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Valuing environmental sustainability attributes of food products in India and China: decomposing the value of New Zealand's 'Clean-Green' brand

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Abstract

Concerns about the general state of the environment have spurred growing consumer demands for food products that have sustainability attributes including information on the environmental impact of production processes. For New Zealand, assessing the role of the 'Clean-Green' brand in export market consumers purchase decisions is of crucial strategic importance. In a series of choice experiments concerning lamb and dairy product purchase decisions, this study estimates willingness to pay for environmental sustainability attributes in India and China alongside animal welfare and food safety. The research design identifies if values differ according to the country of origin. Results indicate that environmental sustainability attributes significantly influence consumers' purchase decisions; however food safety and farm animal welfare are found to be valued more by both Indian and Chinese consumers. Respondents are more likely to purchase lamb and dairy products from New Zealand that have production processes enhancing biodiversity and minimising water pollution. These results support primary sector initiatives to improve environmental performance and aid stakeholders in identifying which elements of the 'Clean-Green' brand influence product choice.

Key Words: Food, Sustainability, Choice experiment, Willingness to pay, Cross-country comparison.

JEL Codes: Q18, Q51, Q56

1. Introduction

Evolving preferences in consumer and retailer demands in food markets are driving substantial changes in the value chains that New Zealand's (NZ) primary industries participate in. There is an increasing expectation that products have sustainability attributes, and that these can be verified. In particular, there is significant and increasing pressure in some key export markets for information on production methods including food safety, how animals are treated and environmental sustainability of production systems. New Zealand is a developed country which is heavily dependent on agricultural exports. Historically, NZ's main export market has been the United Kingdom (UK) but in recent years China and India particularly have gained importance for NZ. There is evidence that as income increases, purchase behaviours change and product attributes other than price may play a greater role in consumption decisions in emerging markets (Dong & Fuller, 2007; Saunders et al, 2010). It is therefore important that NZ understands the attributes that these markets value and how they differ from other markets. This will facilitate NZ's primary industry to determine and interpret market signals and align them with on and off farm practices.

Food produced with environmental sustainable production practices is receiving increasing attention in both public and private domains. However very little research has focused on consumer demand for sustainable production practices and resulting food products with relatively few studies focused on consumers' willingness to pay for sustainability in the context of agricultural production practices (Tonsor and Shupp, 2009). While many applications of eco-label type products exist (e.g. Jaffry et al, 2004; McClusky and Loureiro, 2003), there is a growing recognition that these formats do not address the complex information requirements of emerging consumer preferences (Czamezki, 2011). The future of food eco-labelling requires a development that broadens the current limited measure of environmental performance to include a consideration of a wider set of concerns. This type of eco-label would supply information concerning the environmental costs of food choices and production systems that goes beyond the limited scope of one dimensional labels such as organic, or carbon footprint. This dialogue highlights that there is a relative lack of studies examining consumer willingness to pay for sustainability attributes, particularly in a context of multiple sustainability attributes presented simultaneously.

A focus of this study is the interaction between emerging market consumer preferences over credence attributes and the role of NZ's 'Clean Green' branding. The last major government study on the value of the Clean-Green brand was in 2001. (Thornton et al, 2001). That study concluded that environmental image is a substantial driver of the value NZ can derive for goods and services in the international market place. The study estimated that this image was worth at least hundreds of millions, possibly billions, of dollars and demand for NZ's primary exports might be halved if the brand was lost. The current study aims to decompose the Clean-Green brand into its component factors in an attempt to disaggregate the overall value of the brand and identify the main elements driving consumers' decisions.

This paper has two main objectives. The first is to estimate consumer willingness to pay for sustainability attributes alongside safety and animal welfare of lamb and dairy products in the developing economies of China and India. The second objective is to estimate the relative importance of the components that make up NZ's 'Clean-green' brand. These objectives are achieved through the application of Discrete Choice Experiments for lamb and dairy products. An experimental design that permits estimation of two-way interactions between a country of origin attribute and all other attributes will allow identification of those attributes associated with dairy and lamb product choices specifically produced in NZ.

