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Drought management and planning strategies in semi-arid and arid agro-pastoral systems of West Asia and North Africa: A review

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SUMMARY – The dry areas of West Asia and North Africa (WANA) region are characterized by low rainfall and high fluctuation of the precipitation. The rural livelihoods of these areas are based on agro-pastoral systems of production. These systems have been fragilized by drought that has become more frequent and worsened by human activities. To ensure the long term management of drought and improve and sustain these systems' productions and hence the livelihood of the agro-pastoralists, there is a need for the development of a risk and long term management approach of drought. This requires active participation of the different stakeholders and disciplines in an integrated way. In this process, the use of scientific approaches and methods are valuable and hence the involvement of research institutions is a pre-requisite for any improvement of drought management systems in the region; that is why this study is conducted as a component of a research project conducted jointly by ICARDA and a group of National Research Programs of WANA entitled "Developing Sustainable Livelihood of Agro-pastoral Communities of West Asia and North Africa". The objectives are: (i) to analyze the existing national, regional and international strategies and policies of drought preparedness and mitigation; and (ii) to assess existing technologies and propose new and more adapted options of risk management of drought for the region. This study showed that indigenous and local community strategies of drought management are no longer effective in coping with drought and the action plans that have been launched by the governments to manage this climatic hazard are mostly crisis based programs that encourage the dependency of the producers on the States aids and supports. This dependency has increased the use of non-adapted drought management that worsens the degradation of rangeland and pastures, and hence reduces livestock production and herders income. To improve their drought plans, WANA countries should build their systems on research results and on the experiences of some advanced countries that have developed comprehensive systems of drought risk management. In fact, scientists have developed methods that can be used in early drought warning such as drought indices and remote sensing tools and techniques that can mitigate better drought effects. Unfortunately, most of the studies on drought early warning that have been undertaken concerned crop production and a little effort has been made in relation with range and agro-pastoral systems. Nevertheless, experiences of some countries of Eastern and Western countries of Africa, Australia and New Zealand that tested drought risk management approaches in agro-pastoral sectors can be helpful in developing those adapted to WANA conditions. In fact, in this study, an integrated potential drought risk management system for WANA is proposed. It is based on early warning (Standardized Precipitation Index, Standardized Vegetation Index, Vegetation Moisture Conditions Index, field monitoring and socio-economic indicators), agro-ecological zoning and vulnerability mapping, drought mitigation techniques, polices and organization (livestock mortality-based index, weather-based index, task force and scientific and technical committees).

Key words: Drought, agro-pastoral, risk management, West Asia, North Africa.

Introduction

West Asia and North Africa (WANA) is characterized by low rainfall and high fluctuation of the precipitation. During the last century, this region experienced many episods of drought whose frequency has increased during the last decades. This climatic phenomenon has negatively affected agriculture and livestock production and involved natural resources degradation. These problems have been associated with high population growth and hence they have been aggravated by the use of non adapted management of natural resources. Pastoralists and agro-pastoralists are among the populations that have suffered the most natural resources degradation. In fact, if natural pastures and rangeland areas provided enough feed for the small ruminants that predominated in the region until the beginning of the 20th century, their size and production have decreased and unfortunately today they can not any more meet the needs of the flocks that have increased significantly.

Since indigenous approaches of coping with drought used in the past by pastoralists are not any more adapted, a high proportion of feed is provided by cultivated barley, crop residues and industrial by-products and concentrates. Nevertheless, the situation is different from one country to another. Different systems, varying from nomadic to semi-nomadic rangeland to integrated crop/livestock systems exist in the region. In the Maghreb for example, there is a reduction of livestock and people mobility and an increase of settlement and individual cropping and management of rangeland.

To help agro-pastoralists survive drought, many programs of subsidies and debt rescheduling have been launched by the governments. Unfortunately, these aids and supports have increased the dependency of herders on the State and encouraged the use of management techniques that enhance the agro-pastoral areas degradation. Consequently, there is a need for the development of risk and proactive approach for drought management in dry areas.

