

## Arab Islamic Contribution to Agriculture in Andalusia: 129- 407 A.H. / 746-1016 A.D.

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### ABSTRACT

The agriculture emerged as a buoyant component of economy of Islamic Andalusia. Prior to the advent of the Islamic conquest of the region, agriculture was being managed on the old Roman pattern. The Arab Muslim rulers introduced and encouraged new patterns of crops like wheat, cotton, fig etc. and also introduced new means of irrigation, particularly the noria system. Plantation of olive was also encouraged. Increased agricultural production not only boosted the economy of Andalusia but also proved instrumental in transforming the dietary habits of the native population, comprising Muslims, Christian, Neo-Muslims etc. Improved agricultural conditions in Islamic Andalusia helped not only in providing a fillip to the local economy but also impacted upon the socio-economic conditions of the people in terms of providing more employment, increasing exports and improving dietary habits of the people of Islamic Andalusia.

**Keywords:** Andalusia, The Economic in Andalusia, The Agriculture in Andalusia, The Arab Muslim, The Roman pattern, The Islamic Andalusia.

### 1. INTRODUCTION

Undoubtedly, Baltasar Gracián, in his description of Spanish society of the seventeenth century as "just as God created her, without a single improvement made by her inhabitants, except for the small amount of work done by the Romans,"<sup>1</sup> was perhaps expressing a perception of the immobility and stagnation of Spanish society of that period. However, Gracián was mistaken because the Spanish cultural landscape of that period had largely been created during the early Middle Ages, as the result of the Islamic conquest and of the early modalities of Christian settlement. The Muslims built landscape in the south on a Roman base, which was substantially orientalized.

It is noteworthy that the outstanding image associated with Arabic literary perceptions of Andalusia is that of the Quranic paradise. Famous historian al-Razi's description of Andalusia's natural endowments like numerous rivers which allowed widespread irrigation, a salubrious climate, good wines, and great mineral wealth

etc., had led certain authors to say that "Spain resembled God's paradise". The semblance of highly developed irrigated sectors of the Valencian huerta surrounding the city led more than one poet to describe the city as paradise.<sup>2</sup>

The emblematic worth of the formal Islamic garden was as an earthly anticipation of paradise. Allusions to water, shady trees, and flowers, which are contents of a beautiful garden, were dictated by a generalized reaction to the desert environment, the traditional environment of Arabs, one that is dominated, of course, by aridity and conditioned by associations of the desert with fear and evil.<sup>3</sup> It is interesting to note that desert images, a traditional theme in Arabic poetry, are almost completely missing in Andalusian poetry, except as a device to introduce, for example, the paradisiacal, watery freshness of a place like Valencia.

Identical ecological settings made the Arab migrants in Andalusia to establish themselves in new territories without substantially changing their settlement patterns, agricultural regimes, or diet. Al-Himyari likened Andalusia to Syria in fertility and "the purity of its air," to the Yemen for its even, temperate climate, to India for its aromatic plants, to China for its mineral richness, and to

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Aden for its seashore economy.<sup>4</sup> In the aftermath of the Islamic conquest of Andalusia, there occurred extensive Syrianization of the landscape throughout the eighth century. Settlement of Syrian *junds* or contingents in places like Seville and Valencia; the wholesale importation of Syrian styles, introduction of Syrian agricultural systems, of hydraulic machinery used in Syria, of Syrian building techniques and decorative motifs, the deliberate importation of vegetation native to Syria were among the many discrete measures that contributed to the Syrianization of Andalusia.

## **2. Agriculture Prior to Islamic Conquest**

Agriculture was distinguished for the large-scale production of cereal grains, olives, and grapes, of which olives and grapes were specifically grown in large units for export during the Roman occupation of Spain. However, increasing predominance of irrigation agriculture under the Romans resulted in the relegation to background of other agriculture sectors like dry-farming, arboriculture, and herding. Accordingly, there followed a progressive retreat of wheat cultivation. Under the Islamic rule in Andalusia, the balance among the agrarian sectors and its contours were partially decided by ethnic cleavages on ecological lines. The fertile lowland areas were reserved for the Arabs and their Neo-Muslim or Christian tenants for the development of hydraulic agriculture; the Berbers maintained a pastoral and arboricultural economy in the mountains; and cereal dry-farming was continued by the indigenous population.<sup>5</sup>

The agricultural regime in the Islamic Andalusia was a phenomenon explicable not merely in economic terms alone but as the result of complex processes of acculturation and cultural diffusion. The increasing reliance on irrigated agriculture to support the expanding urban economies of the great Andalusian cities, led to a vast movement of acculturation and dry-farmers became irrigators through the learning of new techniques and, acquired through emulation of the dominant group's lifestyles, different dietary and culinary tastes.

