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**SEVILLE (SPAIN)**
**July 9 - 11, 2008**
http://www.upo.es/econ/IIOMME08

# Environmental Analysis of household activity in Aragon

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*Abstract*

The objective of this paper is to analyse the environmental impact of the Aragonese economy by way of per capita ecological impacts, particularly with respect to atmospheric emissions, water consumption and water pollution. The framework of the analysis is a SAMEA (Social Accounting Matrix and Environmental Accounts) built for Aragon, 1999. This SAMEA is composed of the SAM, built for Aragon, and accounts of water resource and some indicators of water and atmospheric pollution. Therefore, this SAMEA describes the links between productive sectors, institutional activities and the environment. Only households are taken as an exogenous account, while government, labour, capital and other accounts are treated as endogenous. To obtain the pollution impact of an individual in the Aragonese economy and to measure his/her individual responsibility, per capita ecological impacts are estimated for two categories of water resource, six categories of water pollution and six categories of atmospheric emissions. Finally, the per capita ecological impacts are obtained for each household category according to income level. The objective is to know the environmental effects of an individual according to his/her income.

**Keywords**: Per capita ecological impacts, atmospheric emissions, water resource, SAMEA, Aragonese economy.

## 1. Introduction

A very tie problem to the economic activity and that in the last years has acquired a greater importance in economy are the environmental questions. It is a result of the negative environment effects of the productive activity and of consumption. These effects have increased the worry about securing a compatible economic growth with the preservation of the natural resources, that is to say, about what is denominated sustainable development. On this way, a subject that worries to the economists more and more is to secure that sustainable development from the life styles from a country or region.

In order to be able to treat this subject, environmental indicators are necessary to reflect the pressure on the environment caused by the economic activity and consumption patterns. One of the first approaches to this necessity arises in 1996, when Wakernagel and Rees (1996) defined the concept of Ecological Footprint as "*the land and water area that is required to support a defined human population and material standard indefinitely, using prevailing technology*". This concept has been used in numerous researches as indicator to evaluate if the life style of a specific population is sustainable. In this context, our objective is to analyze the environmental impact of an individual in the Aragonese economy. Aragon is a Spanish region, located in the Northeast of Spain. Between its main environmental problems to emphasize the following. The problems related to the water resource arise mainly because the water is a limited resource, and the water demand is increasing because of the economic and demographic growth. In Aragon, the water demands have been more and more important both for the field, for the industry and for the city. The main problems related to hydric pollution in Aragon are the diffuse contamination by farming activities, urban and industrial waste spills. As far as the air pollution, the growth percentage of the atmospheric emissions of Aragon, in spite of being inferior to those of Spain, exceeds too much 15% allowed to carry out the Protocol of Kioto. Moreover, the percentage of Aragonese emissions on the total of Spain is superior than its GIP and population percentage.

As in this work we study both the environmental effects of the productive activities to satisfy the demand of the households, and the effects of the own

consumption of the households, the analysis framework used is a SAMEA (Social Accounting Matrix and Environmental Accounts) built for Aragon for year 1999. This SAMEA is composed of an SAM and Environmental Accounts: Water Accounts, Accounts of Hydric Contamination and Accounts of Atmospheric Emissions.

The use of the model of Leontief based on a SAM facilitates the understanding of how the water consumption and pollution associated with the household activity and consumption patterns circulate through map of an economy. As the interest in this work is to estimate contamination and water consumption associated with the household activity and consumption patterns for Aragon, we assumed that all the industries and rest institutions act to satisfy the needs of the households. Therefore, the household account is considered as the unique exogenous account. The productive activities, the Overseas trade and the rest of institutional accounts: Government, Productive factors and Savings-Investment are treated as endogenous accounts, they consume water and they generate contamination to satisfy the household consumption. Finally, to obtain the water consumption and pollution effects that an individual produces in the Aragonese economy and to measure its individual responsibility, the environmental impacts for two categories of the resource of the water, six categories of the hydric contamination and six categories of atmospheric emissions are considered.

## 2. Methodology

The SAMEA used in the work has the structure presented in table 1. The SAM is composed by seven added account blocks that represent the agents of the economy: Productive activities, Productive factors, Households, Companies, Government, Savings-Investment and Overseas trade.

The SAMEA registers by rows the flows of natural resources that are captured from the nature by the different economy agents and are used as inputs. What each economic agent throws to the nature is registered by columns. From Water Accounts we consider the accounts of Water consumption and Physical water consumption (Water consumption minus the returns). In the Accounts of the Hydric Contaminación six subaccounts are included: Biochemical oxygen demand (BOD), Chemical oxygen demand (QOD), Metals, Phosphorus, Nitrogen and Solids in Suspension. In

atmospheric emissions Accounts, the six gases considered are the greenhouse effect gases that are included in the Protocol of Kioto: Dioxide of Carbon, $CO_2$, Nitrous Oxide, $N_2O$, Methane, $CH_4$, Hidrofluorocarburos, HFC, Perfluorocarburos, PFC, Hexafluoruro of sulphur, $SF_6$.

### Table 1. Structure of the SAMEA

| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | WATER RETURNS | WASTE POURING TO WATER | ATMOSPHERIC EMSSIONS |
|---|---|---|---|---|---|---|---|---|---|---|
| 1. Productive Activities | | | | | | | | | | |
| 2. Productive Factors | | | | | | | | | | |
| 3.Households | | | | | SAM | | | WATER ACCOUNT | HYDRIC POLLUTION ACCOUNT | ATMOSPHERIC EMISSION ACCOUNT |
| 4.Companies | | | | | | | | | | |
| 5.Government | | | | | | | | | | |
| 6.Savings-Investment | | | | | | | | | | |
| 7. Overseas Trade | | | | | | | | | | |
| Water Consumption and Uses | | | WATER ACCOUNT | | | | | | | |

According to our objective, we consider the households as exogenous account, and the rest of accounts as endogenous accounts: Productive activities, Productive factors, Companies, Government, Savings-Investment and Overseas trade. Following our selection of exogenous accounts, the equations associated with the SAM represented in Table 1 are expressed of the following way:

$$\mathbf{y} = \mathbf{A}\mathbf{y} + \mathbf{x}$$

where $\mathbf{A}$ is the matrix of average propensities to the expensive, $\mathbf{y}$ is the sum vector of the vectors column of the endogenous accounts, and $\mathbf{x}$ the vector column of Households. Solving this equation for $\mathbf{y}$, the income of the endogenous accounts is obtained, based on the household income:

$$\mathbf{y} = (\mathbf{I} - \mathbf{A})^{-1}\, \mathbf{x} = \mathbf{M}\, \mathbf{x}$$

where M is the Countable Multiplier Matrix.

In order to consider the total impact on the water consumption and each type of atmospheric emission and hydric contamination related to the household expense, it is necessary to consider, on the one hand, the pollution and water consumption caused by the productive processes, and on the other hand, the pollution and water consumption produced in the own consumption of goods and services.

To calculate the pollution and water consumption incorporated in the productive processes in the described model, the vector of unitary coefficients of pollution, $\mathbf{c}$, is multiplied by M. The result is the unitary values vector, $\lambda_k$. $\mathbf{c}_k$ is the coefficients vector that measures the pollution of type k directly incorporated to a monetary unit of production. Unitary values vector of that type of pollution is $\lambda_k´ = \mathbf{c}_k$ $\mathbf{M}$, that measures the amount of contamination that is generated in the productive process of each sector, by unit of exogenous account. The same would be for the water consumption. The contamination generated of that type k by the production and attributable to the expense of the exogenous account is $\lambda_k´\mathbf{x} = \mathbf{c}_k´\mathbf{M}\ \mathbf{x}$.

To obtain the water consumption and the direct contamination generated by the own consumption a vector of coefficients is used $\mathbf{d}_k$. This vector is obtained dividing the water consumption or the contamination of type k produced by the own consumption of a good or service, by the expenses incurred that consumption. Therefore, the water consumption or total contamination for the expenses of the households is obtained from $\mathbf{c}_k´\mathbf{Mx} + \mathbf{d}_k´\mathbf{x}$. This expression gather both components of the total expense, the generated one in the productive process and the generated one in the own consumption, the values of contamination and water consumption that include these two components are expressed as $\mathbf{v}_k´= \mathbf{c}_k´\mathbf{M} + \mathbf{d}_k$. Each $\mathbf{v}_{kj}$ represents the contamination or water consumption direct or indirectly necessary for each unit of expense of households in j, generated both in the productive process and in the own consumption.