Overview of the situation of drought and pastoralism in WANA

WANA rangeland and natural pastures areas that have less than 200 mm were, in 1950s, the main source of feed needs (70%) of small ruminants (Ngaido, 2002). These areas are experiencing now high degradation. In fact, the biodiversity is decreasing very rapidly due to the overgrazing caused by very high increase of flock numbers (50% increase of livestock number during the last quinquennium) and non adapted animal and natural vegetation management. Moreover, rangeland and pastures are shrinking (10-25% of 1950s situation) because of the increasing transformation of these areas into cropped land and the introduction of intensive irrigation systems. Cropping of marginal lands using non adapted techniques has enhanced soil degradation and desertification. In Tunisia, the contribution of rangelands to livestock diet has decreased from 65% to 10% (Nefzaoui, 2002). In Jordan, these ecosystems used to provide 70% of feed requirements for animal grazing; today, it has declined to 20-30% (Roussan, 2002).

Drought management in agro-pastoral and rangeland systems of arid and semi-arid zones of WANA

Analysis of indigenous and local community knowledge

As stated before, drought has been one of the most limiting factors of crops and livestock productions in arid and semi-arid areas of WANA region. The most direct impact of a rainfall shortage on pastoralists' livelihoods is the drying up of water resources and declining forage resources for livestock. To cope with this recurrent natural problem, pastoralists developed traditionally strategies that enabled them to survive and produce under these harsh environments. These strategies were well adapted because both human and animal populations were relatively low and the rangeland was large enough and easily accessible. The strategies that have been developed by agro-pastoralist societies of MENA region were summarized by Hazell *et al.* (2001). Some of these strategies are:

(i) Mobile or transhumant grazing practices that reduce risks of having insufficient forage in any location. The migration of herders to high productive zones that alleviates drought stress on less productive or over-grazed areas has, however, decreased because of the privatization and the creation of boundaries on some collective lands that did not exist (Blench and Marriage, 1999).

(ii) Reciprocal grazing arrangements with more distant communities for access to their resources in dry years.

(iii) Adjustment of flock sizes and stocking rates to match available natural feed resources.

(iv) Keeping extra animals that can be easily liquidated in a drought, either for food or cash.

(v) Investment in digging of wells, cisterns and water harvesting systems.

(vi) Diversification of crops and storage of surplus grains, straw and forage as a reserve in good rainfall years. Some crops are more tolerant to drought than others.

(vii) Diversification among animal species and breeds within species. Some animals are more vulnerable to drought than others. The grazing habits can differ from one species or breed to another and small ruminants and camels are more tolerant to drought than cattle. Moreover, alternating on an area animals that have different digestion capacities of feed can improve space use efficiency, allow the vegetation recovery and survival of a minimum number of livestock (Blench and Marriage, 1999).

(viii) Income diversification into non-agricultural occupations.

Analysis of governmental actions and programs

Recently, in WANA, governments have been concerned by drought and have launched many programs to provide assistance to affected people. Nevertheless most of these programs have been oriented towards crisis and reactive management that solves partially and for a short term the communities' problems. Not too much investment in long term solutions through the development of strategies based on risk manageent has been made.

Among the crisis management programs used in the region is the provision of supplementary feeds to safeguard livestock with the predominant investments going to subsidies towards the costs and distribution of concentrates, especially barley, the authorization and encouragement of wells digging and subsidies of irrigation equipments. Debt forgiveness has been also a part of the program in certain countries under severe drought conditions.

Another policy that has been used in the region is the bank credit support under drought. In many countries, the policy that can be used to help the herders after a dry year is the rescheduling of credit as it is used in farming.

The consequence of the reactive actions is that they lead to the dependency of agro-pastoralists on government assistance and drought compensation. This policy encourages the practices of unsustainable management techniques in drought prone areas. Another problem is that the programs mentioned above cost the governments too much without ensuring long term solutions.

New approaches in drought management of agro-pastoral systems: Drought preparedness and mitigation

Drought early warning system development

Drought preparedness refers to action taken before a drought to increase the level of readiness by all stakeholders. The development of a drought early warning and monitoring system is an important phase to improve drought preparedness. In many countries, this system is usually based on meteorological data only. To improve this system and make it more effective, it should integrate information from all elements of the hydrologic system to allow the assessment of climate and water supply conditions.

Drought early warning is based on three tools which are climate prediction, drought indices and remote sensing measurements. Predictions are based on statistical, dynamic and hybrid models. The most used indices are the Deciles (Gibbs and Meher, 1967), the Standardized Precipitation Index (SPI), the Palmer Drought Severity Index PDSI (Palmer, 1965), the Surface Water Supply Index (SWSI) (Shafer and Dezman, 1982) and the new Standardized Water Index (SWI) (Bhuiyan, 2004) which gives and idea on the situation of the level of water table (deficit in the aquifer recharge).

