

“ALQUEVA – A WATER PROJECT FOR THE SUSTAINABLE DEVELOPMENT OF THE ALENTEJO – PORTUGAL”

Adérito Serrão, Chairman of the Board of Directors, EDIA
Empresa de Desenvolvimento e Infra-estruturas do Alqueva, S.A. (Portugal)

Summary

The socio-economic evolution and adverse climatic factors which have traditionally affected the Alentejo region in southern Portugal, in which special reference should be made to water shortages, explain the importance afforded to the resolution of this constraint with a view to preventing the region's decline in a national and Community context.

The adoption of the Alentejo Irrigation Plan in the fifties demonstrated the need to regularise the water resources of the basin of the River Guadiana, shared by both Portugal and Spain, as the source and strategic water reserve which would effectively ensure that the objective of guaranteeing public supply, downstream environmental flows and the generation of renewable energy would be achieved

These aims were provided for by the construction of the Alqueva Dam and Hydroelectric Power Station and infrastructures associated with the Multipurpose Alqueva Project as a structuring development instrument for a significant zone of the Alentejo. The plans were defined in such a way as to additionally benefit a series of actions and specific policy measures.

The ups and downs characterising the decision making process in respect of the Multipurpose Alqueva Project, since the sixties to the middle of the last decade has resulted in the preparation of a highly comprehensive range of sectorial studies and summaries. Such studies and summaries, coinciding with the international acceptance of the principle of sustainable development, incorporated this principle in the performance of the Alqueva Project and particularly the preparation and performance of an Environmental Management Programme and suitable territorial planning policy instruments.

The management of the Multipurpose Alqueva Project involved the incorporation of the public limited company EDIA—Empresa de Desenvolvimento e Infra-estruturas do Alqueva, S.A., which was given responsibility for its design, performance, construction and operation, benefiting from a concession contract entered into with the Hydro Domain and national and Community financing.

A BRIEF SOCIO-ECONOMIC CHARACTERISATION OF THE ALENTEJO

The Alentejo Region comprises an area of around 27,000 square metres. It is located in southern Portugal and extends from the Atlantic Ocean up to the border with Spain, occupying around 30% of Mainland Portugal. It had a total number of 543,000 inhabitants in 1991, i.e. no more than 5.5% of the national population.

The loss of demographic vitality is one of the area's most serious problems and the reduction in population has continued to be a significant factor over the latter decades. In the period between censuses (1981-1991), the Alentejo Region lost around 35,000 inhabitants, especially young people of working age. This had the additional effect of significantly increasing the number of senior citizens.

Between 1991 and 1996, the region was estimated to have lost around 24,000 inhabitants. This contrasts with a slight increase in population on the rest of the Portuguese mainland.

The Alentejo has a population density of 20.2 inhabitants per square kilometre. This figure is very low in comparison to the Portuguese mainland (106 inhabitants per square kilometre). More than half of the population lives in communities of less than 2,000 inhabitants. 10.6% of the population lives in isolation and 21,000 live in communities of less than 100 inhabitants.

In terms of employment, the Alentejo Region absorbed no more than 4.5% of the national workforce in 1992 with unremunerated labour accounting for 32% of total employment.

The unemployment rate in the region in 1996 was 15%. This particularly included women workers who accounted for 65% of total unemployment and people looking for a new job (75% of the unemployed) ???. This is clearly indicative of the loss of economic regional vitality and the

consequent difficulty in retaining the working population. An additional difficulty lies in the low levels of qualification and vocational training of the workforce in the Alentejo and its poor mobility between operating sectors.

The human resources situation has further accentuated the debility of a regional system of production which, in itself is limited in terms of diversification, and is both lacking in dynamism and competitiveness.

Gross Domestic Product (GDP) in the Alentejo, at market prices, between 1991 and 1995, varied between 500 billion and 693 billion escudos. Such a variation failed to accompany the increase in GDP on the rest of mainland Portugal, and its proportion fell from 4.7% to 4.6% of the total.

Gross Disposable Family Income varied between 395 billion and 506 billion escudos between 1991 and 1995. This figure represented no more than 4.7% of the indicator for the Portuguese mainland. Last year's *per capita* income was around 975,000 escudos.

Gross Value Added (GVA) in the Alentejo, in 1995, was 635 billion escudos or around 4.6% of the total, as in the case of GDP. Around 56.5% of the Alentejo's gross value added comprised tertiary sector activities. The secondary sector, in turn, accounted for around 30% and the primary sector around 13.5%.

