



Stakeholder involvement and the management of animal genetic resources across the world



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ABSTRACT

The sustainability of activities related to animal genetic resources (AnGR) management depends largely on the participation of a range of stakeholders, both public and private. In this study, we investigated factors explaining differences in stakeholder involvement in AnGR management across countries, based on an historical perspective and an analysis of the 128 official country reports provided during preparation of *The Second Report on the State of the World's Animal Genetic Resources for Food and Agriculture*. Results of principal component analyses indicated that countries differed in the involvement of stakeholders in AnGR management, generally with greater involvement of livestock breeders and their organizations in developed countries. Developing countries tended to be divided into two groups, those with little involvement by stakeholders and those with high involvement by government/research organizations. Depending on the country, the involvement of government/research organizations versus breeders/livestock keepers organizations and commercial companies also differed, which could be linked to some extent to their historical background. The level of involvement of breeders' associations or cooperatives was positively correlated ($r=0.68$) to the general extent of AnGR activities within the country. Our results underline the importance of involving breeders and livestock keepers in the development of management activities, while public support is required as well, especially in the early stages of capacity development. In developing countries, development policies relative to AnGR management should therefore seek to promote coordination among livestock keepers through creation and empowerment of cooperatives, associations or community-based approaches.

1. Introduction

Animal Genetic Resources (AnGR) have a critical role in the provision of food and other services such as workforce, fiber, fertilizer, landscape management, and capital. Over the last several decades, the productivity of livestock has improved in developed countries, mainly through the application of more efficient breeding programs (Havenstein et al., 2003). In developing countries, the demand for animal products is currently increasing and is expected to increase over the next few decades. Attempts to meet this growing demand have often focused the importation of exotic breeds, largely because of the low productivity of local breeds and challenges in the implementation of effective breeding schemes to quickly improve productivity (Wurzinger et al., 2011; Leroy et al., 2016a). This situation is a threat to local genetic resources. Country-level data collected for *The Second*

Report on the State of the World's Animal Genetic Resources for Food and Agriculture (SoW2) were used to assess the management, status, and trends in AnGR and provided the basis for an appraisal of the challenges that animal genetic resources are currently facing (FAO, 2015). One main finding was that the institutional framework and capacity to properly manage AnGR require strengthening, to improve the characterization, selection and conservation of local livestock breeds. This finding is in agreement with literature (Wurzinger et al., 2011; Zonabend et al., 2013). The situation differs among countries. Statistical analyses (Leroy et al., 2016b), based on the 128 country reports coordinated by government-nominated National Coordinators for the SoW2, specifically showed a large difference in the extent of AnGR activities between OECD and BRICS (Brazil, Russia, India, China and South Africa) countries compared to less developed countries (for example: characterization, breeding programs, conservation and use of

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reproductive biotechnologies).

Several studies have emphasized that the sustainability of AnGR management activities depends on, among other things, the participation of a diversity of stakeholders (Rewe et al., 2009; Lauvie et al., 2011; Wurzinger et al., 2011; Zonabend et al., 2013; Mueller et al., 2015). Those stakeholders include livestock keepers (generally associated with small-scale livestock production) and breeders (a term generally applied to farmers involved in more sophisticated breeding programs), either individually or organized in associations or cooperatives. In developing countries, community-based organizations are also becoming recognized as important partners for implementation of sustainable breeding programs (Wurzinger et al., 2011). Commercial companies, either country-based or international, are also potential major stakeholders in the breeding process. Research organizations, either public or private, and public services (government, veterinary and extension services) may also have an important role to play. Finally, civil society organizations and, to a lesser extent, international donors may also be involved in AnGR activities, mostly in developing countries. The question of stakeholders participation is important because animal genetic resources, and especially ruminants, have commonly been managed as a common good (Labatut et al., 2013) involving private and public interests. Stakeholder involvement includes participation in policy-level activities (implementation, establish of data recording programs, provision of services, decision making, etc.) as well as specific animal-level activities (animal identification, artificial insemination, genetic evaluation etc.) Stakeholder involvement may, however, differ among species and countries, or even within countries, depending on the array of engaged stakeholders and their relationships to animal production (Faco et al., 2011).