This paper's contribution benefits primary sector producers, analysts of credence attributes in consumer purchase decisions, and public policy makers mandated with oversight of certification standards. Assessing the importance of sustainability criteria in marketing of products are important considerations in proactively positioning primary sector industries for the emerging sustainability agenda of export markets. The literature valuing sustainability attributes is scarce. To the best of the authors' knowledge this study is one of the first to provide a cross-country comparison applying choice experiments to value consumer preferences for sustainability attributes of lamb and dairy within a developing economy context.

The following section provides some background to the trade relationship between NZ, China and India and the potential role for sustainability attributes. Section three presents methodology, followed by description of survey development and application. Section five presents and discusses choice experiment results. Conclusions end the paper.

2. The importance of China and India's emerging markets and their consumers' preferences to New Zealand exporters

China and India are two growing export markets for NZ and exports to these countries have risen over 2008 - 12. Agricultural exports to China have more than tripled between 2008 and 2012 accounting for an increase of NZ\$2.8 billion. Since 2010 China has become NZ's key export market for agricultural commodities. Dairy exports increased five-fold between 2008 and 2012, and sheep meat exports more than tripled during the same period (SNZ, 2012) this are the highest growth rates in trade with China on record. The increase in trade flows between NZ and China has been stimulated by the Free Trade Agreement (FTA) between the two countries which became binding in 2008. NZ was the first OECD economy to sign an FTA with China, and it provides for the successive removal of tariffs on 96 per cent of traded goods (MFAT, 2008).

Likewise, NZ's exports to India have increased significantly between 2008 and 2012. Since 2008, NZ's agricultural exports to India have grown by more than 75 per cent accounting for an increase in value of NZ\$72 million (SNZ, 2012). Dairy exports increased by more than 19-fold between 2008 and 2012 (SNZ, 2012). India started negotiations towards a bilateral Free Trade Agreement with NZ in 2010, and in January 2012 NZ hosted the seventh round of these negotiations (MFAT, 2012).

The value that consumers place on different food attributes is likely to vary across different countries and commodities. However, the empirical literature is concentrated primarily on consumer preferences in markets in Europe and the USA. There is little research valuing credence attributes of food products in developing economies such as India or China. Some exceptions in China include food safety of pork (Ortega et al, 2009; 2011) and country of origin attributes of onions (Ehmke et al, 2008). While Indian valuation applications have studied Genetic Modification to reduce pesticide residues in vegetables (Krishna and Qaim, 2008) and food safety and organics in grapes (Birol et al, 2010). Similarly there is little literature providing direct cross-country comparisons of food attribute values. Some exceptions include preferences for eco-labelled seafood in Norway and the United States of America (USA) (Johnston et al, 2001), Fair Trade coffee in Germany and the USA (Basu and Hicks, 2008), growth hormones or GM feed in beef across France Germany the UK and the USA (Lusk et al, 2003), food safety in beef steak across Canada Japan Mexico and the USA (Tonsor et al, 2009).

In a study specific to NZ examining consumer attitudes towards food attributes, Betts et al. (2010) examined Chinese attitudes towards sustainability attributes of NZ kiwifruit. Results showed that

Chinese consumers' value sustainability attributes in fruit products, and have an increasing interest in sustainable practices and purchases. Participants valued most products that are free of chemical residue, from pollution-free production and from environmentally-friendly production practices. There was a neutral attitude towards products indicating low carbon emissions during production and products with biodegradable packaging. Information on the product's water efficiency was selected as the least important by all participants compared with the other environmental product attributes. The study showed further that consumers valued country-of-origin information on fruit products but concern was also noted over a lack of trust in the validity of product labels (Betts et al., 2010).

While these results do indicate a certain level on environmental concern amongst Chinese and Indian consumers, there is still very little known about consumers' attitudes and preferences for the different attributes of food products in emerging markets.

3. Choice Experiment Method

This study employed the Stated Preference method of Choice Experiment to estimate the value of sustainable production credence attributes of lamb and dairy products alongside food safety and animal welfare to consumers in India and China. This approach involves simulating the context in which consumers would normally make choices among a set of competing product alternatives. This is achieved by designing experiments in which product characteristics and prices are systematically and independently varied to produce multiple choice scenarios. Consumers are then asked to indicate their preferred alternative in each scenario. The observed choice, levels of attributes in the chosen alternative and levels of attributes in non-chosen alternatives, are modelled in a probabilistic econometric framework.