## 3. Main Results

### 3.1 Environmental effects of the Households

The starting point to obtain the model described in the previous section has been the construction of the SAMEA of Aragon for 1999 and its associated model: $\mathbf{y}= (\mathbf{I} - \mathbf{A})^{-1}\ \mathbf{x}$

= **M x**, with the households as exogenous. From this SAMEA we have calculated the coefficient vector of the water consumption and of each pollutant, $c_k$, that appears in Table 2. In this table her we can observe the activities that greater water consumption and pollution directly incorporate to the production of 1000 Euros household demand. These activities are Energy products, Agriculture, Water sector, Cattle farming and the Overseas trade. Emphasizing Energy products mainly by its atmospheric emissions, Agriculture and Water by its water consumption, the Cattle farming by its hydric contamination and Overseas trade in water consumption, hydric contamination, and atmospheric emissions. The vector $d_k$ is obtained from data of INE (National Statistic Institute of Spain) too.

From **M**, $c_k$, $d_k$ and **x**, water consumption and contamination generated by the productive processes, by the own consumption, and the totals related to household expense are estimated. These estimations appear in Table 3.

According to the results, the water consumption produced by the productive processes in Aragon is of 67.96% for the total consumption, and 77.72% in physical Consumption, while the direct consumption of the households represents 1.18% for the total consumption, and 0.42% in Physical Consumption. The imported water is the 30.86% in total Consumption and 31.86% in Physical Consumption. Therefore, the direct consumption of the households is not significant respect to the consumption of the productive processes.

The hydric contamination produced by productive processes emphasizes, being their percentages between 67 and 71%, with the exception of QOD. As far as the atmospheric emissions it is verified that the percentage of the productive processes are smaller, increasing those of the imports, therefore the Aragonese economy through the imports avoids to produce a substantial part of atmospheric emissions required to obtain the final goods and services for the domestic consumption. To indicate that the percentage of the water consumption and contamination that is produced by the households are not important in relation to that are produced by the productive processes and imports to satisfy the household demand.

## Table 2. Direct pollution per thousand euros

| | | CONS (1000 m³) | CF (1000 m³) | DOB Kg | DOQ kg | Metales kg | Nitrogeno kg | Fósforo kg | Sol Susp kg |
|---|---|---|---|---|---|---|---|---|---|
| AP1A | Agriculture, forestry and aquiculture | 2.3478 | 1.6433 | 0.0000 | 0.0000 | 0.0000 | 1.9499 | 4.4667 | 0.0000 |
| AP1B | Cattle farming | 0.0818 | 0.0162 | 593.9911 | 0.0000 | 0.0000 | 166.8826 | 112.5206 | 1086.2701 |
| AP2 | Energu products | 0.1460 | 0.0082 | 0.0019 | 0.0008 | 0.0003 | 0.0002 | 0.0001 | 0.0000 |
| AP3 | Water | 0.3620 | 0.1672 | 47.1613 | 93.5431 | 30.4015 | 8.7697 | 6.2362 | 0.0000 |
| AP4 | Minerals and metals | 0.0050 | 0.0046 | 0.1037 | 0.0432 | 0.0180 | 0.0088 | 0.0037 | 0.0000 |
| AP5 | Minerals and non-metal products | 0.0010 | 0.0005 | 0.4295 | 0.1470 | 0.0211 | 0.0262 | 0.0161 | 0.0000 |
| AP6 | Chemical products | 0.0599 | 0.0328 | 28.0500 | 23.8033 | 14.2279 | 1.7041 | 1.6770 | 0.0000 |
| AP7 | Metallic products and machinery | 0.0009 | 0.0004 | 0.4304 | 0.2180 | 0.0743 | 0.0243 | 0.0266 | 0.0000 |
| AP8 | Transportation material | 0.0006 | 0.0005 | 0.0957 | 0.0595 | 0.0163 | 0.0189 | 0.0044 | 0.0000 |
| AP9 | Food products, drinks, tobacco | 0.0010 | 0.0007 | 0.3108 | 0.1970 | 0.0290 | 0.0293 | 0.0183 | 0.0000 |
| AP10 | Textiles, leather and footwaer | 0.0003 | 0.0002 | 0.0414 | 0.0192 | 0.0012 | 0.0022 | 0.0007 | 0.0000 |
| AP11 | Paper. Articlesof paper and impression | 0.0056 | 0.0007 | 4.6696 | 2.2587 | 1.1883 | 0.6776 | 0.1915 | 0.0000 |
| AP12 | Wood, Cork (excepto furniture) | 0.0016 | 0.0016 | 0.0545 | 0.0255 | 0.0007 | 0.0038 | 0.0009 | 0.0000 |
| AP13 | Rubber, plastics and other manufactures | 0.0425 | 0.0159 | 27.9274 | 13.7824 | 0.7513 | 3.5523 | 1.7363 | 0.0000 |
| AP14 | Construction and engineering | 0.0004 | 0.0002 | 0.0338 | 0.0548 | 0.0330 | 0.0066 | 0.0052 | 0.0000 |
| AP15 | Recovery and repairs | 0.0084 | 0.0041 | 4.6507 | 2.2824 | 0.1118 | 0.6061 | 0.2837 | 0.0000 |
| AP16 | Commercial services | 0.0010 | 0.0004 | 0.1219 | 0.1976 | 0.1190 | 0.0239 | 0.0188 | 0.0000 |
| AP17 | Hotel trade and restaurants | 0.0042 | 0.0018 | 0.5276 | 0.8554 | 0.5152 | 0.1035 | 0.0814 | 0.0000 |
| AP18 | Transports and communications | 0.0006 | 0.0003 | 0.0761 | 0.1235 | 0.0744 | 0.0149 | 0.0117 | 0.0000 |
| AP19 | Crédit and insurances | 0.0003 | 0.0001 | 0.0323 | 0.0524 | 0.0316 | 0.0063 | 0.0050 | 0.0000 |
| AP20 | Real states services | 0.0003 | 0.0001 | 0.0360 | 0.0584 | 0.0352 | 0.0071 | 0.0056 | 0.0000 |
| AP21 | Private education | 0.0022 | 0.0009 | 0.2792 | 0.4527 | 0.2727 | 0.0548 | 0.0431 | 0.0000 |
| AP22 | Private health | 0.0037 | 0.0015 | 0.4561 | 0.7396 | 0.4455 | 0.0895 | 0.0703 | 0.0000 |
| AP23 | Other services for the sale | 0.0013 | 0.0006 | 0.1665 | 0.2700 | 0.1626 | 0.0327 | 0.0257 | 0.0000 |
| AP24 | Housework | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 |
| AP25 | Public education | 0.0016 | 0.0007 | 0.1927 | 0.3125 | 0.1882 | 0.0378 | 0.0297 | 0.0000 |
| AP26 | Public Health | 0.0023 | 0.0010 | 0.2908 | 0.4715 | 0.2840 | 0.0571 | 0.0448 | 0.0000 |
| AP27 | Public Services | 0.0140 | 0.0122 | 12.0268 | 19.5014 | 11.7458 | 2.3604 | 1.8546 | 0.0000 |
| ESP | Spain | 0.1920 | 0.0774 | 32.1835 | 5.3020 | 2.6329 | 9.2353 | 5.9391 | 69.4959 |
| U.E. | European Unión | 0.0648 | 0.0252 | 14.0269 | 3.2339 | 1.5972 | 3.6354 | 2.3429 | 26.6772 |
| RDM | Rest of the World | 0.0752 | 0.0283 | 9.0410 | 2.7494 | 1.2609 | 2.2399 | 1.4302 | 14.2334 |
| L | Labour Factor | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 |
| K | Capital Factor | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 |
| SOC | Companies | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 |
| AA.PP. | Government | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 |
| A - I | Savings- Investment | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 |