## **3. The Muslims and Irrigation**

In the Islamic Andalusia, emphasis was laid on urban water supply projects, such as the canalization of water from the Sierra Morena to supply the Mosque of Córdoba, built at the behest of the caliph 'Abd al-Rahmân III.<sup>6</sup>

Viewed in a broad spectrum, irrigation systems influence the power structure not through administrative or labor requirements but, through the production of local

surpluses which are then converted into tokens of power and prestige in the extralocal world. It seems immaterial as to who controls the water-source but what is important is who gets the benefit of agricultural surpluses produced as a result of irrigation-intensive agriculture. In the Islamic world the process of conquest and colonization nudged stagnant local economies, put money into circulation again, and caused a price rise that provided a real spur to the development of craft trades and thus to urbanization. The beneficiaries of this development, as Lombard puts it, the urban merchant class, were soon able to purchase land in the surrounding countryside and thus to establish a real dominance of the towns over the countryside.<sup>7</sup>

Broadly speaking, this process was responsible for the creation of the typical urban-huerta landscape, a town surrounded by a belt of fields irrigated either from gravity-flow canals or by means of wells tapped by animal-driven hydraulic wheels. Spurred by economic growth and reinforced by technological innovations, the process was self-perpetuating unless interrupted by a major economic catastrophe. Andalusia managed to avoid the decay which had begun to afflict other areas of the Islamic world as a result of the disruptions of the eleventh century.

There were two kinds of irrigation systems in Andalusia, although the huertas resultant from their development were quite similar both in structure and in economic function. In first category included systems where individual fields were served by canals bearing water delivered by gravity flow either from a river or from a spring. Secondly, there were other huertas where individual fields were served by wells, with the water raised to the height of the fields by an animal-driven hydraulic wheel. In addition, fields could be watered by current-driven wheels, lifting water from a river or a canal, combining the two modes.

Apart from harnessing the specific technologies, these irrigation systems were also characterized by the manner in which water was distributed to the users. There is very little documentary evidence surviving from the Islamic period in Andalusia and therefore perceptions about the irrigation arrangements followed in the Islamic Andalusia are based on the rich documentation surviving from the centuries after Christians had taken over the systems, preserving Islamic customs, and from comparative study of traditional irrigation systems in contemporary Islamic countries.<sup>8</sup>

The distribution of water among the eight canals of the Valencian huerta was associated with a specific Islamic model. The river, now called by its Roman name the Turia, but in Islamic times known as the Wād al-Abyad (Guadalaviar, "White River"), was considered to be divided into successive stages, each stage representing the point of derivation of one main canal which drew all the water at that stage, or of two canals, dividing the water among them. At each stage the river was considered to hold twenty-four units of water. The twelve-base system is standard in many areas of the Islamic world and is clearly related to the hours of the day. A paradigmatic system, so structured, would envision a river divided into 168 units (representing seven days and nights, or 144 if a day of rest was customary).<sup>9</sup> The units were not, however, expressed in hours, but as simple proportions of a whole. Thus, in times of abundance, each canal drew water from the river according to the capacity of the canal; in times of drought, the canals would take water in turn, for a commensurate number of hours or a proportional equivalent.

#### 4. The Noria Revolution

The introduction of the noria in any district had salutary impact upon agricultural productivity. In Andalusia, water-driven wheels were found in conjunction with canal systems in Murcia, where the mammoth wheel at La Nora was driven by the current of the Aljufia canal, and most typically in Toledo, described by al-Idrisî, in twelfth century, as having around it gardens interlaced with canals on which were established wheels for irrigation, and Córdoba, where al-Shaqundî (thirteenth century) described 5,000 norias (probably including both lifting and milling devices) on the Guadalquivir.<sup>10</sup> In the ancient Mediterranean world, generally only winter crops were grown, with each field yielding one harvest every other year. The Arabs introduced a variety of new crops of Indian origin. (of which the Andalusian agronomists were fully aware - al-Tignarî of Granada makes reference to "Indian agriculture"). As these crops required heat, they were grown in the summer. Thus a rotation of crops became the norm, and irrigated fields yielded as many as four harvests annually. More kinds of soil were used than had been the custom in antiquity, and the aeronomical handbooks indicate that each soil type should be fully exploited.<sup>11</sup>