The regional productive structure, in sectorial terms, is characterised, by the existence of around 47,000 agricultural operations comprising an average area of 47 hectares. The current Common Agricultural Policy and respective institutional application framework, in addition to worldwide market liberalisation, have been creating problems for the maintenance of traditional agricultural systems, based on unirrigated cereal crops. The coincidence of the implementation of such policies together with the occurrence of drought conditions over the latter years, have contributed to the worsening of the situation in the agricultural sector and has led to the shedding of agricultural assets which have not been absorbed by other activity sectors.

Cereals comprise 22% of the useable agricultural area, whereas permanent crops, particularly olive groves and vines, resulting in high quality products, account's for 12%. Silviculture and grazing activities in *Hispania* and holm oak groves are important activities. Special reference should be made to cork production owing to its high economic and social value.

The industrial sector is in its infancy and mainly comprises small companies. It generally suffers from problems associated with organisation, management and market access, whose use of outdated technologies and the low incorporation of added value are standard characteristics.

The food, beverages and tobacco industries absorb 32% of regional employment in the manufacturing industry sub-sector. This is followed by the textiles sector with 12%. The food industry is also responsible for 35% of the sectorial turnover. The manufacture of chemicals and artificial fibres, in turn, account for 26%.

The low level of commercial activity employs few workers and is particularly geared to meeting the basic needs of the population and the supply of production factors for agriculture.

In the domain of tourism, regional hotels represent 15% of the national total and 11% of the accommodation capacity, notwithstanding the major potential for regional forms of tourism and particularly the non-mass market in terms of "rural tourism", "heritage tourism" and hunting. There is a shortage of respective structures and reception and animation facilities.

Crafts comprise one of the traditional activities in the region and have earned a certain degree of socio-economic relevance in areas such as pottery, embroideries and articles made from wood, especially furniture, hides, basketwork and tapestries.

THE IMPORTANCE OF WATER FOR THE ALENTEJO

The relatively flat Alentejo region and its location in the south of the country, has one of the lowest rates of rainfall over the whole of Portuguese territory, generally varying between 500 and 600 litres per square metre *per annum*. This is less than half the volume of rainfall recorded in the north of Portugal.

In addition to low levels, the inter-annual distribution of rainfall in the region is extremely irregular, varying between 250 litres per square metre in dry years and 900 litres per square metre in rainy years. This variability is amplified in terms of water flow.

The seasonal distribution of rainfall and water flow is also highly irregular. There are periods of drought which sometimes extend up to the end of the Autumn, during which many of the rivers in the region run dry.

As a consequence of this extreme irregularity of water flow, the guarantee of supply of water from surface resources can only be achieved by building significantly large dams whose reservoirs are large enough to ensure an inter-annual regularisation of tributary flows.

The quality of underground water, which is relatively abundant in some zones and practically non-existent in others, is not always up to standard, although it continues to be the most commonly used source for meeting the needs of the municipal authorities and farmers.

As regards the public water supply, the dispersion of small communities over such an extremely large area as the Alentejo, with a surface area of around 27,000 square meters, provides added complications *vis-à-vis* supplying the population with water.

To cater for water shortages in the Alentejo, around 2,500 small dams, whose principal objective is to provide irrigation facilities or drinking water for cattle were built, particularly starting in the 19th century.

The main source of water in the Alentejo is the River Guadiana, which is one of the three major rivers on the Iberian Plateau, whose basin encompasses an area of around 66,800 square metres, of which 11,500 square metres are located in Portugal. The quality of the water entering Portugal, suffers from the effects of urban-industrial and agricultural pollution, and requires growing attention and the search for solutions by the Portuguese, Spanish and Community authorities.

BACKGROUND TO THE ALQUEVA PROJECT

The first references to the Alqueva Project appear in 1957 with the initial preparation of the Alentejo Irrigation Plan. This was part of a global project for the supply of water to the region based on the regularisation of the water resources generated within the geographical area. After it was established that the amount of water reserves was insufficient to proceed with the above referred to plan, attention was turned to the River Guadiana which flowed through a significant part of the Alentejo in a north-south direction and whose respective basin was shared by Portugal and Spain, as the only source of water capable of making up the necessary shortfall in water supply.

This resulted in plans for the construction of a dam to be located near Alqueva.

Due to the characteristic hydrological regime in the basin of the River Guadiana, with an enormous variation in rainfall and inter and intra annual flows, the inevitability of creating a huge reservoir allowing a significant proportion of tributary flow to be regularised was recognised. This would also guarantee the resources which, in the case of a significant number of reservoirs, would be the source of water for supplying the population and/or irrigation requirements in the Alentejo, and which is not available in dry years in their respective water courses.