| | | $CO_2$ (t) | $CH_4$ (t) | $N_2O$ (t) | HFC (kg) | PFC (kg) | $SF_6$ (kg) | $CO_2$ Eq (t) |
|---|---|---|---|---|---|---|---|---|
| AP1A | Agriculture, forestry and aquiculture | 0.4827 | 0.0013 | 0.0031 | 0.0000 | 0.0000 | 0.0000 | 1.47 |
| AP1B | Cattle farming | 0.0065 | 0.0805 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 1.70 |
| AP2 | Energu products | 5.4230 | 0.0067 | 0.0001 | 0.0000 | 0.0000 | 0.0000 | 5.60 |
| AP3 | Water | 0.0012 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.00 |
| AP4 | Minerals and metals | 0.1045 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.11 |
| AP5 | Minerals and non-metal products | 1.1224 | 0.0000 | 0.0001 | 0.0000 | 0.0000 | 0.0000 | 1.15 |
| AP6 | Chemical products | 0.0393 | 0.0001 | 0.0000 | 0.0243 | 0.0000 | 0.0000 | 0.11 |
| AP7 | Metallic products and machinery | 0.0765 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.08 |
| AP8 | Transportation material | 0.1079 | 0.0000 | 0.0000 | 0.0002 | 0.0000 | 0.0000 | 0.11 |
| AP9 | Food products, drinks, tobacco | 0.0078 | 0.0001 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.01 |
| AP10 | Textiles, leather and footwaer | 0.0017 | 0.0000 | 0.0000 | 0.0015 | 0.0000 | 0.0000 | 0.01 |
| AP11 | Paper. Articlesof paper and impression | 0.1895 | 0.0001 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.20 |
| AP12 | Wood, Cork (excepto furniture) | 0.0024 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.00 |
| AP13 | Rubber, plastics and other manufactures | 0.0144 | 0.0000 | 0.0000 | 0.0020 | 0.0000 | 0.0000 | 0.02 |
| AP14 | Construction and engineering | 0.0698 | 0.0000 | 0.0000 | 0.0004 | 0.0000 | 0.0000 | 0.07 |
| AP15 | Recovery and repairs | 0.0385 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.04 |
| AP16 | Commercial services | 0.1244 | 0.0000 | 0.0000 | 0.0003 | 0.0000 | 0.0000 | 0.13 |
| AP17 | Hotel trade and restaurants | 0.0201 | 0.0000 | 0.0000 | 0.0001 | 0.0000 | 0.0000 | 0.02 |
| AP18 | Transports and communications | 0.3931 | 0.0000 | 0.0000 | 0.0002 | 0.0000 | 0.0000 | 0.40 |
| AP19 | Crédit and insurances | 0.0114 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.01 |
| AP20 | Real states services | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.00 |
| AP21 | Private education | 0.0207 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.02 |
| AP22 | Private health | 0.0214 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.03 |
| AP23 | Other services for the sale | 0.0190 | 0.0040 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.11 |
| AP24 | Housework | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.00 |
| AP25 | Public education | 0.0035 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.00 |
| AP26 | Public Health | 0.0046 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.01 |
| AP27 | Public Services | 0.0212 | 0.0040 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.11 |
| ESP | Spain | 1.1261 | 0.0069 | 0.0004 | 0.0054 | 0.0006 | 0.0001 | 1.42 |
| U.E. | European Unión | 0.5197 | 0.0032 | 0.0002 | 0.0036 | 0.0006 | 0.0000 | 0.65 |
| RDM | Rest of the World | 0.5409 | 0.0021 | 0.0002 | 0.0028 | 0.0004 | 0.0000 | 0.65 |
| L | Labour Factor | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.00 |
| K | Capital Factor | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.00 |
| SOC | Companies | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.00 |
| AA.PP. | Government | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.00 |
| A - I | Savings- Investment | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.00 |

Since it has been explained in the methodology, the type k pollutant generated to produce 1000 Euros of the household expense in each account is given by the Value vector $v_k' = c_k'M + d_k$. This Value includes the contamination or water consumption of the productive processes, reflected by $c_k'M$, and the contamination or water

consumption that is generated by the own households consumption, $d_k$. The Value Vectors are shown in table 4.

**Table 3. Direct pollution from households and imports**

| | CONS (1000 m³) | CF (1000 m³) | DOB Kg | DOQ kg | Metales kg | Nitrogeno kg | Fósforo kg | Sol Susp kg |
|---|---|---|---|---|---|---|---|---|
| PRODUCTIVE PROCESSES | 4,187,211 | 2,695,653 | 817,290,940 | 112,945,374 | 51,827,417 | 210,920,517 | 147,106,104 | 1,256,066,062 |
| | 67,96% | 77,72% | 70,28% | 53,73% | 63,06% | 69,46% | 71,06% | 64,07% |
| HOUSEHOLDS | 72,438 | 14,554 | 15,950,594 | 35,758,860 | 49,287 | 818,527 | 795,782 | 21,156,313 |
| | 1,18% | 0,42% | 1,37% | 17,01% | 0,06% | 0,27% | 0,38% | 1,08% |
| IMPORTATION | 1,901,258 | 758,278 | 329,745,437 | 61,500,414 | 30,313,815 | 91,896,784 | 59,107,092 | 683,338,707 |
| | 30,86% | 21,86% | 28,35% | 29,26% | 36,88% | 30,27% | 28,55% | 34,85% |
| TOTAL | 6,160,907 | 3,468,485 | 1,162,986,971 | 210,204,648 | 82,190,518 | 303,635,828 | 207,008,977 | 1,960,561,082 |

| | $CO_2$ (kt) | $CH_4$ (t) | $N_2O$ (t) | HFC (kg) | PFC (kg) | $SF_6$ (kg) |
|---|---|---|---|---|---|---|
| PRODUCTIVE PROCESSES | 12,526 | 123,336 | 5,416 | 51,132 | 126 | 281 |
| | 47,70% | 62,67% | 54,69% | 44,18% | 1,44% | 29,50% |
| HOUSEHOLDS | 1,653 | 1,191 | 192 | 369 | 0 | 0 |
| | 6,29% | 0,61% | 1,94% | 0,32% | 0,00% | 0,00% |
| IMPORTATION | 12,080 | 72,280 | 4,295 | 64,223 | 8,579 | 672 |
| | 46,00% | 36,73% | 43,37% | 55,50% | 98,55% | 70,50% |
| TOTAL | 26,259 | 196,807 | 9,903 | 115,724 | 8,705 | 953 |

According to the results, the sectors with the greatest values of water consumption are Agriculture and the Food products, along with the Water activity. As far as the values of hydric contamination, the sectors with the greatest value depend on the pollutant that is considered. The Water and Chemical activities emphasize in DOQ and Metals, while the Cattle farming and Food products emphasize in Nitrogen and Phosphorus, and along with the Water activity in DOB and Solids in Suspension. As far as the atmospheric emissions the agents who present major value of equivalent $CO_2$ are the Energy Product activity, in $CH_4$ the Cattle farming, in $N_2O$ Agriculture, in HFC Chemical activities, in PFC Spain and $SF_6$ the Metallic products and machinery activity.

However, the unitary values show only an aspect of the problem. For a complete vision, we needed to consider the total values. For this reason, the Table 5 provides a percentage of the water consumption and contamination according to the components of the household expense.

