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Economic effects of the changing regime of autumn rains onto sheep breeding farms

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Abstract. The change in the autumn rain regime can create problems for sheep breeding based on pasture or non-irrigated grass. A reduction in the useful rain hampers the growth of grass production, preventing grazing, and requiring farms to tap into the stock of hay to feed animals in the autumn-winter season. Farms may have to rent more land to produce grass in the spring in order to expand their forage production with an increase of costs that will be difficult to endure in a declining milk prices scenario. This analysis assesses whether the changes in climate variability, which are already under way, alter the probability distribution of rainfall in autumn, reducing the days of rain for the growth of grass. The economic effects of this and other changes will be evaluated by means of a Discrete Stochastic Programming territorial model that allows to represent the choices of farms under uncertainty; in this work we present a preliminary simulation concerning the effect of autumnal rainfall on sheep breeding. The analysis shows the different situation of a farm type that grows the grass completely non-irrigated, another with a limited supply of water from wells and a third that can tap into the water supply of a Water User Association.

Keywords. Sheep breeding – Rain fed grassland – Sheep livestock management – Climate change.

Les effets économiques du changement du régime des pluies d'automne sur les fermes d'élevage ovin

Résumé. *Le changement dans le régime de pluies d'automne peut créer des problèmes pour l'élevage ovin basé sur des pâturages. Une réduction de la pluie utile peut entraver la croissance de l'herbe, ce qui empêche le pâturage, et obligeant des fermes de puiser dans le stock de foin pour nourrir les animaux pendant la saison automne-hiver. Les exploitations agricoles peuvent avoir besoin de louer plus de terres pour produire de l'herbe au printemps, afin d'accroître leur production de fourrage avec une augmentation des coûts qui seront difficiles à supporter dans un scénario de baisse des prix du lait. Cette analyse évalue si les changements dans la variabilité du climat, qui sont déjà en cours, de modifier la distribution de probabilité de pluie en automne, ce qui réduit les jours de pluie pour la croissance de l'herbe. Les effets économiques de ceci et d'autres changements seront évalués au moyen d'un modèle territoriale de programmation stochastique discret qui permet de représenter les choix des exploitations agricoles dans l'incertitude. Dans ce travail, nous présentons une simulation préliminaire concernant l'effet des précipitations automnales sur l'élevage des moutons. L'analyse montre que la situation est différente selon le type d'exploitation: celles qui exploitent des pâturages sans irrigation, celles ayant un approvisionnement limité en eau à partir de puits, et finalement les fermes ayant disponibilité d'eau d'irrigation à partir d'une association des usagers de l'eau.*

Mots-clés. *Élevage ovin – Pâturages non irrigués – Gestion du bétail – Changement climatique.*

I – Introduction

The change in the autumn rain regime can create problems for sheep breeding farms that are based on pasture or non-irrigated grass. A reduction in the useful rain hampers the grass production, preventing grazing, and requiring farms to tap into the stock of hay to feed animals in the autumn-winter season. This requires these farms to expand their production of forage, by renting more land to produce spring grass, or by irrigating this crop, or by recurring to the market of fodder.

This analysis first assesses whether the changes in climate variability, which are already under way, alter the probability distribution of rainfall in autumn, reducing the days of rain for the growth of grass. Second, evaluates the possible effects of this change on different sheep farm typologies. As a next step of the research, those typologies will get plugged into a territorial Discrete Stochastic Programming model in order to evaluate the reaction of the whole agricultural sector of the area.

II – Materials and methods

This study focused on the province of Oristano in Sardinia, a major area of sheep farming in Italy. Its data source was the FADN European database on farming accounting, consisting of annual observation of 77 farms over 3 years (2005-2007). Information on structural, economic and technical characteristics of the farms were provided by the database.