#### 5. Impact of Arab Agricultural System

The process of economic growth in Andalusia had become closely linked to the introduction and acclimatization of new crops based on Arab agricultural system. Of the plants brought by the Arabs to the peninsula, their Arabic names passed into the Spanish languages. Amir Abd al-Rahmân I was personally responsible for the introduction of several species, including the date palm. A variety of pomegranate was introduced from Damascus by the chief judge of Cordoba, Mu'awiya b. Salih, who personally presented the plant to the Amir. From the palace at Cordova, a Jordanian soldier named Safar took a cutting and planted it on his estate in the Málaga region. This species, called *safrî* after the soldier, subsequently became widely diffused.

The poet al-Ghazâl of Jaén returned from a mission to the east early in the ninth century with the donegal fig, which became one of the four or five staple fig varieties in the country.<sup>12</sup> The full description of the poet's *modus operandi* is symptomatic of the way cultural elements were diffused in that cosmopolitan world:

The donegal (*dunaqal*) fig was introduced by al-Ghazâl when he went from Córdoba to Constantinople as an envoy. He saw that fig there and admired it. It was forbidden to take anything from Constantinople. He took the green figs and put them with his books that he had wrapped up, after he had unfolded the strings and wrapped them again. When he made his departure, he was searched and no sign was found of it. When he arrived in Cordoba he removed the plant from the middle of the twine, planted it, and cared for it. When it bore fruit, he went with the fig to the lord of Córdoba and it amazed him. He told him about his ruse in procuring it. The lord thanked him for his deed and asked him about its name. Al-Ghazal replied: 'I do not know what its name is except that when the one who picks it gives some of it to someone he says 'Dunahu qawli' which means "Oh my lord, look!" and so the Commander of the Faithful named it Dunaqal.<sup>13</sup>

Such details are all too infrequent in the literature, but represent what must have been a common pattern.

Newly introduced plants were frequently acclimatized in royal gardens, first in that of the Umayyads in Cordoba and, in the eleventh century, in the royal gardens of Toledo (where the agronomists ibn Bassâl and ibn Wâfid

were both employed) and Almería. Many of the new plants were either tropical or semi-tropical varieties that required irrigation, or were temperate species that could only be stabilized in a semi-arid environment by irrigation. Therefore the Andalusian agronomists paid special attention to the water requirements of each species. Ibn al-'Awwam was precise in stipulating the water needs of mountainous plants transplanted in the lowlands.<sup>14</sup>

Sugarcane was chief among the newly introduced irrigated crops, which in Andalusia was watered every four to eight days, and rice, which had to be continually submerged. Cotton was cultivated at least from the end of the eleventh century and was irrigated, according to Ibn Bassâl, every two weeks from the time it sprouted until first of August. The Andalusians were almost self-sufficient in cotton and exported it. Oranges and other citrus plants were also irrigated, as were many fruit trees and dry-farming crops.

Coupled with extension and intensification of irrigation, the introduction of new crops gave rise to a complex and varied agricultural system, whereby a greater variety of soil types were put to efficient use; where fields that had been yielding one crop yearly at most prior to the Islamic invasion were now capable of yielding three or more crops, in rotation; and where agricultural production responded to the demands of an increasingly sophisticated and cosmopolitan urban population by providing the towns with a variety of products unknown in northern Europe.

## 6. Arboriculture

The standard Mediterranean vine and tree crops, the most important of which were olives, the fig, and grapes, complimented field crops. Although these three crops were generally considered to occupy the same ecological niche – hill country and unirrigated plateaux – fig trees were frequently used as borders on irrigated fields and grapes were often irrigated, when practicable, to increase yields.<sup>15</sup> Undoubtedly, the olive plantation had been a staple of Hispano-Roman agriculture, but the stress that Islamic culture placed on it, particularly in the almost exclusive use of olive oil for cooking, to the exclusion of animal fats, left an indelible mark on its usage in contemporary Andalusian society. Though the olive tree has a Roman name – *olivo* – the fruit and oil are known by Arabic names – *aceituna*, *aceite*, from *al-zaituna*, *al-zait*.

