Assessment of drought risk perception in southeast Spain (Guadalentin river basin)

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Abstract:

The human perception of physical phenomena such as drought, very common in Mediterranean areas, is not the same in all the regions in Spain. Land planning and water management are decisive factors that can change the people perception about dry periods. The limit for considering whether a region suffering drought or not depends on the values of accumulated rainfall, but also on the water availability (surface and groundwater), and on the existing demand for different land uses. In order to better understand the drought perception, people from places frequently affected by drought were interviewed. The drought perception has changed along with the economic transformation and the modification of lifestyle and consumption habits since 1950 to now in the affected society. Possibly, the dry period suffered during the years 1966 and 1967, with tragic economic consequences for the region of Southeast Spain, determined changes in the traditional perception of this natural phenomenon. This perception remained during the later episodes of drought (1978-84, 1992-96 and 2005-07). The excessive growth in the demand and the mismanagement of water in this territory, due to an inefficient land planning, are the main causes of the risk perception.

Keywords: Drought. Risk. Perception. Water management. SE Spain.

Resumo:

Avaliação da perceção do risco de secas no sudeste de Espanha (bacia do rio Guadalentin)

A perceção humana do fenómeno pluviométrico da seca, muito habitual nas zonas mediterrânicas, não quer dizer uma diminuição de chuvas em todas as regiões de Espanha. A organização do território e a gestão dos recursos hídricos realizada pela sociedade é um factor decisivo que modifica a perceção de bem-estar em um período de seca. O limite real da seca numa região ou território deve ser estabelecido de acordo com valores de precipitação acumulada mas, também, de acordo com os recursos hídricos disponíveis, sejam superficiais e/ou subterrâneos, e com as demandas existentes para diferentes usos desse recurso hídrico. Para aprofundar na perceção da população espanhola em relação ao fenómeno climático da seca, realizaram-se entrevistas à população rural na região sudeste de Espanha (Múrcia). A perceção do fenómeno climático da seca mudou a partir de transformações económicas, responsáveis da alteração de hábitos de vida e formas de consumo, sobretudo depois dos anos cinquenta (sécu-

lo XX). Possivelmente, a ocorrência da seca de 1966-67, de trágicas consequências económicas para a região do sudeste espanhol, determinou alterações na perceção tradicional quanto à diminuição de chuvas como fenómeno calamitoso, consolidando essa perceção durante os episódios posteriores da seca (1978-84, 1992-96 e 2005-07). A baixa quantidade de chuvas e a fragilidade no planejamento e gestão dos recursos hídricos na região estudada, estão na origem da compreensão desse fenómeno embora seja um fenómeno natural.

Palavras-chave: Risco de seca. Perceção. Ordenamento do Território. SE Espanha.

1. Introduction: assessment of the perception regarding the drought phenomenon

The high frequency and duration of dry periods in Guadalentín basin (South-east of Spain) (Figure 1) make furthermore scanty the water available resources in this zone and it unleashes socioeconomic crises of undoubted media repercussion. The drought phenomenon is not recent in this territory, but it has appeared with different periodicity, duration and intensity in different historical periods. Nowadays, and in spite of the scientific advances, better knowledge of the territory, major capacity of social organization and economic power, the problems and difficulties caused by the droughts continue unresolved, turning into one of the principal political weapon (García-Marín, 2008).

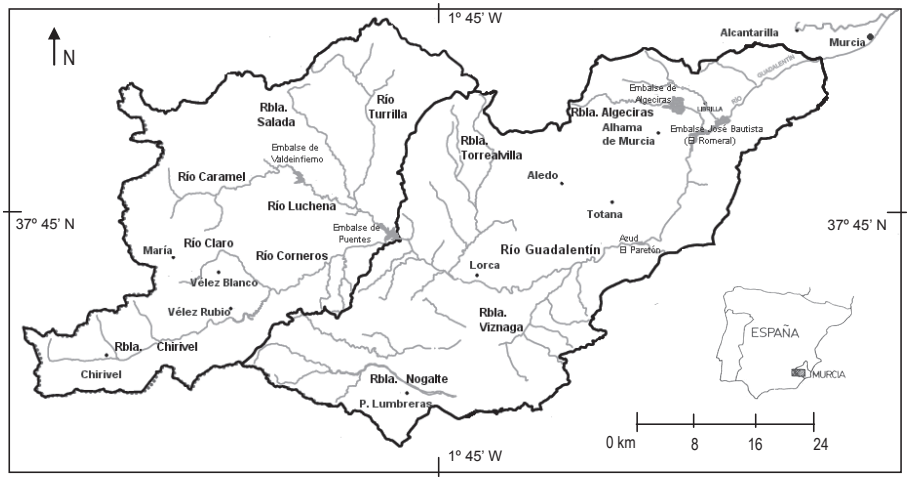

Figure 1
Location of the hydrographic basin of the river Guadalentin (South-east of Spain). Rivers, ephemeral channels (ramblas) and urban areas.

The last dry period (2005-2007) (Figure 2) shows again that the water offer is scarce in relation to demands. This time the climatic event did not come accompanied by important water restrictions, probably because of the improvement of the resource management (García-Marín, 2009). Nevertheless, a great part of the Spanish population still has in mind the chaotic situations that took place during the 1990s' drought (Llamas, 1997), due to the lack of an

adequate forecast on the part of the administration, which often forgets that droughts never miss their appointments (López, 2006).

