Sense of Place and the Provision of Environmental Services

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Abstract. This paper studies the decision of managers of natural resources endowed with a Sense of Place in a static game. Such individuals face a trade-off between devoting fewer resources to the provision of an environmental service while losing their identification and attachment to their physical surroundings. Sustainable management of natural resources can be achieved as Sense of Place becomes salient to the manager. Moreover, if the underlying equilibrium of the game is characterized by strictly positive contributions, individuals will hold a certain Sense of Place in order to maximize their payoffs. Policymakers should be careful since each environmental policy prescription has a different effect on agents' Sense of Place with consequences on their welfare and sustainable management.

1. Introduction

What begins as undifferentiated space becomes place as we get to know it better and endow it with value.
(Tuan 1977, p. 6)

Natural resources management lies at the top of environmental authorities' agenda because of the alarming rates of depletion of such resources and the relevance of the wide array of environmental services they provide[1]. These environmental services have a positive effect on livelihoods, health risks, and economic development of individuals[2].

Most natural resources are commonly considered common-pool resources (CPR's) and the environmental services they provide public goods, because of the difficulty of excluding potential users from its benefits. The problem resides in the individual incentives to free ride from the provision activities of others. This is reflected in a straightforward and pessimistic fashion in Hardin's *tragedy of the commons* (1968), Olson's *impossibility of collective action* argument (1965) and the Prisoner's Dilemma (PD).

It is now widely accepted that such gloomy standpoints need not be true because: individuals respond to incentives and they do not care solely about their own payoffs; individuals are not isolated and they communicate and are capable of learning; not all commons are open-accessed and they are subject to a set of rules and institutions defined by its users; and individuals hold a common social identity[3].

On account of the experimental evidence which contradicted the unenthusiastic theoretical predictions, different explanations to why individuals cooperate in public

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[1] Such services include: consumption goods and production inputs; regulation of climate and air and water quality; cultural services (e.g. recreation and aesthetic enjoyment); support to other ecosystem services (e.g. soil formation); and provision of a living (e.g. agriculture, fishing, etc.).

[2] Apart from contributing to key sectors in developing countries like tourism, the provision of environmental services improves the resilience of (poor) people to natural disasters and health risks, (UNEP, 2009).

[3] To be fair, although Hardin and Olson's models as well as the PD are far from being the norm, they remain valid in some real life situations.

good games have been put forward. With respect to selective incentives, the effects of rewards and punishments (Fehr & Gächter, 2000; Andreoni *et al*, 2003) and its combination with covenants (Ostrom *et al*, 1992) have been analysed. On the social preferences stance: the *warm-glow* (Andreoni, 1989), fairness (Rabin, 1993), inequity aversion (Fehr & Schmidt, 1999), and reciprocity (Falk & Fischbacher, 2006). Communication effects on cooperation are discussed in Isaac & Walker (1988) and Ostrom & Walker (1991). In regard to the impact of rule configuration on the structure of CPR games, the seminal work of Ostrom *et al* (1994) provides a detailed analysis. Finally, in-group favouritism and cooperation is studied in Ellemers *et al* (1997) and Hewstone *et al* (2002).

Sense of Place is a concept originated in the environmental psychology literature which describes the meaning attached to a spatial setting by an individual or a group and which encompasses a Place Attachment and a Place Identity (Jorgensen & Stedman, 2001). It displays features not acknowledged by the previous studies and so it promises to deliver interesting insights regarding the individuals' management of their physical surroundings and in consequence, on their natural resources[4].

Place Attachment refers to the individual's level of commitment to a place expressed by social involvement and subjective feelings (Gerson *et al*, 1977). Hidalgo & Hernandez (2001) stress that it is the affective and positive bond that people establish with specific settings. Mitchell *et al* (1993) define Place Attachment in terms of ecological stewardship and emotional responses to nature which is measured in terms of attitudes towards the setting and level of concern about how a place is managed. Hence, Place Attachment suggests an active stance for place protective measures through which individuals are willing to fight for places central to their identities and that they perceive as being in less-than optimal conditions (Stedman, 2002).

The idea of Place Identity was established by Proshansky *et al* (1983) as a sub-concept of the Social Identity Theory's self-identity, in a sense that the evolving processes between place and identity are the same as between groups and identity. Thus, places become the providers of sense-of-self meanings through the significance of its physical attributes, i.e. individuals acquire an identity through their places.