Based on the above presupposition, the Alentejo Irrigation Plan, which had, in the meantime progressed, required hydraulic infrastructures to be designed and sized with a view to catering for the additional water resources to be obtained by regulating the River Guadiana.

After the technical solution necessary to ensure the necessary supply of water had been found, it was only at the end of the following decade that the necessary political agreement between Portugal and Spain was reached. Pursuant to the terms of the agreement on the use and hydroelectric exploitation of international rivers, entered into between the two countries, in 1968, Portugal was given responsibility for the management of a section of the River Guadiana with an annual average flow of 2,421 hm³, determined by the historical series of existing natural flows, adjusted for future water needs in Spain, which were, at the time in question, estimated at 1,277 hm³.

The negotiations involving the referred to agreement provided for the construction of a dam in Alqueva. The adjusted resources were to be used on a multipurpose water project.

The second half of the seventies saw the beginning of the preliminary works for the construction of the Alqueva Dam. These were interrupted, by a government resolution adopted in 1978 at a time when the respective caissons and deflection tunnel on the River Guadiana had already been built.

Various sectoral studies had, in the meantime, been prepared by several government departments of which special reference should be made in the eighties to two studies referring to agricultural sector enhancements, several dealing with hydroelectric aspects, hydrological surveys on the River Guadiana, tidal and current studies in the estuary's zone of influence and in 1985, the Environmental Impact Study of the area of the Alqueva Reservoir and its surrounds.

The existence of such a large collection of part studies suggested the need for the preparation of an integration study to undertake a global evaluation of the project. This study, benefiting from the joint promotional efforts of national and Community authorities was prepared in 1992, following which the government adopted a definitive resolution to re-launch the construction of the Multipurpose Alqueva Project.

As an intermediate step for the effective relaunch of the project works and after the Environmental Evaluation Impact on the Hydroelectric Component Part of the Alqueva Project had been prepared, the European Commission, taking into account the project's inclusion in the Regional Development Plan submitted by Portugal pursuant to the provisions of dispositions for the application of the 2nd Framework Community Support Project arranged for the preparation of the Integrated Environmental Impact Study of the Multipurpose Alqueva Project in 1994. The evaluation confirmed the compatibility between the project and environmental preservation.

The follow-up to the Evaluation of the Environmental Impact process included in the latter study, involving the technical evaluation of a National Commission comprising representatives from the various national authorities, public consultations and meetings in Portugal and Spain, and the contribution of the Spanish authorities responsible for water and environmental resources resulted in a positive opinion issued by Portuguese ministers responsible for the environment and planning and regional development, on the basis of which the licence for the construction of the Alqueva Dam was issued.

The preliminary works recommenced in 1995, while the construction of the Alqueva Dam and Hydroelectric Power Station, whose tender had been awarded in December 1996, began in first quarter 1997. These core infrastructures of the Multipurpose Alqueva Project are scheduled for completion by the year 2002.

The building of the subsequent infrastructures and, particularly, the global irrigation system, whose construction works began in 2000 together with the Alqueva/Alvito connection system and improvements to the first block of the secondary irrigation network is scheduled for completion in the year 2025.

OBJECTIVES

The evolution of the design of Alqueva Project is associated with the different operating strategies and solutions for the development of the Alentejo, pursuant to which the Portuguese body responsible for the production and marketing of electricity undertook the preliminary works involving the construction of the caissons and the provisional deflection tunnel on the River Guadiana between 1976 and 1979.

At the same time and notwithstanding the various development prospects and the corresponding policy actions and measures implemented since the fifties, there has been no upturn in the Alentejo's socio-economic characteristics.

Pursuant to this context, a global evaluation study of the project was prepared, at the beginning of the nineties, coinciding with the worldwide acceptance of the principle of sustainable development. The study incorporated the various part and/or existing sectorial studies and consequently gave rise to the Multipurpose Alqueva Project.

The following structuring objectives have been retained:

- the construction of a strategic water reserve,
- the guarantee of a regular water supply,

- the alteration of the agricultural specialisation model in southern Portugal,
- an increase in electricity generating capacity,
- creation of tourist potential,
- promotion of the regional employment market and business environment,

Other objectives have also, at the same time, been incorporated. These include the struggle against physical desertification and climate change and organised intervention in the environmental and heritage domains, not merely adopting a reactive approach to the project, but particularly as part of a proactive approach from which the part of the basin of the River Guadiana downstream from the Alqueva and most particularly the estuary zone will derive benefits, in terms of sustainable development.

