

1 Conservation impediments and incentives – progressing the
2 understanding of linkages between the adoption of conservation
3 practices and the motivational orientation of graziers in the
4 tropical savannas

5 **Abstract**

6 The adoption of conservation practices is a complex matter – rural landholders consider a wide variety of
7 factors and characteristics when deciding whether to adopt a conservation practice. Recent research has
8 suggested that graziers’ goals affect the adoption of conservation practices. We describe an empirical link
9 between graziers’ goals and their perceptions of the relative importance of impediments and the
10 effectiveness of incentives in the adoption of conservation practices. Results suggest that to increase the
11 adoption of conservation practices, schemes will have to be developed with reference to graziers subjective
12 views on impediments and on the effectiveness of incentives.

13 **Keywords**

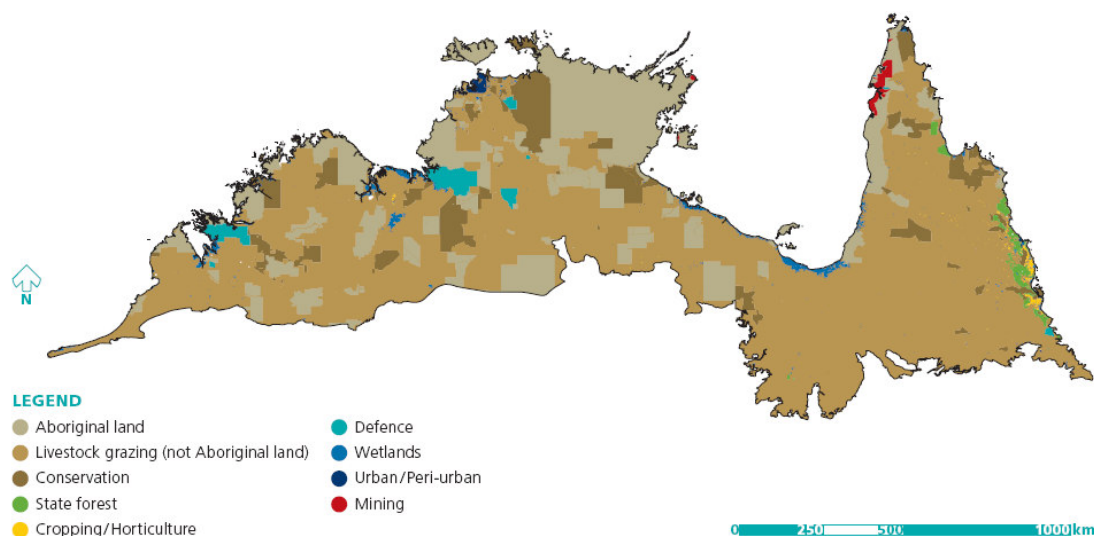
14 Graziers, goals, conservation, tropical savannas, impediments, incentives

15 **Introduction**

16 Australia’s tropical savannas are the environments of dense grass and scattered trees that range over the
17 vast majority of the northern part of the continent (TS-CRC, 2008). The tropical savannas are home to a
18 rich variety of plants and animals and, in Australia, substantial portions of these ecosystems are relatively
19 pristine (Woinarski *et al.*, 2007). Currently the tropical savannas have a population of approximately
20 500,000 with more than half living in Townsville and Darwin. The majority of land (65%) is used for

21 grazing purposes (Figure 1); Aboriginal land and the conservation estate are the next largest uses of land
22 representing approximately 11% and 5% of the area respectively (Garnett *et al.*, 2008).

23 **Figure 1: Australia's tropical savannas**



24

25 **Source: (Woinarski *et al.*, 2007) page 25**

26

27 Australia contains more than 25% of the world's remaining tropical savannas (Woinarski *et al.* 2007).
28 While relatively intact these landscapes are under increasing threat due to a multitude of interacting factors
29 including the introduction of exotic plant and animal species, intensification of pastoral production, and
30 climate change (Woinarski *et al.* 2007). The traditional approach to conservation through the development
31 of reserves and conservation parks is unlikely to succeed in the tropical savannas due to their
32 expansiveness, interconnectedness and the lack of unallocated land – conservation efforts will require the
33 inclusion of land managers to be effective in conserving the natural values of the tropical savannas
34 (Woinarski *et al.* 2007). As the most extensive users of land in the tropical savannas, and in response to the
35 limitations of the conventional approach to conservation (Woinarski *et al.* 2007) graziers are coming under
36 increasing pressure to incorporate the amenity and environmental values of the remainder of the Australian
37 population in their operations (Greiner *et al.* 2008).

38 In recent decades there has been a shift in the perception of land and landscapes from a primary
39 productivity focus to one that values the intrinsic characteristics of natural ecosystems and their ecosystem

40 services (Greiner *et al.* 2009; Holmes 2002; Wilson 2001). In Australia the shift in focus from a
41 productivity orientation to one including environmental values arguably began in 1989 with the National
42 Landcare Program (NLP) which, at that time, was the single largest stand-alone public investment with
43 conservation objectives in Australia's history (Hajkowicz 2009). The primary success of the NLP was that
44 it raised awareness and engaged communities in conservation activities (Hajkowicz, 2009).

45 Adoption rates of conservation practices advocated under different conservation schemes have tended to
46 vary widely following the implementation of the NLP (Pannell *et al.*, 2006). Recent programs implemented
47 to improve conservation outcomes across Australian catchments (National Heritage Trust 1~ \$1.3b;
48 National Heritage Trust 2~ \$1.2b; National Action Plan for Salinity and Water Quality ~\$1.4b) have
49 generally been unable to demonstrate significant results with respect to their intended outcomes (Hajkowicz
50 2009). There is a consensus that conservation outcomes will require greater provision of financial
51 incentives to be effective – however there is a danger of public investments crowding out intended private
52 investments in conservation activities (Hajkowicz 2009). The issue of low levels of effectiveness for
53 traditional and more modern conservation schemes such as those described by Hajkowicz (2009) is cause
54 for concern for the tropical savannas where “the contributions of all property-holders and managers are
55 needed to maintain the North's natural values” (Woinarski *et al.* 2007: p88).