It has been found that voluntary cooperation is more common in individuals with a pro-social attitude and high Place Identity than in those with a pro-self attitude and low Place Identity (Bonaiuto *et al*, 2008). Moreover, highly interconnected communities which share a strong social sense and Place Identity will tend to support environmentally sustainable attitudes and behaviours more than other type of communities (Uzzell *et al*, 2002).

Thus, since the cognitions involved in Sense of Place become influential to the production of responses to environmental policies, it becomes a useful tool to assess how individuals react to human-induced impacts and changes to the natural environment and to evaluate alterations in the welfare of people in the face of an environmental threat or a policy which modifies the environment settings of a certain place.

[4] Stokols and Shumaker (1981) consider that the perceived strength of association between the individual and its place through which the agent compares the current outcomes product of its chosen place to the ones provided by an alternative is a component of Sense of Place as well.

What are then the theoretical consequences of considering individuals endowed with Sense of Place when facing the decision to contribute to the provision of an environmental service? Furthermore, will individuals decide to display a Sense of Place when confronted to a decision process which involves the provision of an environmental service? What policy implications surge, particularly with regard to incentive-based mechanisms?

This paper is organized as follows. In the next section, a public good game where players are endowed with a Sense of Place is presented and the optimal selection of such Sense of Place is discussed. Section 3 introduces an incentive-based mechanism into the game and its impact on players' contribution and Sense of Place is analysed. In section 4, policy implications of considering Sense of Place-endowed individuals are drawn with respect to some commonly used policy prescriptions. Section 5 contains concluding comments and the endogenous Sense of Place best response is found in the Appendix.

2. A Sense of Place game

The departure point is the standard public good (PG) game where a set of $N = \{1,...,n\}$ individuals decide how much of a private good they wish to contribute for the provision of a public good. The payoff function for player i is denoted by:

$$\pi_i(c_i, c_{-i}) = f\left(1 - c_i\right) + g\left(c_i + \sum_{j \neq i} c_j\right) \tag{1}$$

Where c_i is the contribution of player i and f and g denote the marginal return to the private and public good respectively[5]. Assume that the social dilemma condition holds, i.e.: $Ng > f > g$. Hence $c_i^* = 0$, and the usual result of no provision of the public good follows.

Now assume that players display two features not captured by this traditional model: they exhibit Place Attachment and they hold a Place Identity. Thus, their commitment to their place would compel them to contribute to the provision of a public good which benefits the residents of such place, i.e. the more Place Attachment players have, the higher c_i should be. As a consequence, their sense-of-self through physical characteristics of the place is enhanced, i.e. their Place Identity becomes stronger.

It is proposed that the utility function of an individual who holds a Sense of Place is defined by:

$$U_i = \pi_i(c_i, c_{-i}) + \psi_i\left(c_i, c_{-i}\right) \tag{2}$$

Expression (2) is composed by two different kinds of payoffs. The first term captures the standard PG game and henceforth would be referred to as the material payoffs of

[5] The endowment has been normalised to 1. Therefore $c_i \in [0,1]$.

the game. The last term constitutes the psychological payoffs of the game and they are given by:

$$\psi_i\left(c_i, c_{-i}\right) = Z_i\left(c_i, c_{-i}\right) - \tilde{Z} \tag{3}$$

Thus, the psychological payoffs are defined as a loss function that measures the perceived distance between the current set of attributes of the place Z_i, to i's prototypical place $\tilde{Z}$, where $\tilde{Z} \leq 1$ by assumption. Such parameter can be understood as a norm or an *ideal place*[6]. The current set of characteristics of the place is defined in turn as:

$$Z_i\left(c_i, c_{-i}\right) = \tilde{Z}\left(\frac{c_i + \sum_{j \neq i} c_j}{N}\right) \tag{4}$$

As a consequence of this Place Identity loss feature and since players are rational, they would minimize the perceived distance between the current state of characteristics of their place and its norm, i.e., they would minimize Place Identity loss in order to reduce the cognitive costs associated with a low contribution. So, place-committed individuals (high Place Attachment) will tend to have a strong Place Identity (low Place Identity loss) because of their high contribution to the provision of a public good.