## Table 4. Pollution values per thousand euros

| | | CONS (1000 m³) | CF (1000 m³) | DOB Kg | DOQ kg | Metales kg | Nitrogeno kg | Fósforo kg | Sol Susp kg |
|---|---|---|---|---|---|---|---|---|---|
| AP1A | Agriculture, forestry and aquiculture | 3.1153 | 2.0867 | 136.9112 | 17.8869 | 7.9752 | 38.6880 | 29.5167 | 239.0928 |
| AP1B | Cattle farming | 0.8207 | 0.4516 | 719.3340 | 14.5895 | 6.8298 | 200.5096 | 135.5382 | 1305.4311 |
| AP2 | Energu products | 0.6745 | 0.2807 | 103.7478 | 11.8630 | 5.4226 | 28.0112 | 18.8961 | 185.1268 |
| AP3 | Water | 2.5399 | 0.6861 | 519.5632 | 1045.8593 | 35.3501 | 43.7650 | 36.2959 | 645.5566 |
| AP4 | Minerals and metals | 0.5420 | 0.2947 | 111.1328 | 14.1443 | 6.4784 | 29.6993 | 20.0401 | 195.1564 |
| AP5 | Minerals and non-metal products | 0.6256 | 0.3397 | 131.0038 | 15.2900 | 6.9550 | 35.2070 | 23.7471 | 232.5219 |
| AP6 | Chemical products | 0.8183 | 0.4461 | 189.0840 | 44.9354 | 24.2294 | 44.4033 | 30.5255 | 280.9924 |
| AP7 | Metallic products and machinery | 0.6153 | 0.3351 | 129.7286 | 16.1755 | 7.3020 | 34.6033 | 23.3376 | 227.8381 |
| AP8 | Transportation material | 0.5203 | 0.2818 | 110.3078 | 15.9647 | 6.8783 | 28.8490 | 19.3882 | 187.2905 |
| AP9 | Food products, drinks, tobacco | 1.1917 | 0.7222 | 223.5736 | 17.5657 | 7.8906 | 61.3746 | 42.0533 | 400.1111 |
| AP10 | Textiles, leather and footwaer | 0.6553 | 0.3590 | 136.0521 | 16.5175 | 7.4965 | 36.4530 | 24.5920 | 239.9780 |
| AP11 | Paper. Articlesof paper and impression | 0.6579 | 0.3701 | 122.9526 | 17.3924 | 8.2977 | 32.2319 | 21.5846 | 206.5137 |
| AP12 | Wood, Cork (excepto furniture) | 0.7598 | 0.4396 | 125.2609 | 15.1233 | 6.9581 | 33.7284 | 22.9761 | 221.4455 |
| AP13 | Rubber, plastics and other manufactures | 0.6543 | 0.3496 | 157.8118 | 31.9914 | 9.0808 | 37.6348 | 24.7366 | 222.5644 |
| AP14 | Construction and engineering | 0.3105 | 0.1695 | 63.0408 | 8.5554 | 3.8724 | 16.6844 | 11.2689 | 108.9070 |
| AP15 | Recovery and repairs | 0.7612 | 0.4161 | 163.7048 | 20.0375 | 8.2071 | 43.6055 | 29.2894 | 284.7003 |
| AP16 | Commercial services | 0.2844 | 0.1533 | 60.3682 | 7.8374 | 3.6087 | 16.1176 | 10.8758 | 105.4394 |
| AP17 | Hotel trade and restaurants | 0.4102 | 0.2406 | 74.2160 | 8.6834 | 4.0567 | 20.0637 | 13.7251 | 129.6159 |
| AP18 | Transports and communications | 0.3252 | 0.1739 | 66.8443 | 8.3602 | 3.8523 | 17.9340 | 12.1001 | 117.8886 |
| AP19 | Crédit and insurances | 0.1785 | 0.0953 | 35.6728 | 4.5239 | 2.0938 | 9.5781 | 6.4619 | 62.8629 |
| AP20 | Real states services | 0.1646 | 0.0897 | 34.3199 | 5.2486 | 2.4601 | 9.0362 | 6.1056 | 58.4835 |
| AP21 | Private education | 0.1147 | 0.0619 | 22.3668 | 3.8204 | 1.8326 | 5.8552 | 3.9669 | 37.3536 |
| AP22 | Private health | 0.1903 | 0.1029 | 39.1619 | 7.6279 | 3.8250 | 9.9634 | 6.7837 | 63.4239 |
| AP23 | Other services for the sale | 0.3581 | 0.1942 | 74.9943 | 10.0404 | 4.6516 | 19.9596 | 13.4630 | 130.7964 |
| AP24 | Housework | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 |
| AP25 | Public education | 0.0601 | 0.0321 | 11.7619 | 2.1304 | 1.0039 | 3.0682 | 2.0771 | 19.4671 |
| AP26 | Public Health | 0.1807 | 0.0984 | 37.6433 | 7.1191 | 3.5892 | 9.5362 | 6.4953 | 61.0127 |
| AP27 | Public Services | 0.1413 | 0.0832 | 36.1064 | 22.8865 | 13.2765 | 8.7455 | 6.1845 | 41.2254 |
| ESP | Spain | 1.0250 | 0.5630 | 216.8246 | 22.5303 | 10.2569 | 59.0409 | 39.8201 | 392.2358 |
| U.E. | European Unión | 0.6158 | 0.3323 | 129.0237 | 18.9529 | 8.5672 | 33.8607 | 22.7680 | 222.2649 |
| RDM | Rest of the World | 0.5804 | 0.3110 | 111.8564 | 16.9733 | 7.6901 | 29.3205 | 19.7623 | 189.5093 |
| L | Labour Factor | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 |
| K | Capital Factor | 0.0884 | 0.0479 | 18.9407 | 3.3610 | 1.5668 | 4.8799 | 3.2948 | 31.1137 |
| SOC | Companies | 0.2127 | 0.1151 | 45.5080 | 7.8200 | 3.6007 | 11.7384 | 7.9204 | 75.0502 |
| AA.PP. | Government | 0.1366 | 0.0754 | 30.3935 | 8.9489 | 4.7965 | 7.6398 | 5.2316 | 45.8213 |
| A - I | Savings- Investment | 0.2826 | 0.1528 | 61.2405 | 10.0305 | 4.4244 | 15.7185 | 10.5973 | 100.2141 |
| | **TOTAL** | **20.61** | **10.95** | **4250.45** | **1500.79** | **244.38** | **1037.50** | **711.42** | **7067.01** |

| | | $CO_2$ (t) | $CH_4$ (t) | $N_2O$ (t) | HFC (kg) | PFC (kg) | $SF_6$ (kg) | $CO_{2\,Eq}$ (t) |
|---|---|---|---|---|---|---|---|---|
| AP1A | Agriculture, forestry and aquiculture | 2.9415 | 0.0234 | 0.0043 | 0.0129 | 0.0010 | 0.0001 | 4.81 |
| AP1B | Cattle farming | 2.2379 | 0.1008 | 0.0011 | 0.0121 | 0.0009 | 0.0001 | 4.75 |
| AP2 | Energu products | 10.4894 | 0.0268 | 0.0012 | 0.0102 | 0.0008 | 0.0001 | 11.46 |
| AP3 | Water | 1.8197 | 0.0097 | 0.0004 | 0.0059 | 0.0004 | 0.0000 | 2.18 |
| AP4 | Minerals and metals | 2.5130 | 0.0187 | 0.0009 | 0.0113 | 0.0009 | 0.0001 | 3.22 |
| AP5 | Minerals and non-metal products | 3.8859 | 0.0219 | 0.0011 | 0.0125 | 0.0011 | 0.0001 | 4.74 |
| AP6 | Chemical products | 3.0822 | 0.0264 | 0.0013 | 0.0423 | 0.0013 | 0.0001 | 4.15 |
| AP7 | Metallic products and machinery | 2.5975 | 0.0215 | 0.0010 | 0.0131 | 0.0011 | 0.0002 | 3.42 |
| AP8 | Transportation material | 2.3523 | 0.0183 | 0.0009 | 0.0126 | 0.0010 | 0.0001 | 3.05 |
| AP9 | Food products, drinks, tobacco | 2.8872 | 0.0350 | 0.0018 | 0.0142 | 0.0012 | 0.0001 | 4.23 |
| AP10 | Textiles, leather and footwaer | 2.5749 | 0.0225 | 0.0011 | 0.0153 | 0.0012 | 0.0001 | 3.44 |
| AP11 | Paper. Articlesof paper and impression | 2.5711 | 0.0198 | 0.0011 | 0.0123 | 0.0009 | 0.0001 | 3.36 |
| AP12 | Wood, Cork (excepto furniture) | 2.5118 | 0.0209 | 0.0012 | 0.0124 | 0.0010 | 0.0001 | 3.37 |
| AP13 | Rubber, plastics and other manufactures | 2.4791 | 0.0210 | 0.0010 | 0.0170 | 0.0011 | 0.0001 | 3.29 |
| AP14 | Construction and engineering | 1.6488 | 0.0107 | 0.0005 | 0.0070 | 0.0005 | 0.0001 | 2.06 |
| AP15 | Recovery and repairs | 3.0003 | 0.0263 | 0.0013 | 0.0147 | 0.0013 | 0.0001 | 3.99 |
| AP16 | Commercial services | 1.4605 | 0.0105 | 0.0005 | 0.0062 | 0.0005 | 0.0001 | 1.85 |
| AP17 | Hotel trade and restaurants | 1.3243 | 0.0120 | 0.0006 | 0.0060 | 0.0005 | 0.0001 | 1.79 |
| AP18 | Transports and communications | 4.1170 | 0.0132 | 0.0008 | 0.0072 | 0.0006 | 0.0001 | 4.67 |
| AP19 | Crédit and insurances | 0.9380 | 0.0069 | 0.0003 | 0.0034 | 0.0003 | 0.0000 | 1.19 |
| AP20 | Real states services | 0.7690 | 0.0060 | 0.0003 | 0.0038 | 0.0003 | 0.0000 | 0.99 |
| AP21 | Private education | 0.5838 | 0.0040 | 0.0002 | 0.0024 | 0.0002 | 0.0000 | 0.73 |
| AP22 | Private health | 0.8844 | 0.0065 | 0.0003 | 0.0054 | 0.0003 | 0.0000 | 1.14 |
| AP23 | Other services for the sale | 1.5587 | 0.0171 | 0.0006 | 0.0078 | 0.0007 | 0.0001 | 2.14 |
| AP24 | Housework | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.00 |
| AP25 | Public education | 0.3086 | 0.0021 | 0.0001 | 0.0012 | 0.0001 | 0.0000 | 0.39 |
| AP26 | Public Health | 0.7721 | 0.0062 | 0.0003 | 0.0055 | 0.0003 | 0.0000 | 1.02 |
| AP27 | Public Services | 0.5844 | 0.0083 | 0.0002 | 0.0024 | 0.0002 | 0.0000 | 0.84 |
| ESP | Spain | 3.8225 | 0.0356 | 0.0017 | 0.0189 | 0.0017 | 0.0002 | 5.16 |
| U.E. | European Unión | 2.7122 | 0.0219 | 0.0011 | 0.0158 | 0.0015 | 0.0002 | 3.56 |
| RDM | Rest of the World | 2.5309 | 0.0189 | 0.0010 | 0.0135 | 0.0013 | 0.0001 | 3.28 |
| L | Labour Factor | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.00 |
| K | Capital Factor | 0.4341 | 0.0033 | 0.0002 | 0.0023 | 0.0002 | 0.0000 | 0.56 |
| SOC | Companies | 1.0488 | 0.0079 | 0.0004 | 0.0056 | 0.0005 | 0.0001 | 1.35 |
| AA.PP. | Government | 0.6149 | 0.0055 | 0.0002 | 0.0037 | 0.0003 | 0.0000 | 0.81 |
| A - I | Savings- Investment | 1.4990 | 0.0106 | 0.0005 | 0.0075 | 0.0006 | 0.0001 | 1.90 |
| | **TOTAL** | **75.5559** | **0.6202** | **0.0296** | **0.3442** | **0.0256** | **0.0028** | **98.8918** |