COMPONENTS PARTS OF MULTIPURPOSE ALQUEVA PROJECT

In terms of infrastructure, the Multipurpose Alqueva Project comprises the following main component parts:

The Alqueva Dam, with a maximum height of 96 metres, a maximum storage level at a datum point of 152, resulting in a reservoir with an area of 250 square kilometres (of which 35 square kilometres in Spain) and a total storage capacity of 4,150 hm³, 3,150 of which comprising useable capacity;

A Hydroelectric Power Station in Alqueva, equipped with 2 turbines/pumps with an installed power rating of 120 MVA each, capable of generating around 350 gigawatts of electricity *per annum*;

The Pedrogão Dam, located downstream to allow the pumping/turbine operation, with a maximum height of 39 metres at a datum point of 84.8 and a useable storage capacity of 54 hm³;

The Alqueva/Alvito Connection System, for supplying water to inhabitants and industries in the irrigation perimeter;

A primary irrigation network with an approximate length of 680 kilometres;

Secondary and tertiary irrigation networks, with an approximate length of 4,400 kilometres.

The respective prior study with a view to defining the configuration of the Multipurpose Alqueva Project's global irrigation system, was completed in 1996. It envisages improvements to around 110,000 hectares, increased supplies to the existing irrigation perimeters and the public water supply.

This study consisted of the reanalysis of the water connection/distribution system with a view to optimising the 1992 global evaluation study, which was carried out on the location of the irrigation areas, the channel configuration, the definition of water sources, general system design and the incorporation of the irrigation perimeters located in the same zone.

As a result of this study, the proposal selected for the Multipurpose Alqueva Project's global irrigation system identified the Alqueva and Pedrogão reservoirs, both located on the River Guadiana, as water sources and channelling it through the following independent subsystems:

Alqueva (right bank of River Guadiana), comprising an area of around 71,000 hectares, irrigated by water pumped from the Alqueva Reservoir;

Pedrogão (right bank of Guadiana) comprising an area of around 29,000 hectares, irrigated by water pumped from the Pedrogão Reservoir;

Ardila (left bank of Guadiana) comprising an area of around 11,000 hectares, irrigated by water pumped from the Pedrogão Reservoir;

MANAGEMENT OF MULTIPURPOSE ALQUEVA PROJECT

The use of water resources and, *ipso facto*, the water extracted from the River Guadiana, the promotion and supply of characteristic regional, quality products and, more recently, the enjoyment of natural heritage associated with the divulgence of cultural heritage, are considered to be the most consensual sustainable development domains, whose respective instruments are being prepared and promoted.

Based on this approach, in 1995, the Portuguese government adopted a resolution, creating the Multipurpose Alqueva Project Intervention Area, partly or fully embracing a total number of 18 municipal districts, most of which located in the Lower Alentejo area and identified on the basis of the location of the future infrastructures of the Multipurpose Alqueva Project or the further 110,000 hectares of irrigation envisaged in the project.

This definition, enacted in law, possesses a virtuosity which is to permit the preparation of an articulated, diversified and multifaceted development strategy, based on a broad geographical expanse with a diversity of characteristics, justifying its own solutions and tailored to local needs in which the influence derived from the construction of the Multipurpose Alqueva Project will be a common denominator.

Giving substance to this approach, the Portuguese government adopted a resolution to institutionalise a Multipurpose Alqueva Project Management Body and, in early 1995, incorporated EDIA-Empresa de Desenvolvimento e Infra-estruturas do Alqueva, S.A. as a public limited company with responsibility for the design, performance, construction and operation, as a means of contributing to regional development promotion.

In January 1996, following the coming into office of a new government elected at the end of 1995, the regional development aspect was emphasised, when EDIA, S.A. was instructed to implement, without further delay, a programme for the performance of the Multipurpose Alqueva Project, making readjustments to its guidelines in conformity with the principles of regional development policy and environmental administration requirements, which were, in any event being incorporated and already comprised essential corporate elements.

The government adopted further resolutions on EDIA, S.A.'s corporate object in 1998, detailing both its role as the Alqueva Multipurpose Project's management body and including the signing of a concession contract with the *Hydro Domain* with the National Water Authority, in addition to involving the farmers' organisations benefiting from the management of the secondary and tertiary irrigation networks.

The preparation of the respective territorial plan has been undertaken as an essential instrument for the organisation and management of the Alqueva and Pedrogão reservoir areas. This will define the rules, conditions and use of the water surface and its banks.