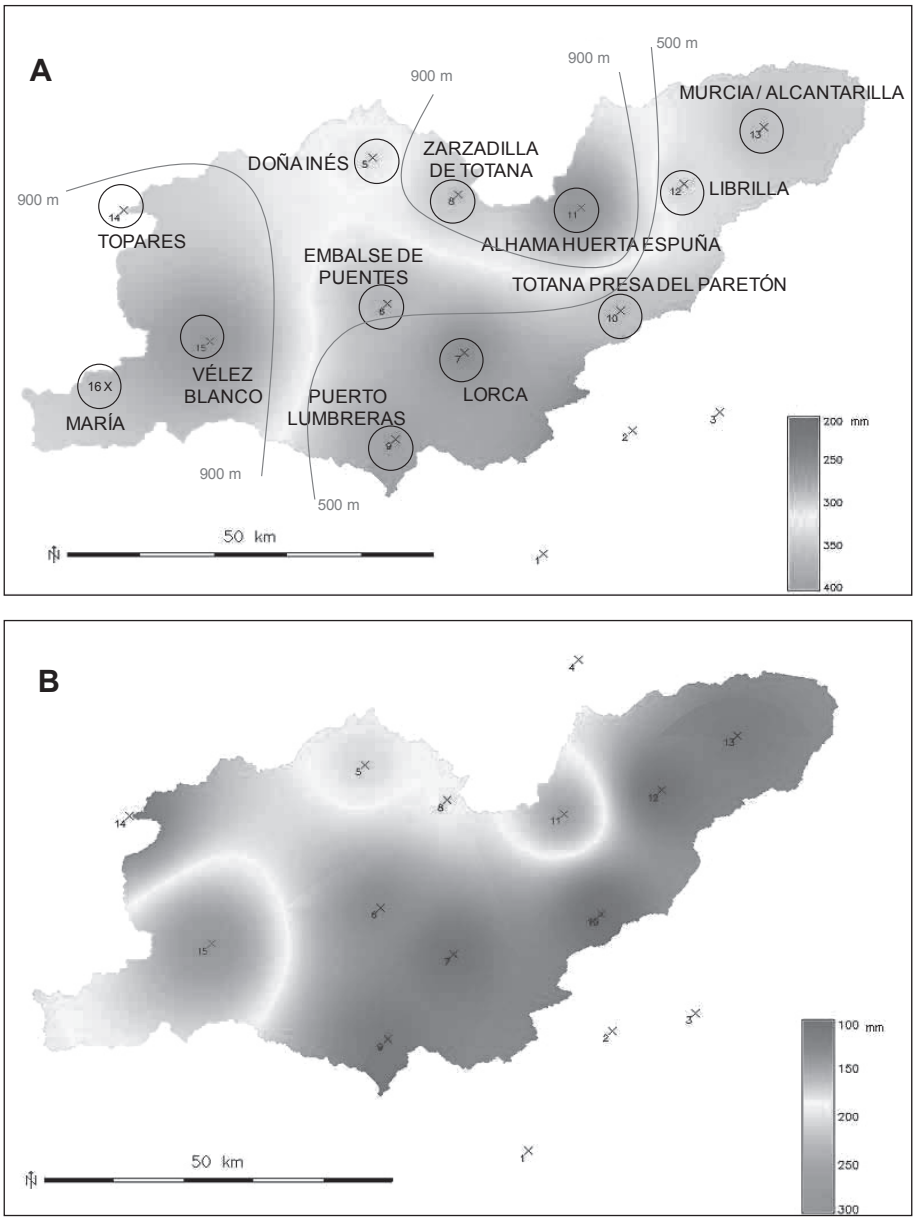

Figure 2

A) Average annual rainfall (1950-2007), meteorological observatories and principal curves of level (altimetry); B) Average rainfall during the period of drought 2005-07.

The Spanish population is made aware of the existing problem of water availability, and a wide consensus exists on the idea of water shortages (82 %) (FBBVA, 2007). Facing the absence of changes in the habits of consumption, the people interviewed for this piece of research ones prefer technological solutions to increase the water offer in Spain, to constructing more dams and reservoirs (76 %), desalinating sea water (74 %) and moving water from one river to another (71 %). The Spanish population does not want an increase in the price of water, but they are delighted with the new infrastructures.

In the opinion of Maceira (2007), "probably we do not realize that the cost of infrastructures (and even more nowadays that the European funds are disappearing) also come go out of our wallets. Although, as we only pay once a year, it seems that it grieves less than the monthly receipts".

The social attitudes to the problem of water develop, in the last instance, as a result of the occurrence of episodes of rain shortage, that is, meteorological droughts that end in hydrological droughts and provoke an imbalance between demand and offer of water resources. The drought phenomenon generates very diverse and different appraisals, being able to generate conflicts between the affected neighbours. For example, the owner of an irrigation farm with a modernized exploitation does not need rain water, which can harm his production, and he prefers that water comes from other places across conductions or channels; on the contrary, his neighbour, the owner of a dry farm, needs rain water to survive and get ahead to raise his crop. Nevertheless, a common reflection is shared by both farmers: that the water resources are not scarce, in spite of the fact that their thoughts differ with respect to the supply form.

The perception of the drought phenomenon has changed in relation with the economic and social transformations of the last fifty years. According to Morales *et al*. (1999), the drought suffered during the years 1966 and 1967, which had serious economic consequences in the Spanish south-east, marked the change of the traditional adjustment to these episodes of rain shortages considered as catastrophic events. This new perception has been consolidated during the most recent drought periods. The new way of understanding a fact with a natural origin resides in the excessive increase of the demands of water resources and in the minimal hydrological planning.