56 A number of papers in the scientific literature suggest that landholder preferences and goals play a
57 significant part in the adoption process of new innovations in agriculture (Greiner *et al.* 2008; Kancans *et*
58 *al.* 2008; Maybery *et al.* 2005; Pannell *et al.* 2006; Torkamani 2005). For example Greiner *et al.* (2008)
59 demonstrated that graziers in the Burdekin region with relatively strong conservation and lifestyle
60 motivations were more likely to adopt conservation practices because they were intrinsically motivated to
61 do so. These results suggest that graziers may follow different pathways when considering the adoption of
62 conservation practices depending on their motivational orientation. The questions are then: How do
63 different motivations come to affect the adoption of conservation practices? Are they directly related to the
64 adoption of conservation practices or do they affect adoption through a different perception of the relative
65 importance of impediments and the relative effectiveness of any incentives offered within a conservation
66 scheme?

67 This paper presents research on the empirical relationships between graziers stated motivations, perceived
68 impediments to undertaking conservation measures and the effectiveness of incentives to facilitate the
69 adoption of conservation measures in the tropical savannas. Three existing datasets from the Northern
70 Territory (Greiner *et al.* 2008), the Northern Gulf (Greiner and Miller, 2008), and the Burdekin (Greiner *et*
71 *al.* 2007) are combined to provide a dataset spanning a large proportion of the Australian tropical savannas.
72 This dataset is used to test the hypothesis that graziers with different goals have different perceptions of the
73 importance of impediments to undertaking conservation measures and of the effectiveness of incentives to
74 alleviate these impediments.

75 The first section of this paper provides a review of literature on impediments and incentives associated with
76 the adoption of conservation practices by graziers in Australia. This is followed by a description of the
77 methodologies used in collecting and combining the data and in the data analysis. Results from the data
78 analysis are then presented followed, finally, by a discussion of the results and conclusions.

79 **The role of impediments and incentives in the adoption of conservation measures by** 80 **Australian rangelands graziers**

81 Investments in the environment are, essentially, investments in a good that is inherently public (Hajkowicz
82 2009; Reeson 2008). Economic theory suggests that private investments in a public good will generally
83 occur below the socially optimal level. Rational actors will invest in public goods only to the point where
84 their marginal private benefits are equal to their marginal private costs for such an investment (Reeson
85 2008). Fortunately, in the case of supplying environmental services, many people voluntarily contribute far
86 more than would seem to be rational given their marginal private use benefit from such investments
87 (Reeson 2008).

88 Graziers may be influenced by intrinsic or extrinsic incentives for the adoption of conservation practices.
89 Those with intrinsic motivation may invest in conservation measures at levels beyond what would be
90 rational if they were only considering marginal private benefits whilst those influenced by predominantly
91 extrinsic factors might be described more accurately by the rational actor model (Reeson 2008). Maybery *et*
92 *al.* (2005) described three categories of goals by which graziers were motivated, namely – economic,

93 conservation, and lifestyle. Similarly Grenier *et al.* (2009) classified the motivational orientation of graziers
94 in the Burdekin into three categories, namely – financial/economic; conservation and lifestyle; and social.

95 The basis for differences in adoption rates of conservation practices may not lay solely in the motivational
96 arena. A common decision theory framework within economics is the utility maximization hypothesis
97 where decision makers maximize utility subject to some constraints (Cox, 1997). Utility may be derived
98 from predominantly economic, conservation, lifestyle or social factors as implied by the motivational
99 orientation of graziers. However graziers maximize their utility when deciding to adopt conservation
100 practices subject to some constraints. As such we cannot proceed to develop a framework for the design of
101 conservation schemes without understanding these constraints in addition to the motivational orientation of
102 graziers. Factors resulting in differential adoption rates for conservation practices are observed to come
103 from a variety of sources including resource constraints, risk issues and characteristics of the practice itself
104 (Pannell *et al.* 2006). Increasingly there is a realisation that conservation measures must consider the
105 human dimension in addition to the production-conservation trade-off (Vogt 2007).

106 Economic considerations are key drivers of intensification of grazing systems in Australia (Greiner *et al.*
107 2007, MacLeod and McIvor 2008) and are generally considered to be extrinsic incentives (Reeson 2008).
108 The adoption of conservation practices, often involves a de-intensification or restriction of options for
109 future intensifications in conserved areas. This can lead to reduced returns from land and reduction in (use)
110 option values for areas subject to conservation measures. Given their importance in land management
111 decisions economic factors are a logical inclusion in the list of constraints to adoption of conservation
112 practices.

113 Other factors that play an important part are those of risk and uncertainty and learning (Marra *et al.* 2003).
114 Uncertainty over future market conditions, regulations, climatic conditions and other factors have been
115 shown to play a role in the decision process for landholders considering adoption of agricultural
116 innovations and conservation practices (Greiner *et al.* 2009; Pannell *et al.* 2006; Marra *et al.* 2003).
117 Knowledge and learning are also aspects that impact on the decision process when landholders consider the
118 adoption of conservation practices on their land (Pannell *et al.* 2006).

119 Social and conservation considerations are also important. Altruism, self-image and fairness aspects can
 120 overcome financial motivations (Reeson 2008). The danger of considering only economic aspects in the
 121 development and extension of conservation schemes is that the creation of formal institutions providing
 122 financial and/or regulatory incentives can crowd out intrinsic motivations to undertake a conservation
 123 activity (Reeson 2008). The result of crowding out of intrinsic conservation intentions is a decline in the
 124 efficiency of conservation schemes.

125 This paper seeks to provide empirical evidence to demonstrate that motivations influence graziers'
 126 perceptions of the constraints to adoption of conservation measures and the efficacy of incentives in
 127 alleviating these constraints. This hypothesis is examined by testing for significant relationships between
 128 the goal orientation of graziers, the perceived importance of impediments to the adoption of conservation
 129 practices and the perceived effectiveness of incentives in alleviating constraints that these impediments
 130 impose.

131 **Method**

132 The research presented in this paper is based on the amalgamation of data from three separate but related
 133 surveys of graziers across the tropical savannas region of Australia. All three surveys dealt with matters
 134 relating to the adoption of conservation practices by graziers and explored the relationships between
 135 graziers goals, the importance of impediments as constraints to adoption of conservation practices and the
 136 effectiveness of incentives in alleviating these constraints. Table 1 provides a brief description of the
 137 purpose of each survey and some descriptive statistics.

