The availability of water in ranches of mediterranean type climate

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ABSTRACT

A preliminary study on water resources for livestock rearing in SW Spain is presented. The objectives of this work were to assess the availability of water for domestic animals in farms and to explain whether water shortages are controlled by environmental factors or are also related with land management. The study was carried out in 54 private farms of wooded and treeless rangelands in Extremadura. Field work, digital topographic maps and aerial photographs were used to assess the potential hydrological resources of each farm. The water needs of livestock were estimated considering the number and species of animals per farm, as well as other factors influencing their water consumption. Furthermore, semi-structured interviews were carried out in order to gather information about water management. Results indicate that almost 20% of the farms suffer problems of water availability in summer and almost 50% during droughts. Different solutions are adopted by the farmers, including construction of infrastructure, bringing water from outside or moving the animals to other areas. Data indicate a positive relationship between problems of water supply and the degree of aridity. Data also point to a relationship with water consumption by livestock and the availability of water by artificial ponds.

Key words: Water availability, livestock, dehesas.

INTRODUCTION

In Mediterranean areas water constitutes a valuable natural resource which is highly variable in space and time. The seasonal variation of rainfall together with the high evaporative demand produces a soil water deficit in summer, a characteristic feature of Mediterranean type climate. Interannual variations of rainfall cause the occurrence of prolonged dry periods (droughts). As a consequence the hydrological cycle suffers temporal variations, which in turn may affect water availability. In rangelands the effects are two-fold, influencing pasture productivity and also the water resources for livestock rearing. The latter is related with runoff production and aquifer recharges. The objectives of this work were to assess the availability of water for domestic animals in private farms in Extremadura and to explain whether water shortages are controlled by environmental factors (climate, lithology, etc.) or are also related with land management. Artificial watering ponds, which collect surface runoff are the most important water resources.

METHODS

The study was carried out in 54 private farms of wooded and treeless rangelands distributed throughout the region of Extremadura in Spain, exhibiting differences with respect to their natural properties, land use and management. Their sizes vary between 100 and 10,000 hectare, mean annual rainfall ranges between 465 and 926 mm and the climate varies from semi-arid to humid. The land is grazed by different types of domestic animals (sheep, cattle, pigs and goats).

Field work and digital topographic maps at a scale of 1:10.000 and aerial photographs were used to assess the potential hydrological resources of each farm, like watering ponds, rivers and wells. Special emphasis was given to the artificial watering ponds, very common in the area. Usually farms have several of these ponds. Because of the large number of ponds it was not feasible to determine their volume, instead their surface area at maximum water level was measured by aerial photograph interpretation. The water needs of livestock were estimated considering the number and species of animals per farm, as well as other factors influencing water consumption such as race, sex, age and season. Information was obtained from the literature (Olson & Fox, 1981; Luke, 1987; Buxadé, 1995; Olivares & Caro T, 1998; Gorlach, 1999; Brown, 2006; Streeter, 2006). For each of the farm the aridity index (UNEP, 1992) is calculated based on the relationship between annual potential evapotranspiration and rainfall. Potential evapotranspiration was estimated using the Thorthwaite method (Dunne & Leopold, 1978) because of its low data requirement. Because the Thornthwaite method underestimates annual evapotranspiration in semi-arid areas, the results were multiplied by a factor of 1.4.

In order to obtain information about the existence and severity of problems faced by the farms for water supply semi-structured interviews were carried out. Furthermore, if they suffer problems the farmers were asked about the solutions they adopt for solving water shortages.

RESULTS AND DISCUSSION

Table 1 presents the summary statistics of the variables used in this study. The aridity indices vary between 0.4 and 0.8, the median being 0.5. The summer dry period of most of the areas has a duration of 4 months (monthly potential evapotranspiration>rainfall), twelve farms have summer dry period of 5 months and only three register 3 dry months.

The estimated annual water consumption by livestock varies between 0.49 and 46.86 $m^3 \cdot ha^{-1}$, with a mean value of 9.49 $m^3 \cdot ha^{-1}$. The interviews revealed that 19% of the farms face problems of water supply in summer, 47% have problems only during periods of prolonged drought and 34% do not have problems (fig. 1). The data indicate a relationship between problems of water supply and the degree of aridity, with a larger number of farms facing problems being located in drier areas (fig. 2A). Data also point to a relationship with the amount of water consumed by livestock, which in turn is related with animal density (fig. 2B). This means that the ones which commonly suffer problems on average have higher stocking densities. Similarly, there exists a negative relationship between the surface area of artificial ponds and water shortage for livestock. However, the latter two results are not statistically significant.

The solutions adopted by the farmers are as follows: 32% use drilling wells for water supply, 26% bring water from outside the farms, 26% improve the storage of water by repairing and constructing ponds, 23% drew water from dams and rivers, 19% move the animals to areas

Table 1. Descriptive statistics of the variables used.