Al-Sharaf or Aljarafe, situated in the west of Seville, was the best-known olive-growing region in Andalusia.

Aljarafe oil was highly esteemed and was exported to Alexandria. At the time of the reconquest of Seville in 1248, the number of olive trees in the province was calculated at more than two and a half million, producing five million kilos of olives. By the end of the century, however, tithes on wheat were more lucrative than the olive tithe, although both were considerable. Other olive-bearing areas of the peninsula may not have matched the Aljarafe in density, but were well known for olive cultivation: Idrisî referred to the Lérida-Mequinzenza region as the *lqlîm al-zaitân* - region of the olives.<sup>16</sup>

Irrespective of the fact that figs could not have had the economic importance of olives, they afforded an excellent example of the intensification of agriculture in Islamic Spain, manifest in the dazzling variety of the fruit available to consumers. In the tenth-century Calendar of Cordoba, the Latin *ficus* (fig) translated the Arabic *shajar* 'trees' (the specific word for fig is *tin*), indicating that the fig was so numerous that it became, by antonomasia, the tree. Malaga was the most important fig center, from the standpoint of production for the export market, being surrounded on all sides by figs of the Rayyo (*rayyî*, also referred to as *mâlaqi*, Malagan) variety. Malagan figs were exported by Muslim and Christian traders and sold in Baghdad and as far away as India and China, where they were valued for their taste and their ability to preserve it over the full year's travel occupied in their transport. In the Sierra Morena a wide variety of figs was grown, including the *qûtiya* (Gothic), *sha'arî* (hairy), and donegal. The fig was also of interest to the agronomists: al-Hijâri reported that in the Garden of the Noria in Toledo there was grown a kind of fig tree whose fruit was half green and half white.<sup>17</sup>

## 7. Problem of Wheat Growing

In the immediate aftermath of the Islamic conquest of Andalusia, wheat-growing had emerged as a problematical question because it assumed a variety of processes. Firstly, the extent to which areas that had been wheat-producing in Andalusia prior to the Islamic conquest became abandoned, particularly in frontier buffer zones, as a result of the conquest. Secondly, the migration of Christian wheat-growers to the northern kingdoms resulted in reduction of remaining wheat production. Thirdly, the Neo-Muslim wheat-growers might have migrated to the towns, abandoning their farms. Fourthly, acculturation of dry-farming Mozarabs and Neo-Muslims to the irrigated style of agriculture resulted in not placing as high a value on wheat.

Viewed in a broad spectrum, the Arabs introduced hard wheat (*Triticum durum*) to Europe, and that this was associated with the wheat called *darmaq*, which passed into medieval Castilian as *adârgama*. Millet, the lower-class staple, was replaced by sorghum (Arabic *dhura*, yielding medieval Castilian *aldora*), was imported from the Sudan, perhaps by Berbers. Sorghum played a significant social and nutritional role in Andalusia. However, there were powerful climatic justifications for the replacement of soft wheat and rye by hard wheat and sorghum, respectively. Hard wheat was resistant to heat and drought, and sorghum, though it required some moisture in the early part of its growing season, could mature in a summer that was very hot and dry. The conduciveness of the dry Iberian air to long-term storage of cereals was much remarked by medieval geographical writers. According to Yaqut, the wheat of Toledo could be stored in silos for a century. As a consequence of more efficient storage capability, seasonal and drought-year shortages could be better handled and the price of grain stabilized.<sup>18</sup>

It is noteworthy that many regions were mentioned as being famous for the quality of their wheat: the campina (*qanbaniyya*) of Cordoba; various places with the name Fahs (meaning plain) – Fahs al-Ballut, to the north of Cordoba and Fahs Qamara, near Colmenar; the plain of Cartagena, and that of Sangonera, near Lorca; the region between Cintra and Lisbon in the far west. After the conquest of Valencia, Muslims typically abandoned the irrigated areas, but retained cultivation of wheat in such places as Viver and Jerica.<sup>19</sup> Yet in spite of the impressive list of places famous for the quality of their wheat, Andalusia had a chronic wheat deficit.