The observations were clustered with K-mean, obtaining 3 homogeneous groups and the centroid of each group was deputed as representative sheep breeding farm typology. The result of this clustering process was validated by checking if the defined typologies were consistent in terms of feed balance. For this purpose an estimation of the animal requirements and the feed availability was carried out. Hence, the demographic categories making up the flock have been identified on a monthly basis and overall needs of dry matter and metabolizable energy were rebuilt, after determining the unitary milk production for productive sheep (assuming the daily production of primiparous as 75% of multiparous). The nutritional needs were determined using the equations proposed by Cannas *et al*. (Cannas *et al*. 2004, Cannas *et al*. 2005).

Also the farm fodder crops have been rebuilt on a monthly basis, taking into account the intensity of the monthly growth (kg of DM/ha/month) of pastured species and production of farm stocks (hay), based on the values of unitary production.

The balance between the needs of the flock and forage availability were found consistent: this was considered as validating the farms represented by the averages of each of the three groups identified by the cluster analysis.

Climate change for Sardinia sheep breeders acts on the likelihood of having a sufficient autumn rain for the fodder to start its cycle efficiently. It has been shown fitting probability distribution for observed current and simulated future rain condition. The variable considered is the occurrence of a sequence of at least three rainy days that sum up to 35 mm of water rained. Climatic daily data are sourced by Agroscenari research project and produced by Italian JRC CNR-Ibimet.

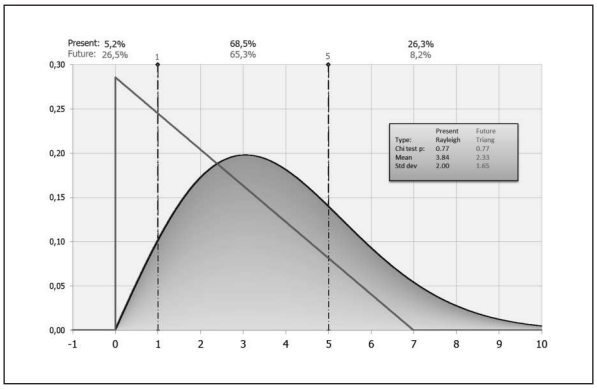

Fig. 1. Occurrence probability of 3-rainy-days sequences (∑>35 mm) over 15 October - 15 November.

III – Results and discussion

Major characteristics of the 3 farm types are presented in Table 1.

Table 1. Types of farms

Typology		OFFWUA_A	OFFWUA_B	ONWUA
Observations (no.)		38	26	9
Land (ha)	UAA	41	62	87
	UAA irrigated	0.0	1.3	5.1
Animals (heads)	Sheeps	148	355	464
	Sheeps/UAA forage	3.8	6.5	6.4
Labour (h)	Family labour	3,211	3,501	4,581
	Total labour	3,289	4,292	6,515
Capitals (€)	Total	373,439	670,888	1,386,997
	Equity	373,110	667,400	1,385,163
Milk Production	Milk (kg)	25,623	61,533	74,010
	Milk (kg) per sheep	170	170	150
	Price (€/kg)	0.628	0.621	0.606
Income statement	Gross Saleable (GDP)	34,488	82,351	110,485
	Milk GDP	16,082	38,229	44,834
	Public support	9,211	21,983	26,309
	Variable costs	9,489	26,237	41,645
	Feeds	4,269	8,934	13,120
	Gross income	25,000	56,114	68,840
	Fixed costs	8,908	13,635	25,203
	Net income	16,092	42,478	43,636
	Indirect Costs	26,149	31,506	42,248
	Comp. to the family labour	20,905	22,235	28,226
	Profit	-10,057	10,973	1,389
Indicators	Total labour per head	22.2	12.1	14.0
	Return On Equity (ROE)	-2.1%	2.1%	-0.1%

A simulation was carried out increasing the likelihood that pastures and grasslands do not produce grass for grazing in autumn, and that this failure occurs at least once every 4 years. This leads to the advanced exhaustion of stocks of hay and the need to meet the needs of the flocks in some other way. Among the various possibilities of some farms is the use of irrigation, with higher costs from the payment of certain reservations to the consortium or lifting water from wells. This solution is impractical on many farms that do not have wells or located in areas not served by community facilities for irrigation (represented by **OFFWUA_A**). Still, this solution is very expensive for farms with wells (**OFFWUA_B**). Finally, it is very expensive even for irrigation supplied by community facilities because it requires the provision of water outside the irrigation season, with high tariffs (**ONWUA**).

