FCT Fundação para a Ciência e a Tecnologia

MINISTÉRIO DA CIÊNCIA, TECNOLOGIA E ENSINO SUPERIOR


# Concursos de Projectos de I&D

Calls for R&D Projects

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## Visão global da candidatura

Application overview

**Ocultar todos as secções desta candidatura**
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**Referência do projecto**

Project reference

PTDC/AGR-AAM/098100/2008

## 1. Identificação do projecto

1. Project description -

**Área científica principal**

Main Area

Ciências Agronómicas e Florestais - Agricultura e Ambiente

**Área científica Secundária**

Secondary area

*(Vazio)*

*(Void)*

**Título do projecto (em português)**

Project title (in portuguese)

Gestão Integrada de Fósforo para Controlo da Eutrofização de Bacias Hidrográficas (Eutrophos)

**Título do projecto (em inglês)**

Project title (in english)

Phosphorous Diffuse Source Management and Eutrophication Control (Eutrophos)

**Financiamento solicitado**

Requested funding

191.353,00€

**Palavra-chave 1**

Eutrofização

**Palavra-chave 2**

Modelação

**Palavra-chave 3**

Bacias Hidrográficas

**Palavra-chave 4**

Fósforo

**Keyword 1**

Eutrophication

**Keyword 2**

Modelling

**Keyword 3**

Watersheds

**Keyword 4**

Phosphorus

**Data de início do projecto**
Starting date
01-01-2010

**Duração do projecto em meses**
Duration in months
36

## 2. Instituições envolvidas
2. Institutions and their roles

**Instituição Proponente**
Principal Contractor

**Instituto Nacional de Recursos Biológicos, I.P. (INRB/MADRP)**
Rua Barata Salgueiro, 37 - 2º
1250-042Lisboa

**Instituição Participante**
Participating Institution

**Instituto Superior Técnico (IST/UTL)**
Av. Rovisco Pais
1049-001Lisboa

**Universidade de Évora (UE)**
Largo dos Colegiais, 2 - Apartado 94
7002-554Évora

**Unidade de Investigação**
Research Unit

**Instituto Nacional de Recursos Biológicos, I.P. (INRB/MADRP)**
Rua Barata Salgueiro, 37 - 2º
1250-042Lisboa

**Unidade de Investigação Adicional**
Additional Research Unit

**Centro de Ambiente e Tecnologia Marítimos (MARETEC/IST/UTL)**
Avenida Rovisco Pais
1049-001Lisboa

**Instituto de Ciências Agrárias e Mediterrânicas (ICAM/UE)**
Herdade da Mitra - Valverde
7000Évora

**Instituição de Acolhimento**
Host Institution

**Instituto Nacional de Recursos Biológicos, I.P. (INRB/MADRP)**
Rua Barata Salgueiro, 37 - 2º
1250-042Lisboa

## 3. Componente Científica
3. Scientific Component

### 3.1. Sumário
**3.1 Summary**

**3.1.a Sumário Executivo (em português)**
3.1.a Executive Summary (in Portuguese)

A eutrofização das águas superficiais começou a verificar-se há cerca de 2 séculos, mas é a partir da década de 50, com a automatização da agricultura, com o incremento do uso de fertilizantes azotados e fosfatados e com o aumento das áreas urbanas, que os seus efeitos se tornaram mais notórios. Lagos e albufeiras, com a acumulação de sedimentos e matéria orgânica, são zonas particularmente vulneráveis àquele fenómeno, verificando-se falta de oxigénio nas camadas mais profundas, e em alguns casos, em toda a coluna de água, resultando em períodos de má qualidade da água e consequente morte de peixes. Se a eutrofização estiver associada ao crescimento de cianobactérias no fitoplâncton, com consequente libertação de compostos tóxicos, a gravidade do problema é ainda maior. O crescimento das cianobactérias é limitado principalmente pela presença de Azoto (N) e Fósforo (P). As cianobactérias conseguem fixar o N atmosférico, tornando-se as espécies dominantes durante os períodos de escassez de N na água. Uma vez que o N atmosférico está sempre disponível, a multiplicação das cianobactérias é controlada pelos níveis de P na água. A bacia hidrográfica e a albufeira do Enxoé pertencem à lista de albufeiras portuguesas onde fortes crescimentos de cianobactérias foram identificados, tornando-a indicada para o estudo deste problema.
O P pode ser proveniente da agricultura e de águas residuais urbanas e industriais. Em condições aeróbias, o P é adsorvido a alguns compostos de Al e/ou Fe existentes na matéria particulada e, consequentemente, o seu destino é determinado pelos processos que afectam aquela, tais como a erosão dos solos, acumulando-se nas albufeiras, onde a velocidade da água é reduzida. Os detergentes arrastados nas águas urbanas eram, até à década de 90, a maior fonte de P. Com as modificações na sua composição e remoção de

P nas estações de tratamento de águas, as actividades agrícolas e pecuárias tornaram-se a maior fonte emissora, estando o seu controlo directamente relacionado com o da erosão do solo.
O projecto pretende: i) compreender a contribuição do P proveniente da agricultura nas águas superficiais, como função das culturas e práticas agrícolas, nomeadamente o regadio; ii) extrapolar resultados para toda a bacia hidrográfica; iii) melhorar os modelos existentes de simulação dos processos nas bacias e albufeiras existentes e determinar as cargas máximas diárias de sedimentos para a albufeira e iv) quantificar o impacto económico e social resultante de mudanças de práticas agrícolas.
O projecto conta com a experiência dos parceiros no controlo da erosão, física do solo, química do solo, rega e modelação. Terá 5 tarefas: 1- Quantificação da erosão e perdas de nutrientes associados, em função dos diferentes usos do solo e sistemas de rega associados; 2- Monitorização dos nutrientes na albufeira do Enxoé; 3- Modelação dos processos na bacia hidrográfica e na albufeira; 4- Quantificação dos impactos ambientais, económicos e sociais resultantes de mudanças das práticas agrícolas e 5- Gestão do projecto e disseminação dos resultados.
O projecto conta com equipas de duas Universidades e do Instituto Nacional de Recursos Biológicos (INRB).

### 3.1.b Sumário Executivo (em inglês)

3.1.b Executive Summary (in English)

Eutrophication of surface waters was identified about 2 centuries ago but was enhanced in 1950's with agriculture automation, the increased use of Nitrogen (N) and Phosphorus (P) fertilizers, and population concentration in large urban areas. Particularly vulnerable to this process are lakes and artificial reservoirs, where sediments and organic matter are accumulated, causing oxygen depletion in the deeper layers, or even in the entire water column, leading to large periods of poor water quality, and to fish killings. The severity of the problem increases when eutrophication is related to cyanobacteria blooms and subsequent development of toxicity events. Cyanobacteria bloom is influenced mainly by the presence of N and P. Cyanobacteria can fix atmospheric N and become the dominant species during periods of N depletion in water. Since atmospheric N is always available to cyanobacteria, their growth control is only achieved by controlling P levels. The Enxoé catchment and reservoir are included in a list of Portuguese reservoirs where strong cyanobacteria blooms have been identified and are suitable for studying this problem.
P is generated by agriculture and by domestic and industrial waste waters. In aerobic conditions, P is adsorbed to some aluminium and/or iron compounds existing in the particulate matter. Its fate will, consequently, be determined by the processes affecting particulate matter, namely soil erosion, and its accumulation on the bottom of artificial reservoirs where water velocity is lower. Detergents dragged in the urban waters have been the major P source up to the late 1990's. With the modification of their composition and P removal in Waste Water Treatment Plants, agriculture and livestock became the major P sources, which can only be controlled by limiting soil erosion.
This project aims: i) to assess the contribution of soil P to surface waters as a function of crops and agricultural practices, with particular emphasis to irrigation; ii) to extrapolate results to the whole catchment, using mathematical models; iii) to improve the existing catchment and reservoir models and determine maximum daily loads, and iv) to quantify the economic impact of agriculture practices changes and assess their social implications.
The project will build on the experience of the partners on erosion control, soil physics, soil chemistry, irrigation, and modelling. It will have 5 tasks: (1) Erosion assessment and control, according to the use of different irrigation methods; (2) Monitoring of nutrients in Enxoé reservoir; (3) Modelling of the catchment and of the reservoir; (4) Assessment of soil use, agriculture practices, and the environmental, economic and social impacts of changing the agricultural practices; and (5) Project management and results dissemination.
The project involves teams from two Universities and the National Institute of Biological Resources.