The Andalusia started importing grain from North Africa from the ninth century onward and, after the Christian recuperation of the Duero Valley, from León (notably during the reign of Ferdinand II, 1157-1188).<sup>20</sup> In this context, ibn Khaldun's comments on wheat are noteworthy when he says that nomadic Arabs were habituated to importing wheat 'from distant places' owing to their great mobility, which can be indicative of a low value assigned to wheat in the traditional hierarchy of Arab food tastes. Ibn Khaldun further observed that among Arab nomads milk fills the role occupied by wheat among sedentary peoples. Indeed, the two primary dietary characteristics of urban dwellers, according to ibn Khaldûn, is much (too much) meat and fine wheat. He attributes the good health of Andalusians to their spartan

diet of sorghum and olive oil.<sup>21</sup>

Consequent upon the Islamic conquest and subsequent depopulation of the clayey, wheat-growing regions of the Duero Valley and other areas witnessed an immediate decline in wheat production from what it had been in Roman times. The wheat growing areas lying within Islamic domain continued to be cultivated by the indigenous population, whether Mozarab or Neo-Muslim. As non-Muslims were disallowed to bring new land under cultivation and the Mozarab agricultural establishment was effectively frozen, the resultant outcome was discernible in sharp decline in wheat production.<sup>22</sup>

The nonstop exodus of Mozarabs from Andalusia to the Christian north seems to have contributed to a continued decline in wheat production, accentuated in the ninth century, when thousands of Mozarabs departed in the wake of martyrdoms at Cordoba and other disturbances in the reign of Abd al-Rahman II. That the Mozarabs who settled in rural Leon came mainly from wheat-growing areas – Toledo, Coria, Cordoba – is evident from the names of the settlements they founded: Toledanos, Coreses, Villa de Cordobeses.<sup>23</sup> Besides, although these settlers commonly built irrigation canals and other water-conduction channels, they did not know the Arabic irrigation terminology which later passed into common usage in much of Christian Spain, in spite of their bilingualism. In other words, it can be said that these cultivators had been wheat-growers in Andalusia and had never been exposed to irrigation agriculture.<sup>24</sup> On the other hand, the migration of Neo-Muslims from the rural areas to the cities to join in the burgeoning artisanal economy also seems to have contributed to the decline of wheat production.

### 8. Irrigation and Dry-Farming

The Islamic jurists evinced interest in the relationship and balance between irrigated and dry-farming land because the two land-use types were taxed according to different scales. Both the tithe and the land tax were adjusted to the productivity of land, which was largely a function of the way it was watered. Land which was not watered artificially was called *ba'l*, as opposed to irrigated land, called *saqi*. Settlers had to make strenuous efforts to establish the legal nature of their land – a caution which is recalled by surviving place-names: Albal, Balbacil, Balazote, the last paradoxically meaning "dry land of the diversion dam" (*ba'l al-sudd*), possibly indicating a change in tax status.<sup>25</sup> The tithe was less on

irrigated lands than on unirrigated, to recompense the cultivator for his additional labour. The land tax, however, was adjusted to the productive value of the land and tended to be higher for irrigated lands, a practice carried over by the Christians.

Whether to characterize the entire Andalusia as an irrigated land or dry-farming land became a matter of debate among the contemporary scholars. Malik, the legal authority whose precepts were most followed in Andalusia, had said it was unlawful to pay rents in kind. But other scholars held that only in irrigated areas like Egypt, where the harvest was assured, should payment be always demanded in coin. In dry-farming areas such a demand would be unjust, owing to the undependability of harvests. It, therefore, became a topic among jurists to decide whether Andalusia should be considered an irrigated land or a dry one.

The Egyptian jurisprudential school counted Andalusia an irrigated land, due to its supposed hydrological similarities with Egypt; but the Medinese school claimed that it was a dry-farming area, that it needed more rainfall than Egypt, and that, therefore, payment in kind should be accepted. The latter opinion was followed in Islamic Spain.<sup>26</sup> Broadly speaking, Andalusia was generally viewed by Arab authors as a place where irrigation agriculture predominated but where it was needed precisely to overcome serious climatic obstacles. Drought was an ever-present threat and its harmful effects multiplied if continued over a number of years. J. A. García de Cortázar opines that the broad pattern of Andalusian agriculture, at its inception at least, resembled that of Visigothic Spain with a monetary economy superimposed upon it.<sup>27</sup>

However, this does not reflect the whole picture, because with the passage of time the original equilibrium among agricultural sectors underwent radical transformation, the major shift being a reduced reliance on extensive cereal culture and a greater reliance on intensively cultivated irrigated gardens surrounding the towns. The Muslims expanded the productivity of sedentary agriculture by exploiting soils and microclimates not utilized to advantage previously, by introducing new crops, and by importing a hydraulic technology capable of sustaining them. The result of these processes, particularly those facilitating the intensive exploitation of individual parcels, was a filling in of rural space with a denser agricultural settlement, although the locus of this settlement gravitated towards the towns and alluvial

valleys, leaving former wheat lands largely empty or perhaps turned to pasture steppe-land.

