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Analyzing the heterogeneity of farmers' preferences for improvements in dairy cow traits using farmer typologies

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ABSTRACT

Giving consideration to farmers' preferences for improvements in animal traits when designing genetic selection tools such as selection indexes might increase the uptake of these tools. The increase in use of genetic selection tools will, in turn, assist in the realization of genetic gain in breeding programs. However, the determination of farmers' preferences is not trivial because of its large heterogeneity. The aim of this study was to quantify Australian dairy farmers' preferences for cow trait improvements to inform and ultimately direct the choice of traits and selection indexes in the 2014 review of the National Breeding Objective. A specific aim was to analyze the heterogeneity of preferences for cow trait improvements by determining whether there are farmer types that can be identified with specific patterns of preferences. We analyzed whether farmer types differed in farming system, socioeconomic profile, and attitudes toward breeding and genetic evaluation tools. An online survey was developed to explore farmers' preferences for improvement in 13 cow traits. The pairwise comparisons method was used to derive a ranking of the traits for each respondent. A total of 551 farmers fully completed the survey. A principal component analysis followed by a Ward hierarchical cluster analysis was used to group farmers according to their preferences. Three types of farmers were determined: (1) production-focused farmers, who gave the highest preference of all for improvements in protein yield, lactation persistency, feed efficiency, cow live weight, and milking speed; (2) functionality-focused farmers with the highest preferences of all for improvements in mastitis, lameness, and calving difficulty; and (3) type-focused farmers with the highest preferences of all for mammary system and type. Farmer types differed in their age, their attitudes toward genetic selection, and in the selection criteria they use. Surprisingly, farmer types did not differ for herd size, calving, feeding system, or breed. These results support the idea that preferences for cow trait improvements are intrinsic to farmers and not to production systems or breeds. As a result of this study, and some bioeconomic modeling (not included in this study), the Australian dairy industry has implemented a main index and 2 alternative indexes targeting the different farmer types described here.

Key words: trait preference, dairy selection index, breeding objective, farmer type

INTRODUCTION

Low uptake of genetic selection tools among livestock farmers is one of the reasons for the lack of realization of potential genetic gain in breeding programs (Duguma et al., 2011; Nielsen et al., 2013). It has been argued that if the uptake of genetic selection tools is to be maximized, breeding objectives have to take into account farmers' preferences for improvements in animal traits (Sy et al., 1997; Nielsen and Amer, 2007). However, the determination of farmers' trait preferences is not trivial. Farmers' preferences are known to be heterogeneous (Sy et al., 1997; Ouma et al., 2007), and not accounting for this heterogeneity might bias the estimate of these preferences (Nielsen and Amer, 2007) in the sense that the mean preferences might not reflect the preferences of a large proportion of farmers.

Farmers' trait preferences have been analyzed, mainly in developing countries, to inform the design of breeding programs by understanding what kind of animals farmers would like to have. This represents an alternative to the calculation of trait economic weights, which is sometimes difficult because of the poor quality of available data (Nielsen and Amer, 2007), and it is also a way of including the value of nonmarket traits in the economic valuation of livestock (Ouma et al., 2007; Bett et al., 2011). In developing countries, and to a lesser extent developed countries, farmer characteristics are thought to have a strong influence on farmers' preferences for improvements in traits, and therefore,

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variables describing farmer characteristics are usually included in studies analyzing heterogeneity of farmers' preferences (Makokha et al., 2007).

Broadly, 3 methodological approaches have been used to analyze stated farmers' preferences: choice experiments (Bett et al., 2011; Duguma et al., 2011), pairwise comparisons (Byrne et al., 2012), and simpler methods such as ranking traits (Dana et al., 2010; Gizaw et al., 2010). Choice experiments have been widely used to analyze farmers' preferences for animal traits. However, the design of choice experiments is complex, and it is not clear whether or not they reveal the "true" preferences, because of bias derived from the complexity of the choice task (Arentze et al., 2003; Caussade et al., 2005; Nielsen and Amer, 2007). Pairwise comparisons require less intellectual effort from participants than choice experiments, because all items are not compared at once. This pairwise comparison makes choice decisions simpler and therefore may be nearer to "true" preferences (Hansen and Ombler, 2009).

Two general approaches have been used to account for heterogeneity in the analysis of farmers' preferences. Often preferences are analyzed within prior groups of farmers that are then compared. Usually, studies look at different farming systems (Tano et al., 2003; Byrne et al., 2012; Ahlman et al., 2014), different production objectives or segment of the industry (Roessler et al., 2008; Gizaw et al., 2010), or different breeds (Duguma et al., 2011). Alternatively, some studies include factors believed to influence preferences as independent variables in the models used to analyze preferences (Makokha et al., 2007; Ouma et al., 2007) or as interaction terms in the models (Tano et al., 2003). In both approaches, researchers have to make assumptions about the factors affecting preference heterogeneity or about the group of farmers that might have different trait preferences. Predefining groups might be appropriate when the primary interest is describing differentiated farmer types or farms (Byrne et al., 2012; Ahlman et al., 2014); however, when the interest is analyzing preference heterogeneity, prior assumptions might bias the results of the analysis.

Several statistical multivariate methods are designed to analyze variability, which can be applied to farmers' preferences without making prior assumptions about the sources of such variability. Cluster analysis (**CA**) might be useful in understanding patterns of preferences that are not evident when analyzing the sampled population as a whole. When the variability of preferences is high and the preferences for different alternatives or traits are related to each other, as is usually the case, the combined use of principal component analysis (**PCA**) and CA can produce robust results (Ben-Hur and Guyon, 2003; Barnes and Toma, 2012).

The aim of this study was to analyze Australian farmers' preferences for improvements in traits in dairy cows to inform the 2014 review of the national breeding objective (**NBO**) for the Australian dairy industry, implemented by the Australian Dairy Herd Improvement Scheme. The Australian NBO aims to increase net farm profit. This NBO is translated into a practical breeding tool in the form of a breeding index or set of breeding indexes. The main purposes of the review were to ensure that the indexes remained relevant for improving on-farm profit and were based on strong scientific principles that are consistent with farmers' preferences. In this context, we aimed to analyze Australian dairy farmers' preferences for improvements in traits, which were expected to be highly variable, evaluated in females without making any assumptions on the sources of its variability.

Specifically, the objectives of this paper were (1) to analyze the heterogeneity of dairy farmers' preferences for improvements in cow traits and determine whether there are farmer types with different preferences, and if so, (2) to analyze whether these farmer types differ in their farming systems, in their attitudes toward breeding and genetic evaluation tools, and in their socioeconomic profile.

MATERIALS AND METHODS

Industry Consultation Survey

An online survey was developed to explore dairy farmers' preferences for improvements in 13 cow traits: protein yield, cow live weight, fertility, longevity, mastitis resistance, milking speed, temperament, calving difficulty, feed efficiency, lactation persistency, lameness, mammary system, and overall type. The survey gathered information about farmer and farm profiles, farmer attitudes toward breeding tools, and the criteria they use for selecting bulls. All these factors were included as potential aspects influencing farmers' preferences for improvements in traits. Thus, the survey was divided into 2 distinct questionnaires explained below: a questionnaire about farmer' preferences for improvements in traits and a questionnaire about farmer and farm profiles.

The survey was pretested with a group of Australian dairy farmers and industry personnel and then refined before releasing it to farmers of all 6,314 Australian dairy farms. The survey was promoted through traditional and social media. All farmers with e-mail addresses were contacted directly, and underusers of Internet technology were supported with the opportunity to be surveyed by phone. Tablet computers were provided at farm walks and field days to facilitate par-