## 3.2. Descrição Técnica

**3.2 Technical Description**

### 3.2.1. Revisão da Literatura

3.2.1. Literature Review

The element P is a plant macronutrient, being generally added to soils in fertilizers together with N and K. In mineral soils, inorganic P forms are mainly adsorbed in the solid phase. As a consequence, soil erosion is the main mechanism for removing P from soils [1]. The need for mitigating soil nutrient losses from agricultural fields is becoming more clear, as point source loads from industrial and municipal origin get more controlled, making agriculture the major contributor for surface water eutrophication [2]. P losses from agricultural land are normally below 1 kg total P/ha/yr, which is usually equivalent to 1-2% of the fertilizer input [3]. Although negligible from an agronomic approach, such P loads may have a significant impact on the aquatic ecosystems.
P is usually the single most limiting nutrient for phytoplankton growth [4], namely cyanobacteria which can fix atmospheric N when this nutrient is depleted [5]. P inputs become a key factor in controlling the trophic state in freshwater [6]. Extremely low surface water concentrations of inorganic and total P (0.01-0.02 mg/L) are considered critical values above which eutrophication is enhanced.
Water dynamics in the vadose zone plays a major role in the fate of nutrient. The flow generated by infiltration is responsible for dissolved matter lixiviation (the major process for N removal), while runoff generated by the non-infiltrated water is responsible for most P removal [7]. PESERA model [8] was selected by ENVASSO team (www.envasso.com) in which INRB took part, as a good indicator for estimating soil losses by water erosion, which is the main process for P transport to the reservoir.
Soil water retention and hydraulic conductivity determines the infiltration rate, runoff and erosion. It also determines the fraction of P that will be dissolved/adsorbed. Water content, soil particle size distribution and clay composition (Fe and Al hydrous oxides contents) determine the chemical feedback between sediments and water, either by oxidation-reduction of Fe-P complexes or, in calcareous sediments, by pH/calcium/P reactions.
Particulate P removed from the soil is carried through the streams, into catchments network settling together with in-stream organic detritus, which amount depends on the water body trophic activity. A low P loading will generate low productivity, keeping sediment concentration low. As the P loading increases so does phytoplankton production and sedimentation, the degradable OM and P contents of the surface sediments [9]. Increasing sediment organic content increases near bottom O2 demand. Anoxic conditions in

the sediment and water column can be generated by liberation of adsorbed P. In aerobic conditions, Fe3+ bounds with P and forms an insoluble complex locking up P in a form that algae cannot access. However, in anaerobic conditions, Fe3+ is chemically reduced to Fe2+, releasing P [10].
Vertical density stratification of the water body (common in summer) reduces vertical diffusion of O2 and increases the probability of the anoxic situations. Late summer is also the period of maximum organic matter deposition (produced since spring) and often a period of surface nutrients depletion (mainly of N). Release of adsorbed P increases the nutrient unbalance, creating conditions for the development of cyanobacteria blooms which can be enhanced by rain events, supplying additional nutrients [11], and creating serious water quality problems.
Maranhão is an example of a subcatchment of the Tagus river where these problems occur and have been studied by the IST team of this proposal. The loads in these catchments were assessed using the HARP-NUT guidelines [12]. 70% of the nutrients reaching the reservoir were generated by agriculture and were assessed based on SWAT model [13]. The total maximum daily load supported by the reservoir was computed using CE-QUAL-W2 [14].
The SWAT model was recommended by EuroHarp for implementing HARP-NUT Guideline 6 (agriculture diffuse pollution) [15]. The CE-QUAL-W2 model [16] includes a hydrodynamic model (2D laterally integrated) and a biochemical model that considers 9 generic functional groups for simulating primary producers (distinguishable in terms of biological activity and nutrients requirements), and includes the Fe cycle and its interaction with P. With 3 functional groups, the model can simulate the implications of unbalance of silica, N, and P.
Similar studies to Maranhão were also carried out in other reservoirs (Alqueva [17], Pracana, Vale do Gaio, Pocinho, and Monte Novo). The case of Alqueva for its dimension required the use of a 3D formulation. CE-QUAL-W2 biogeochemical model was converted into a module of MOHID-Water (www.mohid.com) and a harmonic vertical coordinate was developed. Those studies revealed the importance of associating a socio-economic component to the eco-hydrological component [18].
In the framework of tempQsim (www.tempqsim.net) it was addressed the problem of temporary waters and the role of rainy events for the total river budget. Rainy events are the major drawback of catchment models and SWAT specifically. For that reason, MOHID-Land was developed allowing the use of variable fine grids with local nesting and a dynamic time step determined by the iterative procedure used for computing infiltration [19]. An interface between this model and SWAT was also developed in order to use this latter for simulating agriculture in the catchment and MOHID for simulating the river network and the corresponding sediment transport and biochemistry [20].
EUTROPHOS will be implemented in the Enxoé catchment area which is a sub-catchment of the Guadiana river. Only a few years after its construction, the reservoir started showing symptoms of eutrophication. Agriculture, urban areas, livestock wastes, and tanning are pointed out as main sources of pollution in the watershed. The main source is though not clear, as not many studies have been focused on Enxoé catchment area.

### 3.2.2. Plano e Métodos

3.2.2. Plan and Methods

EUTROPHOS aims to study the processes involved in P use, transport, and cycling, for developing knowledge and tools for managing agriculture diffuse sources, envisaging to control surface waters eutrophication, and especially cyanobacteria blooms.
The project is built on the hypotheses that agriculture is becoming the major cause of P emissions and that their control requires the knowledge of the processes driving P in the surface water, but also of the socio-economic drivers that stimulate its use.
The objectives of the project are: i) to assess the contribution of soil P to surface waters as a function of crops and agricultural practices, with particular emphasis for irrigation; ii) to extrapolate results to the whole catchment, using mathematical models; iii) to improve the existing catchment and reservoir models and determine maximum daily loads, and iv) to quantify the economic impact of agriculture practices changes and assess their social implications.

The Water Framework directive requires the definition of policies and plans for preserving and improving water quality in Europe, requiring monitoring programs and the development of studies for understanding the processes that determine that quality, recognizing that knowledge is the basis for optimum management.
Eutrophication is recognised by the Wastewater Treatment Directive and by the Nitrates Directive as the major threat to water quality, especially in fresh water reservoirs and lakes. Also the new bathing waters directive recognises the algal blooms as an important issue for bathing water managers.
P is the most important nutrient for Eutrophication control in fresh water systems. When it is the limiting factor its reduction will result directly into a reduction of primary production. When P is available, conditions for cyanobacteria blooms become very favourable. As a consequence, improvement of surface water quality, with benefits for water supply and recreation, can only be achieved by controlling P. The control of source point emissions using Waste Water Treatment Plants, and increasing spreading of dairy elevation slurry turns the control of P originated by soil erosion a main concern nowadays. Erosion control is a central point of this project. However erosion is by itself a major threat for the society and its control is a requirement for sustainable agriculture.
The problem to be addressed is particularly important in the inland agricultural areas. EUTROPHOS will be particularly interesting for the Alentejo region where Mediterranean conditions prevail, with high summer temperatures, irregular rainfall and scarce hydrologic superavit conditions, increase the probability of cyanobacteria blooms in the artificial reservoirs in the region. Enxoé, Maranhão, Roxo, Vale do Gaio, Montargil, are examples of reservoirs where strong cyanobacteria blooms have been identified over the last decade. All the catchment areas of those reservoirs have intensive agriculture activities located upstream, where soil erosion is a major soil threat [21]. Eutrophication risks may be enhanced in some of the referred reservoirs, when irrigation area in Alentejo increases with the Alqueva Project, and more soil erosion and more sediments may be dragged into these reservoirs. A sound irrigation policy, according to the European Union directives, must be established to mitigate these risks. Such policy must be based on a quantitative understanding of the subsurface movement of water and dissolved chemicals and also on understanding its impact on farmers' income.

Eutrophication of inland waters and modelling of catchments have been assessed in the last 4 years in the framework of the EU projects www.tempqsim.net, www.icrew.info, and www.ecomanage.info and in the framework of studies carried out for Portuguese Authorities. Among these projects, MOHID-Land was developed and compared with other models, especially with the SWAT model.

EUTROPHOS looks to foster those activities, developing the knowledge on processes determining P cycle and including it into state of the art, like MOHID-Land model, but also into the SWAT model.

This project will contribute to the knowledge of P and N content in Enxoé discharged waters, as well as, P adsorbed in the sediments. It will also focus on quantifying the losses agriculture activities caused by the reduction of production factors, optimizing yield taking into account also environmental goals [22]. The outcomes of this project will allow the extrapolation to different catchment areas located in Alentejo where eutrophication is a general concern. The tools to be developed can be used in any rural area, contributing for improving the implementation of water directives in those areas and for the improvement of the water quality. The development and improvement of such tools are considerably as the Water Framework Directive does not specify the methods to be used to monitor water quality across all Member States. It is up to each country to decide the best method based on local conditions and existing national approaches. The results from this project will help to evaluate the impact of the agricultural practices used in the degradation of the reservoir waters of Enxoé. The methodologies used, after being successfully tested, will be proposed to governing bodies to be considered in the future national monitoring programme to reach for the EU Water Framework Directive goals.

EUTROPHOS will study the contribution of soil P to surface waters from four different perspectives: (1) focus on the fraction of P that will be dissolved/adsorbed in the soil. HYDRUS and MOHID-Land (www.mohid.com) will be used to study this issue at field plot scale; (2) focus on soil loss by water erosion. PESERA [23], SWAT and MOHID-Land models [20] will be used to study the soil erosion at the catchment scale; (3) focus on nutrients and trophic activity in the reservoir [24]. Monitoring the reservoir and determination of the total maximum daily loads will be achieved by modelling with MOHID-Water and CE-QUAL-W2 models; (4) Assessment of the environmental, economic and social impacts of changing the agricultural practices [25]. This task aims to study the impact of implementing restrictions to the use of production factors (N, P, and irrigation water) to the farming systems located upstream of Enxoé reservoir.

As expected results, EUTROPHOS will start by identifying the main sources of P in Enxoé watershed, through monitoring and modelling with tools like HYDRUS. The development of state of the art models, and their inter-comparison with the most popular models for catchments and fresh water trophic systems, will be a guarantee that the results of the work will have important scientific impact, but also that they will have a strong impact on the actors involved on agriculture and Eutrophication control. The models developments will be implemented in such a way that they can be made available to SWAT and CE-QUAL-W2 communities in order to disseminate them, but also to promote the insertion of this team into those models users communities.

EUTROPHOS will be build on the experience of the partners on erosion control, soil physics, soil chemistry, irrigation, modelling, economical and social studies. The leader of the project, as well as, the INRB team, is well experienced in field and laboratory work and modelling at the plot scale. Soil physical and chemical characterization [26] and upscalling with Pedotransfer functions [27], modelling solute transport in soils [28], erosion studies [23], environmental impacts of agriculture practices, namely nitrate leaching, at watershed scale [29], and studies of economic and social impacts of agricultural practices [25, 30] are part of the background and experience of INRB team.