### **9. Expansion of Cereal Cultivation**

In Andalusia, grain was transformed into food by means of water power, and the building of the water mill. Building of mills became a recurring phenomenon in the Cantabrian and Pyrenean mountains in the ninth century and all over Christian Spain in the tenth. Both Muslims and Christians understood this technology. The profusion of tenth-century documents relating to the alienation of shares in mills demonstrates the progressive spread of cereal production in substitution of meadows and woodland in Leon and in Old Castile, in the vicinity of Burgos. The mention of clusters of mills (such as three in Nájera acquired by the monastery of San Millán de la Cogolla in 1038) indicates the expansion of cereal production in a given regional focus. Mills were especially typical features of the Catalan landscape, and again in an area where cereal production was particularly intensive, as in the plain of Barcelona in the late tenth and early eleventh centuries, mills tended to be clustered together, built in lines along the rivers.<sup>28</sup>

By and large, the centre and east of Old Castile and much of the Leonese plain were good wheat lands. Cereal production expanded there steadily throughout the eleventh and twelfth centuries when population pressure in some areas of Castile even forced the conversion of vineyards and flax fields into wheat.<sup>29</sup> Cereals were grown on open fields under a cultivation system called *ano y vez*, meaning that a field was planted to wheat one year and left fallow the next. In many areas no rotation was practiced, but in others a two-course rotation appeared when organized fallowing became an economic necessity. The advantage of a two-course rotation was that local herds could be grazed on half of the fields annually, a stratagem that was unnecessary as long as there was abundant uncultivated land.

In areas where local herding was particularly strong, a further adaptation was made in the form of *cultivo al tercio*, which freed more space for fallow grazing. Given the summer aridity and the continued use of the light Roman plow, it was never feasible to introduce the northern European three-course rotation, with a spring sowing; the only way to boost wheat cultivation was by extending the arable land at the expense of pasture and woodland and, later, even of vineyards and irrigated fields. The increasing trend away from local towards transhumant herding – also an effect of increased use of

land for agriculture – heightened the dependence of cultivators upon fallowing, to make up for the loss of local sources of fertilizer.<sup>30</sup>

Wheat was rich people's food. The usual poor man's bread was of rye or *comuna*, which was wheat and rye mixed. Lords could determine production allocation among the different cereals by demanding payment of dues in kind of wheat and barley in varying ratios. Thus in the sandy soils of the Galician littoral, where rye grows better than wheat, wheat cultivation still gained (with accordingly low yields) because the lords demanded it.<sup>31</sup>

Grain was not only grown for human consumption but also was harvested green for forage, particularly for stabled animals. These *herrenales* (*ferraginers* in Catalonia) were typically enclosed and for the use of individual proprietors. Oats were rarely grown before 1000, but increased dramatically in production in Catalonia in the first half of the eleventh century. Another important fodder was the turnip, which made a great impact in Galicia in the late thirteenth century when its cultivation permitted a substantial reduction in fallowing. The climatic situation there made a real rotation system possible: winter corn was harvested in the summer; then turnips were planted and harvested in the spring; then spring corn (barley and millet) was planted and the cycle repeated itself every two years.<sup>32</sup>

#### 10. Forests and Timber

Maurice Lombard in his comparison of the eastern and western Islamic worlds, distinguished between deforestation characteristic of the former, and clearance typical of the latter.<sup>33</sup> The same distinction can be applied to Andalusia, where the possibilities of regeneration of timber decreases from north to south. The progress of clearance, however, linked to agricultural and industrial development, began first in the south and only became a problem in the Christian kingdoms well after A.D. 1000, when the settlement of the plains was in full swing.