The Choice Experiment method is one of various choice modelling approaches that are underpinned by the theory of consumer choice behaviour known as random utility theory (e.g. McFadden, 1974; Ben-Akiva and Lerman, 1985). Random utility theory postulates that consumers associate some utility (a latent measure of preference) with each product that they consider. Consumers try to maximise their utility by choosing the things that they think suit them best, all else equal. That is, consumers try to choose products that are "best" for them, subject to what they know about competing options and whatever constraints, such as income, are operating on their choices. The model can be made operational by formulising the relationship as follows:

$$U_{ij} = \beta_{0ij} + \sum \beta_k x_{ij} + e_{ij} \quad (1)$$

Where U_{ij} is the measure of utility derived by individual i from alternative j , which is a function of the sum of the utilities for each k attribute $\sum \beta_k x_{ij}$, where β is the utility weight given to attribute k in the valuation, and e_{ij} is an error term which is randomly distributed. The random component allows analysts to express consumer choice in probabilistic terms that enables the underlying preferences for attributes to be extracted.

$$P_{(ij|A)} = \text{Prob}(U_{ij} > U_{i1}) \text{ where } 1 \in A \text{ and } 1 \neq j \quad (2)$$

Where the probability that individual i chooses alternative j in the choice set A (i.e. $P_{(ij|A)}$) is commensurate with the probability that the utility U_{ij} is greater than the utility of the other alternatives U_{i1} in A . The most commonly used form of discrete choice model is the Multinomial Logit model which takes the form:

$$P_{iq} = \exp(V_{iq}) / \sum_{j=1}^J \exp(V_{jq}) \quad (3)$$

In which the error terms of alternatives are assumed to be independently and identically distributed as extreme type I variates. The Random Parameter Logit (RPL) model represents a full relaxation of the IID assumption and addresses the other behaviour limits of MNL models by accommodating correlations among panel observations and accounting for uncontrolled heterogeneity in tastes across respondents (Train, 2003). The parameter vector can be expressed as the population mean β and the individual specific deviation from the mean η_i . Hence the above utility function can be rewritten as:

$$U_i = \beta X_i + \eta_i X_i + \varepsilon_i \quad (4)$$

The stochastic part of utility now may be correlated among alternatives and across the sequence of choices via the common influence of η_i (Hensher and Greene, 2003). In this paper the study allows for correlation patterns between the unobserved portions of the utility of the alternatives by employing an Error Components specification. The choice probability resulting from this specification does not have a closed form solution and requires estimation by simulated Maximum Likelihood (ML). The ML algorithm searches for a solution by simulating m draws from distributions with given means and standard deviations. Probabilities can then be calculated by integrating the joint simulated distribution (the mixture distribution of the IID distribution of ε_i and the specified distribution for η_i). After evaluating the results from various distributional functional forms, a normal distribution is assumed for all attributes except cost which is fixed thus avoiding concerns of non-finite moments of subsequently derived willingness to pay distributions (Daly et al, 2011).

4. Survey and Description and Application

To develop the Choice Experiments two stages were used. The first stage comprised firstly of the conventional in-depth literature review route that formed the basis for the broad categorisation of food production attributes relevant to NZ's lamb and dairy exports. This encompassed review of published documents within both the public policy and academic domains (Driver et al, 2011). As well as discussion with industry stakeholders including key members of the Agricultural Research Group on Sustainability, a long running public-private consortium mandated to examine the environmental, social and economic sustainability of NZ farming systems (Saunders et al, 2010b). The second phase involved development and administration of a structured self-administered scoping survey conducted in China and India in August 2012. The sampling strategy involved recruiting 100 lamb and dairy consumers in each country from an online panel database of consumers maintained by Research Now™, with surveys implemented using Qualtrics™ online survey software.