After the period of droughts suffered during the first half of the 1990s, research on the analysis of vulnerability regarding episodes of rain shortage has made progress. Nevertheless, the approximations to the different ways of living through these droughts, in relation with customs, habits, etc., have been less abundant, and this study intends to show the real experience behind these situations of water deficit in a certain territory.

1.1. Traditional perception of the droughts: adjustment to the water deficit

The feeling of drought does not derive from a decrease of rainfalls in all the Spanish regions. The organization of the territory and the management of the water resources made by a society are also decisive factors that can modify the sensation of being or not in a period of droughts (Heathcote, 1999). García de Pedraza and García (1989) have established values for the reduction of rainfalls in contrast to the average, in different Spanish regions, to indicate when one year can be considered as dry. Morales *et al*. (1999), from quantitative measures of rainfall and qualitative information (documentary sources), have also proposed some percentage values for the reduction of rains for a year to be considered as a dry one. These values allow one to

see how the regions with higher percentages of rain of Spain are the most sensitive to a decrease of the annual contributions. On the contrary, the most arid regions support higher reductions of rains.

Which is the origin of this paradoxical fact? The real threshold of drought in a region or territory must be established according to the values of accumulated rainfall, but also considering the availability of superficial and underground water resources, as well as the demands for the different uses. The perception of having a drought depends on the reduction of rainfalls, but it is also determined by the adjustments that society has made to the territory, managing and organizing the uses of the soil to be able to resist the drought periods. In this respect, the agrarian and urban uses of water in the south east of Spain (where the basin of the Guadalentín joins) have better water distribution networks, rafts for storage, cisterns, etc., that is, a whole series of infrastructures that, together with a selection of different agricultural species and cattle adapted to the water deficit, ensure that, despite being the most arid sector of the Iberian Peninsula, they can endure a high threshold of drought: a reduction of rainfalls regarding the normal level in which the society develops comfortably.

In establishing the thresholds of drought in the basin of the river Guadalentin one should not only consider the quantities of rain gathered in its own hydrographic basin, those gathered in the basin of the River Segura, of which it is tributary, but it is also necessary to take into account the rainfalls fallen in the high basin of the Tajo river and also the management of these waters in relation to the existence of the system of the water transfer Tajo-Segura, which yields important volumes of water to supply the new watered lands and populations settled in the basin of the Guadalentin. In this specific case, the above-mentioned system of transfer can actually modify the perception of a dry episode from the one that really exists in this territory of the Spanish south-east. For instance, the effects of the drought 1981-84 in the lands of the south-east of Spain were aggravated by the enormous transfers of water coming from the basin of the Tajo during 1979 and 1980, which were years of normal rains in the south-east of the Iberian Peninsula. If these excessive transfers of water had not been produced in years with normal rains, the economic consequences for the later years of drought would have turned out to be minor, thanks to the possible existence of a flow of water in the high basin of the Tajo river to supply the channel Tajo-Segura which did not exist for the above-mentioned circumstance (Morales *et al.*, 1996). The former water supply from the reservoirs of Entrepeñas and Buendía (head-board of the Tajo river) may have slowed the feeling of being in this period of drought.

1.2. Evolution in the perception of the droughts: diversity of appraisals

Traditionally, and in agreement with Morales *et al.* (1999), the perception that the drought phenomenon has arisen, especially in rural lands, has been related to the degree of incidence in crops; it was considered a dry year when the rainfalls were not sufficient to develop the agrarian production or to support the cattle with pastures from spring season to autumn. From the 1950s, farmers have been leaving the systems of rotation - biennial or triennial - in dry lands, and continuous farming activities do not allow enough time for an ideal hydration of the soil to be cultivated. Since then, when the rains are lower than the average records, the reduction of the agrarian yields is assumed to result from the drought, when the real reason is a qualitative change in the form of production and the abandonment of a traditional system of cultivation, adapted to the limited resources of water due to meteorological conditions.

The expansion of the grown lands dedicated to irrigation and the processes of urbanization and tourist and industrial development during the 20th century, together with the new environmental values, have favoured a number of qualitative changes in the perception of droughts. Such a natural phenomenon is nowadays estimated by the higher or lower volume of water available on the reservoirs to attend the current demands, so that the year will be considered to be dry, even if the annual rains are normal, when the sufficient volumes of water stored are not enough - as much in artificial reservoirs as in subsurface aquiferous zones -, whether for natural motives - storms of strong hourly intensity with rapid not infiltrated run-offs - or human reasons - reservoirs badly managed -,. For this reason, the population affected by the insufficiency of water resources will acquire an erroneous perception of the drought phenomenon as a natural risk, when in fact this period of rain shortages does not really exist.

Before this socioeconomic evolution, populations start to consider the drought episodes as catastrophic, disturbing the daily functioning of economic and social activities, instead of considering them as something belonging to the climatic conditions of the territory, which they have to adapt.

There is a very different sense of appreciating the consequences of droughtd in relation to the impacts caused by the temporary lack of rainfall in different economic and social activities. Different perceptions coexist regarding the droughts in this territory, that is, diverse ways of understanding this natural phenomenon. Perceptions are conditioned by the geographical location and by opposite ways of living these meteorological episodes in relation with the socioeconomic activities (Dagel, 1997). There are, among others, completely different perceptions of rural and urban drought sequences, as well as a very different perception of the phenomenon on the part of the people and the Administration (Table I).