In antiquity, deforestation was mainly the result of mining and shipbuilding, the industries that made the greatest demand upon wood supply. In Spain, this affected only the forests of eastern Baetica, particularly the area around Almería, which, in Islamic times, was the site of an arsenal that had to be supplied either from inland stands or, by ship, from the Moroccan Rif. Otherwise the peninsula was still densely forested. Pines were found in the Algarve and Murcia in the south, in the mountains of Cuenca and Albarracín, in the hinterland of Tortosa, and on the island of Ibiza.

The Aljarafe area of Seville was famous for acacias. Oaks were found in vast areas of Andalusia, notably at Fahs al-Ballut (Plain of the Acorns, now Los Pedroches), a vast stand of evergreen oaks extending across mountains and high plateaux to Almaden. Oaks were also found in Algarve, Extremadura, and New Castile. To the south of the Duero lay another great sash of oak, respected by the Muslims as a strategic barrier, and the entire northern meseta was rich in kermes, evergreen, and holm oaks. The cork oak was also widely diffused, in the south of Old Castile and in al-Andalus.<sup>34</sup>

The demands made upon timber supply by the rapid urbanization of Andalusia (house construction, furniture, industrial fuel), by intensification of agriculture (hydraulic wheels), and by the rise of the Umayyad state to hegemony in the western Mediterranean (naval supplies) resulted in a retreat of forests from high-demand areas, the growth of wood-related industries in remote mountain villages, and the establishment of bonds of economic interdependence with the North African coastal region.

The area around Almería, where 'Abd al-Rahman II established an arsenal, was supplied from the Moroccan Rif, from pine stands in the interior of the Betic cordillera, from the Balearics and from the eastern coast, where logs were floated down the Júcar and other rivers to Cullera. Entire villages in the mountains of Segura, Cazorla, and Alcaraz supported themselves by exporting wooden vessels and utensils to urban centers. The same was true of a number of places in the Algarve. Yet Andalusia was well enough supplied with this resource to be a major exporter of wood in the Islamic world, shipping both timber and finished products from the east and west coasts to Morocco, from which (particularly the port of Qasr al-Saghir) timber was also imported.<sup>(134)</sup>

Nevertheless, as wood became more valued, lords sought to protect their own sources by making them off-limits to the peasantry (by creating *defesas* or preserves). Conservation has always begun typically as the strategy of an elite group to conserve a vital economic interest. The monastery of Cardeña had a *defesa lignorum* as early as the tenth century; the eleventh-century Fuero of Najera prohibited the cutting of wood in the town forest; restrictions on the communal use of forests became generalized, and by the thirteenth century alarm was widespread. It is probable that aristocratic concern was able, at the expense of social justice, to ward off extensive deforestation for several hundred years,

postponing the price that the Islamic world began to pay in the eleventh century.

## 11. CONCLUSION

The agriculture system in Andalusia received fillip during the Islamic rule. While retaining the old Roman agricultural methods which were congenial to the region, the Islamic rulers encouraged harvesting of crops and plantation imported from the Arab world and also introduced advanced irrigation methods for augmenting

the agriculture production. Expansion of the wheat-growing areas, boost to irrigation means, particularly the noria mechanism, plantation and preservation of olive trees as well as fig cultivation were main contribution of the Islamic civilization to Andalusia which helped in raising the nutritional values and transforming the dietary habits of the native populace as well as in boosting the Andalusian economy by increasing the export of agricultural products.

## NOTES

- (1) Critic on, III; edited by Castro, *The Spaniards*, p. 119; Al-Andalusi, Abi Kheir, *Ketab fi Al-Filaha*, 1st ed. Al-Matba`a Al-Jadeedah, Fez-Morocco, 1357, pp. 89-91.
- (2) E. Levi-Provencal, "La Description de l'Espagne d'Ahmad al-Razi", (Ahmad al-Razi's Description of Spain), *al-Andalus*, Vol. 18, 1953, pp. 61-62; Al-Tarabolsi, Borawi, *Nasha't Elm Al-Filaha*, Dar Al-Janoub for Publication, 1st ed., Tunisia, 2005, p.237; Al-Himyari, Mohammad Bin Abd Al-Munim, *al-Rawd al Mi'tar fi Khabar Al-Aqtar*, edit by Ihsan Abbas, Lebanon Library, 1st ed. Beirut, 1975, p.32.
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- (4) Himyari, *Peninsule Iberique*, p. 5.
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