Nash Equilibria in a Continuous Choice Setup

Assume players' actions are a continuum within the space $[0,1]$. So they can contribute to the public good a fraction of their endowment. In this case, the problem that player i faces is:

$$\max_{0 \leq c_i \leq 1} U_i(c_i, c_{-i}) = \gamma \pi_i\left(c_i, c_{-i}\right) + \left(1-\gamma\right)\psi_i\left(c_i, c_{-i}\right) \tag{5}$$

Where γ and $1-\gamma$ denote the relative weights of the material and psychological payoffs in the utility function. After some pertinent substitutions this translates into:

$$\max_{0 \leq c_i \leq 1} U_i(c_i, c_{-i}) = \gamma\left(f\left(1-c_i\right) + g\left(c_i + \sum_{j \neq i} c_j\right)\right) + \left(1-\gamma\right)\left(h\left(\frac{c_i + \sum_{j \neq i} c_j}{N} - 1\right)\right) \tag{6}$$

[6] Notice that the current set of characteristics of the place is affected by the actions of all players in the game and that the ideal place is exogenous and it is not affected by players' actions. This is of course a rather strong assumption since we should expect this ideal place to be a concept that evolves in time but it will keep the model tractable in order to obtain results regarding other parameters of interest.

Where h denotes i's marginal return from investing in his Sense of Place. The optimal contribution for this problem is found setting: $U_i'(c_i) = 0$[7]. Then we get that the best response is:

a) $c_i^* = 0 \quad \Leftrightarrow \quad f - g > \frac{1-\gamma}{\gamma}\frac{h}{N}$.

b) $c_i^* = 1 \quad \Leftrightarrow \quad f - g \leq \frac{1-\gamma}{\gamma}\frac{h}{N}$.

Player i will contribute to the provision of the public good if the marginal return of investing in his Sense of Place, exceeds his net marginal gain in terms of material payoffs. In other words, i will contribute when his Sense of Place is salient, i.e. when $\frac{1-\gamma}{\gamma}$ is high enough.

So far it has been considered that players place a fixed weight to their material and psychological payoffs. The claim made above was that cooperation can be sustained in a PG game when players hold a certain Sense of Place, or alternatively when they place at least a certain weight to their psychological payoffs. The question then becomes: is the weight attached to psychological payoffs actually different from zero when individuals play this *Sense of Place game*?

To answer this question consider the case where "someone" chooses the weights placed to each payoff type, or in other words, consider that the selection of γ is endogenous. Then, suppose it is nature which chooses this relative weight so as to maximize the sum of payoffs across players at the Nash Equilibrium. The result of such selection would give us insight on whether players are actually placing a positive weight to the psychological payoffs when confronted to play the *Sense of Place game*.

So, once players have been confronted with the decision process of (5) and they have computed their optimal contribution, the relevant problem becomes:

$$\max_{0\leq\gamma\leq 1} \sum_{i=1}^{n} U_i\left(c_i^*(\gamma), c_{-i}^*(\gamma)\right) \tag{7}$$

Since the game is symmetric, $c_1^* = ... = c_i^* = ... = c_n^*$. Therefore, (7) turns into:

$$\max_{0\leq\gamma\leq 1} \gamma\left(Nf\left(1-c_i^*(\gamma)\right) + Ng\left(c_i^*(\gamma)\right)\right) + N(1-\gamma)\left(h\left(c_i^*(\gamma)-1\right)\right) \tag{8}$$

The optimal material payoffs weight is $\gamma^* \neq 1 \quad \forall c_i^* > 0$. The following Lemma describes it in words.

[7] In this formulation U_i is strictly concave and twice differentiable $\forall c_i < 1$ and $\gamma \neq 0$.

Lemma *When at the Nash Equilibrium individuals contribute a positive amount of their endowments to the provision of the public good, nature places a positive weight on individuals' psychological payoffs, i.e. nature provides individuals with a Sense of Place.*

The proof of the lemma follows from the conditions a) and b) and I argue by contradiction.

Proof. Suppose not. Then, when nature chooses the optimal material payoffs weight that maximizes the sum of payoffs across players at the Nash Equilibrium of the game $c_i^*(\gamma)=1$ it chooses $\gamma^*=1$, i.e. it selects a null weight on psychological payoffs. However, remember that $c_i^*(\gamma)=1$ is the Nash Equilibrium of the game if and only if $f-g\le\frac{1-\gamma}{\gamma}\frac{h}{N}$, and if $\gamma^*=1$ the condition is then $f\le g$. Yet this is not true by the social dilemma condition. Hence, $c_i^*(\gamma)=1$ is not the Nash Equilibrium of the game. Q.E.D.