IST team is well experienced in modelling water resources at field plot and watershed scales (www.mohid.com) [19]. It has been using watershed models to estimate nutrient export from the watershed in to surface waters like reservoirs and estuaries [15, 20]. Reservoir modelling has also been made by the group tackling problems related with eutrophication due to P [18].

UE team has long experience in monitoring water quality in the Portuguese reservoirs, namely, nutrients, organic carbon, chlorophyll, diatoms and cyanobacteria concentration, phosphate, ammonia, nitrate, turbidity, O2 content, and in characterizing bottom sediments properties [17, 24].

All partners have been maintaining a very good working relationship, having had many joint research projects over the last years.

### 3.2.3. Tarefas
### 3.2.3. Tasks

**Lista de tarefas** (4)
**Task list** (4)

| Designação da tarefa<br>Task denomination | Data de início<br>Start date | Data de fim<br>End date | Duração<br>Duration | Pessoas * mês<br>Person * months |
|---|---|---|---|---|
| Task 1. Erosion assessment and contro... | 01-01-2010 | 31-12-2012 | 36 | 39 |

**Descrição da tarefa e Resultados Esperados**
Task description and Expected results

Task 1 will be coordinated by José Casimiro Martins (INRB) and has contributions from all partners.
In Task 1, all field work will be carried out in order to assess soil erosion and nutrient losses in the watershed.
Soil losses by water erosion will be assessed with PESERA model, based on climatic, soil, vegetation, and topographic data for the entire watershed. 4 experimental sites will be installed in farms in the Enxoé watershed, assessing different crops and agricultural/irrigation techniques practiced in the region. These experimental sites will be selected from the areas with higher erosion risks obtained in PESERA, and will be used to validate model results.
In the 4 experimental sites, soil physical and chemical properties will be characterised at the beginning of the project for setting up input information for water and solute transport models, for assessing infiltration and runoff generated in the field. Physical analyses will include available water capacity, field capacity, wilting point, saturated hydraulic conductivity, infiltration rates, bulk density, and porosity. Soil chemical parameters include pH, organic matter content (OM), N, P and K.

Erosion will be measured using erosion-boxes sized 1x4 and 2×4 m2 deployed in the land plots along the land slope and connected to plastic traps for storing runoff water and eroded soil. A sediment trap will be also installed at the land plot outlet for measuring the total amount of soil loss. This value will be used for assessing the legitimacy of the extrapolation and for improving the extrapolation method.
An automatic sampling station will be installed at the outlet of the sub-catchment Erosion and deposition in each land plot will be assessed in 3 points, following the slope. The sites will be visited on a regular basis once a month and extraordinarily after events. At the land plot farmers will be instructed for warning the research team, while at the sub-catchment scale, an automatic sampler will be installed equipped with a level gauge and a GSM device for providing daily level and sending alert messages whenever the sudden level rises occur. Event will deserve a special attention in this project because they are responsible for a major part of the catchments export, especially in the southern European areas (ex: Alentejo) where late summer and autumn storms can generate intense floods with strong carrying capacity. The importance of these storms was assessed by the FP6 project TempQsim (www.tempqsim.net) finished in April 2006 where some of the members of this team were involved. This project could not however distinguish between sediments generated in the river network bottom and those generated by surface runoff.
N, soluble P, and Fe content in runoff waters will be measured at the outlet of the erosion boxes, at the outlet of the land plot and at the outlet of the sub-catchment and will be correlated in order to check for the quality of the values obtained by extrapolation. Fe and P will be also measured in the sediments trapped at the same points and Fe effect on P immobilization will be assessed. The first 4 months will be for identify the risk areas. 24 regular monthly field campaigns will be done starting at month 4 of the project. The last 8 month will be dedicated to final data processing and to any additional sampling found useful during the data analysis.

The following products will be produced with this task:
1.1–Identification of major water erosion risks with PESERA model
1.2–Identification of major soil uses
1.3–Assessment of soil physical and chemical properties of the selected experimental sites
1.4–Production of time series of (1) irrigation water volumes (2) rainfall (3) land plot runoff (4), land plot soil losses, (5) plant growth, (6) fertilization, (7) subcatchment soil losses, (8) nitrate and soluble phosphorous in the land plot liquid phase, (9) phosphorous in the eroded sediments in the plot, and (10) at the subcatchment outlet.

**Membros da equipa de investigação nesta tarefa**
Members of the research team in this task
(BI) Bolseiro de Investigação (Mestre) 1; (BI) Bolseiro de Investigação (Mestre) 2; Abílio Augusto Machado Guerreiro; Adélia Maria Rocha Gomes Varela Macara e Castro; Angela Cristina Brandão Fonseca Oliveira Prazeres; David Armando Costa Brito; Fernando Luis Pereira Pires; Francisco Lúcio dos Reis Borges Brito dos Santos; JOSÉ CASIMIRO ARAÚJO EUSÉBIO MARTINS; Manuel Luís Alves Fernandes; Maria Conceição Pinto Baptista Gonçalves; Maria da Graça Nóbrega Baptista Serrão; Paulo Filipe de Almeida Brito da Luz; PAULO JORGE NORTE CASTANHEIRA; Pedro Chambel Filipe Lopes Leitão; Shakib Shahidian;

| **Designação da tarefa**<br>Task denomination | **Data de início**<br>Start date | **Data de fim**<br>End date | **Duração**<br>Duration | **Pessoas * mês**<br>Person * months |
|---|---|---|---|---|
| Task 3. Modelling phosphorus and nitr... | 01-01-2010 | 31-12-2012 | 36 | 62,5 |

**Descrição da tarefa e Resultados Esperados**
Task description and Expected results

Task 3 will be coordinated by Ramiro Neves (IST) and has contributions from all partners.
Modelling will be developed with 3 aims: (1) Integration of data from other tasks, (2) improving understanding of the processes determining the path of P and N from the agriculture fields up to the discharge into the downstream reservoir, and (3) extrapolating the results from this project to other catchments/agricultural practices. For reaching these objectives, the modelling task must access the problem at the plot scale, at the catchment scale an in the reservoir.
Three different model applications will be used:
3.1– Model processes at field plot scale: soil moisture, infiltration, runoff, plant growth, nutrient evolution (N and P), erosion and deposition. The models used will be HYDRUS and MOHID-Land. Data measured in Task 1 will be used for specifying soil properties, boundary conditions and for validating the results. Experimental data will also be used for validating infiltration, runoff and erosion. Erosion algorithm will be based on existing algorithms modified for optimum fitting to the experimental data, benefiting from the capacity of MOHID-Land for computing infiltration and runoff at field plot and catchment scales.
3.2– Model processes at the catchment scale: total water, soil erosion, and nutrients generated by the catchment. The catchment scale results will be obtained implementing MOHID-Land and SWAT models. Hydrology in the former is process oriented computing the hydrological properties in a grid of at least 250x250 points (spatial step of about 300 m), and consequently, the results of land plot applications can be upscaled by extrapolating its results to the whole catchment. Erosion and deposition simulations will be a major improvement of this project, benefiting from the capacity of MOHID-Land for simulating runoff in a grid. In each cell, a mass balance of water, dissolved matter, and sediment is performed. The capacity for eroding will be computed following the USLE approach, with the capacity for transporting (and depositing) being a function of the velocity and shear.
SWAT is a very popular model and will be used in this project as a reference. SWAT model will be used to simulate runoff, erosion, N and P in the watershed. SWAT plant growth module will be coupled to MOHID-Land, since the development of such module is out of the scope of this project and of the plans of this team.
3.3– Reservoir model: Trophic activity in the reservoir and the fate of the nutrients generated in the catchment. In the reservoir, both the original CE-QUAL-2E and MOHID-Water will be implemented. The former is 2D laterally integrated, while the latter is 3D, permitting a more realistic flow simulation. In the framework of former projects, the water-quality module from CE-QUAL-2E was coupled to MOHID-Water.

Expected results:

- Evaluation of nutrient losses (N and P) at field plot scale using HYDRUS and MOHID-LAND, according to the agricultural practices of the region.
- Mapping soil erosion risks in Enxoé watershed based on MOHID-Land estimates.
- Comparison of erosion rates estimated with Mohid-Land against the estimated from PESERA model, provided in Task 1.
- Implementation of CE-QUAL-2E and MOHID-Water models to track trophic activity in the reservoir and the fate of the nutrients generated in the catchement.
- Define the weight of agricultural practices used in the region on the eutrophication of the watershed.
With these models different management and agriculture practice scenarios will be simulated and the environmental benefits will be assessed in the reservoir and in the catchment. The implications on production will be assessed, providing results to task 4 that will determine the socio-economic consequences of those management scenarios.