The scoping survey contained a range of questions constructed to assess consumers' attitudes and preferences towards a number of food attributes and was designed as a substitute to conventional in-person focus group and interview work that were beyond available resources to conduct given the geographical distances involved. The survey informed final attribute selection and definitions for the Choice Experiment, and included an open-ended Contingent Valuation exercise that aided in defining the price vector for the Choice Experiment cost attribute. Following the scoping surveys, the choice experiment surveys were conducted in China and India in November 2012 achieving sample sizes of 686 for China and 695 in India. These surveys were implemented using a combination of Qualtrics™ and purpose built software developed and used in the Agribusiness and Economics Research Unit at Lincoln University (Kaye-Blake et al, 2009). Each survey was stratified by the countries' age, household income and occupation of the households' chief income earner using the widely applied

National Readers Survey¹ definitions. The sample was randomly distributed geographically. For the Chinese survey the questionnaire was translated into traditional Chinese by a professional translation service.

The price attribute was framed as a percentage increase in the price currently paid for lamb or dairy products. The final choice of non-price attribute framing and description was for a certification standard applied to general lamb and dairy products. These are presented alongside their levels in *Table 1*. These descriptions are taken from the lamb product surveys as presented to respondents and are identical to the dairy product surveys with only the product type substituted. Dairy products are defined to include cow milk products only.

Table 1: Attribute descriptions and levels used in Choice Experiments

Attribute	Description	Levels
Price change	This attribute compares the price for lamb in the survey to the price you currently pay for lamb you normally buy. The lamb in the survey may cost the same or may cost more than you currently pay	1%, 5%, 10%, 20%
Safety certified	The lamb product has been officially certified by a Food Safety Agency who guarantees that the food product is safe to eat	Yes/No
Farm animal welfare certified	The lamb product has been officially certified by a Farm Animal Welfare Agency who guarantees that the production of this product has met at least minimum welfare standards	Yes/No
Water management certified	The lamb product has been officially certified by an Environmental Agency who guarantees that the production of this product employs a management system that minimises water pollution	Yes/No
GHG minimisation certified	The lamb product has been officially certified by an Environmental Agency who guarantees that the production of this product employs a management system that minimises Green-house-gas emissions	Yes/No
Biodiversity enhancement certified	The lamb product has been officially certified by an Environmental Agency who guarantees that the production of this product employs a management system that enhances biodiversity	Yes/No
Country of origin	The consumer is able to identify the country where the lamb product is manufactured or produced	Domestic / New Zealand / Foreign other than NZ

¹ The NRS social grades are a system of demographic classification used in the United Kingdom. The social grades are based on the occupation of the chief income earner of the household. Income is not part of the social grade classification. However there is a strong correlation between income and social grade. The classifications are often grouped into ABC1 and C2DE in order to equate to middle class and working class, respectively (NRS, 2010).

A D-efficient fractional factorial experimental design was created using NGene™ that allowed estimation of all main effects, and two way interactions between the country of origin attribute and all other attributes. This design facilitates identification of the attributes consumers associate specifically with NZ. This resulted in 16 profiles which were then randomly blocked into two survey versions of eight choice sets, each containing three alternatives. An example of a choice set used in the Indian lamb survey is shown in *Figure 1*.

Set 1 of 8 Compared to the lamb you normally buy, which of the three types of lamb below would you prefer to buy at the price indicated? Select your choice and click on >> below.

	Option A	Option B	Option C	More Info
Safety certified	Not certified	Safety certified	Safety certified	
Farm Animal Welfare certified	Not certified	Farm Animal Welfare certified	Farm Animal Welfare certified	
GHG minimisation certified	Not certified	GHG minimisation certified	GHG minimisation certified	
Water management certified	Not certified	Water management certified	Not certified	
Biodiversity enhancement certified	Biodiversity enhancement certified	Not certified	Biodiversity enhancement certified	
Country of Origin	India	India	New Zealand	
Price Change	+20%	+1%	+10%	

Selection	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	>>
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0%  100%

Figure 1: Example of choice set used in the Indian lamb survey

5. Results and Discussion

The modelling results for China are presented in *Table 2*. The base model for each food product is given first and is intended as an initial look at whether a country of origin effect exists for NZ and elsewhere. The country of origin attribute is effects coded and as can be see there is greater preference for lamb and dairy from NZ compared to other foreign countries. Models estimated with this attribute coded to include domestic origin estimated negative coefficients, meaning that consumers are less likely to choose a lamb or dairy product produced in China. In light of these findings models are estimate specifying interactions between a NZ origin variable (recoded from the country of origin attribute) and all other attributes to try and decompose the premium preference that NZ products attract. These models indicate that dairy product consumers are more likely to choose NZ dairy certified for biodiversity enhancement followed by safety, while lamb consumers are more likely to choose NZ lamb certified for safety followed by biodiversity enhancement.