Table I
Different perceptions of the risk of drought

Traditional perception	Adjustment to the natural conditions of every territory: - Selection of plants resistant to the drought. - Rain water management in the domiciles (cisterns). - Freshet water management
Public administrations	The "stubborn" drought is a phenomenon that allows justifying the absence of necessary actions to relieve the water lack in a region. When a drought takes place it is refered to his consideration of natural "extraordinary" phenomenon.
Rainfed agriculture	The drought provokes field abandon. If the plots place in hillsides the processes of erosion are activated.
Extensive watered lands	Opposite to a sequence of drought it is necessary to find water resources. The farmers exploit the underground water. The farmers demand foreign water (transfers).
Agriculture of manipulated cycle	This agriculture needs water but not rain *in situ* because it stains the fruits, activates plagues and reduces, definitively, the commercial value of the production. The businessmen resort to the procedure of "sows of clouds" with substances to avoid the rain in his plots.
Drought in the city	The problem of the drought is not perceived while water of the faucet goes out. The water restrictions provoke protests in demand of solutions.
Tourist activity	The tourism of "Sun and beach", and, in general, any activity of leisure outdoors, values the abundance of clear days, without rain. The problem of the drought is not perceived while the domiciliary supply is assured. The bad planning of water resources provokes problems of restrictions.
Environmental perception	The episodes of drought relate to the question of the climatic change. The dry periods generate a state of opinion sensitive to the problem of the desertification.

Source: Morales, Olcina and Rico (1999); Olcina (2001).

Finally, the perception of the climatic phenomenon of droughts has changed in relation with the economic transformation and the modification of the habits of life and of consumption practises since the 1950s. Possibly, the sequence of droughts of 1966-67, of tragic economic consequences in the Spanish south-east, determined a change from the traditional adjustment to the reduction of rains to its consideration as a calamitous phenomenon, being consolidated this perception during later episodes of droughts (1978-84, 1992-96 and 2005-07). The excessive accentuation of the water demands and the lack of planning in the use of the scant water resources in this territory are clearly in the origin of understanding a natural fact.

2. Method: the survey as an effective instrument to know social perceptions before the risk of droughts

Being the aims of this research to determine the social discourse on the risk of drought among the population of the area that is the object of analysis, it has been chosen to approach the question from two different and complementary perspectives. On the one hand, to make a general wide survey and, on the other, to complete the results by means of interviews destined for a much more limited group of "privileged witnesses". The combination of both skills, even though it complicates the interpretation of the results, undoubtedly provides a more complete image of the attitude of the population facing the risk of drought: and this is a kind of indispensable knowledge to carry out any effective policy in this respect. On the basis of the surveys accomplished by Diggs (1991) the risk of drought in the northern Great Plains (USA), a general questionnaire has been elaborated adapted to the social reality of the area under study. Equally, but with a more specific character, another questionnaire-guide has been elaborated to orientate the interviews that have to be administered by people in their capacity of agents in charge of the prevention and management of the risk of droughts: municipal authorities, civil servants, members of different NGOs, etc.

2.1. Process of polling selection

The choice of the localities where the interviews were conducted has relied on the municipal statistics of population (2008). For the municipalities of Lorca, Totana, Alhama of Murcia, Puerto Lumbreras, Librilla, Aledo (Region of Murcia) and the region of Velez (province of Almeria), a total population of 197.040 inhabitants for the area of study has been established. Immediately afterwards a sample of 261 individuals (0.20 % of the population subject to polling) has been selected; this sample has been stratified on the basis of two criteria:

i) Demographic stratification: 20-year-old and younger inhabitants have been disregarded as potential addressees of the campaign of surveys, since they may have developed their own judgment to value this type of phenomenon, and, as a result, their answers could reflect influenced opinions. This population represents 28 per cent of the whole and, for this reason, the universe subjected to polling has been reduced to 130.643 individuals.

ii) Spatial stratification: the distribution of population has been divided into rural and urban establishments, assigning the number of surveys proportionally to the total population. In a second stage, the population centres object of survey have been

established, intending to cover the totality of the area. Moreover, this provides the opportunity to pay major attention to those specific sectors where the drought phenomenon has an evident incidence, both on facilities and on the population. Inside these subareas the sample has a random character. The technical violation of the criteria of randomness that such stratification entails, has tried to be compensated by accomplishing a small percentage of surveys (never superior to 3 per cent) out of the indicated subareas.

Table II
Distribution of questionnaires

Place (municipality, region)	Urban hull	Population disperses
Lorca	93	47
Totana	29	15
Alhama of Murcia	19	10
Puerto Lumbreras	13	7
Librilla	5	2
Aledo	1	1
region of The Velez	13	6
Total surveys	173	88

The municipalities of Lorca, Totana, Alhama of Murcia and Puerto Lumbreras, due to their major number of inhabitants, concentrate the greatest part of the sample (89.8 %). The population of these municipalities concentrates in a high proportion inside the valley of the Guadalentin River, related in numerous cases to direct or indirect agricultural activities, sometimes exercising a type of leisure agriculture.

3. Results and discussion: analysis of the surveys and interviews

Without the analysis of information relative to the distribution of the sample (sex, age, place of residence, etc.), that will be commented as part of the results obtained in the questions and that, of general form, offer relative similar figures in his distribution, the explanation centres on the answers obtained in the point 2 of the survey - guide showed in the Table III.