138 **Table 1: Description of the three surveys utilized in this research**

Survey region	Year conducted	Sample size	Sample response rate	Percentage of combined dataset	Purpose of survey
Northern Territory	2008	63	33%	28%	Evaluate graziers perspectives on conservation covenants and conservation management agreements
Northern Gulf (Qld)	2007-8	76	35%	34%	Provide a foundation for the development of a grazing code of practice in the Northern Gulf
Burdekin (Qld)	2006-7	85	32%	38%	Evaluate the adoption of Best Management Practices amongst graziers in the Burdekin region

140

141 The three surveys contained a set of three questions eliciting graziers motivations, perceptions on the
142 importance of constraints to adoption of conservation measures and the preferred incentives to alleviate
143 these constraints. Respondents were asked to rank a list of items on an ordinal scale. The questions were:

144 (1) “When you think about being a grazier and managing your operation, how important are the
145 following goals to you?”

146 (2) “To what extent do the following factors currently prevent you from undertaking conservation
147 measures on your operation?”

148 (3) “How effective would the following measures be in removing those impediments and helping you
149 to undertake (more) conservation activities on your operation?”

150 The motivational questions asked respondents to provide an indication of the importance to them of a range
151 of goals related to the grazing lifestyle. These broadly covered economic, lifestyle, environmental and
152 social goals. Respondents in all three surveys were asked to rank items listed on a scale from 1 (“Not at all
153 important”) to 10 (“Extremely important”). There were 10 equivalent motivational items present across the
154 three surveys.

155 The impediments to conservation measures questions asked respondents to provide an indication of the
156 level of constraint a range of factors played in limiting the adoption of conservation measures on-farm.
157 Impediment items covered a range of sources including: financial and resources constraints, knowledge
158 limitations, practicality issues and, risk and uncertainty issues. Burdekin respondents rated these items on a
159 scale from 1 (“Not a constraint”) to 10 (“Fundamental constraint”). Northern Territory and northern Gulf
160 respondents rated these items on a scale from 1 (“Not an impediment”) to 5 (“Fundamental/Major
161 impediment”). A total of 10 impediment items were equivalent across the three surveys. The difference in
162 rating scales for the impediments question was rectified by halving the scores for Burdekin graziers.

163 Graziers were asked to rate a range of incentive items in terms of their effectiveness in alleviating
164 constraints to undertaking conservation measures on-farm. The lists included incentives based on: financial
165 incentives, improved information collection and flows, increased public and peer recognition, management
166 plans, and government intervention (regulation). All graziers rated the effectiveness of incentive items on a

167 scale from 1 (“Completely ineffective”) to 5 (“Completely effective”). A total of 11 incentive items were
168 equivalent across the three surveys.

169 The ordinal nature of the data necessitated some adjustments prior to the merging of the dataset. Question
170 lists from each of the surveys included some items that were not common across the three surveys – results
171 from these items were not included in this analysis. Due to the different settings in which the questions
172 were contained (overall survey orientation) and the fact that the presented lists were not identical between
173 the surveys graziers may have responded with different points of reference on which to rate items. The
174 absolute level of rating was not of concern for this research; rather the relative differences between ratings
175 were of primary interest as this alone can show how responses to three questions are related. To ensure that
176 regional/survey reference points did not confound the examination of relationships the distribution of
177 responses to each question and each region were corrected by subtracting mean ratings from individual
178 responses. A mathematical representation is provided below:

179
$$x_{ijk}^* = x_{ijk} - \sum_{i=1}^n x_{ijk}$$

180

181 Where:

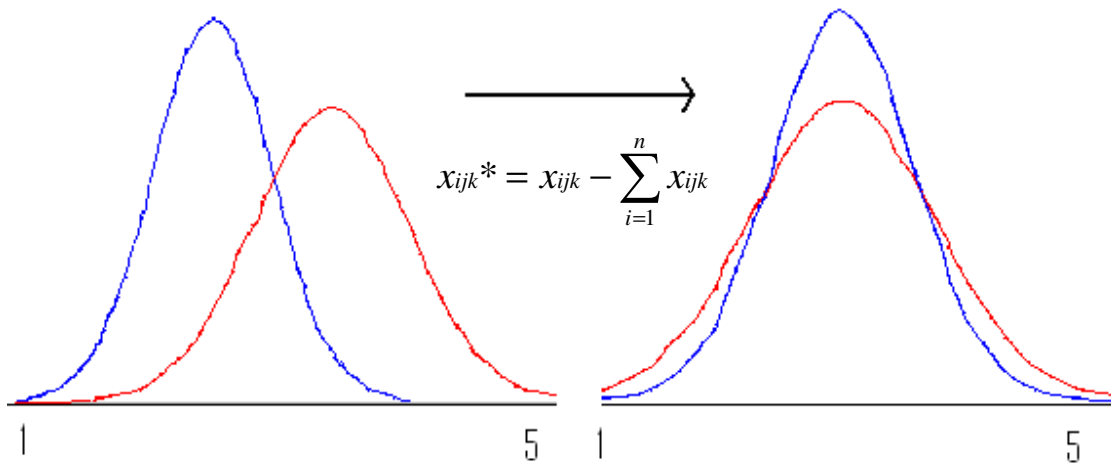
182 x^* = Adjusted response variable

183 i = Response

184 j = Survey (i.e. Northern Territory, northern Gulf or Burdekin)

185 k = Question (i.e. motivations, impediments or incentives)

186 **Figure 2:** Two distributions with different locations and variance (left) and the same
 187 **distributions re-located over the same point by subtracting the mean from each**
 188 **element (right)**



189

190 Factors were derived from the items using Principal components analysis (PCA) to group variables which
 191 were highly correlated and represent them as a new single variable (StatSoft, 2001). In doing so, PCA
 192 identifies underlying structures or latent variables using combinations of indicator variables. The variance
 193 contribution of each factor component was extracted using orthogonal axis rotation. Missing data were
 194 deleted from the relevant data analysis matrix in a pair-wise manner. Multiple models were estimated and
 195 final models were selected on the basis of parsimony and consistency of factor structure.

196 Correlation analysis was undertaken using Spearman rank order correlation. The distributions of derived
 197 factor variables were significantly non-normal and thus not conducive to the use of the Pearson R
 198 correlation coefficient (Diekhoff 1992).

199 Histograms and non-parametric (Mann-Whitney U) tests for differences in distributions are presented using
 200 original data normalised to identical scales but not centred over the same location as in the procedure above
 201 (Figure 2). Non-parametric tests were employed because of the non-continuous data obtained from
 202 responses using Likert scales and because distributions were significantly non-normal.