Table 2: Credence attributes of Dairy and Lamb products: CE RPL EC models of Chinese consumers

	Dairy		Lamb	
	Base Model	NZ Interactions	Base Model	NZ Interactions
<i>Random parameters in utility functions</i>				
Safety	2.16***	2.09***	2.44***	2.29***
Welfare	0.76***	0.77***	0.76***	0.65***
Water		0.22*		
GHG	0.76***	0.60***	0.79***	0.60***
Biodiversity	0.65***	0.39***	0.81***	0.52***
Foreign Origin	0.80***	0.71***	0.61***	0.46***
NZ Origin	1.46***		1.31***	
NZ Safety		0.68***		0.71***
NZ Welfare		0.9		0.32
NZ Water		0.49**		0.28
NZ Biodiversity				0.49**
<i>Nonrandom parameters in utility functions</i>				
Price	-2.85***	-2.99***	-5.41***	-5.56***
Water	0.50***		0.34***	0.52***
NZ GHG		0.45**		0.48*
NZ Biodiversity		0.89***		
<i>Distributions of standard deviations of random parameters(Normal)</i>				
Safety	1.69***	1.79***	2.02***	2.14***
Welfare	0.63***	0.63***	0.49***	0.45**
Water		0.44***		
GHG	0.63***	0.84***	0.49***	0.69***
Biodiversity	0.60***	0.74***	1.29***	1.35***
Foreign Origin	0.52***	0.65***	0.91***	0.88***
NZ Origin	1.15***		1.30***	
NZ Safety		0.61*		0.94***
NZ Welfare		1.26***		1.15***
NZ Water		1.07***		0.73**
NZ Biodiversity				0.79**
<i>Standard deviations of latent random effects in Utility functions</i>				
Alt1 & Alt2	0.39***	0.33**	0.48***	0.48***
Alt1 & Alt3			0.37***	0.33*
Alt2 & Alt3	0.45***	0.71***		0.41**
Number of obs.	3032		2456	
McFadden Pseudo R ²	0.29	0.32	0.30	0.31

Notes ***, **, * denote statistical significance at the 1%, 5% and 10% level respectively.

Similar to the base China models, base models estimated for Indian consumers find an increased likelihood of selection of NZ products, as can be seen in *Table 3*. The model suggests that consumers are less likely to choose a product of foreign origin, however, models estimated with this attribute recoded to include domestic origin are also found to be negative. It is unlikely that Indian consumers only prefer lamb and dairy from NZ, what may be occurring is that the agglomeration of countries into a collective foreign origin variable is masking preferences over some of the constituent countries that are likely to be considered positively by Indian consumers. Results of the NZ interaction models indicate that dairy consumers are more likely to choose NZ products certified for biodiversity enhancement followed by farm animal welfare. Indian lamb consumers are more likely to choose NZ products if they are certified for production methods that have management systems for water pollution minimisation.

Table 3: Credence attributes of Dairy and Lamb products: CE RPL EC models of **Indian** consumers

	Dairy		Lamb	
	Base Model	NZ Interactions	Base Model	NZ Interactions
<i>Random parameters in utility functions</i>				
Safety	1.29***	1.38***	1.01***	1.06***
Welfare	0.74***	0.87***	0.53***	0.54***
Water		0.133		0.26***
GHG		0.55***	0.51***	0.46***
Biodiversity	0.49***	0.32***	0.56***	0.53***
Foreign Origin	-0.36***	-0.30***	-0.07	-0.13
NZ Origin	0.16***		0.28***	
NZ Safety				
NZ Welfare		0.52**		0.05
NZ Water				
NZ GHG				0.15
NZ Biodiversity				
<i>Nonrandom parameters in utility functions</i>				
Price	-1.68***	-1.13***	-1.26***	-1.25***
Water	0.35***		0.35***	0.26***
GHG	0.66***			
NZ Safety		0.20		0.03
NZ Water		0.33***		0.26**
NZ GHG		0.16		
NZ Biodiversity		0.64***		0.14
<i>Distributions of standard deviations of random parameters(Normal)</i>				
Safety	1.31***		1.19***	1.23***
Welfare	0.59***		0.35**	0.39***
Water				
GHG			0.34***	0.36**
Biodiversity	0.85***		0.66***	0.69***
Foreign Origin	0.70***		0.79***	0.83***
NZ Origin	0.75***		0.59***	
NZ Safety				
NZ Welfare				0.83***
NZ Water				
NZ GHG				0.79***
NZ Biodiversity				
<i>Standard deviations of latent random effects in Utility functions</i>				
Alt1 & Alt2	0.52***	0.68***	0.39***	0.32**
Alt1 & Alt3	0.57***	0.55***	0.32***	0.39***
Alt2 & Alt3	0.62***	0.59***	0.63***	0.69***
Number of obs.	2864		2696	
McFadden Pseudo R ²	0.18	0.20	0.15	0.19
Notes	***, **, * denote statistical significance at the 1%, 5% and 10% level respectively.			