To evaluate agricultural drought, many indices were developed: Climatic Deficit Index (Aghrab, 2003), Soil Water Balance, Crop Water Stress Index CWSI (Jackson, 1982) and Actual Water Deficit AWD (Wilhelmi *et al.*, 2002).

For the remote sensing tool, it is possible to detect, follow up and evaluate the impact of drought by the estimation of vegetation stress through derived indices from AVHRR. By this method, three indices characterizing the conditions of moisture (VCI), temperature (TCI) and vegetation health (VT)

can be calculated using the Normalized Difference Vegetation Index (NDVI) and the Brightness Temperature (BT). Extreme conditions are derived by calculating the maximum values of NDVI and BT (Kogan, 2000). Many other drought indices can be derived.

Drought mitigation and response

Drought mitigation actions are implemented during and in advance of drought to reduce the degree of risk to human life, property and productive capacity. The effect of drought is mitigated by two factors (http://www.nda.agric.za/docs/drought_plan_0905.pdf) which are: (i) the modification of drought hazard through the use of suitable and drought resistant breeds and cultivars, the preparation of food security programs and the limitation of water wastage and losses; and (ii) the diversification of crops and animals and the use of good farming practices.

Recommendation of key elements for the development of drought mitigation plan for WANA

The comprehensive system of drought management for WANA region should take into consideration the technical (drought early warning and mitigation), institutional and policies aspects and hence it has to encourage the risk and proactive measures.

Drought early warning

Drought early warning is an important step in drought risk management. The ones that have proven to give more accurate information by many scientists and that are easy to calculate with routinely gathered data at different time scales (short, medium and long terms) can be used in the region; these are:

(i) The Standardized Precipitation Index (SPI) – SPI is one of the indices that have been strongly suggested by many scientists because it is based on historical rainfall data only and gives a fair idea on drought intensity at different time scales (15 days, a month, 3 months, 6 months and 12 months intervals). Consequently, with this index we can monitor the different drought types (agricultural, pastoral, hydrological droughts).

(ii) Field monitoring and remote sensing systems – field monitoring should provide periodically (two-week period or monthly) flows of information on the availability of water and the general state of crop, pasture and livestock production. Remote sensing is a valuable tool when used in conjunction with field and pasture monitoring. One of the parameters that can be used is NDVI. This parameter has been used by scientists to calculate two indices that are the Standardized Vegetation Index (SVI) and the Vegetation Moisture Conditions Index (VCI). Consequently, measurements of these indices give a better estimate of plants health under drought.

(iii) Socio-economic indicators – socio-economic and other parameters should be gathered through surveys to validate and complete the bio-physical indices described above.

Drought mitigation

In addition to the early drought warning system, natural resources conservation techniques should be promoted. Among these techniques are soil and water conservation practices, water harvesting and early varieties and adapted crops, the de-stocking of animals to adjust the number of animals to the forage availability, the preservation of crops, pastures and rangelands biodiversity, the alternation of grazing areas to avoid the overgrazing, the introduction of more drought resistant shrubs such as atriplex and cactus and the application of phosphorus fertilizer to stimulate legume plants growth in pastures.

Policies and organization

The micro-finance strategy used in some countries in agriculture should be extended to the pastoral and agro-pastoral sectors because it can play an important role in the risk management. In fact, the micro-credit can help pastoralists replace livestock after drought and the micro-insurance protect them from animal losses (Swift, 2002). The index-based insurance used in Mongolia seems to be one of the promising options for drought risk management. WANA countries should benefit from this experience and if the approach is improved it can be applied successfully in the region; so, it is worthwhile testing. Swift (2002) described two forms of this insurance, livestock mortality-based insurance and weather-based insurance.

Conclusions

From this study, we can conclude that although drought phenomenon is complex and remains a little understood, many indicators of early warning and drought mitigation and strategies have been developed and tested by scientists worldwide. Moreover, some countries (Australia, New Zealand) and regions (East and South Africa) have developed drought risk management approaches for agro-pastoral sectors. Unfortunately, the implementation of these approaches by the governments remains a problem, especially in the developing countries, because of the lack of funds and adapted policies. In WANA region, drought management remains dominated by short term crisis coping strategies. But, because of the increasing frequency of drought and natural resources degradation, the countries of WANA should launch and use drought risk management plans based on early warning and tele-detection indicators, natural resources conservation techniques and community and participative approaches and policies. To reach this objective should strengthening its research and technology transfer programs to develop new tools and plans (early warning indicators, mitigation techniques, policies) taking into consideration the experiences of countries that developed comprehensive systems and plans of drought risk management.