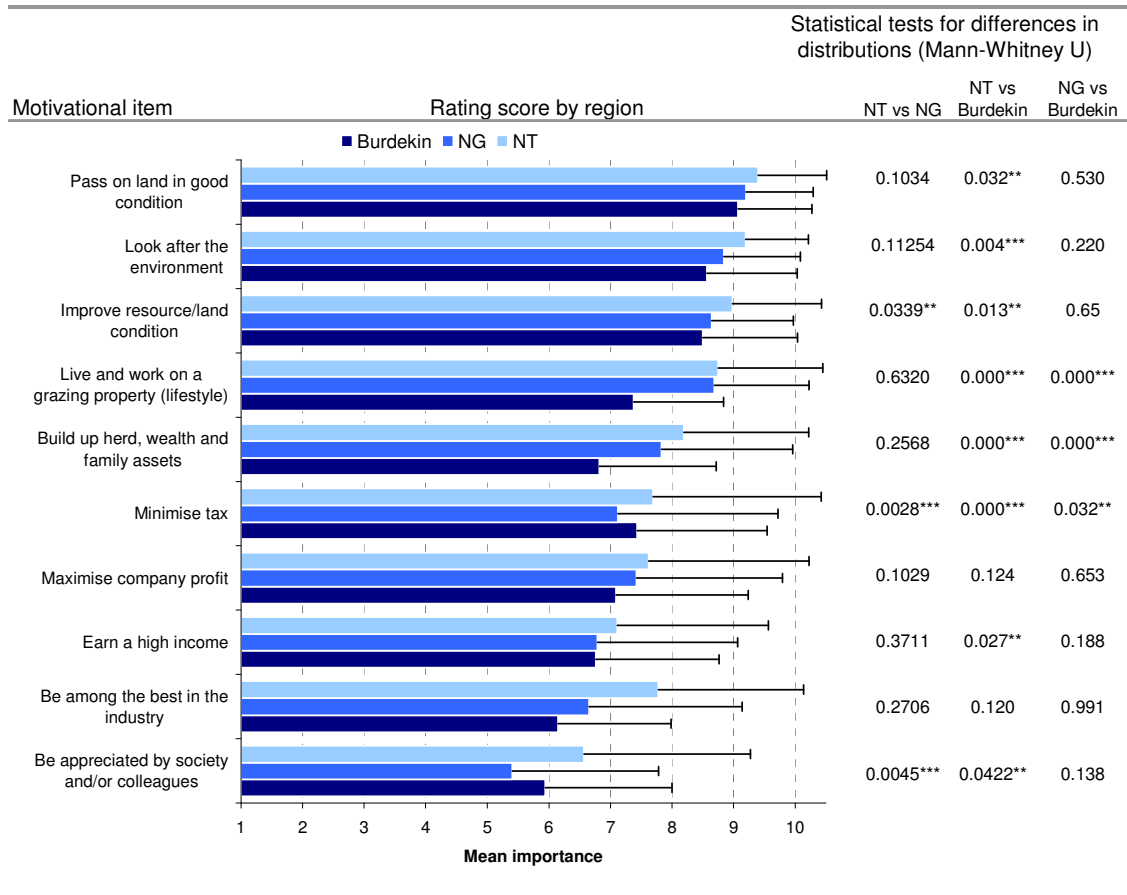
203 Data analysis was carried out in STATISTICA – a comprehensive, integrated data analysis, graphics, and
 204 database management system (StatSoft, 2001). Data management was undertaken in Microsoft Excel™.

205 **Results – Histograms and regional differences**

206 The first set of tests sought to explore whether there were differences in motivational orientation, the
207 perceived impediments to conservation and the preferred incentives amongst the sub-samples (Northern
208 Territory, Northern Gulf, and Burdekin respondents).

209 Figure 3 shows histograms of the mean and standard deviation for motivational items by region. Results are
210 presented with statistically significant differences – p-values are shown to the right of the histogram for the
211 paired differences tests.

212 **Figure 3: Means, standard deviations and statistical differences of rating scores for**
 213 **motivational items by region**



214
 215 **Note: ** = significant at 5% level of significance**

216 ***** = significant at 1% level of significance**

217 **Items sorted by overall mean value.**

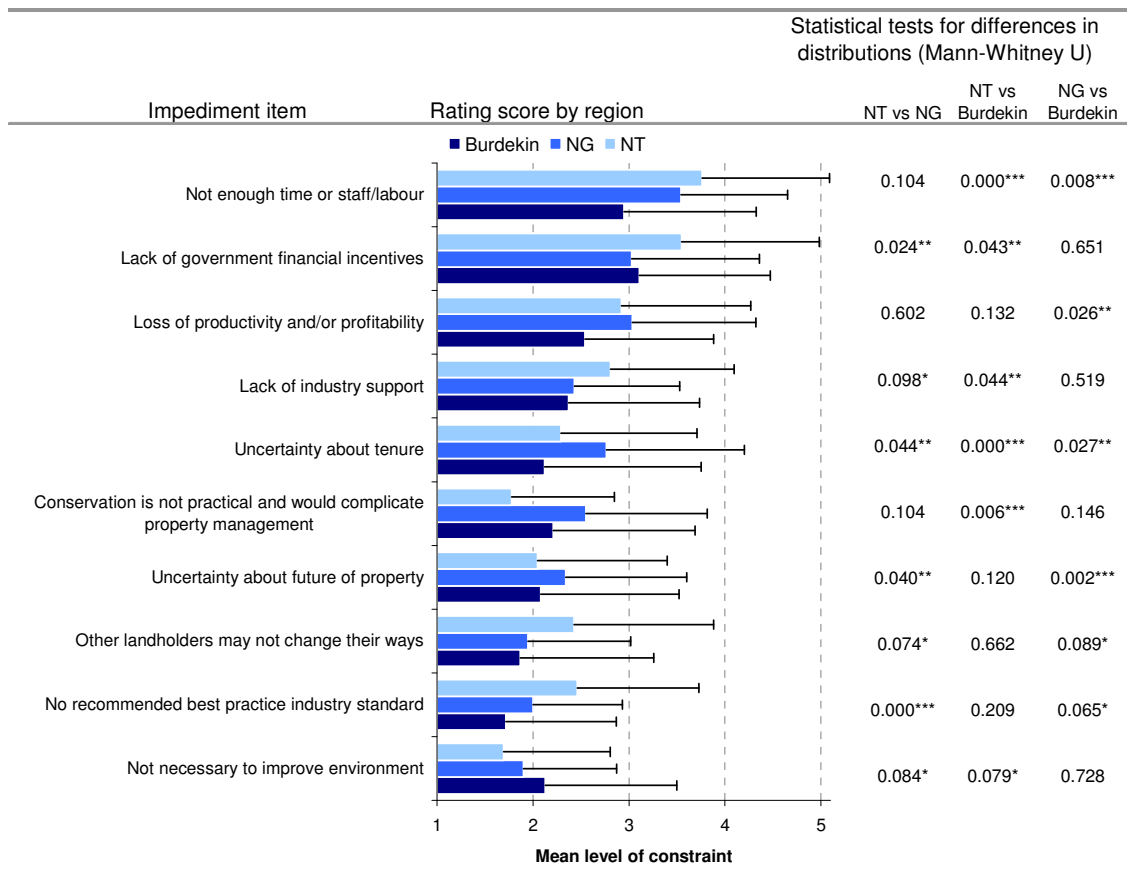
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219 Graziers from all three regions rated stewardship aspects as the top three items. Lifestyle was also rated
 220 highly by Northern Territory and Northern Gulf graziers but somewhat less by Burdekin graziers. The
 221 motivational item “Be appreciated by society and/or colleagues” was consistently rated as the item of least
 222 importance. The majority of ties in ranks (where two regions ranked an item in the same place) occurred
 223 between the Burdekin and Northern Gulf group (six ties). The Burdekin and Northern Territory groups had
 224 four ties and the Northern Gulf and Northern Territory groups had five ties. There were a total of three ties
 225 when comparing all three groups of graziers.