Practically the totality of informants thinks that the current rainfalls are lower than the quantities of rain registered in the past (Figure 3). In this territory, the sequences of drought are believed to have been preceded by rainy and normal years: they are seen as natural cycles and typical of the climatic conditions of the zone. Nevertheless, the notable increase of water demands also favours this perception, because it generates a chronic water deficit that leads to the rejection of the numerous requests of use of water resources. Indeed, this fact is perceived when, in spite of the appearances of a year of normal rains, or a lightly humid one, conflicts keep arising between users of the water resources. Opposite to this situation, it is necessary to speak about induced drought and not about natural drought, revealed by demands of water superior to the water offers.

The creation of numerous infrastructures of water storage, aqueducts like the Tajo-Segura transfer, as well as the existence of confidence in technical progress, which has given

Table III

Survey-guide for the analysis of the perception on the risk of drought

OPINION POLL: PERCEPTION ON NATURAL RISKS. THE RISK OF DROUGHT (MARK WITH X WHERE IT CORRESPONDS AND SPECIFIES WHEN IT IS NECESSARY)
1. IDENTIFICATION OF RESPONDENT:
A) GENRE: MASCULINE ( ) FEMININE ( )
B) AGE: <30 ( ) 31-65 ( ) > 65 ( )
C) PLACE OF RESIDENCE (MUNICIPALITY): C.1. FIELD ( ) CITY ( )
D) LEVEL OF STUDIES: WITHOUT STUDIES ( ) PRIMARY OR ELEMENTARY ( ) SECONDARY ( ) SUPERIORS ( )
E) DO YOU SUPPORT SOME ACTIVITY RELATED TO THE AGRICULTURAL SECTOR? YES ( ) NOT ( ). In affirmative case indicate if it is related to a system of irrigation or dryness. IRRIGATED LAND ( ). HAVE YOU GOT ENOUGH WATER TO OBTAIN SUITABLE RETURNS?: DRYLAND ( ). DOES THE CLIMATE OF YOUR AREA TO OBTAIN ADEQUATE RETURNS? IS THIS RETURN ACCEPTABLE EVERY YEAR OR EVERY SEVERAL YEARS?:
2. RISK OF DROUGHT:
A) DO YOU BELIEVE THAT IT RAINS MORE OR LESS THAT FORMERLY? MORE ( ) LESS ( )
B) DO YOU BELIEVE THAT THERE ARE MORE OR LESS DROUGHTS THAT FORMERLY? MORE ( ) LESS ( )
C) DO YOU REMEMBER WHICH HAS BEEN THE PERIOD OF THE MOST SERIOUS DROUGHT HAPPENED IN THE LAST TWENTY YEARS? —indicate you approximate dates—
D) WHY DO YOU BELIEVE THAT THE EPISODES OF DROUGHT APPEAR? PUNISHMENT OR GOD'S WILL ( ) PURELY NATURAL REASONS ( ) CLIMATIC CHANGE ( ) HUMAN REASONS ( ) —You specify—
E) PRINCIPAL CONSEQUENCES OF EPISODES OF DROUGHT (TO ORDER NUMERICALLY ACCORDING TO IMPORTANCE OF THE GRAVITY): ENVIRONMENTAL CONSEQUENCES (FIRES, AQUIFEROUS OVEREXPLOITATION...) ( ) SOCIAL CONSEQUENCES (RESTRICTION OF WATER DRINKABLE, CONFRONTATION FOR WATER USES...) ( ) POLITICAL CONSEQUENCES (POLITICAL CONFLICTS...) ( ) ECONOMIC CONSEQUENCES (LOSS OF CROPS AND EMPLOYMENT, DECREASE OF THE TOURISTS...) ( )
F) CONSEQUENCES OF EPISODES OF DROUGHT. SECTORS MORE HARMED (TO ORDER NUMERICALLY ACCORDING TO IMPORTANCE OF THE GRAVITY): AGRARIAN SECTOR ( ) INDUSTRIAL SECTOR ( ) TOURIST SECTOR ( ) URBAN SUPPLY ( )
G) ADEQUACY OF INSTRUMENTS FOR THE IMPROVEMENT OF THE MANAGEMENT OF THE WATER (TO ORDER NUMERICALLY ACCORDING TO IMPORTANCE): APPLICATION OF A STRICT POLICY THAT CONTROLS THE USE OF POLLUTANT SUBSTANCES ( ) IMPROVE THE MANAGEMENT AND PUBLIC CONTROL OF THE WATER USE (IMPROVEMENT OF THE DISTRIBUTION NETWORK...) ( ) SUPPRESS THE GRANTS OF WATER TO THE FARMERS WHO DO NOT USE THE WATER ADEQUATELY ( ) MODERNIZATION OF THE SYSTEMS OF IRRIGATION ( ) TO REALIZE FORMATIVE ACTIVITIES FOR THE FARMERS ( ) PUTTING IN ACTION INSTRUMENTS THAT ALLOW THE WATER TRANSFER BETWEEN FARMERS AND OTHER USERS OF WATER ( ) APPLICATION OF HIGHER PRICES OF THE WATER ( ) TO ELIMINATE AGRARIAN GRANTS ( )
H) DO YOU KNOW IF, IN YOUR COMMUNITY, THE MINORS RECEIVE IN SCHOOL OR SECONDARY SCHOOL SOME EDUCATION OR INSTRUCTION ON HOW TO REACT OR TO BEHAVE DURING A DROUGHT? YES ( ) NOT ( )
I) WHAT TYPE OF INFORMATION YOU CONSIDERS THAT IS NECESSARY TO ACQUIRE, TO SHARE OR TO OBTAIN TO IMPROVE THE MANAGEMENT OF THE RISK OF DROUGHT? (TO ORDER NUMERICALLY ACCORDING TO IMPORTANCE): CHARACTERISTICS OF THE PHYSICAL ENVIRONMENT (CLIMATE, SUPERFICIAL AND UNDERGROUND HYDROLOGY...) ( ) CHARACTERISTICS OF THE WATER DEMANDS (AGRARIAN, TOURIST, URBAN, INDUSTRIAL AND ENVIRONMENTAL) ( ) USES OF THE SOIL EXPOSED TO POSSIBLE DROUGHTS AND HIS VULNERABILITY ( ) STATE OF THE WORKS OF WATER SUPPLY, BOTH AGRICULTURAL AND INDUSTRIAL AND URBAN ( ) PLANS, PROGRAMS AND PROJECTS TO MINIMIZE THE IMPACTS GENERATED BY DROUGHTS ( ) DIRECTIVES, PLANS, PROGRAMS AND ACTIONS OF LAND MANAGEMENT ( ) ANOTHER TYPE OF INFORMATION, WHICH? ( )
J) DOES A POLITICAL WILLINGNESS EXIST TO SOLVE THE DEFICIT OF WATER RESOURCES IN HIS MUNICIPALITY? YES ( ) NOT ( )
K) WHAT POLICY DO YOU PREFER TO MINIMIZE THE IMPACTS PROVOKED BY DROUGHTS?: LAND MANAGEMENT, TO ORDER AND TO ORGANIZE USES OF THE SOIL DEPENDING ON WATER AVAILABILITIES ( ) —you go on to the point L— GROWTH OF THE OFFER OF WATER RESOURCES OR CREATION OF INFRASTRUCTURES TO INCREASE THE WATER AVAILABILITIES ( ) —you go on to the point M—
L) ARRANGE NUMERICALLY THE FOLLOWING POLICIES OF MANAGEMENT OF THE TERRITORY ACCORDING TO THE IMPORTANCE TO YOU: MODERNIZATION OF THE SYSTEMS OF IRRIGATION ( ) IMPROVEMENT OF THE URBAN NETWORK OF DRINKABLE WATER ( ) REASSIGNMENT OF USES OF THE WATER DEPENDING ON HIS PROFITABILITY ( ) EDUCATION FOR THE SUSTAINABILITY IN THE USE OF THE WATER ( ) OTHERS —you specify— ( )
M) ARRANGE NUMERICALLY ACCORDING TO the IMPORTANCE TO YOU THE FOLLOWING POLICIES FOR THE GROWTH OF THE AVAILABILITY OF WATER RESOURCES: TRANSFERS OR AQUEDUCTS BETWEEN HYDROGRAPHIC BASINS ( ) DESALINATION OF SEA WATER OR GROUNDWATER ( ) PURIFICATION AND REUTILIZATION OF WASTE WATER ( ) OTHERS —you specify— ( )