References

Aghrab, A. (2003). *Caractérisation de la sécheresse et élaboration des indicateurs climatiques pour son alerte précoce dans la région du Sais*. Mémoire de fin d'étude, Ecole Nationale d'Agriculture de Meknès, Maroc.

Bhuiyan, C. (2004). Various drought indices for monitoring drought condition in Aravalli Terrain of India. In: *Geo-Imagery Bridging Continents: XXth ISPRS Congress*, (Commission 7), Istanbul (Turkey), 12-23 July, 2004.

Blench, R. and Marriage, Z. (1999). *Drought and livestock in Semi-Arid Africa and South West Asia*. Working Paper 117, March 1999. Overseas Development Institute, Portland House, London, UK.

Gibbs, W.J. and Maher, J.V. (1967). *Rainfall deciles as drought indicators*, Bureau of Meteorology, Bulletin No. 48. Commonwealth of Australia, Melbourne, Australia.

Hazell, P., Oram, P. and Chaherli, N. (2001). *Managing droughts in the low-rainfall areas of the Middle East and North Africa*, EPTD Discussion Paper No. 78. Environment and Production Technology Division, International Food Policy Research Institute, Washnigton, D.C., USA. http://www.ifpri.org/divs/eptd/dp/papers/eptdp78.pdf.

Jackson, R.D. (1982). Canopy temperature and crop water stress. In: *Advances in Irrigation*, Vol. 1, Hillel, D. (ed.). Academic Press, New York, pp. 43-85.

Kogan, F.N. (2000). Contribution of remote sensing to drought early warning. In: *Improving Drought Early Warning Systems in the Context of Drought Preparedness and Mitigation*, Wilhite, D.A., Sivakumar, M.V.K. and Wood, D.A. (eds), Lisboa (Portugal), September 2000, pp. 65-100.

Nefzaoui, A. (2002). Rangeland management options and individual and community strategies of agro-pastoralists in Central and Southern Tunisia. In: *International Conference on Policy and Institutional Options for the Management of Rangelands in Dry Areas*, Workshop summary paper, CAPRI working paper No. 23, Ngaido, T., McCarthy, N. and Gregorio, M.D. (eds), Tunis (Tunisia), January 2002. http://www.capri.cgiar.org/pdf/capriwp23.pdf.

Ngaido, T. (2002). Overview of Mashreq and Maghreb project. In: *International Conference on Policy and Institutional Options for the Management of Rangelands in Dry Areas*, Workshop summary paper, CAPRI working paper No. 23, Ngaido, T., McCarthy, N. and Gregorio, M.D. (eds), Tunis (Tunisia), January 2002. http://www.capri.cgiar.org/pdf/capriwp23.pdf.

Palmer, W.C. (1965). *Meteorological drought*, Research paper No. 45. US Department of Commerce, Weather Bureau, Washington, DC.

Roussan, L. (2002). Community and household level impacts of institutional options for managing and improving rangeland in the low rainfall areas of Jordan. In: *International Conference on Policy and Institutional Options for the Management of Rangelands in Dry Areas*, Workshop summary paper, CAPRI working paper No. 23, Ngaido, T., McCarthy, N. and Gregorio, M.D. (eds), Tunis (Tunisia), January 2002. http://www.capri.cgiar.org/pdf/capriwp23.pdf

Shafer, B.A. and L.E. Dezman. (1982). Development of a Surface Water Supply Index (SWSI) to assess the severity of drought conditions in snow pack runoff areas. In: *The Westen Snow Conference*. Colorado State University. Fort Collins, Colorado, USA, pp. 164-175.

Swift, J. (2002). *Financial services for risk management in pastoral systems,* NRI/IDS report for DFID/World Bank. http://www.nri.org/projects/pastoralism/microfinance.pdf.

Wilhelmi, O.V., Hubbard, K.G. and Wilhite, D.A. (2002). Spatial representation of agro-climatology in a study of agricultural drought. *International Journal of Climatology*, 22: 1399-1414.