The next stage in the analysis is estimate consumers' willingness to pay for dairy and lamb production attributes, these are contained in *Table 4*. Willingness to pay was estimated using the unconditional parameter estimates from the NZ interaction models and derived using the parametric bootstrapping technique of Krinsky and Robb (1986; 1990) employing 10,000 draws.

Table 4: Food attribute Willingness to Pay : New Zealand Origin Interaction Models

	China		India	
	Dairy	Lamb	Dairy	Lamb
Food safety	68%	42%	111%	83%
Animal welfare	25%	12%	71%	42%
Water conservation	6%	9%	-	19%
GHG minimisation	19%	10%	45%	36%
Biodiversity enhancement	12%	11%	24%	41%
Foreign Origin	22%	9%	-26%	-
NZ Safety	22%	13%	-	-
NZ Welfare	-	-	45%	-
NZ Water	15%	-	27%	19%
NZ GHG	14%	9%	-	-
NZ Biodiversity	28%	11%	51%	-

Notes: WTP derived using Krinsky and Robb method.
No WTP estimate is provided where model parameter is insignificant.

While the absolute WTP values may differ, *Table 4* shows some fairly consistent relative results across both countries and food product types. Putting aside the NZ interaction effects for a moment and examining the main effects results show that consumers in India and China are WTP the most for guaranteed food safety, with farm animal welfare certification second. GHG minimisation is the next most valued attribute for all Chinese and Indian consumers.

Turning to the NZ origin attribute interactions coefficients reveals that Chinese consumers place relatively high value on food safety certification of NZ products. This may not be a surprising result given the serious 2008-2010 melamine in milk powder incident involving in part, product associated with NZ in that Fonterra had part ownership of one of the offending Chinese companies, Sanlu.

One of the main discoveries is that consistently across both countries and food types we find that consumers are WTP more for NZ products with biodiversity enhancement and water pollution minimisation certification. Of the sustainability attributes, biodiversity enhancement seems to be the main driver of preferences for NZ dairy and lamb products.

6. Conclusions

This paper presented results from a series of choice experiments on lamb and dairy products conducted in China and India. The study had several key goals: to estimate values of credence attributes of food products in developing economies including sustainability attributes of production, to compare values of credence attributes of differing food products, and to decompose the elements of NZs 'Clean-Green' brand in consumers product choices.

Results show that credence attributes of NZ exports are important to consumers in both China and India. Furthermore, not only are these attributes considered important, but they are also valued, as shown by consumers' willingness to pay for food products certified for most of the attributes considered in this study. Modelling results indicate significant heterogeneity in coefficient estimates for most attributes across both countries and food types.

This study has attempted to decompose the elements of NZs 'Clean-Green' brand relating to agricultural production systems into management of water pollution, GHG emissions and biodiversity enhancement. Overall, analysis demonstrates that consumers are more likely to choose products from NZ if its production is certified for biodiversity enhancement management systems, followed by water pollution minimisation certification. These results support primary sector initiatives to improve environmental performance and help indicate the relative importance of alternative policy direction.

The outcomes of this study, while encouraging, represent the early stages of research into sustainability attributes in NZs developing economy export markets. This study forms part of the groundwork for further research that aims to identify opportunities for alignment of farming systems with emerging consumer preferences in markets for NZs primary industry exports.

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