**Membros da equipa de investigação nesta tarefa**
Members of the research team in this task
(BI) Bolseiro de Investigação (Mestre) 1; (BI) Bolseiro de Investigação (Mestre) 2; Angela Cristina Brandão Fonseca Oliveira Prazeres; David Armando Costa Brito; Maria Conceição Pinto Baptista Gonçalves; Paulo Filipe de Almeida Brito da Luz; PAULO JORGE NORTE CASTANHEIRA; Pedro Chambel Filipe Lopes Leitão; Ramiro Joaquim Jesus Neves;

| **Designação da tarefa**<br>Task denomination | **Data de início**<br>Start date | **Data de fim**<br>End date | **Duração**<br>Duration | **Pessoas * mês**<br>Person * months |
|---|---|---|---|---|
| Task 4. Assessment of the environment... | 01-01-2010 | 31-12-2012 | 36 | 21 |

**Descrição da tarefa e Resultados Esperados**
Task description and Expected results
Task 4 will be coordinated by Nuno Siqueira de Carvalho (INRB) and has contributions from all partners.
The evidential requirement to promote sustainable agriculture, regarding yield, economical, social and ecological challenges, implies a greater complexity of the decision-making processes and planning, taking into account its optimisation, dealing with a wide range of conflicting objectives.
Mathematical programming models and operative techniques of the multiple criteria decision-making, proved to be very useful tools for Decision Support Systems in agriculture, particularly multiobjective programming, and compromise programming, used to find Pareto efficient and compromise solutions, and also goal programming, helping decision makers to achieve a set of goals (or targets) as closely as possible.
Restrictions to the use of agricultural production factors required for environmental reasons can lead to significant yield reductions and consequent farmer's income reductions. According to [25] and [30], minimizing nitrogen consumption in the eight main farming systems of the south-western region of Portugal can lead to drastic yield reductions (up to 70%) relatively to the optimum production that could be obtained, and which must be considered when defining the budget for agro-environmental subsidies.
In order to get homogeneous groups of farms, it will be defined a typology (representative farm Systems) - with criteria of geographic localization, dimension of the irrigated area and the relative weight of this last one in the total agricultural area - based upon a sample survey on irrigated farms, covered by Portuguese Farm Account Data Network (FADN).
The results of some plurianual field research in Portugal irrigated regions will be used to test the optimum yield levels of important crops through technical and economic maximization of water (Q) and fertilizer (N and P) yield factors effect.
With some of the proposed methodologies, this task aims to study the impact of implementing restrictions to the use of production factors (nitrogen, phosphorus and irrigation water) to the farming systems located upstream of Enxoé's reservoir. The main underlying problem is to find a compromise between economical objectives (like income maximization, costs and risk minimization, and so on) and environmental objectives (like biodiversity optimisation, water use efficiency maximization, fertilizer and energy consumptions minimization, soil and underground water pollution minimization, and so on).

Expected results:
4.1 - Technical and economical characterization of representative farming systems, using FADN account data, and collection of existing experimental data on the main local agricultural activities of the catchments area including the agriculture practices;
4.2 - Determination of the "pay-off matrix", using multiple criteria linear programming models, by optimising each one of the objectives under consideration (ideals values) and then computing their value in each one of other optimal solutions (anti-ideals values). The "pay-off matrix is very useful to illustrate the degree of conflict between the objectives;
4.3 - Some of the operative techniques of multiobjective programming (NISE method, restriction method, weighting method, and so on), compromise programming and goal programming will be applied to obtain the trade-offs between objectives and to evaluate the economic impacts of "good" farming practices;
4.4 - Presentation of alternative efficient and compromise solutions for economic-environmental decisions.

**Membros da equipa de investigação nesta tarefa**
Members of the research team in this task
(BI) Bolseiro de Investigação (Mestre) 1; JOSÉ CASIMIRO ARAÚJO EUSÉBIO MARTINS; Manuel Luís Alves Fernandes; Maria Conceição Pinto Baptista Gonçalves; Nuno José Siqueira Cabral de Carvalho; Paulo Filipe de Almeida Brito da Luz; Victor Manuel da Conceição Martins;

| **Designação da tarefa**<br>Task denomination | **Data de início**<br>Start date | **Data de fim**<br>End date | **Duração**<br>Duration | **Pessoas * mês**<br>Person * months |
|---|---|---|---|---|
| Task 2. Monitoring nutrients and trop... | 01-04-2010 | 31-12-2012 | 33 | 23 |

**Descrição da tarefa e Resultados Esperados**

Task description and Expected results

Task 2 will be coordinated by Manuela Morais (UEv) and has contributions from all partners.
In Task 2, monitoring the water quality in Enxoé's reservoir will be carried out. Enxoé reservoir is the most sensitive surface water body due to the water residence time, vertical stratification (inhibiting vertical diffusion), and due to the accumulation of OM on the bottom and consequent OM sediment enrichment. The reservoir is consequently the first water body where eutrophication symptoms are detected and also the one where eutrophication creates bigger problems due to the amount of water stored and of its socio-economic importance. Monitoring of the reservoir and determination of the total maximum daily load is very important for defining bounds for the catchments activities environmentally acceptable.
Reservoir samples will be collected next to the reservoir wall at one meter deep, following the standard sampling method. Samples for characterizing the river discharge will be collected from the bridge upstream the reservoir. These sampling methods minimise costs and follow the standard methodology used in Portugal, simplifying comparison with historical data. The parameters to be measured are temperature, nutrients, organic carbon, chlorophyll, and bacteria concentration.
Reservoir profiles will be executed using a small boat rented locally and will be measured using an automatic data acquisition system using a laptop computer, a datalogger, a multiprobe (YSI6600), a portable nutrients analyser (Systea DPA) that require 5 min per sample*parameter and a GPS. The profiles will be collected in longitudinal and transversal profiles. Vertical profiles will be executed in a horizontal grid with a step that will be decided in place, analysing the data from previous profiles. The parameters to be measured are temperature, chlorophyll, turbidity, O2, phosphate, NH4+ and NO3-.
Sediment samples will be collected using corers for obtaining undisturbed samples that will permit the characterization of the vertical structure of sediments. These campaigns will be carried out in the same days of campaigns for profiles. The material provided by these samples will supply information about the evolution of bottom sediments and will be analysed for determining the relation between Fe and P. The cores will be stored and made available to other teams for other analysis.

Monitoring of the reservoir will produce 3 types of results:
2.1- Production of monthly time series of temperature, nutrients, organic carbon and chlorophyll, quantifying separately diatoms and cyanobacteria concentrations in one point in the reservoir and another at the river discharge point.
2.2- Production of seasonal and horizontal profiles of temperature, chlorophyll, turbidity and O2, phosphate, NH4+ and NO3-.
2.3- Production of end-summer and early spring characterization of bottom sediment properties.
The time series to be obtained in (2.1) will provide data for assessing the reservoir catchments production (point at the river discharge) and the evolution of the water quality in the reservoir. By themselves these results are beneficial for characterizing the result of the processes in the catchments and what is the result of the processes happening inside the reservoir.
The profiles produced in (2.2) will generate information for understanding the processes that are happening inside the reservoir, being very important for understanding the role of vertical stratification for the trophic activity and water quality.
Sediments act as an integrating system of what is happening in the water column, receiving the particulate matter discharged in the reservoir and produced by the trophic chain. Early spring the contribution of particulate matter from the catchment is maximal and at the end of summer contribution from autochthonous production is expected to be maximal. The results produced in (2.3) will highlight both contributions and will contribute for the validation of the reservoir model.

**Membros da equipa de investigação nesta tarefa**

Members of the research team in this task

(BI) Bolseiro de Investigação (Mestre) 1; (BI) Bolseiro de Investigação (Mestre) 2; Angela Cristina Brandão Fonseca Oliveira Prazeres; David Armando Costa Brito; Fernando Luis Pereira Pires; Francisco Lúcio dos Reis Borges Brito dos Santos; Manuel Luís Alves Fernandes; Maria Conceição Pinto Baptista Gonçalves; Maria da Graça Nóbrega Baptista Serrão; Maria Manuela Queiroz Martins Mantero Morais; Maria Paula Abranches Alvarinhas Fareleira; Pedro Chambel Filipe Lopes Leitão;

## 3.2.4. Calendarização e Gestão do Projecto

### 3.2.4. Project Timeline and Management

### 3.2.4.a Descrição da Estrutura de Gestão

3.2.4.a Description of the Management Structure

This activity is referenced as Task 5-Dissemination and Management. Task 5 will be coordinated by Maria da Conceição Gonçalves (INRB) and has contributions from all partners. This Task will involve 29.6 persons x month. A steering group will be set up composed by the coordinators of all Tasks and will have ordinary meetings twice a year for discussing the evolution of the project in terms of activities, products and administrative issues. Extraordinary meetings, as well as meeting with all partners, will be organized when necessary.

Tasks 1 and 2 require field activity and intensive laboratory analysis which will be organized by the project manager in order (1) to optimize resources, (2) to assure results consistency, and (3) to simplify results debate within the consortium and contribute for the success of the modelling Task 3 and consequently to the success of Task 4.

The debate within the consortium will contribute for the scientific production and consequently for the dissemination of the project, both through publication of scientific papers and a final workshop.

Dissemination actions/products will include:
1 PhD and 2 MSc thesis
2 Progress Reports and 1 Final Report

3 papers in international journals
7 papers in national journals
11 participations in scientific meetings
1 web page
Final workshop

A web page will be construed and will include a description of the project and will be used for publishing documents created during the project. The calendar of the field campaigns will be written directly by the partners in the web page, in order to guarantee activities coordination. A database geographically referenced directly updatable by the partners will also be included in the web page, allowing graphical queries and being able to export data for worksheets. This database (in PostgreSQL) has been developed in former projects by IST team and is being used for distributing data among partners of specific projects and for disseminating public domain data.

Participation in local meetings is a tradition of this consortium, especially in meetings organized by local Water Boards, “the farmers associations managing the irrigation infrastructures and water” and Centro Operativo e de Tecnologias de Regadio, a national organisation based in Alentejo, that is in charge of providing technical irrigation support to farmers. A final Workshop will be held with the help of these institutions.

As a result of the project management the consortium expected:
-Maximization of the efficiency of the project implementation
-Maximization of the interaction between partners and disciplines
-Optimization of results dissemination

The Project’s financial and administrative management is a competence of the Administrative Services of INRB, which will give support towards the execution of Project budgets. It is also of its concern the execution of all legal and required financial reports.