Intuitively, if at the Nash Equilibrium of the game players contribute a positive amount of their endowments to the provision of the public good, they will not just receive material benefits from such provision, but also cognitive benefits in terms of building a Sense of Place. Hence, players will be better-off if they do not neglect such benefits by placing a positive weight on their psychological payoffs. Alternatively, at the Nash Equilibrium of the game, contributing individuals will bring forth their Sense of Place.

A non-linear example

To disentangle de features of deeming players with a Sense of Place, the following functional example is proposed. The problem faced by player i is[8]:

$$\max_{0\le c_i\le 1}U_i(c_i,c_{-i})=\gamma\left(\sqrt{1-c_i}+\frac{\alpha}{N}\left(c_i+\sum_{j\neq i}c_j\right)\right)+(1-\gamma)\left(\frac{c_i+\sum_{j\neq i}c_j}{N}-1\right) \tag{9}$$

The optimal contribution for player i is found setting: $U_i'(c_i)=0$. The best response for player i is[9]:

$$c_i^*=\frac{\gamma^2\left(\alpha^2-2\alpha+1-\frac{1}{4}N^2\right)+\gamma(2\alpha-2)+1}{(\alpha\gamma+1-\gamma)^2} \tag{10}$$

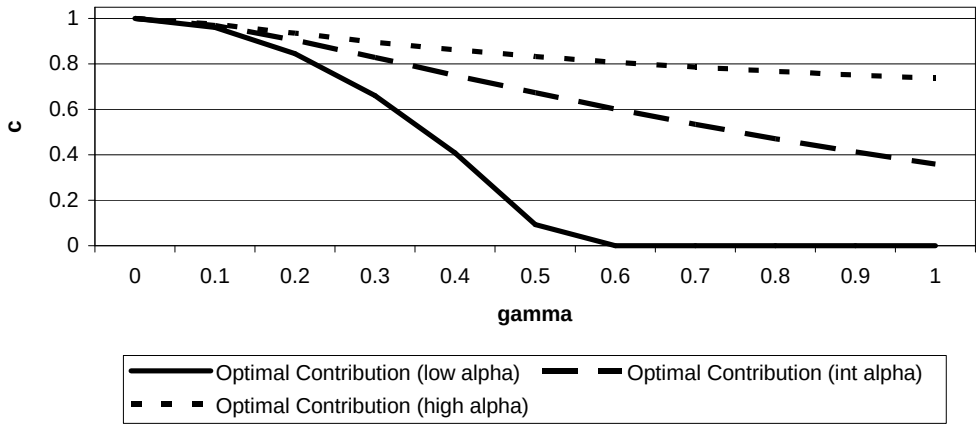
[8] The set of assumptions made are: $f=h=1$, $g=\frac{\alpha}{N}$, and $1<\alpha<N$.

[9] Condition (10) holds only for certain values of the material payoffs weight. More precisely: $c_i^*=0 \Leftrightarrow \gamma\ge\frac{1}{1+\frac{N}{2}-\alpha}$.

The optimal contribution depends on: the relative weight placed on material payoffs (γ), the marginal return on the public good (α), and the number of players in the game (N). Moreover, we have that: $c_i^* = c_i^*(\gamma, \alpha, N)$.
$\underset{-}{} \quad \underset{+}{} \quad \underset{-}{}$

Graph 1 shows that for a given number of players in the game and a marginal return of the public good, increasing the relevance of Sense of Place (or the relative weight of the psychological payoffs) increases the optimal contribution of player i[10]. Observe that this positive relationship is stronger the lower the marginal return of the public good is. Additionally, note that when such return is at its lowest, despite their holding of a weak Sense of Place, individuals' optimal contribution is zero. Finally, note that if individuals' Sense of Place is strong, the change in the marginal return of the public good makes little difference to the optimal contribution of the players, which is already very high.