According to the results we verified that the activities in which the households carry out the greater percentage of their expenses are the same as the activities with majors percentage of water consumption and contamination generated in their productive processes to satisfy the household demand. These activities are Commercial services, Hotel trade and restaurants and Food products, drinks and tobacco. In the first two cases that result is caused by the amount of in those activities, whereas the result for

Food products, drinks and tobacco is caused by its capacity of contamination and water consumption and the amount of household demand.

**Table 5. Percentage embodied pollution per components of household expenditure**

|  |  | HOG | CONS | CF | DOB | DOQ | Metales | Nitrogeno | Fósforo | Sol Susp |
|---|---|---|---|---|---|---|---|---|---|---|
| AP1A | Agriculture, forestry and aquiculture | 1.11% | 9.49% | 11.21% | 2.21% | 1.90% | 1.80% | 2.37% | 2.66% | 2.29% |
| AP1B | Cattle farming | 0.12% | 0.27% | 0.26% | 1.25% | 0.17% | 0.17% | 1.32% | 1.31% | 1.34% |
| AP2 | Energu products | 2.18% | 4.04% | 2.97% | 3.30% | 2.48% | 2.41% | 3.37% | 3.34% | 3.48% |
| AP3 | Water | 0.23% | 0.39% | 0.33% | 0.32% | 2.20% | 1.57% | 0.28% | 0.28% | 0.17% |
| AP4 | Minerals and metals | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% |
| AP5 | Minerals and non-metal products | 0.07% | 0.13% | 0.12% | 0.14% | 0.11% | 0.10% | 0.14% | 0.14% | 0.15% |
| AP6 | Chemical products | 0.94% | 2.11% | 2.03% | 2.59% | 4.05% | 4.64% | 2.31% | 2.33% | 2.28% |
| AP7 | Metallic products and machinery | 1.04% | 1.76% | 1.69% | 1.97% | 1.62% | 1.55% | 1.99% | 1.97% | 2.05% |
| AP8 | Transportation material | 2.13% | 3.05% | 2.91% | 3.43% | 3.27% | 2.99% | 3.40% | 3.36% | 3.45% |
| AP9 | Food products, drinks, tobacco | 5.83% | 19.08% | 20.39% | 19.00% | 9.82% | 9.37% | 19.76% | 19.88% | 20.12% |
| AP10 | Textiles, leather and footwaer | 2.40% | 4.31% | 4.16% | 4.75% | 3.79% | 3.66% | 4.82% | 4.78% | 4.96% |
| AP11 | Paper. Articlesof paper and impression | 0.76% | 1.38% | 1.36% | 1.36% | 1.27% | 1.29% | 1.35% | 1.33% | 1.36% |
| AP12 | Wood, Cork (excepto furniture) | 0.04% | 0.09% | 0.09% | 0.08% | 0.06% | 0.06% | 0.08% | 0.08% | 0.08% |
| AP13 | Rubber, plastics and other manufactures | 1.28% | 2.30% | 2.17% | 2.94% | 3.93% | 2.37% | 2.66% | 2.57% | 2.46% |
| AP14 | Construction and engineering | 0.42% | 0.36% | 0.35% | 0.39% | 0.35% | 0.33% | 0.39% | 0.39% | 0.40% |
| AP15 | Recovery and repairs | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% |
| AP16 | Commercial services | 10.92% | 8.53% | 8.10% | 9.61% | 8.20% | 8.02% | 9.72% | 9.63% | 9.93% |
| AP17 | Hotel trade and restaurants | 10.23% | 11.52% | 11.91% | 11.07% | 8.51% | 8.45% | 11.33% | 11.38% | 11.43% |
| AP18 | Transports and communications | 2.79% | 2.49% | 2.35% | 2.72% | 2.24% | 2.19% | 2.76% | 2.74% | 2.83% |
| AP19 | Crédit and insurances | 1.13% | 0.55% | 0.52% | 0.59% | 0.49% | 0.48% | 0.60% | 0.59% | 0.61% |
| AP20 | Real states services | 6.96% | 3.15% | 3.02% | 3.48% | 3.50% | 3.48% | 3.47% | 3.44% | 3.51% |
| AP21 | Private education | 0.97% | 0.31% | 0.29% | 0.32% | 0.36% | 0.36% | 0.31% | 0.31% | 0.31% |
| AP22 | Private health | 1.64% | 0.86% | 0.82% | 0.94% | 1.20% | 1.28% | 0.90% | 0.90% | 0.90% |
| AP23 | Other services for the sale | 2.85% | 2.80% | 2.68% | 3.12% | 2.74% | 2.70% | 3.14% | 3.11% | 3.21% |
| AP24 | Housework | 0.74% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% |
| AP25 | Public education | 0.19% | 0.03% | 0.03% | 0.03% | 0.04% | 0.04% | 0.03% | 0.03% | 0.03% |
| AP26 | Public Health | 0.46% | 0.23% | 0.22% | 0.25% | 0.31% | 0.33% | 0.24% | 0.24% | 0.24% |
| AP27 | Public Services | 0.16% | 0.06% | 0.06% | 0.08% | 0.35% | 0.43% | 0.08% | 0.08% | 0.06% |
| L | Spain | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% |
| K | European Unión | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% |
| SOC | Rest of the World | 5.63% | 3.29% | 3.14% | 3.73% | 4.22% | 4.13% | 3.65% | 3.61% | 3.64% |
| AA.PP. | Labour Factor | 29.11% | 10.92% | 10.63% | 12.90% | 24.97% | 28.42% | 12.28% | 12.35% | 11.50% |
| A - I | Capital Factor | 7.04% | 5.47% | 5.21% | 6.29% | 6.77% | 6.34% | 6.11% | 6.05% | 6.09% |
| ESP | Companies | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% |
| U.E. | Government | 0.49% | 0.83% | 0.79% | 0.92% | 0.89% | 0.86% | 0.92% | 0.91% | 0.94% |
| RDM | Savings- Investment | 0.12% | 0.19% | 0.18% | 0.19% | 0.19% | 0.18% | 0.19% | 0.19% | 0.19% |
|  | TOTAL | 100.00% | 100.00% | 100.00% | 100.00% | 100.00% | 100.00% | 100.00% | 100.00% | 100.00% |