226 Results of the regional analysis for the importance of impediments are shown in Figure 4.

227

228 **Figure 4: Means, standard deviations and statistical differences of rating scores for**
 229 **impediment items by region**



230

231 **Note: ** = significant at 5% level of significance**

232 ***** = significant at 1% level of significance**

233 **Items sorted by overall mean value.**

234

235 The top three rated impediment items were the same across the three regions and broadly reflected
 236 productivity concerns and a lack of resources. Burdekin graziers rated the assertion that conservation
 237 practices were “not necessary to improve the environment” as the sixth most important impediment to
 238 conservation practices – this compares with Northern Territory and Northern gulf graziers who considered

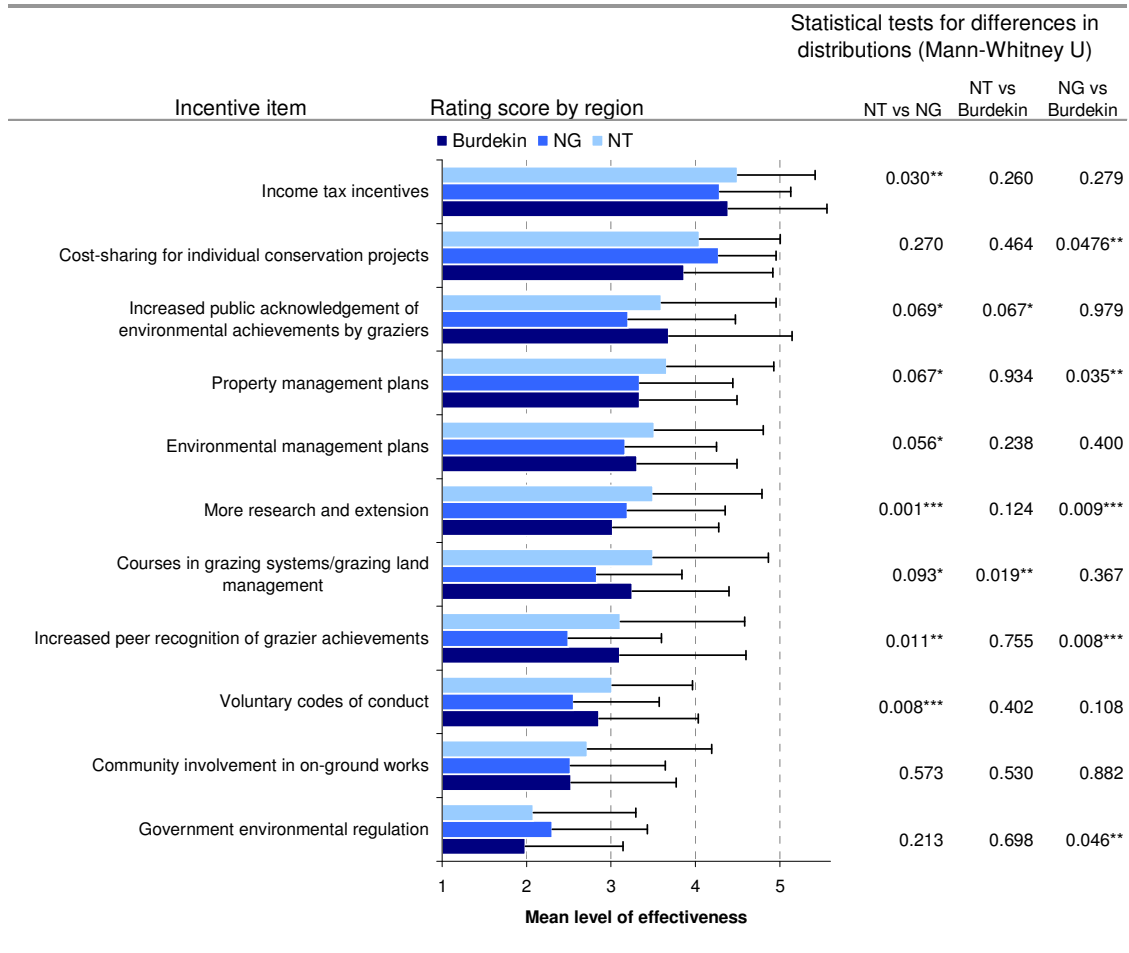
239 it the least important (10th most important). Burdekin and Northern Gulf graziers considered the practicality
240 of conservation measures and uncertainty over tenure as relatively more important than Northern Territory
241 graziers. Northern Territory graziers, on the other hand, considered the lack of a best practice industry
242 standard and the fact that other landholders may not change their ways as relatively more important than
243 the Northern Gulf and Burdekin graziers.

244 Four ties in ranking location were observed for the Burdekin and Northern Territory graziers. One tie in
245 item ranking was observed for the Burdekin and Northern Gulf comparison and two were observed for the
246 Northern Gulf and Northern Territory comparison.

247 The range of ratings from each group varied widely with at least five significant differences in the location
248 of distributions when using paired tests for differences.