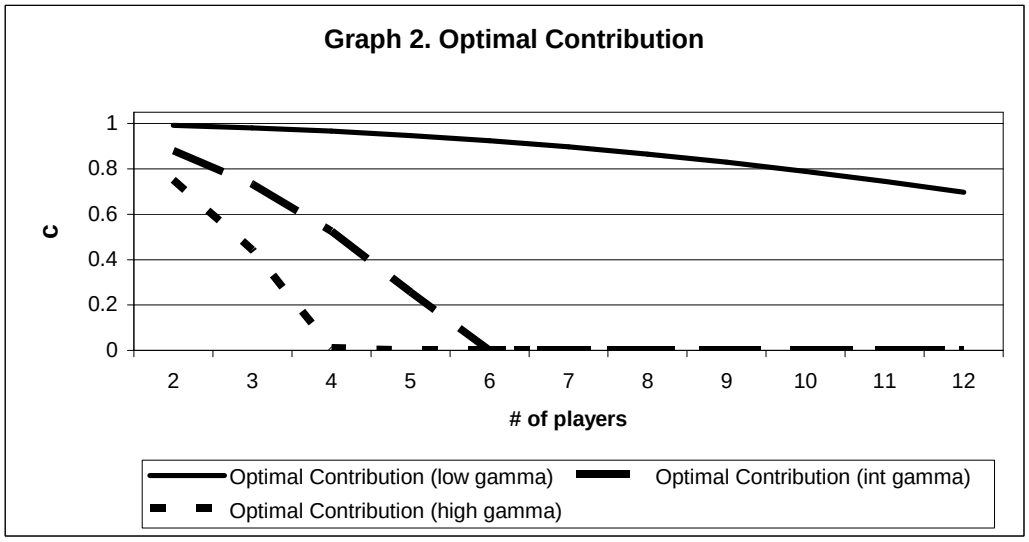
Graph 1. Optimal Contribution small groups



Graph 2 shows that for a given marginal return of the public good and a relative weight on the material payoffs, increasing the number of players in the game decreases the optimal contribution[11]. The intuition for this result is that by construction $c_i^* < 1 \Rightarrow Z_i \neq \tilde{Z}$, which means there is a positive cognitive cost associated to Place Identity loss. The more participants in the game, the more does Place Identity erode and so, optimal contribution falls.

Furthermore, when Sense of Place is not strong, the optimal contribution is zero for small groups, and in contrast, when Sense of Place is strong the public good can be provided even in large groups.

[10] Group sizes are defined as in Isaac & Walker (1988), i.e. small groups: $N = 4$, and large groups: $N = 10$. The different values for small groups' α are: 1.1, 2.5, and 3.99.
[11] The marginal return of the public good was set at $\alpha = 1.99$.

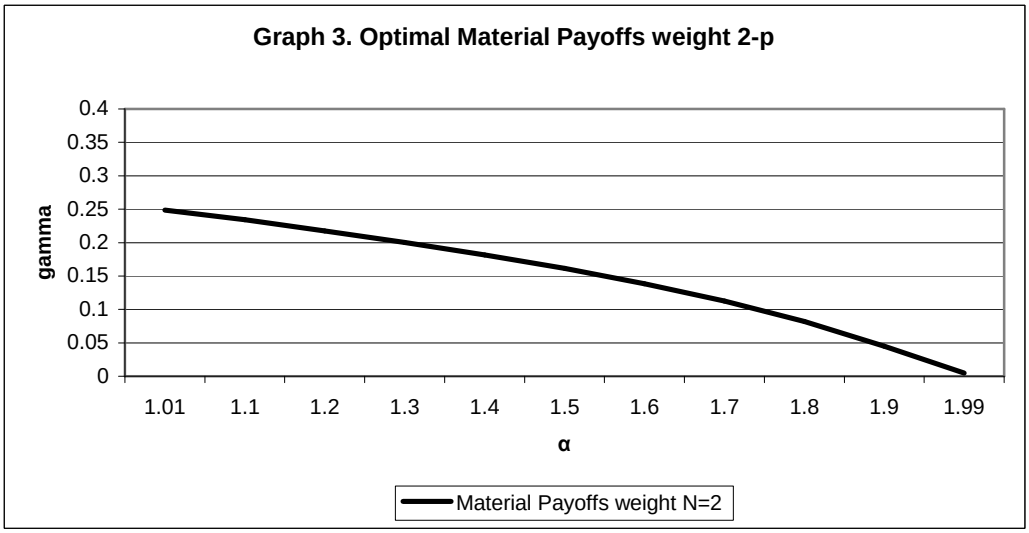


Finally, when the number of players in the game increases, Sense of Place relevance needs to be stronger for the public good to be provided. In the limit material payoffs are completely neglected or: $\lim_{N\to\infty} 1-\gamma = 1$[12].