Then there is the possibility of renting of agricultural land to be allocated to the production of grass spring to increase the stocks available. This solution is expensive because it requires that farms take each year leased land, as a precaution about the year of crisis. Furthermore, the

increased demand for land is concentrated in the territory concerned and greatly increases the cost of rent.

Finally, there is the possibility of purchase on the hay market, drawing it in the last months before the new spring production company. This possibility would lead to increased purchases of hay between different types, ranging from 25% to 75%. At current prices the budgetary impact on the farms is very limited. There would be a rather remarkable effect in the event of a price increase, and this is likely to occur because the new climatic conditions would affect simultaneously all sheep farms in Sardinia, simultaneously increasing market demand for these forages. The model used does not allow to simulate the effects on the price of the variation of this application. However, an analysis of the market and prices of these forages has shown that in the last 20 years there have been differences of 50% between the observed maximum price and the average price. If one of the most productive areas of the country simultaneously enter on feed markets, as a result of climate change, the price could plausibly increase even higher. However it was considered interesting to carry out a simulation with a price 50% higher. Under these conditions the model generated reductions in net income of 4.2%, 3.1% and 2.3%, respectively for **OFFWUA_A**, **OFFWUA_B, ONWUA** farms.

IV – Conclusions

The sheep farms are potentially exposed to multiple critical events due to the CC. They may be in trouble in the spring haying operations, due to a different distribution of rainfall at that time hindering their access into the field. There are problems of milk production in summer because of higher temperatures resulting in a stress to the sheep, and even less availability of pasture. Here was considered only one possible critical aspects of sheep farms management related to climate change: the possibility that every four years, the autumn-winter pastures are not available because the rain in October-November period was not sufficient. The effect of this phenomenon on farm income becomes relevant only if it affects large areas, pushing their farms to resort simultaneously to fodder markets. It is also differentiated by type of farm, and it is found that smaller farms without any irrigation water supply suffer a greater percentage reduction of their income.

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References

Bullitta, P. and Spanu, A., 1977. Il ruolo dei cereali autunno-vernini nell'approvvigionamento foraggero delle aziende meridionali.

Bullitta, P., 1978. Valutazione agronomica di foraggere poliennali in ambiente mediterraneo.

Cannas A., Tedeschi L.O., Fox D.G., Pell A.N. and Van Soest P.J., 2004. A mechanistic model to predict nutrient requirements and feed biological values for sheep. In: *Journal of Animal Science*, 82, 149-169.

Cannas A. and Atzori A.S., 2005. Development and evaluation of a model to predict sheep nutrient requirements and feed utilization. In: *Italian Journal of Animal Science*, 4 (Suppl. 1), 15-33.

Cavallero, A. and Talamucci, P., 1992. Caratterizzazione della dinamica produttiva di pascoli naturali italiani.

Cocks, K.D., 1968. Discrete Stochastic Programming. In: *Management Science. Theory Series*, 15, 72-79.

Dono, G. and Mazzapicchio, G., 2010. Uncertain water supply in an irrigated Mediterranean area: An analysis of the possible economic impact of climate change on the farm sector. In: *Agricultural Systems*, 103 (6): 361-370, doi:10.1016/j.agsy.2010.03.005.

Hartigan, J.A., 1975. Clustering Algorithms. New York: Wiley.

Sulas, L., Porqueddu, C., Caredda, S. and Bullitta, P., 1997. Confronto fra sistemi foraggero-zootecnici per ovini da latte in ambiente asciutto : risultati agronomici del triennio 1990-93.