Another decisively important territorial planning policy instrument for the sustainable use of the Alqueva Dam's surrounding area, which defines the existing potential and resources, lists existing environmental, heritage and landscape features and establishes the general guidelines on the location of the production facilities and conditions to be fulfilled in the installation and operation thereof, as in the case of urban development whose preparation is at an advanced stage. The regional territorial plan for the area surrounding the Alqueva Reservoir has already been submitted for appropriate government approval. This plan embraces the municipal district areas in whose territory the Alqueva and Pedrogão reservoirs will be located and it will be used as a reference to be complied with by the municipal authorities when licensing economic activities and urban development projects in the zone.

One aspect to which special reference should be made in the contents of the government resolution of January 1996, instructing EDIA, S.A., to proceed with the Multipurpose Alqueva Project Programme, is the preparation of an integrated development plan, in conformity with the *modus operandi* leading to the definition of the project's zone of influence.

This resolution was welcomed and approved by Community instances and after a detailed preparatory process which was realised in partnership between the Portuguese and Community authorities, PEDIZA (Specific Integrated Development Programme for the Alqueva Zone) was approved in July 1997. The central core of the programme provides support for the erection of the project's infrastructures while also adopting a series of measures and actions ranging from environmental management to economic sectors and vocational training support.

PEDIZA, as a programme, therefore involves the three Structural Funds and the Cohesion Fund, with the same time span as the 2nd Community Framework Support Programme. The adoption of this operating instrument also presupposed a European Commission commitment to the continuity of its joint funding during the following period and, in particular, 3rd Community Framework Support Programme, effectively occurring this year.

ENVIRONMENTAL INTERVENTION ON THE DEVELOPMENT OF THE MULTIPURPOSE ALQUEVA PROJECT

The success of the Multipurpose Alqueva Project depends, to a large extent, on the way in which its environmental management is handled. This is considered as a development promotion instrument which can help to reduce negative impacts (the most significant of which having been identified) and leverage the positive effects.

The major environmental administration guidelines result from the consideration of the following general dispositions:

- recommendations made by the different environmental studies, particularly the evaluation of the Integrated Environmental Impact Study (1994/1995);
- national and Community environmental policy guidelines, including the 5th Community Programme on the Environment and Sustainable Development;
- existing national specifications of the different sectorial and regional policies in force in the project's area;
- the Community study on the environmental measures required for the project's implementation;
- EDIA, S.A.'s project performance strategy.

EDIA, S.A has implemented the following strategic environmental intervention guidelines:

- to minimise and/or to compensate for the most significant negative impacts;
- to preserve and promote the most sensitive and important environmental zones in the Alqueva Multipurpose Project's Intervention Area;
- to broaden its pool of knowledge, monitoring and predicting the effects for a sustainable environmental intervention on the uncertain or less precise impacts;
- to promote and stimulate the quality of the environment;
- to actively promote the rational management of the strategic water reserve.

As a consequence of this framework, the preparation and implementation of an environmental management programme whose objective, in addition to minimising and/or compensating for the most significant negative impacts, is to define strategic guidelines for the active promotion of the rational management of the strategic water reserve and the preservation and promotion of the most sensitive and important environmental zones has been assumed by EDIA, S.A. since 1995.

With the objective of achieving the defined strategy, the Environmental Management Programme includes:

- the environmental objectives to be attained;
- the mechanisms to attain them;
- the processes for the introduction of alterations or modifications to performance projects;
- the correction mechanisms to be activated in case of need, in addition to the means of activating them and evaluating their suitability *vis-à-vis* any specific situation to which they are applied.

In practical terms, it is assumed that the Environmental Management Programme will be performed on three intervention levels associated with three environmental sub-programmes:

Environmental management sub-programme for the dam and associated infrastructures, and its respective services:

- strategic reserve,
- water supply,
- electricity generation;

Specific environmental management sub-programme for the services performed by the company itself, including:

- the development of studies, projects, plans, agreements and specific programmes,
- training and demonstration actions,
- information;

Environmental management sub-programme for regional development and the irrigation area:

- irrigation blocks,
- effluent processing,
- conservation projects.

Positive results will also be achieved in the domain of cultural heritage as a plan designed to enhance heritage resources from a viewpoint of integrated and sustainable regional development, to be implemented in partnership with local municipal authorities, universities and sector technical staff is currently in progress.

These policies which are scheduled for implementation during the project's performance stage (already definitively assimilated by the management body and other instrumental agents), are by no means the only considerations *vis-à-vis* the search for sustained rationality involving a balance between costs and benefits, with the necessary predominance of the latter during the project's administration stage.