| | | HOG | CO$_2$ (t) | CH$_4$ (t) | N$_2$O (t) | HFC (kg) | PFC (kg) | SF$_6$ (kg) | CO$_{2\,Eq}$ (t) |
|---|---|---|---|---|---|---|---|---|---|
| AP1A | Agriculture, forestry and aquiculture | 1.11% | 2.22% | 2.22% | 8.22% | 2.07% | 2.13% | 2.01% | 2.78% |
| AP1B | Cattle farming | 0.12% | 0.18% | 1.03% | 0.23% | 0.21% | 0.20% | 0.19% | 0.29% |
| AP2 | Energu products | 2.18% | 12.83% | 4.75% | 3.74% | 3.08% | 3.51% | 3.36% | 10.83% |
| AP3 | Water | 0.23% | 0.28% | 0.19% | 0.17% | 0.19% | 0.19% | 0.19% | 0.26% |
| AP4 | Minerals and metals | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% |
| AP5 | Minerals and non-metal products | 0.07% | 0.19% | 0.14% | 0.14% | 0.13% | 0.15% | 0.14% | 0.18% |
| AP6 | Chemical products | 0.94% | 1.97% | 2.12% | 2.07% | 5.77% | 2.40% | 2.24% | 2.03% |
| AP7 | Metallic products and machinery | 1.04% | 1.84% | 1.92% | 1.87% | 1.98% | 2.30% | 3.04% | 1.86% |
| AP8 | Transportation material | 2.13% | 3.41% | 3.34% | 3.26% | 3.91% | 4.28% | 4.37% | 3.40% |
| AP9 | Food products, drinks, tobacco | 5.83% | 11.44% | 17.45% | 18.03% | 11.98% | 13.18% | 12.33% | 12.84% |
| AP10 | Textiles, leather and footwaer | 2.40% | 4.19% | 4.61% | 4.52% | 5.30% | 5.35% | 5.00% | 4.29% |
| AP11 | Paper. Articlesof paper and impression | 0.76% | 1.33% | 1.29% | 1.40% | 1.36% | 1.39% | 1.31% | 1.33% |
| AP12 | Wood, Cork (excepto furniture) | 0.04% | 0.07% | 0.08% | 0.09% | 0.08% | 0.09% | 0.08% | 0.08% |
| AP13 | Rubber, plastics and other manufactures | 1.28% | 2.16% | 2.30% | 2.24% | 3.15% | 2.68% | 2.56% | 2.19% |
| AP14 | Construction and engineering | 0.42% | 0.47% | 0.39% | 0.39% | 0.43% | 0.43% | 0.46% | 0.46% |
| AP15 | Recovery and repairs | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% |
| AP16 | Commercial services | 10.92% | 10.84% | 9.77% | 9.08% | 9.88% | 10.32% | 10.10% | 10.53% |
| AP17 | Hotel trade and restaurants | 10.23% | 9.20% | 10.53% | 11.05% | 8.83% | 9.36% | 9.05% | 9.55% |
| AP18 | Transports and communications | 2.79% | 3.81% | 2.78% | 2.71% | 2.72% | 2.96% | 2.85% | 3.56% |
| AP19 | Crédit and insurances | 1.13% | 0.72% | 0.66% | 0.58% | 0.56% | 0.61% | 0.58% | 0.70% |
| AP20 | Real states services | 6.96% | 3.64% | 3.55% | 3.35% | 3.78% | 4.09% | 4.16% | 3.60% |
| AP21 | Private education | 0.97% | 0.39% | 0.33% | 0.31% | 0.33% | 0.33% | 0.32% | 0.37% |
| AP22 | Private health | 1.64% | 0.99% | 0.91% | 0.95% | 1.29% | 0.98% | 1.02% | 0.97% |
| AP23 | Other services for the sale | 2.85% | 3.02% | 4.16% | 3.07% | 3.23% | 3.60% | 3.41% | 3.17% |
| AP24 | Housework | 0.74% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% |
| AP25 | Public education | 0.19% | 0.04% | 0.03% | 0.03% | 0.03% | 0.03% | 0.03% | 0.04% |
| AP26 | Public Health | 0.46% | 0.24% | 0.24% | 0.25% | 0.36% | 0.26% | 0.27% | 0.24% |
| AP27 | Public Services | 0.16% | 0.06% | 0.11% | 0.06% | 0.05% | 0.06% | 0.06% | 0.07% |
| L | Spain | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% |
| K | European Unión | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% |
| SOC | Rest of the World | 5.63% | 4.01% | 3.79% | 3.56% | 4.56% | 5.10% | 5.40% | 3.95% |
| AA.PP. | Labour Factor | 29.11% | 12.17% | 13.80% | 11.58% | 15.68% | 14.01% | 14.31% | 12.36% |
| A - I | Capital Factor | 7.04% | 7.18% | 6.39% | 5.92% | 7.70% | 8.33% | 9.55% | 6.97% |
| ESP | Companies | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% |
| U.E. | Government | 0.49% | 0.91% | 0.92% | 0.90% | 1.12% | 1.42% | 1.31% | 0.91% |
| RDM | Savings- Investment | 0.12% | 0.20% | 0.19% | 0.20% | 0.23% | 0.29% | 0.27% | 0.20% |
| | TOTAL | 100.00% | 100.00% | 100.00% | 100.00% | 100.00% | 100.00% | 100.00% | 100.00% |

The activity of Real estate services, although it emphasizes between the activities with greater percentage of household expense, its percentages of contamination and water consumption are important. On the contrary Agriculture presents an important percentage of Physical consumption, much greater than the

percentage of household expense. The same happens for the activity Chemical products as far as the hydric contamination.

Until now, all the results obtained have not been per capita, so that it has not allowed to knowing the individual environmental impact in the Aragonese economy. As this is an objectives of the work, the per capita figures are obtained, they are a certain approach to Ecological Footprint of water consumption, hydric contamination and atmospheric emissions.

For the case of the water consumption, from the SAMEA it is obtained that the direct water consumption by person, in the Aragonese economy, for a year is around 610,339 liters, whereas as a result of the water returns, the physical consumption is five times less 122,626 liters. Nevertheless, in the table it is observed that the water consumption that really is caused by a person as a result of its activities is 5.184.294 ls., while the physical water consumption that is of 2.918.669 ls. In other words, the households consume water through demanded products mainly, more than in their direct consumption. For this reason, it would turn out interesting to carry out policy oriented to change the landlords of demand, or the production systems that satisfy that demand, with the aim of a more efficient use of the water.

According to the results obtained for hydric contamination, the six accounts that generate, per capita, greater hydric pollution to satisfy the household demand for each pollutant or pollution indicator, are the productive activities: Food products, drinks and tobacco, Commercial services and Hotel trade and restaurants, Textile, leather and footwear, along with the institutional accounts of the Government and Savings-investment.

According to the results for atmospheric emissions, the activities of Food Products, drinks and tobacco, Energy products, Commercial services, and Hotel trade and restaurants, along with the Government and Saving Investment, are those that produce the greatest amount of atmospheric emissions to satisfy the household demand, per capita.