Now, if nature again chooses the relative weight that maximizes the sum of payoffs across players at the Nash Equilibrium, the problem becomes:

$$\max_{0\le\gamma\le 1} \gamma N\left(\sqrt{1-c_i^*}+\alpha\left(c_i^*\right)\right)+N\left(1-\gamma\right)\left(c_i^*-1\right) \tag{11}$$

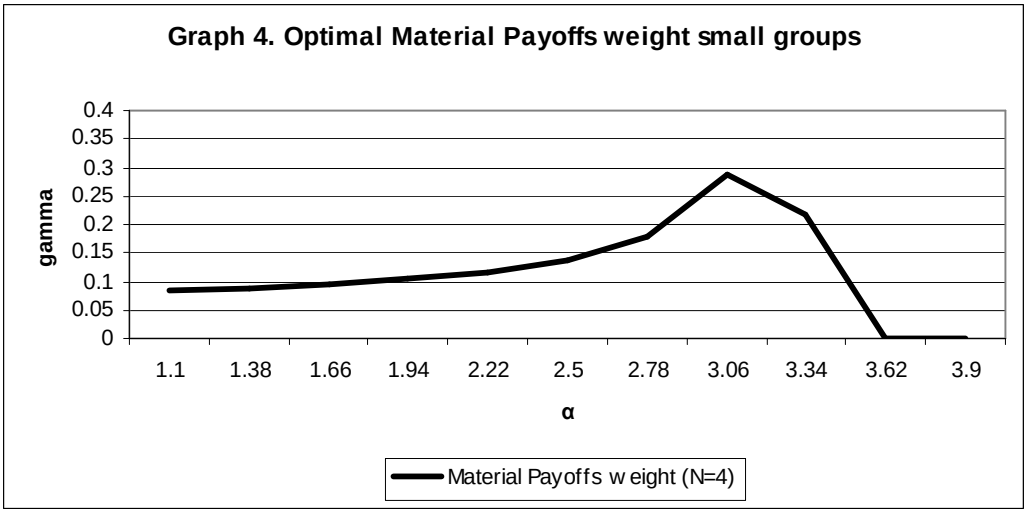
The solution to this problem is $\gamma^*\left(\alpha,N\right)\neq 1$[13]. Graphs 3,4, and 5 show the relation between the marginal return of the public good and the optimal psychological payoffs weight for different group sizes.

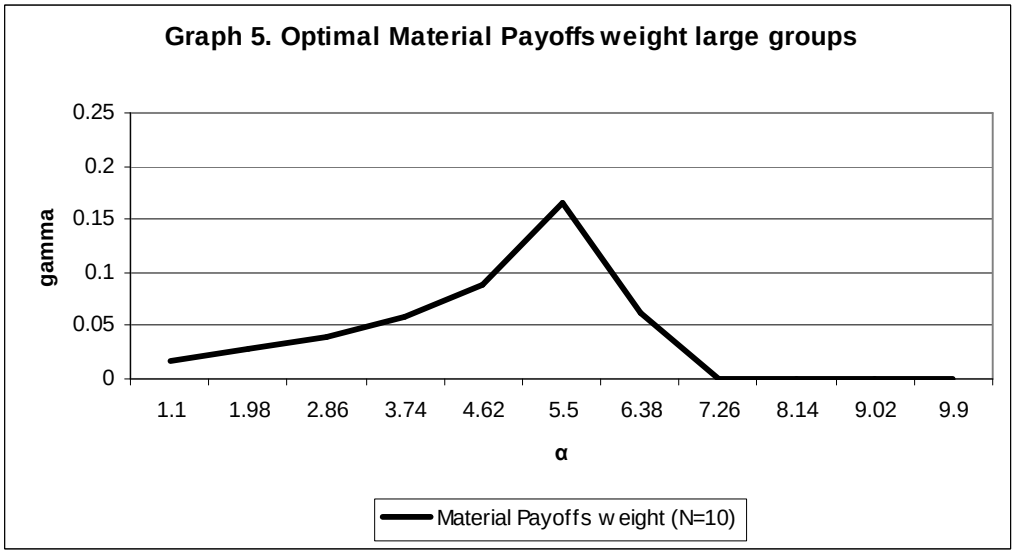


[12] See footnote 5 for the relevant condition on the material payoffs weight to obtain a strictly positive optimal contribution to the public good.
[13] The actual expression is found in the Appendix.

In the *2*-player case, increasing the marginal return of the public good increases the optimal psychological payoffs weight. Apparently, increasing the benefits delivered by the provision of additional units of the public good enhances Sense of Place.