### 3.2.4.b Lista de Milestones

3.2.4.b Milestone List

| **Data**<br>Date | **Designação da milestone**<br>Milestone denomination |
|---|---|
| 01-04-2010 | Starting Periodic Field Campaigns |

**Descrição**
Description

Start of field experimental work, namely installation of erosion plots, soil physical and chemical characterization, water sampling in rivers and Enxoé reservoir.

| **Data**<br>Date | **Designação da milestone**<br>Milestone denomination |
|---|---|
| 31-12-2010 | Characterization of farming systems |

**Descrição**
Description

Characterization of the agricultural practices in the Enxoé catchment area, namely, crops, soil management and phosphorus inputs in the fertilization.

| **Data**<br>Date | **Designação da milestone**<br>Milestone denomination |
|---|---|
| 31-12-2011 | Field Plot Simulations |

**Descrição**
Description

End of field plot simulations with HYDRUS and MOHID-Land.

| **Data**<br>Date | **Designação da milestone**<br>Milestone denomination |
|---|---|
| 31-07-2012 | Watershed and reservoir modelling |

**Descrição**
Description

End of watershed simulations with SWAT and MOHID-Land. End of reservoir simulations with MOHID-Water and CE-QUAL-2E.

| **Data**<br>Date | **Designação da milestone**<br>Milestone denomination |
|---|---|
| 30-11-2012 | Final Workshop |

**Descrição**
Description

Presentations of the scientific activities will be given in a conference to the general public, consortium participants, scientific community, stakeholders, decision-makers and policy makers, responsible by implementing the Water and the Nitrate Framework Directives in Portugal.

### 3.2.4.c Cronograma

3.2.4.c Timeline

*Ficheiro com a designação "timeline.pdf", no 9. Ficheiros Anexos, desta Visão Global (caso exista).*
*File with the name "timeline.pdf" at 9. Attachments (if exists).*

### 3.3. Referências Bibliográficas
### 3.3. Bibliographic References


| Referência<br>Reference | Ano<br>Year | Publicação<br>Publication |
|---|---|---|
| *(vazio)*<br>*(void)* | *(vazio)*<br>*(void)* | *(vazio)*<br>*(void)* |
| *(vazio)*<br>*(void)* | *(vazio)*<br>*(void)* | *(vazio)*<br>*(void)* |
| *(vazio)*<br>*(void)* | *(vazio)*<br>*(void)* | *(vazio)*<br>*(void)* |
| *(vazio)*<br>*(void)* | *(vazio)*<br>*(void)* | *(vazio)*<br>*(void)* |
| *(vazio)*<br>*(void)* | *(vazio)*<br>*(void)* | *(vazio)*<br>*(void)* |
| [1] | 2001 | **Westermann D. T., Bjorneberg D. L., Aase J. K., Robbins C. W., 2001. Phosphorus Losses in Furrow Irrigation Runoff. J. Environ. Qual. 30:1009–1015.** |
| [2] | 1980 | Taylor, A.W, Kilmer, V.J., 1980. Agricultural Phosphorus in the environment. In: Stelly, M. (ed.) The Role of Phosphorus in Agriculture. pp 545-558. American Society of Agronomy, Crop Society of American, Madison, Wisconsin USA. |
| [3] | 1995 | **Heckrath, G., Brookes, P.C., Poulton, P.R., Goulding, K.W.T., 1995. Phosphorus leaching from soils containing different phosphorus concentrations in the Broadbalk experiment. J. Environ. Qual. 24: 904–910.** |
| [4] | 1991 | Goltermann, H.L., de Oude, N.T., 1991. Eutrophication of lakes, rivers and coastal seas. In O. Hutzinger (ed.) The handbook of environmental chemistry. Vol. 5. Part A. Water pollution, pp. 79-124. Springer Verlag, Berlin, Germany. |
| [5] | 1991 | Barroin, G., 1991. La réhabilitation des plans d'eau. La Recherche 22: 1412-1422. |
| [6] | 1998 | **Daniel, T.C., Sharpley, A.N., Lemunyon, J.L., 1998. Agricultural phosphorus and eutrophication: A symposium overview. J. Environ. Qual. 27: 251–257.** |
| [7] | 1997 | **McDowell, R.W., Sharpley, A.N., Condron, L.M., Haygarth, P.M., Brookes, P.C., 2001. Processes controlling soil phosphorus release to runoff and implications for agricultural management. Nutrient Cycling in Agroecosystems 59:269-284.** |
| [8] | 2008 | **Kirkby, M.J., Irvine, B., Jones, R.J.A. & Govers, G., 2008. The PESERA coarse scale erosion model for Europe. I – Model rationale and implementation. European Journal of Soil Science, 59 (6): 1293-1306.** |
| [9] | 1998 | Gibson, G.E. 1998. The dynamics of phosphorus in freshwater and marine environments. In: Tunney, H, Carton, O.T., Brookes, P.C., Johnston, A.E. (eds.) Phosphorus loss from soil to water. pp 119-135. Cab international, Wallingford, UK. |
| [10] | 2008 | **Pizarro, M.J., Hammerly, J., Maine, M.A., Suñe, N. 1992. Phosphate adsorption on bottom sediments of the Rio de la Plata. Hydrobiologia, 228: 43-54.** |
| [11] | 2003 | **Havens, K., James, R.T., East T., Smith, V.H., 2003. N:P ratios, light limitation, and cyanobacterial dominance in a subtropical lake impacted by non-point source nutrient pollution. Env. Pollution, 122 :379-390** |
| [12] | 2005 | **Neitsch, S.L, Arnold J.G., Kiniry, J.R., Williams J.R., 2005. Soil and Water Assessment Tool Theoretical Documentation. Soil and Water Research Laboratory, Agricultural Research Service and Blackland Research Center, Texas Agricultural Experiment Station.** |
| [13] | 2003 | **EUROHARP, 2003. Towards European Harmonised Procedures for Quantification of Nutrient Losses from Diffuse Sources** |
| [14] | 2005 | Coelho H., Mateus S., Neves, R., 2005. Modelação da Qualidade da água da albufeira do Maranhão: Estado de referência e cenários de redução de cargas afluentes. Relatório INAG. |
| [16] | 2000 | **Cole, T.M., Wells, S.A., 2000. CE-QUAL-W2: A two-dimensional, laterally averaged, hydrodynamic and water quality model, version 3.0,: U.S. Army Corps of Engineers Instruction Report EL-00-1.** |
| [17] | 2007 | Morais, M., Serafim A. M., Pinto P., Ilhéu A. & Ruivo M., 2007. Monitoring of the water quality in Alqueva reservor, Guadiana river, southern Portugal. In: G Gunkel, G., Sobral, M.C. (eds.), Reservoir and River Basin management: Exchange of Experiences from Brazil, Portugal and Germany. Technical University of Berlim, Berlim: 96-112. |
| [18] | 2008 | **Coelho H., Silva, A., Chambel-Leitão, P., Obermann, M., 2008. On The Origin Of Cyanobacteria Blooms In The Enxoé Reservoir. 13th World Water Congress, Montpellier, France.** |
| [20] | 2007 | **Leitão, P.C., Braunchweig, F., Fernandes, L., Galvão P.B, Neves. R., 2007. Integration of MOHID Model and Tools with SWAT Model. 4th International SWAT** |

| | | |
|---|---|---|
| | | **Conference. Delph, The Netherlands.** |
| [21] | 2005 | Martins, J.C.; Ramos, T.B.; Pires, F.P.; Oliveira, A.V.; Bica, M.A.; Castanheira, N.L.; Reis, J.L., Santos, F.L., 2005. Runoff and soil erosion in a soil with maize irrigated by center-pivot under different tillage techniques and polyacrylamide application. Revista de Ciências Agrárias, vol. XXVIII, 2: 49-62. |
| [22] | 2008 | **Ramos, T. B., Gonçalves, M. C., Castanheira, N. L., Martins, J. C., Santos, F. L., Prazeres, A., Fernandes, M. L., 2008. Effect of sodium and nitrogen on yield function of irrigated maize in southern Portugal. Agricultural Water Management, (doi:10:1016/j.agwat.2008.09.23).** |
| [23] | 2009 | Gonçalves, M.C., Ramos, T.B., Martins, J.C., Kosmas, C., 2009. Methodologies for soil erosion and land desertification risk assessment. The case study of Vale do Gaio watershed. Submitted to Revista das Ciências Agrárias |
| [25] | 2006 | Carvalho, N.S., 2006. Planeamento agrícola num quadro multiobjectivo de natureza económica e ambiental. Agronomia Lusitana, 51 (3): 109-133. |
| [27] | 2001 | **Gonçalves, M. C., Leij, F. J., Schaap, M. G. 2001. Pedotransfer functions for solute transport parameters of Portuguese soils. European Journal of Soil Science 52 (4): 563-574.** |
| [29] | 2008 | **Catronga, H. D., Varela, M. B., Boteta, L. I., Guerreiro, C. S., Ferreira, V. O., Oliveira, I. B., Martins, J. C., Pires, F. P., Araújo, A. A., Ramos, T. B., Prazeres, A. O., Castro, A. M., Chibeles, C. A., 2008. Rede de controlo da qualidade da água de rega – RECOQUAR. 9º Congresso da Água, CD-ROM, 2-4 de Abril, Cascais, Portugal.** |
| [30] | 2006 | **Carvalho, N.S., 2005. Planeamento e gestão de sistemas de produção agrícola de regadio (no sul do país) num quadro multiobjectivo de natureza económica e ambiental. In: Carvalho, N.S. (ed.), Investigação e Planeamento de Sistemas de Produção Agrícola em Portugal, pp. 447-564. Edições Colibri/Estação Agronómica Nacional, Lisboa.** |


