extended to a third of the total agrarian acreage of the *Vega* and the associated industrial sector was working to full capacity. These circumstances collaborated in explaining the correction of the original socio-economic imbalances caused by the first stage of the agrarian Capitalism in Santa Fe.

Obviously the sugar beet was not a direct source of nutrients for human consumption but the economic benefits grew exponentially and the agrarian wages increased considerably due to the labour force demand. According to Martín Rodríguez (1982), they rose between 33.3 and 50 per cent between 1883 and 1903 in the *Vega*, whereas the general prices index remained almost invariable in Spain. Immigration and the decrease of mortality caused another demographic spurt in the *Vega* but the new productive conditions allowed supporting a risen population without any serious risk of agrarian failure and chronic undernourishment like in the previous period. The progress reached by the stature between 1905 y 1916 had probably no precedents in Santa Fe contemporary history.

¹¹ Although the first harvests were obtained at the beginning of the 1880s, by 1889 the crop still occupied only 250 hectares (the crop acreage of the *Vega* was of 20000 hectares by this time.)

The fact to point out is not only the positive progress of the stature but also, particularly, the reduction in the annual variations (Figure 8.) This aspect informs about the consecution of a relative stability in terms of collective nutrition. The crises kept on happening but their intensity was clearly lower.

Nevertheless, the decade of the 1920s lived a new stagnation and even a decline of the stature. Two possible explanatory factors may be discussed. Firstly, the general economic crisis that often implied a productive restructuring at the local levels. This explanation would be supported by the results of the mortality rates that show a slight increase by the first half of the 1920s. Within a new local economy with a high degree of commercialisation, the importance of salaries and agrarian prices became decisive for the nutritional status of the population. Being so, the crisis of sugar beet could strongly beat to households dependent on salary. By 1930, the acreage of the sugar beet had declined from 350 to 123 hectares only in the municipality of Santa Fe.

Secondly, if it is assumed that the physical growth cycle goes beyond the age of 18 in Spain by this time (until 20 or 21 at least), the cohorts that experienced the height stagnation during the 1920s were those that also lived their last growth years during the Spanish Civil War and the first post-bellum period. Thus they could suffer from a *late stunting effect*.

The next rising trend shown by the stature merged with the economic activation promoted by the establishment of a new industrial crop (the tobacco), not to mention the recovery of some traditional self-consumption crops like potatoes and vegetables. Hence, the first half of the 1930s was characterized by an improvement in the biological living standard of the community carrying the mean height out to 1.66 m. just before the Spanish Civil War.

3.4. First social explorations behind the anthropometric data

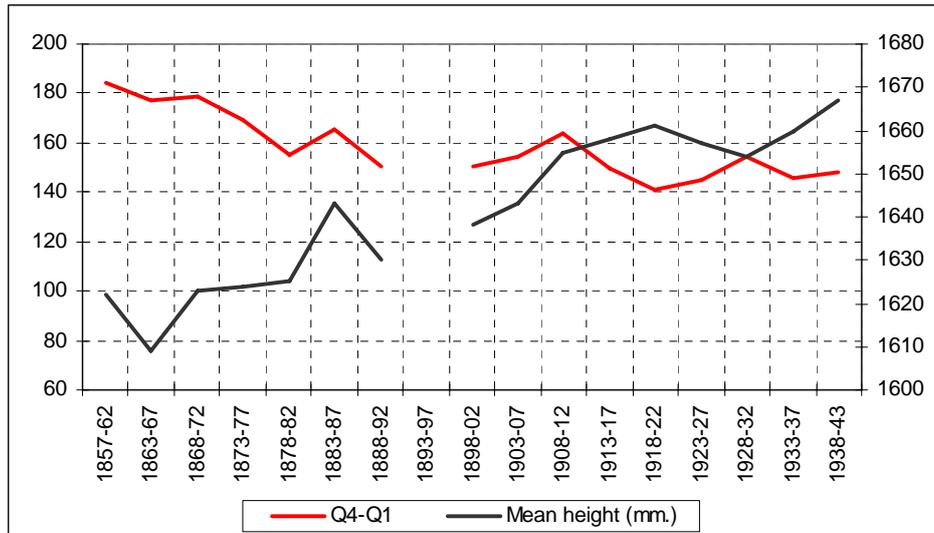
According to the height distribution presented in Table 3, during the analyzed period the variations in stature within the first quartile were much more higher than those occurred within the upper one. The differences were especially relevant during the decline cycles of mean stature. Consequently it may be assumed that the drops of height were not equally distributed, being some sectors of the population who especially suffered the consequences of the nutritional imbalances.

Table 3. Statistical distribution of height Santa Fe, 1857-1943

Birth cohort	Valid cases	Q1 (mm.)	Q4 (mm.)	Q4-Q1	Mean height (mm.)	Std. Deviation
1857-62	281	1535	1719	184	1622	77,21
1863-67	106	1532	1709	178	1609	72,19
1868-72	245	1544	1723	179	1623	70,02
1873-77	290	1534	1703	169	1624	73,55
1878-82	260	1551	1706	155	1625	61,76
1883-87	293	1547	1712	165	1643	63,24
1888-92	251	1556	1706	150	1630	54,71
1893-97						
1898-02	376	1562	1713	151	1638	58,5
1903-07	387	1562	1716	154	1643	63,12
1908-12	392	1564	1728	164	1655	74,85
1913-17	253	1579	1729	150	1658	58,45
1918-22	160	1588	1730	141	1661	55,02
1923-27	329	1586	1731	145	1657	58,55
1928-32	335	1574	1728	154	1654	61,18
1933-37	235	1586	1732	146	1660	57,26
1938-43	465	1594	1742	148	1667	57,81

Data: Mentioned sources. Q = Quartile

Figure 11. Male mean height by birth cohorts (mm.) Santa Fe, 1857-1943



Data from Table 3 (Mentioned sources)

It is difficult to determine the total proportion of yeomen and major landowners (*labradores*) among population because the defining criteria shifted over time in the local sources. A first estimate for the municipality of Santa Fe identify as *labradores' households* to no more than 10 per cent of the households directly entailed to the agrarian activity along the analyzed period. Note this proportion is rarely maintained in the social filiations of the shortest recruits (Q1, where usually yeomen's sons are underrepresented) and even less significant for the tallest recruits (Q4, where they are clearly overrepresented.) The presence of yeomen's sons among the well-nourished recruits is a constant and reaches very high levels during the periods of nutritional crisis for the community.