249 Figure 5 presents the regional analysis of effectiveness ratings for incentives.

250 **Figure 5: Means, standard deviations and statistical differences of rating scores for incentive**
 251 **items by region**



252

253 **Note: ** = significant at 5% level of significance**

254 ***** = significant at 1% level of significance**

255 **Items sorted by overall mean value.**

256

257 Graziers from all three regions considered financially oriented incentives to be the most effective in
 258 alleviating constraints to the adoption of conservation practices on-farm. There were no major differences
 259 in the rankings between regions with the relative rankings of incentive items differing by one ranking
 260 position at most.

261 There was a high level of agreement on the ranking of incentive items for the three graziers groups. The
 262 most similarities were observed for the Burdekin and Northern Territory groups for which seven ties were

263 observed for item rankings. The least similar were the Burdekin and Northern Gulf groups with three ties in
 264 item ranking observed. For Northern Gulf and Northern Territory graziers, ties in ranking were observed
 265 for six incentive items.

266 **Results – Factor model estimation and correlation analysis**

267 The following section presents the results of PCA derived factors for the motivational orientation of
 268 graziers and their perceived impediments and preferred incentives with regards to conservation measures.

269 PCA on motivational items produced a three factor model shown in Table 2 explaining a total of 70% of
 270 the variance within the dataset for this question. There was no incidence of items loading on multiple
 271 factors for goal orientation and the factors derived were internally consistent.

272 **Table 2: Factor loading matrix of Goals: three factor model (valid n = 213)**

Motivation items	Factor 1	Factor 2	Factor 3
Be appreciated by society and/or colleagues	0.186	0.157	0.808
Be among the best in the industry	0.156	0.108	0.848
Build up herd, wealth and family assets	0.818	0.106	0.177
Earn a high income	0.855	0.060	0.141
Improve resource/land condition	0.068	0.860	0.218
Live and work on a grazing property (lifestyle)	0.299	0.549	0.013
Look after the environment	0.020	0.897	0.108
Maximise company profit	0.879	0.119	0.146
Minimise tax	0.649	0.233	0.065
Pass on land in good condition	0.191	0.882	0.084
Variance explained	2.786	2.743	1.516
Proportion of variance	0.279	0.274	0.152

274 **Goal 1: Financial and economic**

275 **Goal 2: Conservation and Lifestyle**

276 **Goal 3: Social and peer group**

277

278 The motivations factor model explains a high proportion of the variance within the dataset and is consistent
 279 with Greiner *et al.* (2009) who estimated a Principal Components Model on the Burdekin data only.

280 Financial and economic goals primarily reflect a production and profit orientation with goals including
 281 wealth and asset accumulation and profit and tax minimization. Conservation and lifestyle goals reflect

282 concerns oriented around sustainability, conservation, and lifestyle considerations. Social and peer group
283 goals reflects desires to be appreciated by society/colleagues and to be among the best graziers in the
284 industry.

285 PCA on impediment items produced a four factor model which is shown below in Table 3 which explained
286 65% of the variance within responses to this question.

287 The impediment factor “opportunity costs” represents constraints to the adoption of conservation measures
288 based on a view that they are not practical, not necessary and have adverse impacts on
289 productivity/profitability. The factor “financial and resources constraints” represents capacity constraints –
290 in terms of labour, capital and time resources, and lack of industry support. Issues with uncertainty over the
291 future of the property and tenure are described by the factor “uncertainty”. The fourth factor, “no best
292 practice and lack of integrated action”, represents a perceived lack of industry position on the matter,
293 absence of recommended best practice standards and free-rider/effectiveness issues due to neighbouring
294 landholders failing to adopt the conservation practices.

295 **Table 3: Factor loading matrix of Impediments: four factor model (valid n = 178)**

Impediment items	Factor 1	Factor 2	Factor 3	Factor 4
Conservation is not practical	0.799	0.049	0.149	0.182
Lack of government financial incentives	0.049	0.712	0.175	0.166
Lack of industry support	0.024	0.733	0.099	0.392
Loss of productivity and/or profitability	0.695	0.262	0.110	-0.032
Not enough time or staff/labour	0.166	0.706	-0.094	-0.099
Not necessary to improve environment	0.623	-0.069	0.012	0.478
No recommended best practice industry standard	0.061	0.172	0.101	0.801
Other landholders may not change their ways	0.199	0.100	0.102	0.760
Uncertainty about future of property	0.230	0.046	0.818	0.036
Uncertainty about tenure	0.016	0.074	0.858	0.156
Variance explained	1.637	1.666	1.509	1.699
Proportion of variance	0.164	0.167	0.151	0.170

296

297 **Impediment factor 1: Opportunity costs**

298 **Impediment factor 2: Financial and resources constraints**

299 **Impediment factor 3: Uncertainty**

300 **Impediment factor 4: No best practice and lack of integrated action**

301

302 Table 4 shows the five-factor incentives model resulting from PCA which explained 66% of the total

303 variance within the data.

304 **Table 4: Factor loading matrix of Preferred Incentives: five factor model (valid n = 192)**

Incentive items	Factor 1	Factor 2	Factor 3	Factor 4	Factor 5
Cost-sharing for individual conservation projects	0.146	-0.110	0.852	0.215	0.080
More research and extension	0.152	0.020	0.045	0.108	0.854
Courses in grazing systems/grazing land management	0.307	0.139	0.064	0.013	0.748
Voluntary codes of conduct	0.645	-0.081	0.150	0.058	0.181
Community involvement in on-ground works	0.398	-0.063	0.161	0.533	0.150
Property management plans	0.863	0.178	0.062	0.068	0.178
Environmental management plans	0.833	0.235	-0.007	0.158	0.159
Increased public acknowledgement of environmental achievements	0.209	0.847	0.151	-0.113	0.045
Increased peer recognition of grazier achievements	0.013	0.899	-0.010	0.160	0.101
Income tax incentives	0.050	0.350	0.774	-0.197	0.035
Government environmental regulation	0.049	0.078	-0.045	0.903	0.030
Variance explained	2.202	1.785	1.408	1.267	1.422
Proportion of variance	0.200	0.162	0.128	0.115	0.129

305
306 **Incentive factor 1: Guidelines and management plans**

307 **Incentive factor 2: Peer and public recognition**

308 **Incentive factor 3: Financial incentives**

309 **Incentive factor 4: Community involvement and regulation**

310 **Incentive factor 5: Research, extension and education**

311

312 The first incentive factor (“guidelines and management plans”) represents the application of guidelines and
 313 planning tools to alleviate constraints to conservation. The incentive factor “peer and public recognition”
 314 describes improvements in public and peer recognition as facilitating the adoption of conservation
 315 measures. Incentive factor 3 (“financial incentives”) represents items such as cost-sharing and income tax
 316 incentives. The fourth incentive factor (“community involvement and regulation”) represents the
 317 involvement of local community in farm work and the application of government environmental regulation.
 318 The last factor (“research, extension and education”) describes research, extension and education efforts as
 319 alleviating constraints to conservation.