## Table 6. Per capita (embodied) pollution for the Aragonese economy in 1999 and breakdown by accounts

| | | CONS (1000 m³) | CF (1000 m³) | DOB Kg | DOQ kg | Metales kg | Nitrogeno kg | Fósforo kg | Sol Susp kg |
|---|---|---|---|---|---|---|---|---|---|
| AP1A | Agriculture, forestry and aquiculture | 0.4864 | 0.3258 | 21.3778 | 2.7929 | 1.2453 | 6.0409 | 4.6088 | 37.3328 |
| AP1B | Cattle farming | 0.0138 | 0.0076 | 12.0534 | 0.2445 | 0.1144 | 3.3598 | 2.2711 | 21.8743 |
| AP2 | Energu products | 0.2071 | 0.0862 | 31.8507 | 3.6419 | 1.6647 | 8.5995 | 5.8011 | 56.8342 |
| AP3 | Water | 0.0809 | 0.0219 | 16.5527 | 33.3198 | 1.1262 | 1.3943 | 1.1563 | 20.5667 |
| AP4 | Minerals and metals | 0.0001 | 0.0001 | 0.0225 | 0.0029 | 0.0013 | 0.0060 | 0.0041 | 0.0396 |
| AP5 | Minerals and non-metal products | 0.0065 | 0.0035 | 1.3536 | 0.1580 | 0.0719 | 0.3638 | 0.2454 | 2.4026 |
| AP6 | Chemical products | 0.1083 | 0.0590 | 25.0227 | 5.9466 | 3.2064 | 5.8762 | 4.0396 | 37.1855 |
| AP7 | Metallic products and machinery | 0.0903 | 0.0492 | 19.0415 | 2.3742 | 1.0718 | 5.0791 | 3.4255 | 33.4420 |
| AP8 | Transportation material | 0.1563 | 0.0846 | 33.1367 | 4.7958 | 2.0663 | 8.6663 | 5.8243 | 56.2625 |
| AP9 | Food products, drinks, tobacco | 0.9777 | 0.5926 | 183.4338 | 14.4120 | 6.4739 | 50.3556 | 34.5032 | 328.2763 |
| AP10 | Textiles, leather and footwaer | 0.2209 | 0.1210 | 45.8624 | 5.5680 | 2.5270 | 12.2881 | 8.2898 | 80.8952 |
| AP11 | Paper. Articlesof paper and impression | 0.0705 | 0.0396 | 13.1662 | 1.8624 | 0.8886 | 3.4515 | 2.3114 | 22.1143 |
| AP12 | Wood, Cork (excepto furniture) | 0.0047 | 0.0027 | 0.7727 | 0.0933 | 0.0429 | 0.2081 | 0.1417 | 1.3660 |
| AP13 | Rubber, plastics and other manufactures | 0.1179 | 0.0630 | 28.4252 | 5.7623 | 1.6356 | 6.7788 | 4.4556 | 40.0884 |
| AP14 | Construction and engineering | 0.0185 | 0.0101 | 3.7601 | 0.5103 | 0.2310 | 0.9952 | 0.6721 | 6.4958 |
| AP15 | Recovery and repairs | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 |
| AP16 | Commercial services | 0.4370 | 0.2355 | 92.7542 | 12.0419 | 5.5446 | 24.7643 | 16.7104 | 162.0051 |
| AP17 | Hotel trade and restaurants | 0.5904 | 0.3463 | 106.8119 | 12.4972 | 5.8384 | 28.8757 | 19.7532 | 186.5436 |
| AP18 | Transports and communications | 0.1276 | 0.0682 | 26.2331 | 3.2810 | 1.5118 | 7.0382 | 4.7487 | 46.2655 |
| AP19 | Crédit and insurances | 0.0284 | 0.0152 | 5.6780 | 0.7201 | 0.3333 | 1.5245 | 1.0285 | 10.0058 |
| AP20 | Real states services | 0.1611 | 0.0878 | 33.5921 | 5.1373 | 2.4080 | 8.8446 | 5.9761 | 57.2433 |
| AP21 | Private education | 0.0157 | 0.0085 | 3.0645 | 0.5234 | 0.2511 | 0.8022 | 0.5435 | 5.1179 |
| AP22 | Private health | 0.0439 | 0.0238 | 9.0386 | 1.7605 | 0.8828 | 2.2996 | 1.5657 | 14.6383 |
| AP23 | Other services for the sale | 0.1436 | 0.0779 | 30.0779 | 4.0269 | 1.8656 | 8.0052 | 5.3996 | 52.4583 |
| AP24 | Housework | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 |
| AP25 | Public education | 0.0016 | 0.0009 | 0.3136 | 0.0568 | 0.0268 | 0.0818 | 0.0554 | 0.5191 |
| AP26 | Public Health | 0.0116 | 0.0063 | 2.4229 | 0.4582 | 0.2310 | 0.6138 | 0.4181 | 3.9271 |
| AP27 | Public Services | 0.0032 | 0.0019 | 0.8103 | 0.5136 | 0.2979 | 0.1963 | 0.1388 | 0.9251 |
| L | Spain | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 |
| K | European Unión | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 |
| SOC | Rest of the World | 0.1685 | 0.0912 | 36.0376 | 6.1926 | 2.8513 | 9.2955 | 6.2721 | 59.4319 |
| AA.PP. | Labour Factor | 0.5595 | 0.3089 | 124.4965 | 36.6559 | 19.6470 | 31.2938 | 21.4296 | 187.6909 |
| A - I | Capital Factor | 0.2801 | 0.1514 | 60.7000 | 9.9420 | 4.3854 | 15.5797 | 10.5037 | 99.3295 |
| ESP | Companies | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 |
| U.E. | Government | 0.0426 | 0.0230 | 8.9181 | 1.3100 | 0.5922 | 2.3405 | 1.5737 | 15.3630 |
| RDM | Savings- Investment | 0.0096 | 0.0051 | 1.8515 | 0.2810 | 0.1273 | 0.4853 | 0.3271 | 3.1369 |
| | TOTAL | 5.1843 | 2.9187 | 978.6331 | 176.8835 | 69.1619 | 255.5042 | 174.1944 | 1649.7776 |

| | | CO₂ (t) | CH₄ (t) | N₂O (t) | HFC (kg) | PFC (kg) | SF₆ (kg) | CO₂ Eq (t) |
|---|---|---|---|---|---|---|---|---|
| AP1A | Agriculture, forestry and aquiculture | 0.4593 | 0.0037 | 0.0007 | 0.0020 | 0.0002 | 0.0000 | 0.75 |
| AP1B | Cattle farming | 0.0375 | 0.0017 | 0.0000 | 0.0002 | 0.0000 | 0.0000 | 0.08 |
| AP2 | Energu products | 3.2203 | 0.0082 | 0.0004 | 0.0031 | 0.0003 | 0.0000 | 3.52 |
| AP3 | Water | 0.0580 | 0.0003 | 0.0000 | 0.0002 | 0.0000 | 0.0000 | 0.07 |
| AP4 | Minerals and metals | 0.0005 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.00 |
| AP5 | Minerals and non-metal products | 0.0402 | 0.0002 | 0.0000 | 0.0001 | 0.0000 | 0.0000 | 0.05 |
| AP6 | Chemical products | 0.4079 | 0.0035 | 0.0002 | 0.0056 | 0.0002 | 0.0000 | 0.55 |
| AP7 | Metallic products and machinery | 0.3813 | 0.0032 | 0.0002 | 0.0019 | 0.0002 | 0.0000 | 0.50 |
| AP8 | Transportation material | 0.7066 | 0.0055 | 0.0003 | 0.0038 | 0.0003 | 0.0000 | 0.92 |
| AP9 | Food products, drinks, tobacco | 2.3688 | 0.0287 | 0.0015 | 0.0116 | 0.0010 | 0.0001 | 3.47 |
| AP10 | Textiles, leather and footwaer | 0.8680 | 0.0076 | 0.0004 | 0.0051 | 0.0004 | 0.0000 | 1.16 |
| AP11 | Paper. Articlesof paper and impression | 0.2753 | 0.0021 | 0.0001 | 0.0013 | 0.0001 | 0.0000 | 0.36 |
| AP12 | Wood, Cork (excepto furniture) | 0.0155 | 0.0001 | 0.0000 | 0.0001 | 0.0000 | 0.0000 | 0.02 |
| AP13 | Rubber, plastics and other manufactures | 0.4465 | 0.0038 | 0.0002 | 0.0031 | 0.0002 | 0.0000 | 0.59 |
| AP14 | Construction and engineering | 0.0983 | 0.0006 | 0.0000 | 0.0004 | 0.0000 | 0.0000 | 0.12 |
| AP15 | Recovery and repairs | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.00 |
| AP16 | Commercial services | 2.2441 | 0.0161 | 0.0007 | 0.0096 | 0.0008 | 0.0001 | 2.84 |
| AP17 | Hotel trade and restaurants | 1.9060 | 0.0173 | 0.0009 | 0.0086 | 0.0007 | 0.0001 | 2.58 |
| AP18 | Transports and communications | 1.6157 | 0.0052 | 0.0003 | 0.0028 | 0.0002 | 0.0000 | 1.83 |
| AP19 | Crédit and insurances | 0.1493 | 0.0011 | 0.0000 | 0.0005 | 0.0000 | 0.0000 | 0.19 |
| AP20 | Real states services | 0.7527 | 0.0059 | 0.0003 | 0.0037 | 0.0003 | 0.0000 | 0.97 |
| AP21 | Private education | 0.0800 | 0.0005 | 0.0000 | 0.0003 | 0.0000 | 0.0000 | 0.10 |
| AP22 | Private health | 0.2041 | 0.0015 | 0.0001 | 0.0013 | 0.0001 | 0.0000 | 0.26 |
| AP23 | Other services for the sale | 0.6251 | 0.0069 | 0.0003 | 0.0031 | 0.0003 | 0.0000 | 0.86 |
| AP24 | Housework | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.00 |
| AP25 | Public education | 0.0082 | 0.0001 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.01 |
| AP26 | Public Health | 0.0497 | 0.0004 | 0.0000 | 0.0004 | 0.0000 | 0.0000 | 0.07 |
| AP27 | Public Services | 0.0131 | 0.0002 | 0.0000 | 0.0001 | 0.0000 | 0.0000 | 0.02 |
| L | Spain | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.00 |
| K | European Unión | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.00 |
| SOC | Rest of the World | 0.8305 | 0.0062 | 0.0003 | 0.0044 | 0.0004 | 0.0000 | 1.07 |
| AA.PP. | Labour Factor | 2.5189 | 0.0227 | 0.0009 | 0.0152 | 0.0010 | 0.0001 | 3.34 |
| A - I | Capital Factor | 1.4858 | 0.0105 | 0.0005 | 0.0075 | 0.0006 | 0.0001 | 1.88 |
| ESP | Companies | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.00 |
| U.E. | Government | 0.1875 | 0.0015 | 0.0001 | 0.0011 | 0.0001 | 0.0000 | 0.25 |
| RDM | Savings- Investment | 0.0419 | 0.0003 | 0.0000 | 0.0002 | 0.0000 | 0.0000 | 0.05 |
| | TOTAL | 22.0966 | 0.1656 | 0.0083 | 0.0974 | 0.0073 | 0.0008 | 28.4790 |