rise to new resources for water desalination and purification, have generated a sensation of safety among the society settled in this territory of the south-east of the Iberian Peninsula, contrary to the periodic episodes of drought. Nevertheless, this feeling of confidence has generated a continuous increase of the activities that require water (irrigation, tourism, industry) and an increase in the figures of population, who keeps requesting a major water volume to carry out their domestic tasks. Definitely, this safety sensation has created, paradoxically, a perception of the existence of a major number of droughts (Figure 4).

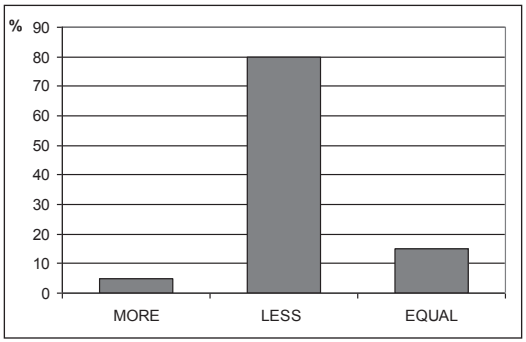

Figure 3
Does it rain more or less that before?

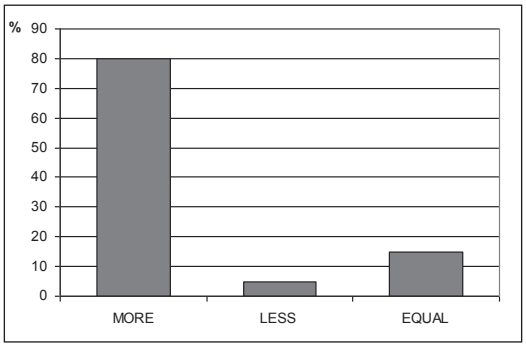

Figure 4
Do you believe that there are more or less droughts than before?

Most people interviewed believe that the main reason of the major succession of sequences of drought resides in the so called climatic change – so fashionable these days (Figure 5). Nevertheless, the analysis of the information of rainfalls made by different climatic observatories of the Guadalentín basin (García Marín, 2006), does not show a clear trend of change in the record of total annual rains during the last fifty years. It is more than probable that this high percentage of answers transmitting the perception of climatic change as reason of the increase of droughts is due to the alarmism provoked by the mass media. Press, television and radio, conscious of the interest and debate generated by the issue of climatic change,

sometimes with the help of environmental groups and not always in an objective way, transmit to the population ideas that, in the absence of well-grounded personal opinions, may become assumed by the individuals.