### 3.4. Publicações Anteriores
**3.4. Past Publications**


| Referência<br>Reference | Ano<br>Year | Publicação<br>Publication |
|---|---|---|
| [28] | 2006 | **Gonçalves, M. C., Šimunek, J., Ramos, T. B., Martins, J. C., Neves, M. J. and Pires, F. P. 2006. Multicomponent solute transport in soil lysimeters irrigated with waters of different quality, Water Resour. Res., 42, W08401, doi:10.1029/2005WR004802** |
| [26] | 2006 | **Ramos, T. B., Gonçalves, M. C., Martins, J. C., van Genuchten, M. Th. & Pires, F. P. 2006. Estimation of soil hydraulic properties from numerical inversion of tension disc infiltrometer data and using laboratory methods. Vadose Zone J. 2006.5: 684-696. doi: 10.2136/vzj2005.0074.** |
| [24] | 2006 | **Serafim, A., Morais, M., Guilherme P., Sarmento P., Ruivo M. & Magriço A, 2006. Spatial and temporal heterogeneity in the Alqueva reservoir, Guadiana river, Portugal. Limnetica, 25 (3): 771-786.** |
| [15] | 2008 | **Chambel-Leitão, P., 2008. Load and flow estimation: HARP-NUT guidelines and SWAT model description. In: Neves, R., Baretta, J., Mateus, M. (eds.), Perspectives on Integrated Coastal Zone Management in South America. IST Press, Lisbon, Portugal. (ISBN: 978-972-8469-74-0).** |
| [19] | 2009 | **Trancoso, A.R., Braunschweig, F., Chambel-Leitão, P., Obermann, M., Neves, R., 2009. An advanced modelling tool for simulating complex river systems. Sci. Total Environ., doi:10.1016/j.scitotenv.2009.01.015.** |


## 4. Equipa de investigação
4. Research team

-

### 4.1 Lista de membros
**4.1. Members list**

| Nome<br>Name | Função<br>Role | Grau académico<br>Academic degree | %tempo<br>%time | CV nuclear<br>Core CV |
|---|---|---|---|---|
| **Maria Conceição Pinto Baptista Gonçal...** | Inv. Responsável | DOUTORAMENTO | 33 | |
| **Angela Cristina Brandão Fonseca Olive...** | Investigador | DOUTORAMENTO | 17 | |
| **Francisco Lúcio dos Reis Borges Brito...** | Investigador | AGREGAÇÃO | 14 | |
| **JOSÉ CASIMIRO ARAÚJO EUSÉBIO MARTINS** | Investigador | LICENCIATURA | 19 | |
| **Maria da Graça Nóbrega Baptista Serrã...** | Investigador | LICENCIATURA | 14 | |
| **Maria Manuela Queiroz Martins Mantero...** | Investigador | DOUTORAMENTO | 5 | |
| **Maria Paula Abranches Alvarinhas Fare...** | Investigador | DOUTORAMENTO | 6 | |
| **Nuno José Siqueira Cabral de Carvalho** | Investigador | LICENCIATURA | 22 | |

| | | | |
|---|---|---|---|
| **Paulo Filipe de Almeida Brito da Luz** | Investigador | MESTRADO | 17 |
| **PAULO JORGE NORTE CASTANHEIRA** | Investigador | DOUTORAMENTO | 17 |
| **Ramiro Joaquim Jesus Neves** | Investigador | DOUTORAMENTO | 10 |
| **Shakib Shahidian** | Investigador | DOUTORAMENTO | 5 |
| **Abílio Augusto Machado Guerreiro** | Outro | LICENCIATURA | 11 |
| **Adélia Maria Rocha Gomes Varela Macar...** | Outro | LICENCIATURA | 6 |
| **David Armando Costa Brito** | Outro | LICENCIATURA | 19 |
| **Fernando Luis Pereira Pires** | Outro | LICENCIATURA | 17 |
| **Manuel Luís Alves Fernandes** | Outro | LICENCIATURA | 17 |
| **Pedro Chambel Filipe Lopes Leitão** | Outro | MESTRADO | 19 |
| **Victor Manuel da Conceição Martins** | Outro | MESTRADO | 19 |

*(O curriculum vitae de cada membro da equipa está disponível clicando no nome correspondente)*
*(Curriculum vitae for each research team member is available by clicking on the corresponding name)*
**Total: 19**

### 4.2. Lista de membros a contratar durante a execução do projecto
**4.2. Members list to hire during project"s execution**

| **Membro da equipa**<br>Team member | **Função**<br>Role | **Duração**<br>Duration | **%tempo**<br>%time |
|---|---|---|---|
| (BI) Bolseiro de Investigação (Mestre) 1 | Bolseiro | 36 | 100 |
| (BI) Bolseiro de Investigação (Mestre) 2 | Bolseiro | 36 | 100 |

**Total: 2**

## 5. Projectos financiados
5. Funded projects

-

### Lista de projectos financiados
Funded projects list

| **Referência**<br>Reference | **Título**<br>Title | **Estado**<br>Status |
|---|---|---|
| **AGRO 727** | Demonstração e divulgação de t... | Concluído |
| **PEDIZA 2004.64.001978.4** | Rede de Controlo da Qualidade ... | Concluído |
| **PTDC/AGR-AAM/66004/2006** | Optimização da Fertilização Az... | Em curso |

*(Os detalhes de cada projectos estão disponíveis clicando na referência correspondente)*
*(Details for each project are available by clicking on the corresponding reference)*
**Total: 3**

## 6. Indicadores previstos
6. Expected indicators

-

### Indicadores de realização previstos para o projecto
**Expected output indicators**

| **Descrição**<br>Description | **2009** | **2010** | **2011** | **2012** | **2013** | **Total** |
|---|---|---|---|---|---|---|
| **A - Publicações**<br>Publications | | | | | | |
| Livros<br>Books | 0 | 0 | 0 | 0 | 0 | **0** |
| Artigos em revistas internacionais<br>Papers in international journals | 0 | 0 | 0 | 3 | 0 | **3** |
| Artigos em revistas nacionais<br>Papers in national journals | 0 | 1 | 3 | 3 | 0 | **7** |
| **B - Comunicações**<br>Communications | | | | | | |
| Comunicações em encontros científicos internacionais<br>Communications in international meetings | 0 | 1 | 1 | 3 | 0 | **5** |
| Comunicações em encontros científicos nacionais<br>Communications in national meetings | 0 | 1 | 3 | 3 | 0 | **7** |
| **C - Relatórios**<br>Reports | 0 | 1 | 1 | 1 | 0 | **3** |
| **D - Organização de seminários e conferências**<br>Organization of seminars and conferences | 0 | 0 | 0 | 1 | 0 | **1** |
| **E - Formação avançada**<br>Advanced training | | | | | | |

| | | | | | | |
|---|---|---|---|---|---|---|
| Teses de Doutoramento<br>PhD theses | 0 | 0 | 0 | 1 | 0 | **1** |
| Teses de Mestrado<br>Master theses | 0 | 0 | 1 | 1 | 0 | **2** |
| Outras<br>Others | 0 | 0 | 0 | 0 | 0 | **0** |
| **F - Modelos**<br>Models | 0 | 0 | 0 | 1 | 0 | **1** |
| **G - Aplicações computacionais**<br>Software | 0 | 1 | 1 | 1 | 0 | **3** |
| **H - Instalações piloto**<br>Pilot plants | 0 | 0 | 0 | 0 | 0 | **0** |
| **I - Protótipos laboratoriais**<br>Prototypes | 0 | 0 | 0 | 0 | 0 | **0** |
| **J - Patentes**<br>Patents | 0 | 0 | 0 | 0 | 0 | **0** |
| **L - Outros**<br>Other | | | | | | |
| | 0 | 0 | 0 | 0 | 0 | **0** |
| | 0 | 0 | 0 | 0 | 0 | **0** |
| | 0 | 0 | 0 | 0 | 0 | **0** |

**Acções de divulgação da actividade científica**
**Scientific activity spreading actions**

Results of the project will be disseminated using all the new communication methods: Scientific papers, scientific meetings, a web page, and numerical models.
At least 10 papers will be prepared, 3 of them to be submitted to international journals and the remaining will be presented in national meetings and printed in national journals or proceedings. The numerical models used (PESERA, HYDRUS, SWAT, MOHID, CE-QUAL-2E), with their graphical interfaces, are powerful tools to make results more comprehensible to everyone. The results of process oriented studies will be included in the models SWAT and MOHID, making those achievements automatically available to their user's communities. A web page will be designed in Portuguese, with an English translation of the most important issues, to disseminate the project results to a wider audience. Also, the collaboration with "Centro Operativo e de Tecnologias de Regadio" (COTR), a national organization based in Alentejo, that deals with technicians and irrigators, will help to disseminate the project results in written documents (posted and distributed on their web site) and also with technical meetings or visits. The pedagogic role of the teachers involved in this project will be enhanced, leading to more specific teaching, based on the knowledge and expertise acquired with the project activities. Presentations of the scientific activities in the framework of EUTROPHOS will be given in a conference to the general public, consortium participants, scientific community, stakeholders, decision-makers and policy makers, namely the National Water Institute, and the National Institute of Agricultural Engineering and Rural Development, responsible by implementing the Water and the Nitrate Framework Directives in Portugal.