On the contrary, the socio-biological base (peasants' and *jornaleros'* sons) manifested a much higher exposure in front of the nutritional decline cycles, particularly during the central decades of the nineteenth century (Figure 12.)

A convergence process can be appreciated since the last two decades of the nineteenth century merging with the first transition towards an industrial economy (Table 3.) The new energetic sources, as well as the new crops themselves, early became the key factors to explain a rising demand of labour as mentioned before. Even though the local productive system had moved away from its original vocation to satisfy the local

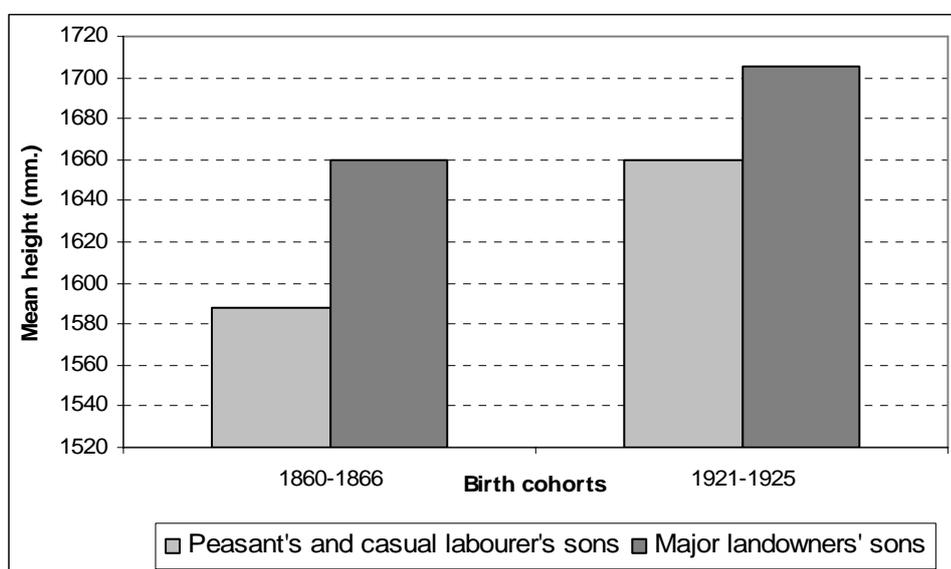
consumption needs, the *social character* of the new industrial crops (high demanders of manual labour) produced some collective benefits.

Table 4. Fathers' recruits social status for agrarian activities (per cent)

	Q1		Q4	
	Yeomen	Peasant/labourer	Yeomen	Peasant/labourer
1857-67	6	94	31,65	68,35
1883-93	13,15	86,85	29,8	70,2
1918-28	3,95	96,05	15	84,95

Data: Local Recruitment Acts, Province Recruitment Books and Local Censuses. Q = Quartile

Figure 12. Comparative evolution in height according to social filiations in Santa Fe



Data: Local Recruitment Acts, Province Recruitment Books and Local Censuses

To some extent, the rise of agrarian wages favoured a process of wealth distribution improving the agrarian working classes situation. The small peasant as well as tenants under old lettings and *jornaleros* benefited from the development of the new highly

profitable cash crops. In the case of the sugar beet, the parallel development of an integrated industrial sector (sugar and alcohol production) reinforced the labour supply. Also, a context of integration of the national food markets and the improvement of purchasing capacity on the part of the local social base could favour the access to a more abundant and diversified diet (an ongoing research at this moment.)

5. Conclusions

The first stage of the agrarian Capitalism in Spain occurred within the physical constraints framework imposed by an organic economy. Meeting human needs depended on the nearby natural resources, the productive capacity of the Mediterranean agro-ecosystems and the balance in land uses. The breakdown of this balance in a context of demographic growth often caused distortions in the peasant households' reproductive strategies that consequently could derive into a deterioration of some living standard components. This fact contributes to explain the paradox of the biological living standard collapse merging with both an agrarian growth process and a mercantile expansion within rural society.

The progressive agricultural specialization affected some traditional subsistence strategies either reducing some means or limiting some practices. The new adaptive strategies became highly dependent on the market as prevalent provider of resources. During this initial stage, until the end of the nineteenth century, having no energetic resources to intensify the agrarian output, these changes caused the greatest structural crisis in the biological living standard of Spanish rural population. Such a crisis merged with extreme different biological answers that accurately represent the asymmetric social cost of the agrarian growth process.

Basically, the recovery and convergence of the biological living standards in rural Spain took place within the context of a different energetic regime that guaranteed the accumulation of capital and energy. Only the energetic contribution of mineral fertilizers could compensate the original imbalances created in the relation among population and resources. In the case of Santa Fe, this new ecological scene and a high labour force demand would have made possible that the most impoverished social groups could start to reach the minimum level of nutritional sufficiency.

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