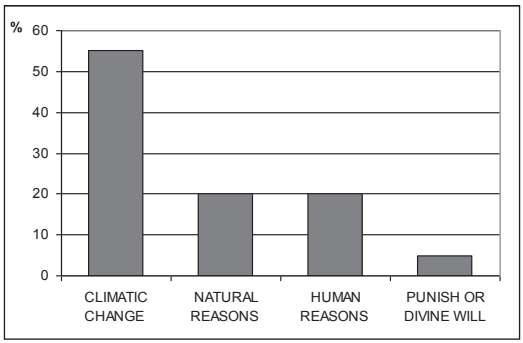

Figure 5
What does originate the succession of episodes of drought?

It is also possible to notice also a similar percentage of answers that express as origin of the droughts purely natural or human reasons. This implies a change of conception of the drought event, perceived increasingly as an induced risk, as it was commented previously.

Regarding the consequences that the drought phenomenon carries out when the risk becomes a disaster, most of the answers (47 %) affirm that the environmental consequences are the most worrying, closely followed (consecutively) by economic ones (41 %) and, to a certain distance, by social ones (12 %). Apparently, the political consequences are the least interesting: 88 % of the interviewed persons place this type of repercussions in the last instance. A rank based on the importance of the consequences or repercussions that the drought has on the affected population can, in this respect, be established. Firstly, the environmental consequences stand out. It is necessary to bear in mind before this affirmation that a considerable reduction of rainfalls provokes to a great extent the decrease of the underground water flows, which carries with it the disappearance, circumstantial or final, of wetlands or historical springs. It is also the reason that natural vegetation enters in a condition of wilting, an increasing aggressiveness of certain plagues, and decreasing of the circulating superficial waters, among other effects. But probably, and connecting with the second consequence considered more serious (economic loss), the decrease of the water volume stored in aquiferous leads to the deepening of wells to obtain the water necessary for agriculture (the great part of the surface of irrigation in this territory, especially the surfaces established in hillsides, is supplied by underground water).

Economic damages are considered the second most harmful by the population interviewed, especially as they affect agricultural activities, which constitutes the economic basis in the basin of the Guadalentin river and in a great part of the Spanish south-east. The multitudinous manifestations and complaints that the farmers made to the political authorities in demand of a greater contribution of water resources, independently of the real existence of drought

periods, generate this condition of opinion among the population not linked to this sector of activity.

Economic sequels are followed by social consequences, although this is not a categorical order. The spoiling of crops, for example, generates unemployment and reduction of the quality of life, with special incidence on the sections of the population most economically disadvantaged. This could also generate the migration of the workforce from the fields to other places with a temporary or definitive character in search of new opportunities. Last, but not least, it may also entail cuts in the supply of drinkable water to the population, forcing people to adapt to some established plans to favour its saving, etc. Finally, a minor worry exists for the political effects caused by the droughts, in the form of resignations of political authorities in charge of the management of the water resources or of the so-called "water wars", as exemplified by the one which nowadays involves the governments of the Valencian Country and Murcia opposing the policy of the government of the nation, or that involving the Region of Murcia and Castilla-La Mancha for the Tajo-Segura transfer of water.

Practically one hundred per cent of the people interviewed answered that the sector of activity most harmed by the droughts is the agrarian sector, followed by the urban supply. The tourist sector is valued like the third most harmed, and, finally, the industrial one.

In general terms, the information most necessary to society is the following: explanations on how to improve the environmental situation of the water ecosystems, how to anticipate the forest fires – a risk that increases during a sequence of droughts--, information about offer and demand of water resources, statistics of a meteorological character and uses of the soil and explanations of the benefits that an ideal management of the water resource carries. But, undoubtedly, one of the showiest demands is the following one: to try to improve the preparation of teachers so that they are capable of informing well and of educating the pupils in order that they are critical regarding these questions of general interest.

To improve the capacity to predict the risk of drought, it is necessary to increase access to the information about plans, programs and existing projects to minimize the impacts generated by droughts and to know the uses of the soil and the most vulnerable activities in relation to these climatic events. Likewise, understanding the characteristics of the physical environment and their functioning should also be improved. Moreover, at a lower level, it is widely thought that it would be advisable to control not only the characteristics of the water demands, but also the condition of the infrastructures supplying it, as well as directives, plans, programs and actions of land management (Figure 6).

As for the instruments necessary to improve the management of the water resources, a preference exists, as the first measure, to apply a strict policy that controls the use of polluting substances (28,6 %), followed by an improvement in the management and public control of the use of water (improvement of the network of urban supply…) and modernizing the irrigation system (21,4 % and 21,1 % respectively). 14 % of answers indicate that it would be necessary to improve the formation of farmers. As the last option, that is to say, with scant reception on the part of the informants, there is the application of higher prices to the use of water, eliminating the agrarian subsidies, in order to use the water resources in plantations.

Near 63 % of the population interviewed think that political will does not exist to solve the serious problem of water deficit existing in the basin of the Guadalentin river (Figure 7), in

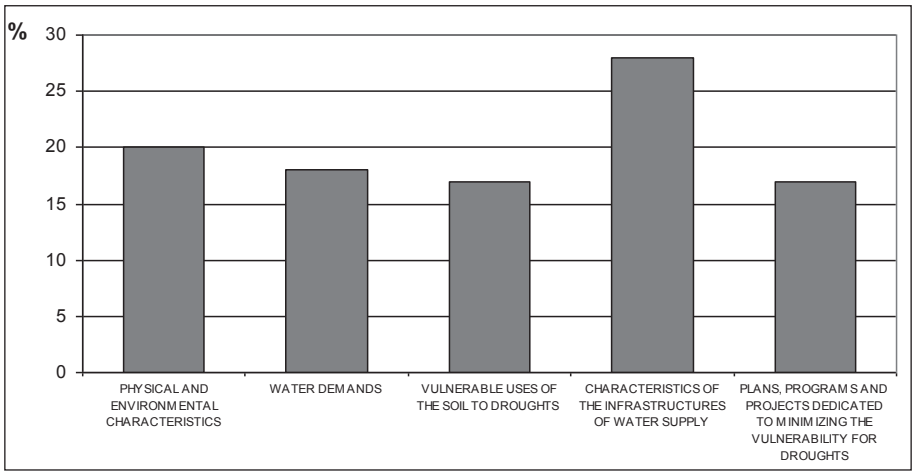

Figure 6
What aspects would you be interested to know to improve your knowledge about the risk of drought?