However, as graph 4 shows, the positive relation between the marginal return of the public good and the optimal psychological payoffs weight no longer holds for all values of α when we move from the *2*-player case to small groups. Up to intermediate-high levels of α, the relationship is reversed, i.e. increasing the marginal return to public good decreases the optimal psychological payoffs weight. Yet, from a very high marginal return of the public good, the positive relationship appreciated in the *2*-player case is maintained[14].





As depicted in graph 5, the relationship between the marginal return of the public good and the optimal psychological payoffs weight in large groups is similar to the

[14] Such value is $\alpha = 3.06$.

one observed in small groups. Yet, in the former, the relationship is reversed for a lower marginal return per capita (MRPC)[15].

In conclusion, whereas in the *2*-player game, the relationship between the marginal return of the public good and the optimal psychological payoffs weight is unambiguously positive, in small and large groups we find different relationships across three zones of α :

I. $(\alpha_{\min}, \underline{\alpha})$ where increasing α decreases $1-\gamma$.

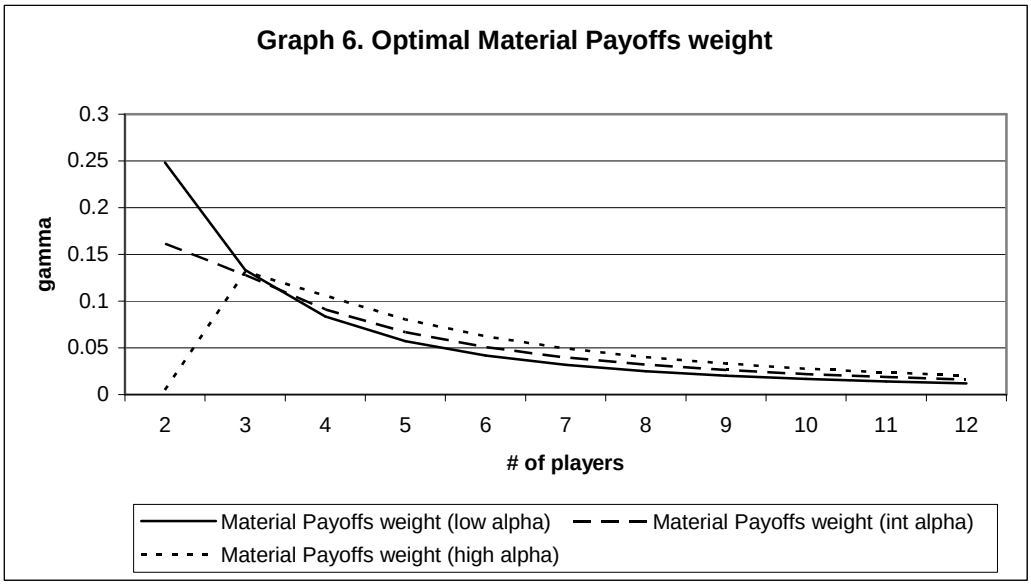
II. $(\underline{\alpha}, \bar{\alpha})$ where increasing α increases $1-\gamma$.

III. $(\bar{\alpha}, \alpha_{\max})$ where increasing α has no further effect on $1-\gamma$.

Intuitively, this means that at low levels of the marginal return of the public good, increasing the marginal benefit makes it more attractive for players to increase the weight on their material payoffs. However, there is a value of the marginal return of the public good for which the relationship is reversed and it makes sense now for the players to place a higher weight on their psychological payoffs.

Graph 6 shows that for a given marginal return of the public good, the relationship between the number of players in the game and the optimal psychological payoffs weight is positive. Therefore, since the underlying Nash Equilibrium of the game is such that $c_i^*(\gamma) > 0$, increasing the number of (contributing) players in the game, increases the optimal psychological payoffs weight, or in other words, makes Sense of Place more salient.

Graph 6. Optimal Material Payoffs weight



These results imply that when individuals play the *Sense of Place game*, they do hold a certain Sense of Place. How salient this feature is depends on the underlying Nash

[15] For small groups the MRPC for which the relationship between α and $1-\gamma$ is reversed is equal to 0.765; for large groups it is 0.55.

Equilibrium of the game, the marginal return of the public good, and the number of players in the game.

If we try to reconcile the effects of Sense of Place in achieving cooperation in a PG game with some conceptual solutions found in the public goods literature, we find that although individuals cannot directly punish or reward other individuals for not being committed or identified with their place, there is somewhat an indirect way through which they can affect (negatively or positively) defective individuals.