## 7. Orçamento
7. Budget

-

**Instituição Proponente**
Principal Contractor

**Instituto Nacional de Recursos Biológicos, I.P.**

| **Descrição**<br>Description | **2009** | **2010** | **2011** | **2012** | **2013** | **Total** |
|---|---|---|---|---|---|---|
| Recursos Humanos<br>Human resources | 0,00 | 12.960,00 | 13.020,00 | 13.020,00 | 0,00 | **39.000,00** |
| Missões<br>Missions | 0,00 | 3.500,00 | 3.500,00 | 3.500,00 | 0,00 | **10.500,00** |
| Consultores<br>Consultants | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | **0,00** |
| Aquisição de bens e serviços<br>Service procurement and acquisitions | 0,00 | 5.500,00 | 6.000,00 | 6.000,00 | 0,00 | **17.500,00** |
| Registo de patentes<br>Patent registration | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | **0,00** |
| Adaptação de edifícios e instalações<br>Adaptation of buildings and facilities | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | **0,00** |
| Gastos gerais<br>Overheads | 0,00 | 3.647,00 | 3.378,00 | 3.378,00 | 0,00 | **10.403,00** |
| **TOTAL DESPESAS CORRENTES**<br>TOTAL CURRENT EXPENSES | **0,00** | **25.607,00** | **25.898,00** | **25.898,00** | **0,00** | **77.403,00** |

| | | | | | | |
|---|---|---|---|---|---|---|
| Equipamento<br>Equipment | 0,00 | 2.350,00 | 0,00 | 0,00 | 0,00 | **2.350,00** |
| **Total** | **0,00** | **27.957,00** | **25.898,00** | **25.898,00** | **0,00** | **79.753,00** |

**Instituições Participantes**
Participating Institutions

**Instituto Superior Técnico**

| **Descrição**<br>Description | **2009** | **2010** | **2011** | **2012** | **2013** | **Total** |
|---|---|---|---|---|---|---|
| Recursos Humanos<br>Human resources | 0,00 | 12.960,00 | 13.020,00 | 13.020,00 | 0,00 | **39.000,00** |
| Missões<br>Missions | 0,00 | 3.000,00 | 3.500,00 | 3.500,00 | 0,00 | **10.000,00** |
| Consultores<br>Consultants | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | **0,00** |
| Aquisição de bens e serviços<br>Service procurement and acquisitions | 0,00 | 4.500,00 | 4.500,00 | 4.500,00 | 0,00 | **13.500,00** |
| Registo de patentes<br>Patent registration | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | **0,00** |
| Adaptação de edifícios e instalações<br>Adaptation of buildings and facilities | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | **0,00** |
| Gastos gerais<br>Overheads | 0,00 | 4.492,00 | 4.604,00 | 4.204,00 | 0,00 | **13.300,00** |
| **TOTAL DESPESAS CORRENTES**<br>TOTAL CURRENT EXPENSES | **0,00** | **24.952,00** | **25.624,00** | **25.224,00** | **0,00** | **75.800,00** |
| Equipamento<br>Equipment | 0,00 | 2.000,00 | 2.000,00 | 0,00 | 0,00 | **4.000,00** |
| **Total** | **0,00** | **26.952,00** | **27.624,00** | **25.224,00** | **0,00** | **79.800,00** |

**Universidade de Évora**

| **Descrição**<br>Description | **2009** | **2010** | **2011** | **2012** | **2013** | **Total** |
|---|---|---|---|---|---|---|
| Recursos Humanos<br>Human resources | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | **0,00** |
| Missões<br>Missions | 0,00 | 4.000,00 | 4.000,00 | 4.000,00 | 0,00 | **12.000,00** |
| Consultores<br>Consultants | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | **0,00** |
| Aquisição de bens e serviços<br>Service procurement and acquisitions | 0,00 | 4.500,00 | 5.000,00 | 5.000,00 | 0,00 | **14.500,00** |
| Registo de patentes<br>Patent registration | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | **0,00** |
| Adaptação de edifícios e instalações<br>Adaptation of buildings and facilities | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | **0,00** |
| Gastos gerais<br>Overheads | 0,00 | 1.700,00 | 1.800,00 | 1.800,00 | 0,00 | **5.300,00** |
| **TOTAL DESPESAS CORRENTES**<br>TOTAL CURRENT EXPENSES | **0,00** | **10.200,00** | **10.800,00** | **10.800,00** | **0,00** | **31.800,00** |
| Equipamento<br>Equipment | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | **0,00** |
| **Total** | **0,00** | **10.200,00** | **10.800,00** | **10.800,00** | **0,00** | **31.800,00** |

**Orçamento Global**
Global budget

| **Descrição**<br>Description | **2009** | **2010** | **2011** | **2012** | **2013** | **Total** |
|---|---|---|---|---|---|---|
| Recursos Humanos<br>Human resources | 0,00 | 25.920,00 | 26.040,00 | 26.040,00 | 0,00 | **78.000,00** |
| Missões<br>Missions | 0,00 | 10.500,00 | 11.000,00 | 11.000,00 | 0,00 | **32.500,00** |

| | | | | | | |
|---|---|---|---|---|---|---|
| Consultores<br>Consultants | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | **0,00** |
| Aquisição de bens e serviços<br>Service procurement and acquisitions | 0,00 | 14.500,00 | 15.500,00 | 15.500,00 | 0,00 | **45.500,00** |
| Registo de patentes<br>Patent registration | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | **0,00** |
| Adaptação de edifícios e instalações<br>Adaptation of buildings and facilities | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | **0,00** |
| Gastos gerais<br>Overheads | 0,00 | 9.839,00 | 9.782,00 | 9.382,00 | 0,00 | **29.003,00** |
| **TOTAL DESPESAS CORRENTES**<br>TOTAL CURRENT EXPENSES | **0,00** | **60.759,00** | **62.322,00** | **61.922,00** | **0,00** | **185.003,00** |
| Equipamento<br>Equipment | 0,00 | 4.350,00 | 2.000,00 | 0,00 | 0,00 | **6.350,00** |
| **Total** | **0,00** | **65.109,00** | **64.322,00** | **61.922,00** | **0,00** | **191.353,00** |

**Plano de financiamento**
Finance plan

| **Descrição**<br>Description | **2009** | **2010** | **2011** | **2012** | **2013** | **Total** |
|---|---|---|---|---|---|---|
| Financiamento solicitado à FCT<br>Requested funding | 0,00 | 65.109,00 | 64.322,00 | 61.922,00 | 0,00 | **191.353,00** |
| Financiamento próprio<br>Own funding | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | **0,00** |
| Outro financiamento público<br>Other public-sector funding | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | **0,00** |
| Outro financiamento privado<br>Other private funding | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | **0,00** |
| **Total do Projecto**<br>Total of the project | **0,00** | **65.109,00** | **64.322,00** | **61.922,00** | **0,00** | **191.353,00** |

## 8. Justificação do orçamento
8. Budget rationale

-

### 8.1. Justificação dos recursos humanos
8.1. Human resources rationale

**Tipo**
Type
(BI) Bolsa de Investigação (Mestre)

**Nº de pessoas**
No. of persons
2

**Duração (em meses)**
Duration (in months)
36

**Custo envolvido (€)** ***(calculado)***
Total cost (€) *(estimated)*
70.560,00

**Outros custos (€)**
Other costs (€)
7.440,00

**Justificação do financiamento solicitado**
Rationale for requested funding

The project requires intensive field, lab and modelling work to be carried out by specialized people. To respond to those tasks, the research team must be enlarged with 2 fellowships. Following the reorganization of graduation courses according to “Bolonha” protocol, applicants should have a MSc degree. We would like to provide research opportunities for young scientists to do quality research, in assessing the contribution of N and P fertilizers to surface waters eutrophication, by interacting with a well experienced team. The other costs refer to the social security and insurance.

### 8.2. Justificação de missões
8.2. Missions rationale

**Tipo**
Type
Trabalho de campo

**Nº de deslocações**
No. of participations
90

**Local**
Venue
Enxoé catchment area

**Custo envolvido (€)**
Cost (€)
13.590,00

**Justificação do financiamento solicitado**
Rationale for requested funding

The project development involves intensive field work in local farms (soil characterization, installation of erosion plots, monitoring and collection of waters and sediments). These activities will represent several trips from Lisbon and Évora to the Enxoé catchment area. The rate is 32€/day x 40 days of visit/year x 3 years x 3 people of the 3 participating institutions + 55€ (fuel)/visit x 40 days of

visit/year x 3 years.

**Tipo**
Type
Participação em congressos

**Nº de deslocações**
No. of participations
9

**Local**
Venue
International and national events

**Custo envolvido (€)**
Cost (€)
18.910,00

**Justificação do financiamento solicitado**
Rationale for requested funding

The results of these project will be disseminated by atending some important international and national meetings. These costs consider covering conference registration fees, travel and subsistence.

### 8.3. Justificação de consultores
8.3. Consultants rationale

*(Vazio)*
*(Void)*

### 8.4. Justificação de aquisição de bens e serviços
8.4. Service procurement and acquisitions

**Tipo**
Type
Equipment maintenance and repairs

**Custo (€)**
Cost (€)
18.800,00

**Justificação do financiamento solicitado**
Rationale for requested funding

This item includes the payment of equipment maintenance and potencial repairations during the 3 years project, due to its intensive use. Some of the available equipment of this research team has some years of use, namely the Uv/vis spectrophotometer and SKALAR equipment. It also includes costs of renting a small boat for data collecting in profiles in the reservoir.

**Tipo**
Type
Bibliography

**Custo (€)**
Cost (€)
500,00

**Justificação do financiamento solicitado**
Rationale for requested funding

In order to improve knowledge on current methodologies and to support scientifically the results obtained, specific books, journals, papers or reviews will be bought with this funding.

**Tipo**
Type
Chemicals, laboratory, field, office material and publication charges

**Custo (€)**
Cost (€)
26.200,00

**Justificação do financiamento solicitado**
Rationale for requested funding

This funding is requested for the consumables materials that are needed in field experiments (e.g. plastic bags, tensiometer needles***??). Also in laboratory analyses consumables are needed, such as glass and plastic material, filter paper and reagents. Administrative consumables are also considered in this funding, e.g. paper, printer cartridges and other office material. It will also contemplate publication charges in international journals.