Variable	Number of farms	Mean	Median	Minimum	Maximum	Standard deviation
N months with ETP>P	54	4.17	4.00	3.00	5.00	0.50
Aridity index	54	0.55	0.53	0.39	0.81	0.12
Farms with problems (1, 2, or 3)	47	1.85	2.00	1.00	3.00	0.72
Water consumption ($m^3 \cdot ha^{-1}$)	51	9.49	6.90	0.49	46.86	8.07
Surface area of ponds ($m^2 \cdot ha^{-1}$)	53	34.16	19.29	1.96	198.73	40.39
Wells (n)	49	1.67	2.00	0.00	2.00	0.59

outside the farm and 6% adopt other measures. Fig. 3 presents the different forms of solving the problems for the two problem groups (2-during drought, 3-commonly in summer).

CONCLUSIONS

The results shed some light on the forms and causes of problems in water availability for livestock in rangelands of southwest Spain. There is a considerable amount of farms which face problems of water supply for their animals, either during summer or, with less frequency, during drought periods. These problems are related positively with the degree of aridity (natural factor), but also with the amount of animals and the available infrastructures. Various solutions are being adapted which means additional investiments. Some farmers even need to bring water from outside or move the animals to other places. Although the results give some interesting insight into the problem of water use and availability in livestock farms, further investigation is required. The sample size needs to be increased and the precision in determining available water should be improved.

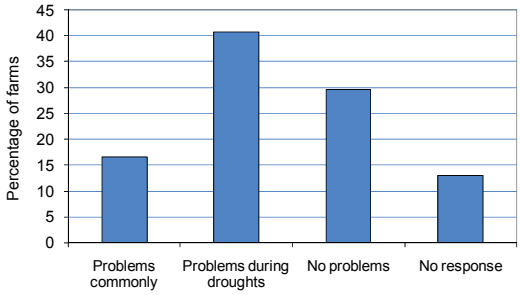

Figure 1. Percentage of farms suffering problems in water supply for livestock. Result of farmer interviews (n=54).

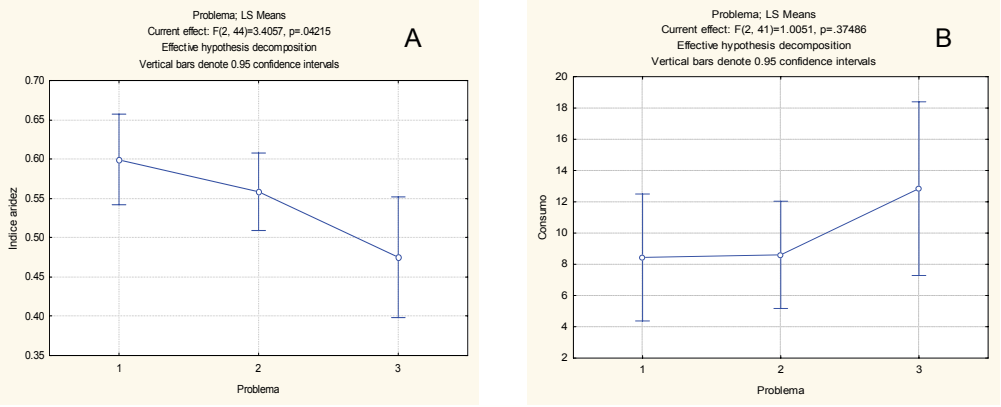

Figure 2. Result of one-way ANOVA for (A) aridity index and (B) water consumption with grouping variable being problems of water supply: 1 - none, 2 - during drought, 3 – commonly (n=47).

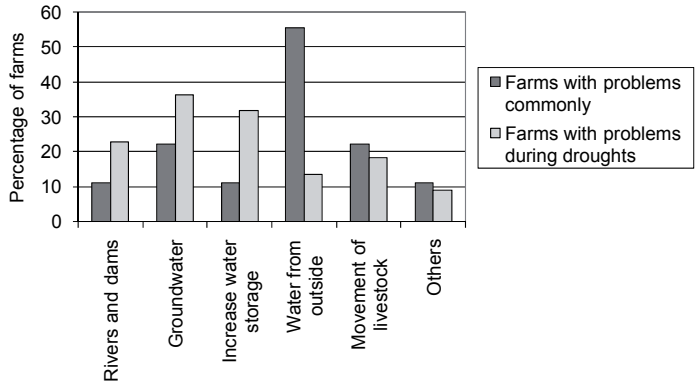

Figure 3. Solutions adopted by farmers who suffer problems in water supply for livestock. Considered are two groups, those facing problems commonly (n=9) and those with problems during droughts (n=22).

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