One of the reasons why the productive activities Energy products, Food products, drinks and tobacco, Commercial services, and Hotel trade and restaurants produce greater pollution, is the high household demand in those activities. To diminish the contamination that is caused, a measure could be to modify the consumption

patterns or to design policies to achieve that those activities are more efficient environmentally, especially in the Energy Product activity.

### 3.2  Environmental effects by yipes of Households

Until now we have analyzed the environmental effects per capita, that is to say, of an individual without distinguishing characteristics of the individual. Nevertheless, one objective of this work is to obtain the environmental impacts per capita for each household category according to its level of monthly income, in 1999. Those categories are the following:

A1    Up to 390 euros.
A2    From 391 to 781 euros.
A3    From 782 to 1.172 euros.
A4    From 1.173 to 1.563 euros.
A5    From 1.564 to 1.953 euros.
A6    From 1.954 to 2.344 euros.
A7    More than 2.345 euros.

Observing the percentages of water consumption and contamination of each component of the expense of each type of household, that are available for who wants them, it is verified that for all the household types the greater percentage of their expense is the activities Commercial services, Food products, drinks and tobacco, and Hotel trade and restaurants. The order of these activities varies according to the household type. Those same sectors are between which they present/display the highest percentage in physical water Consumption, hydric contamination and atmospheric equivalent $CO_2$ emission. To indicate that for all the types of home, although the expense in Agriculture supposes a small percentage of the total, the percentage of Physical consumption is important. The same happens for the Energy products activity as far as its equivalent $CO_2$ emission. Also, this activity supposes a greater percentage of $CO_2$ eq. than the activities of Commercial services and Hotel trade and restaurants, for the households categories of low income and the high income. Nevertheless, for the

categories of average incomes is greater the percentage of emission by their expenses in Commercial services, Hotel trade and restaurants than in Energy products.

Finally, we have collected data per capita for each type of homes, with which the previous analyses are repeated. The results of these analyses appear in tables of the Annex, and other tables available by request to one of the authors.

The total sum by column of the vector $\mathbf{c}_k´\mathbf{Mx} + \mathbf{d}_k´\mathbf{x}$, for each one of the considered pollutants agents and the water consumption, appears in the table A1 of the Annex, for each household type. These total numbers provide a clear representation of the impact that each Aragonese citizen produces in the environment, as far as consumption of water, hydric contamination and atmospheric emissions, according to their level of income. Observing those total figures, a tendency is verified. When the household category is of higher income the total figures are every time majors, being very important those of the type A7, to who the highest income individual belong. The unique exception to this is the individuals who belong to A4 category, whose total figures are minors who those of the individuals of category A3 and even in some cases of A2. From here it might be derived that the individuals with higher income cause majors environmental effects.

Nevertheless, the rate of growth of these total numbers when a household type is compared to the following higher income household type, without considering A4 category in which there is no growth, is decreasing. Therefore, although the impact of an individual of higher incomes is greater, the increase of that impact is decreasing, with the exception of the highest income households, A7. To emphasize the per capita environmental effect of the individuals of average income, (A4), that only surpasses to what are produced by individuals of the lowest income households, A1.

## Annex

### Tabla A1. Per capita (embodied) pollution for the Aragonese household types in 1999. Total figures.

|    |                        | CONS  | CF   | DOB      | DOQ    | Metales | Nitrogeno | Fósforo | Sol Susp |
|----|------------------------|-------|------|----------|--------|---------|-----------|---------|----------|
| A1 | Up to 390 euros        | 2.18  | 1.30 | 410.85   | 57.89  | 10.03   | 112.17    | 77.50   | 753.27   |
| A2 | From 391 to 781 euros  | 3.54  | 2.03 | 703.19   | 107.20 | 33.97   | 186.98    | 127.81  | 1.226.33 |
| A3 | From 782 to 1.172 euros. | 5.35 | 3.06 | 1.065.81 | 159.98 | 56.69   | 283.40    | 193.56  | 1.849.03 |
| A4 | From 1.173 to 1.563 euros | 3.49 | 1.99 | 702.84 | 109.35 | 41.65   | 186.03    | 126.91  | 1.206.68 |
| A5 | From 1.564 to 1.953 euros. | 5.57 | 3.09 | 1.163.30 | 211.38 | 89.29  | 301.72    | 204.98  | 1.929.73 |
| A6 | From 1.954 to 2.344 euros. | 6.76 | 3.78 | 1.404.31 | 237.80 | 102.93 | 366.71    | 249.30  | 2.345.80 |
| A7 | More than 2.345 euros. | 13.66 | 7.52 | 2.882.47 | 520.28 | 231.84  | 745.93    | 505.97  | 4,749.79 |

|    |                          | $CO_2$ (kt) | $CH_4$ (t) | $N_2O$ (t) | HFC (kg) | PFC (kg) | $SF_6$ (kg) | $CO_{2\,Eq}$ (t) |
|----|--------------------------|-------------|------------|------------|----------|----------|-------------|------------------|
| A1 | Up to 390 euros          | 0.0061      | 0.0618     | 0.0031     | 0.0146   | 0.0008   | 0.0000      | 8.3759           |
| A2 | From 391 to 781 euros    | 0.0122      | 0.1123     | 0.0053     | 0.0525   | 0.0039   | 0.0004      | 16.3825          |
| A3 | From 782 to 1.172 euros. | 0.0206      | 0.1732     | 0.0083     | 0.0844   | 0.0062   | 0.0006      | 27.1345          |
| A4 | From 1.173 to 1.563 euros | 0.0140     | 0.1157     | 0.0055     | 0.0595   | 0.0044   | 0.0005      | 18.3406          |
| A5 | From 1.564 to 1.953 euros. | 0.0251    | 0.1974     | 0.0091     | 0.1218   | 0.0092   | 0.0011      | 32.5191          |
| A6 | From 1.954 to 2.344 euros. | 0.0297    | 0.2375     | 0.0111     | 0.1407   | 0.0108   | 0.0012      | 38.6272          |
| A7 | More than 2.345 euros.   | 0.0653      | 0.4964     | 0.0228     | 0.3175   | 0.0247   | 0.0029      | 83.8656          |

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