The SoW2 country reports included responses to several questions related to stakeholder participation, providing an opportunity to understand the degree of involvement of the various actors across the world and in relation to a range of AnGR activities. The aim of this study was therefore to analyze factors that explain differences in stakeholder involvement in activities related to AnGR management and to investigate the link between stakeholder involvement and the overall extent of AnGR management activities. A historical perspective on stakeholder involvement is provided based on a brief literature review. We then use the results from the SoW2 country reports to investigate current differences in AnGR management across activities, species and countries, with particular emphasis on the situation in developing countries. Finally, the potential impact of new technologies on the various actors is discussed.

2. Material and methods

The first step in the study was a brief literature review of the historical involvement of various actors in AnGR management in different countries. The aim of this first section is to assess how stakeholder involvement has evolved through time and been impacted by specific historical circumstances.

Next, in order to illustrate differences in stakeholders' involvement in AnGR management across the world, an analysis was conducted of the 128 Country reports provided to FAO during the preparation of SoW2. These country reports are available at <http://www.fao.org/3/a-i4787e/i4787e01.htm>. A questionnaire was provided to the authors of the country reports and included explanations and definitions of terms to ensure that responses were as consistent as possible. Three questions from the SoW2 country reports were selected for this analysis, dealing with (i) the extent to which livestock keepers are organized for the purpose of animal breeding (including breeders), (ii) the level of stakeholder involvement in the various elements of breeding programs, and (iii) methods used for *in situ* conservation programs by the private and public sector.

Depending on the question, different stakeholders were considered in the reporting format (see Table 1). Potential stakeholders included

Government (Gov), Breeders/livestock keepers (BreLK), Breeders' associations or cooperatives (BreAC), National commercial companies (NComC), External commercial companies (EComC), Non-Governmental organizations (NGO), Research organizations (ResO), Public sector (PubS) (referring here mainly to governmental services and public research institutes), and the Private sector (PrivS) (referring here mainly to associations and NGOs). The study was limited to the "big five" species: cattle, sheep, goats, pigs and chickens, and the questionnaire considered dairy, beef, and multipurpose cattle separately.

Responses to the questions were converted into numerical values (either no = 0 and yes = 1 or none = 0, low = 1, medium = 2, and high = 3), and missing data were imputed using an iterative Principal Component Analysis (PCA) (Josse and Husson, 2012). Variables were then scaled to unit variance, and PCA was applied to investigate factors that discriminate among answers from different countries, considering effects of stakeholders, species or other items. The PCA was conducted independently for each question as if answers to the three questions were analysed together, the questions themselves appeared as the first discriminating factor (data not shown). Resulting synthetic uncorrelated variables were then ranked according to the amount of the variance (inertia) in the data set that was explained. For the PCA, each country was considered as an observation and the country scores for each of the different questions (Table 1) were the variables that were analysed.

To test the relationship between stakeholders' involvement and the implementation of AnGR activities, results for Question 2 (stakeholders involvement in the various elements of breeding programs) from the current study were correlated with a synthetic variable corresponding to the first axis of a PCA of 229 variables related to questions from the SoW2 country reports dealing with characterization, use and conservation of animal genetic resources (Leroy et al., 2016b). This variable explained 34.7% of the inertia of the former data set and was considered to represent the general extent of AnGR activities implemented within the countries. Correlations between answers relative to stakeholder involvement in the various elements of breeding programs in the current study and this synthetic variable were computed and averaged for each stakeholder class (i.e., across 7 species related groups x 5 activities 35 correlations coefficients per stakeholder class).

3. Results

3.1. Participation of stakeholders in breeding activities: historical perspective

Artificial selection of breeding animals is generally considered to have occurred since the beginning of domestication process. However, breeding activities in a modern sense, i.e. the systematic selection of relatively large number of animals over several generations to improve specific traits, was initiated in Europe in the late XVIIIth and early XIXth centuries (see, for instance, Wood and Orel, 2001). Following pioneering work by breeders such as Bakewell and the Colling brothers, the first herd-books were created under the leadership of charismatic farmers and with the support of the first agricultural societies and private initiatives, such as agricultural shows (Bouglér and Delage, 1999). Public institutions, i.e. agricultural and veterinary services were involved from the beginning of the planned breeding. In Europe, active state intervention in agriculture arose already during the XIXth century (Friedmann and McMichael, 1989). For instance, at the beginning on XIXth century, the use of Merino rams was promoted by the Napoleonic administration, for military purposes, to improve the French breeds' wool quality (Wood and Orel, 2001).

A strong development of animal breeding activities and organizations occurred in Europe and North America during the XXth century. In particular, performance recording on farm was developed during the first half of the century and artificial insemination (AI) in some species

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