### 8.6. Justificação do Equipamento
8.6. Equipment rationale

#### 8.6.1. Equipamento já disponível para a execução do projecto
8.6.1 Available equipment

| Tipo de equipamento<br>Equipment type | Fabricante<br>Manufacturer | Modelo<br>Model | Ano<br>Year |
|---|---|---|---|
| TDR - Trase (2) | Soil Moisture Equipment | 6050x1 | 1999 |
| **Tipo de equipamento**<br>Equipment type | **Fabricante**<br>Manufacturer | **Modelo**<br>Model | **Ano**<br>Year |
| tension infiltrometer (2) | Soil Measurement Systems | 20 cm of diameter | 2000 |
| **Tipo de equipamento**<br>Equipment type | **Fabricante**<br>Manufacturer | **Modelo**<br>Model | **Ano**<br>Year |
| Suction Tables | Eijkelkamp | sand | 2002 |
| **Tipo de equipamento**<br>Equipment type | **Fabricante**<br>Manufacturer | **Modelo**<br>Model | **Ano**<br>Year |
| Suction tables | Eijkelkamp | Sand+Kaolin | 2002 |

| Tipo de equipamento<br>Equipment type | Fabricante<br>Manufacturer | Modelo<br>Model | Ano<br>Year |
|---|---|---|---|
| Ceramic Plate extractors | Soil Moisture Equipment Corp. | 5 and 15 Bar | 1996 |
| Evaporation Method | Eijkelkamp | Star 1 | 1996 |
| Condutivimeter (2) | Hanna Instruments | HI9835 | 2001 |
| Conductivimeter | WTW | INO LAB | 2002 |
| EC/mV/pH/T measure unit | Eijkelkamp | 18.21.SA | 2001 |
| Ventilated heating oven | Memert | UL 80 | 1995 |
| pH and Cl electrode | Crison | micro pH 2002 | 2000 |
| Multiparameter (N, P, K, Ca, Mg and S) meter | Hanna | H1 83225 | 2006 |
| Precision balance (2) | METTLER | PJ3000 | 1990 |
| Freezer | Angelantoni | Kryolab 350V | 2005 |
| Fridge | Liebherr | Profi line | 2003 |
| Ultra-centrifugal mill | Retsch | Zm100 | 2003 |
| Heavy duty mill | Retsch | Sm2000 | 2004 |
| Centrifuge | HETTICH | ROTOMAGNA | 1990 |
| Centrifuge | HERMLE | Z513 | 2004 |
| Magnetic stirrer | Velp Scientific | 1100 | 1999 |
| Micropipettes (5) | THERMO | 4500 | 2004 |
| Shaker | BUNSEN | AO400 | 2000 |

| | | | |
|---|---|---|---|
| Heating digester | Velp Scientific | DK200 | 1996 |

| **Tipo de equipamento**<br>Equipment type | **Fabricante**<br>Manufacturer | **Modelo**<br>Model | **Ano**<br>Year |
|---|---|---|---|
| Atomic absortion spectrometer | Varian | SpectrAA-10 Plus | 1994 |

| **Tipo de equipamento**<br>Equipment type | **Fabricante**<br>Manufacturer | **Modelo**<br>Model | **Ano**<br>Year |
|---|---|---|---|
| Atomic absortion spectrometer (GRAPHITE CHAMBER) | Perkin Elmer | AAnalyst 300 | 1998 |

| **Tipo de equipamento**<br>Equipment type | **Fabricante**<br>Manufacturer | **Modelo**<br>Model | **Ano**<br>Year |
|---|---|---|---|
| Uv/vis spectrophotometer | Beckman | DU 520 | 2000 |

| **Tipo de equipamento**<br>Equipment type | **Fabricante**<br>Manufacturer | **Modelo**<br>Model | **Ano**<br>Year |
|---|---|---|---|
| Autoanalyser | SKALAR | San System | 1993 |

| **Tipo de equipamento**<br>Equipment type | **Fabricante**<br>Manufacturer | **Modelo**<br>Model | **Ano**<br>Year |
|---|---|---|---|
| Sampler | SKALAR | 1000 | 1993 |

| **Tipo de equipamento**<br>Equipment type | **Fabricante**<br>Manufacturer | **Modelo**<br>Model | **Ano**<br>Year |
|---|---|---|---|
| Photometer | SKALAR | 6000 | 1993 |

| **Tipo de equipamento**<br>Equipment type | **Fabricante**<br>Manufacturer | **Modelo**<br>Model | **Ano**<br>Year |
|---|---|---|---|
| Interface | SKALAR | San system 8708/16 | 1993 |

| **Tipo de equipamento**<br>Equipment type | **Fabricante**<br>Manufacturer | **Modelo**<br>Model | **Ano**<br>Year |
|---|---|---|---|
| Carbon analyser | SKALAR | 5109 OC | 1993 |

| **Tipo de equipamento**<br>Equipment type | **Fabricante**<br>Manufacturer | **Modelo**<br>Model | **Ano**<br>Year |
|---|---|---|---|
| Nitrogen analyser | SKALAR | 5109 OC | 1993 |

| **Tipo de equipamento**<br>Equipment type | **Fabricante**<br>Manufacturer | **Modelo**<br>Model | **Ano**<br>Year |
|---|---|---|---|
| Water distillation unit (2) | MILLIPORE | ELIX e Milli-Q | 1999 |

| **Tipo de equipamento**<br>Equipment type | **Fabricante**<br>Manufacturer | **Modelo**<br>Model | **Ano**<br>Year |
|---|---|---|---|
| Washing machine | Miele professional | MIELABORG 1783 | 1999 |

| **Tipo de equipamento**<br>Equipment type | **Fabricante**<br>Manufacturer | **Modelo**<br>Model | **Ano**<br>Year |
|---|---|---|---|
| Photocopier | RICOH | ATICIO | 2006 |

| **Tipo de equipamento**<br>Equipment type | **Fabricante**<br>Manufacturer | **Modelo**<br>Model | **Ano**<br>Year |
|---|---|---|---|
| Computer (2) | Triudus | Pentium IV 3.60 GHz | 2005 |

| **Tipo de equipamento**<br>Equipment type | **Fabricante**<br>Manufacturer | **Modelo**<br>Model | **Ano**<br>Year |
|---|---|---|---|
| Inox erosion boxes | hand made | 1*4m and 2*4m | 2000 |

| **Tipo de equipamento**<br>Equipment type | **Fabricante**<br>Manufacturer | **Modelo**<br>Model | **Ano**<br>Year |
|---|---|---|---|
| Deep-sea probe analyser | Systea | DPA | 2005 |

| **Tipo de equipamento**<br>Equipment type | **Fabricante**<br>Manufacturer | **Modelo**<br>Model | **Ano**<br>Year |
|---|---|---|---|
| Automatic sampler | ISCO | 3700 | 2003 |

| **Tipo de equipamento**<br>Equipment type | **Fabricante**<br>Manufacturer | **Modelo**<br>Model | **Ano**<br>Year |
|---|---|---|---|
| Multiprobe | YSI | 6600 | 2005 |

| **Tipo de equipamento**<br>Equipment type | **Fabricante**<br>Manufacturer | **Modelo**<br>Model | **Ano**<br>Year |
|---|---|---|---|
| Datalogger | Campbell Scientific | CRX100 | 2004 |

**8.6.2. Discriminação do equipamento a adquirir**

8.6.2. New equipment requested

| Tipo de equipamento<br>Equipment type | Fabricante<br>Manufacturer | Modelo<br>Model | Custo (€)<br>Cost (€) |
|---|---|---|---|
| Datashow | EPSON | EB - X6 2200 ANSI | 800,00 |

**Justificação do financiamento solicitado**
Rationale for requested funding

This equipment is necessary for results presentation and divulgation, conferences, ordinary meetings for discussing the evolution of the project in terms of activities, products and administrative issues.

| Tipo de equipamento<br>Equipment type | Fabricante<br>Manufacturer | Modelo<br>Model | Custo (€)<br>Cost (€) |
|---|---|---|---|
| Computer (2) | Asus | Intel 2 Quad Core | 4.000,00 |

**Justificação do financiamento solicitado**
Rationale for requested funding

Two personal computers with at least a Intel Core 2 Quad Core, 8 Gb de RAM DDR2 1066 MHz, 2 SATA II of 7200 rpm with 1 TB/each will be used for running the models enhancing the actual calculate capacity of this team. These pc will be chosen according to market offers at the time of the project implementation.

| Tipo de equipamento<br>Equipment type | Fabricante<br>Manufacturer | Modelo<br>Model | Custo (€)<br>Cost (€) |
|---|---|---|---|
| Microsoft Office 2007 and Antivirus | Microsoft and Norton | Office 2007 and Norton | 450,00 |

**Justificação do financiamento solicitado**
Rationale for requested funding

These software licenses are needed with the acquisition of a new portable computer.

| Tipo de equipamento<br>Equipment type | Fabricante<br>Manufacturer | Modelo<br>Model | Custo (€)<br>Cost (€) |
|---|---|---|---|
| Portable computer | Sony | VGNCS11S | 1.100,00 |

**Justificação do financiamento solicitado**
Rationale for requested funding

A portable computer is needed to collect field data and to better fulfil the modeling requirements. The actual modelling capacity will be enhanced with a 4GB RAM, 320GB HDD, Duo processor P8400 (2.26 GHz and 1066 MHz) portable computer.

### 8.7. Justificação de registo de patentes
8.7. Patent registration

*(Vazio)*
*(Void)*

### 8.8. Justificação de adaptação de edifícios e instalações
8.8. Adaptation of buildings and facilities

*(Vazio)*
*(Void)*

## 9. Ficheiros Anexos
9. Attachments

-

| Nome<br>Name | Tamanho<br>Size |
|---|---|
| **Manpower.pdf** | 10Kb |
| **Timeline.pdf** | 97Kb |

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