spite of being this a worrying question, of everlasting and current importance, and that it generates of multitude of social conflicts in this territory.

With regard to the preference of policies to minimize the risk of drought, 72 % the informants believe that a policy to favour the growth of water resources should be implemented, opposite to 28 % who think that it would be advisable to choose a suitable land management, that is to say, to arrange uses of the soil depending on the availability of water (Figure 8).

Among those who incline for implementing a policy of creation of infrastructures to increase the availability of water, 69 % think that the best option would be the construction of a water transfer from the mouth of the river Ebro, 25 % prefer the current national policy that

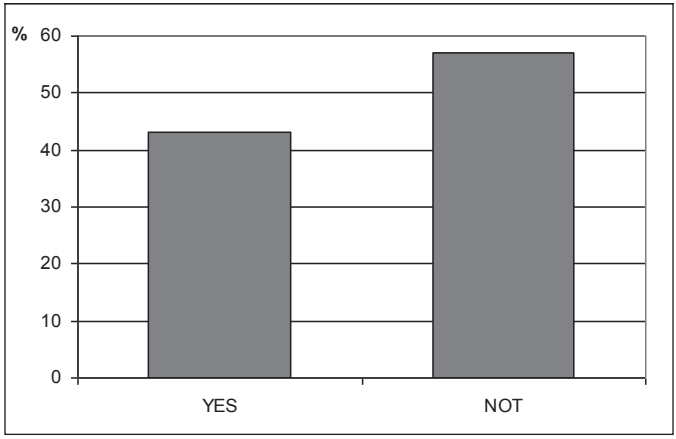

Figure 7
Does a political willingness exist to solve the water deficit?

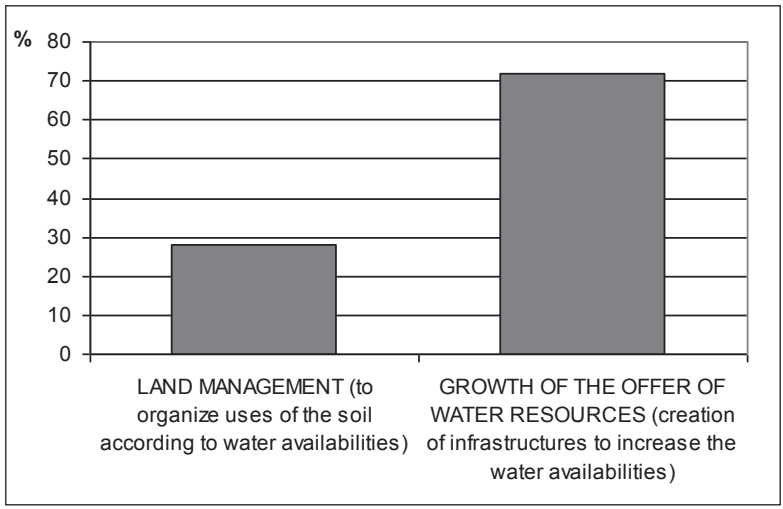

Figure 8
What policy do you prefer to minimize the impacts of droughts?

reinforces the creation of desalination plants, an option which avoids dependence on the management of other hydrographic basins, and 6 % choose to improve the purification and reutilization of water.

Meanwhile, among the informants who prefer a policy of rearrangement of resources, as their first option, they choose the improvement of education for the sustainability in the use of water (57 %), followed by the modernization of the system of irrigation to improve the saving and the efficiency of the application of water in farming activities (29 %), and the improvement of the urban network of drinking water to prevent filtrations and water escapes (14 %). It is necessary to emphasize in this case that none of the informants is interested in the policy of reassignment of water uses depending on the profits afforded by the activity.

4. Conclusions

To conclude, it is possible to notice several attitudes or differences in the perception of the risk of droughts depending on the age, place of residence, field or city, level of studies, and type of economic activity.

Very few informants believe that the climatic phenomenon of drought develops for divine or supernatural reasons, and these answers correspond to people of advanced age, especially of the female gender. For the younger people and with higher academic level the responses were more reasonable, and the interviews indicate that these climatic extreme events are due to natural developments or generated by climatic change.

Among the informants who devote themselves to agrarian labours there is a widespread opinion that the impacts generated by droughts reside in the increase of the demand of water

resources, indicating the transfer of water between basins as the principal measure to sort it out. They also believe that funding is necessary, whether on the part of the regional or national government, to modernize the system of irrigation as a palliative measure. On the other hand, those living in cities and without any relation to the agrarian activity do not perceive the serious problems that a period of drought provokes until they open their faucets and see that not a drop of water falls out. As for the way the politicians and managers of the water resources act in this respect, they tend to promote the idea that the current period of drought is the most damaging, and they tend to describe it as an extraordinary climatic event, probably to avoid the responsibility of its management.

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