320 Correlation analysis (Spearman rank order correlation) was undertaken to enable a description of how
 321 graziers’ goals related to perceived impediments to conservation activities and the preferred incentives to
 322 alleviate these impediments. Correlation coefficients were calculated between all three factor model
 323 combinations. Missing data were deleted in a case-wise manner. Table 5 shows the correlation between
 324 factors derived from graziers’ goals and impediment and incentive factors for respondents across the three
 325 survey regions.

326 **Table 5: Correlations between factors for graziers' goals and impediment and incentive factors**
 327 **(Spearman rank order correlation)**

Impediment factors	Motivation factors		
	Financial and economic	Conservation and lifestyle	Social and peer group
Opportunity costs	0.19**	-0.17**	-0.05
Financial and resource constraints	0.21***	0.03	0.10
Uncertainty	-0.07	-0.08	0.09
No best practice and lack of integrated action	0.14	-0.04	0.26***
Incentive factors			
Guidelines and management plans	0.24***	0.22***	0.19***
Peer and public recognition	0.24***	0.15**	0.40***
Financial incentives	0.15**	0.17***	-0.02
Community involvement and regulation	0.15**	0.12	0.21***
Research, extension and education	0.18**	0.16***	0.17**

329 **Note:** ** = significant at 5% level of significance

330 *** = significant at 1% level of significance

331

332 Graziers with strong *Financial and economic* goals considered a range of impediment types to be more
 333 important in terms of the level of constraint they placed on the adoption of conservation practices than
 334 graziers with strong *Conservation and lifestyle* or *Social and peer group* goals. Specifically, graziers with
 335 strong *Financial and economic* goals were significantly positively correlated with rating *Opportunity costs*
 336 and *Financial and resources* constraints highly in terms of their importance as impediments to the adoption
 337 of conservation practices. Graziers with strong *Social and peer group* goals were significantly positively
 338 correlated with rating the impediment factor *No best practice and lack of integrated action* highly as a
 339 constraint to adoption of conservation measures. Graziers with strong *Conservation and lifestyle* goals were
 340 less likely to rate *Opportunity costs* as significant impediments to the adoption of conservation measures on
 341 farm.

342 The examination of relationships between graziers goals and incentive factors showed that graziers with
343 strong *Financial and economic* goals were significantly positively correlated with the whole range of
344 incentive types. Graziers with strong *Social and peer group* goals were also significantly correlated with a
345 wide range of incentive types but not *Financial incentives*. Those graziers with strong *Conservation and*
346 *lifestyle* goals were positively associated with all types of incentives other than *Community involvement and*
347 *regulation* type incentives. The positive correlation between *Conservation and lifestyle* goals and *Financial*
348 *incentives* was greater than that between *Financial and economic* goals and *Financial incentives*. The
349 strongest correlation between incentive factors and graziers goals is that between *Social and peer group*
350 goals and the incentive factor *Peer and public recognition*.

351 **Discussion**

352 This research utilised a combination of three sets of data obtained from graziers across the tropical
353 savannas of Australia. Previous research (e.g. Greiner *et al.* 2009) was limited by sample size and was thus
354 considered to be exploratory in nature. The research builds on that of Greiner *et al.* (2009) who examined
355 one of the three datasets (Burdekin) included in this paper.

356 The opportunity to combine three datasets was the result of three similar surveys in the Burdekin (Greiner
357 *et al.* 2007), Northern Gulf (Greiner and Miller 2008) and the Northern Territory (Greiner *et al.* 2008). The
358 surveys contained identical questions on the importance of motivations to graziers, the perceived
359 importance of a range of impediments acting as constraints to the adoption of conservation practices, and
360 the perceived effectiveness of incentives in alleviating constraints. The total sample size available for
361 analysis in this paper was 224.

362 Two issues were identified with combining the datasets. Firstly the rating scales were not identical for one
363 of the questions (perceived importance of impediments). This issue was dealt with by halving the scores
364 obtained for Burdekin respondents to ensure all responses were on a scale from 1 (“Not an impediment”) to
365 5 (“Fundamental/major impediment”). Secondly, responses were provided on an ordinal scale which could
366 have been influenced differentially by survey scope, positioning of questions with the surveys and inclusion

367 of different items within each question. This was dealt with by applying a correction factor that centered the
368 distributions of responses over the same location.

369 Statistical analysis of the dataset initially involved testing for significant differences between the regions in
370 responses to questions using non-parametric (Mann-Whitney U) tests. This was followed by the application
371 of PCA to all responses for the questions to derive factors of strongly correlated groups of items. The
372 factors for each question (motivations, impediments and incentives) were then tested for statistically
373 significant correlations using Spearman's rank order coefficient, a non-parametric alternative to Pearson's
374 R.

375 The key drivers for land management decisions have been identified alternatively as economic
376 considerations (e.g. MacLeod and McIvor 2008) or a combination of personal and economic considerations
377 (e.g. Greiner *et al.* 2009, Reeson 2008). Personal considerations have been modeled as graziers goals in a
378 number of studies (Greiner *et al.* 2009; Greiner and Miller 2008; Maybery *et al.* 2005). Factors describing
379 goals of graziers which were identified in this research are entirely consistent with those identified by
380 Greiner *et al.* (2009) and are broadly consistent with those identified by Maybery *et al.* (2005).

381 In two of the studies which have described the goals of graziers (Greiner *et al.* 2009; Greiner and Miller
382 2008) correlations between motivation factors (graziers goals) and impediments and incentives to
383 conservation were estimated to observe relationships between these variables and their relevance to the
384 adoption of conservation practices. Greiner *et al.* (2009) showed that graziers with strong conservation and
385 lifestyle goals were more likely to adopt a range of conservation practices than graziers with strong
386 financial and economic or social goals. In these previous studies (Greiner *et al.* 2009; Greiner and Miller
387 2008) sample sizes limited the interpretability of results. This research builds on these previous works to
388 provide a more detailed examination of the linkages between graziers goals, the impediments to
389 conservation and incentives to alleviate impediments.

390 Economic considerations are important in graziers' decisions on whether to adopt a conservation practice
391 (Reeson 2008; Pannell *et al.* 2006; Greiner and Miller 2008). However it has been shown that these
392 extrinsic constraints can be balanced and even overwhelmed by intrinsic motivations or incentives such as a
393 desire to carry out environmental investments (Reeson 2008). This can result in private investments in

394 environmentally beneficial practices beyond a level that would be considered normal for a public good
395 (Reeson 2008). The results from this and previous research (e.g. Austin *et al.* 1998, Greiner *et al.* 2009)
396 show that farmers attach great importance to the conservation and lifestyle aspects of livestock production
397 – i.e. there likely exists intrinsic motivations to manage productive land in an environmentally sustainable
398 manner amongst the graziers of the tropical savannas.

399 We can now propose a decision framework that is utilized by graziers with diverse motivations. It suggests
400 that the impediments to conservation are judged subjectively and thus viewed through a lens coloured by
401 the motivational orientation of a particular decision maker. That is, the extrinsic constraints to adoption
402 described by Reeson (2008) are not independent of the intrinsic motivations of graziers. Their importance
403 in terms of adoption of conservation practices is a function of the motivational orientation of the decision
404 maker/s and thus beliefs surrounding the characteristics of a particular conservation scheme are subjective.
405 Pannell *et al.* (2006) describe subjectivity with respect to a farmers perspective on the characteristics of a
406 conservation scheme is due to a lack of knowledge, learning or uncertainty and also to farmers goal
407 orientation.

408 The results of this research support those derived in previous research by Greiner *et al.* (2009) and Greiner
409 and Miller (2008). Specifically:

- 410 • Graziers with financial and economic goals were more likely to consider a wide range of
411 impediments to be important constraints to the adoption of conservation measures relative to
412 graziers with either conservation and lifestyle or social and peer group goals
- 413 • Graziers with financial and economic goals were positively associated with ranking the entire
414 range of incentives as effective.
- 415 • Graziers with conservation and lifestyle goals were not correlated with the rating of impediment
416 items in terms of their importance as constraints to the adoption of conservation practices at any
417 standard level of statistical significance
- 418 • Graziers with conservation and lifestyle goals considered guidelines and management plans and
419 research, extension and education to be effective incentives.

420 Examination of the regional differences showed that, in general, the motivational orientation and perception
421 of impediments/incentives with regard to conservation practices is consistent across the tropical savannas.
422 One curious result however is the relatively high importance that Burdekin graziers gave to the comment
423 “[conservation measures are] not necessary to improve the environment” compared with Northern Territory
424 and Northern Gulf graziers who rated it as the least important impediment consideration. Using information
425 from the National Land and Water Resources Audit (online at <http://www.anra.gov.au/mapmaker>;
426 accessed 18/02/2009) it can be seen that the environmental condition of the Burdekin catchment is
427 consistently worse than that of the Northern Territory and the Northern Gulf. This would suggest that
428 conservation measures *are* important to improve the environment in the Burdekin catchment but that many
429 Burdekin landholders are unable to recognize degradation.

430 Pannell *et al.* (2006) describe the importance of learning and knowledge in the adoption of conservation
431 practices by rural landholders. The results from this research provide support for the importance of learning
432 and knowledge in the adoption process as it is a highly rated incentive, in terms of effectiveness, for
433 graziers motivated by any of the goals described above.

434 Beyond the role of individual factors in the adoption of conservation practices, this research shows that a
435 diversity of impediments constrains adoption decisions and that the provision of a range of incentives may
436 alleviate these constraints. However these factors cannot be viewed as characteristics of a conservation
437 scheme or region that are independent of the relevant actors within it – they are affected by subjective
438 perceptions on their relative importance (for impediments) or relative effectiveness (for incentives).
439 Hajkowicz (2009) described community landcare groups as suffering from “burnout” – this may be
440 explained as farmers with *Conservation and lifestyle goals* not being provided with sufficient guidance,
441 knowledge or learning experiences which this research shows to be important incentive factors for this
442 group. Even graziers with *Financial and economic goals* may require more than mere financial assistance –
443 they were more strongly associated with rating *Guidelines and management plans* and *Peer and public*
444 *recognition* as effective incentives than *Financial incentives*. Additionally, graziers with *Social and peer*
445 *group* goals may require more efforts to promote a favourable public opinion of graziers conservation
446 efforts in the media to undertake increased levels of conservation activity. Of all of the types of incentive
447 types available to graziers, those with strong motivations of any type were significantly positively

448 correlated with rating *Guidelines and management plans*, *Peer and public recognition*, and *Research*,
449 *extension and education* as effective incentives.

450 **Conclusions**

451 This paper presents empirical research from the combination of datasets from three separate surveys of
452 graziers within the tropical savannas in Australia. The surveys had broadly different objectives but all were
453 carried out with an intention of examining the relationships between graziers goals, the importance of
454 impediments and the effectiveness of incentives with reference to the adoption of conservation practices.

455 The research set out to test the hypothesis that graziers goals affected the adoption of conservation practices
456 through creating different, subjective views on:

- 457 1. the importance of impediments as constraints to adopting conservation practices on farm
- 458 2. the effectiveness of incentives in alleviating constraints to the adoption of conservation practices

459 The results from this research suggest that future conservation schemes should be designed with
460 consideration to the different goals of graziers and the way these goals affect the perception on the
461 importance of impediments to conservation and the effectiveness of incentives.

462 Of particular note from these results is that graziers with financial and economic goals did not explicitly
463 prefer financial incentives – rather they considered the whole range of incentives to be effective in
464 facilitating the adoption of conservation practices. All respondents to these surveys were highly motivated
465 graziers – irrespective of their predominant type of motivation. Graziers of any motivation were
466 significantly positively correlated with rating *Guidelines and management plans*, *Peer and public*
467 *recognition*, and *Research, extension and education* as effective incentives to alleviate constraints in the
468 adoption of conservation practices.

469 This research shows that graziers are not a homogenous group with a purely objective understanding of the
470 constraints they face to adoption of conservation measures on-farm. Graziers across Australia likely have
471 heterogeneous motivations which influence their perception of the constraints to adoption of conservation
472 measures and the effectiveness of incentives to alleviate constraints. The significance of these motivations

473 in influencing subjective judgements on the influence of constraints and incentives suggests conservation
474 schemes should be developed with a high level of input from the target grazier population. Grazier input
475 should facilitate the elicitation of subjective views of constraints to adoption of conservation practices and
476 the preferred incentives to alleviate these constraints.

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