By contributing less to the public good, individuals hurt themselves by incurring in a Place Identity loss. However, they also impose a cost on the rest of individuals in the group. In the same way, when individuals contribute to the public good they benefit others by making the current set of characteristics of the place closer to the norm of the group.

So, the fact that individuals can help or harm others through their optimal contributions can accommodate the idea that individuals are conditionally altruistic or that they have to some extent social preferences. An individual who is highly committed and identified with his place might reduce his optimal contribution by selecting a lower weight on his psychological payoffs because his cognitive costs are increasing on others' defection. If on the contrary, others are contributing to the public good, that same individual will incur in little Place Identity loss and he will be tempted to select a higher weight to his psychological payoffs and foster his Place Attachment and Place Identity.

Finally, notice that considering players hold a Sense of Place acts as a different *rule configuration* under Ostrom's framework. It is clear then that players can escape the social dilemma's tragic fate when the structure of the game is affected in such a way that it is best for individuals to keep and foster their attachment and identity towards their place.

In the next section, the consequences of the introduction of a selective incentive which induces individuals to cooperate in a market-based mechanism on the Nash Equilibrium of the game and on the endogenous choice of the optimal psychological payoffs weight are analysed with the same functional example.

3. PES and Sense of Place

So far, the decision of individuals regarding the management of natural resources has been considered in isolation, without any external force which might alter such decision process. Although it is plausible to encounter such scenario, it is rather not likely in reality because of the relevance of the environmental services provided by such resources.

In this section an incentive-based mechanism which mimics a Payment for Environmental Services (PES) is introduced. Such policy response springs from the recognition of a market failure where one group of individuals are made worse-off because of the under (or null) provision of an environmental service that is caused by the depletion of a natural resource by some other group. Then, a PES market solves this problem by charging a price to the users of environmental services and delivering

the payment to the natural resource manager to give him the incentive to make a sustainable use of it[16].

Assume that the government supervises the PES scheme and that a player can (voluntarily) choose to participate in the PES by contributing to the public good[17]. In turn, he will receive a payment for such participation which covers his opportunity cost, i.e. he will be paid the amount contributed to the public good at the price of the private good. Therefore, the problem that player i faces is:

$$\max_{0\le c_i\le 1} U_i(c_i, c_{-i}) = \gamma\left(\sqrt{1-c_i} + \frac{\alpha}{N}\left(c_i + \sum_{j\neq i} c_j\right) + c_i(1-k)\right) + (1-\gamma)\left(\frac{c_i + \sum_{j\neq i} c_j}{N} - 1\right) \quad (12)$$

Where $c_i(1-k)$ is the payment that player i receives for participating in the PES and k is the cost that i incurs when participating in such scheme[18]. Setting $U_i'(c_i) = 0$, we find the optimal contribution for player i:

$$c^*_{i\,PES} = \frac{\gamma^2\left(1+\alpha^2-2\alpha+N^2\left(\frac{3}{4}+k^2-2k\right)+2N(\alpha+k-\alpha k-1)\right)+2\gamma(N+\alpha-kN-1)+1}{\left(\gamma(N(1-k)+\alpha-1)+1\right)^2} \quad (13)$$

Now, the optimal contribution depends on the relative weight placed on material payoffs (γ), the marginal return on the public good (α), the number of players in the game (N), and the cost of participating in the PES (k). Furthermore, we have that: $c^*_{i\,PES} = c^*_{i\,PES}(\underset{-}{\gamma}, \underset{+}{\alpha}, \underset{-}{N}, \underset{-}{k})$.

Graph 7 shows a comparison of the optimal contribution before and after the PES introduction for the same number of players and marginal return of the public good[19]. For any weight of the psychological payoffs, introducing a PES programme (no matter its cost) increases players' optimal contribution. Yet, this is more dramatic for low psychological payoffs weight levels.

Hence, when Sense of Place is salient, introducing a PES affects positively optimal contributions but in a slight fashion. Given the objectives of the PES, the scheme works better when Sense of Place is weak and when it is cheaper for individuals to participate in the programme. In other words, the efficient design of a PES programme becomes more relevant when individuals are not committed to their place and they are not identified with it.

[16] The logic behind the PES schemes is not new; Swallow *et al* (2009) consider it was developed in the 1960s. However, their application in developing countries burgeoned after the Rio Summit in 1992.

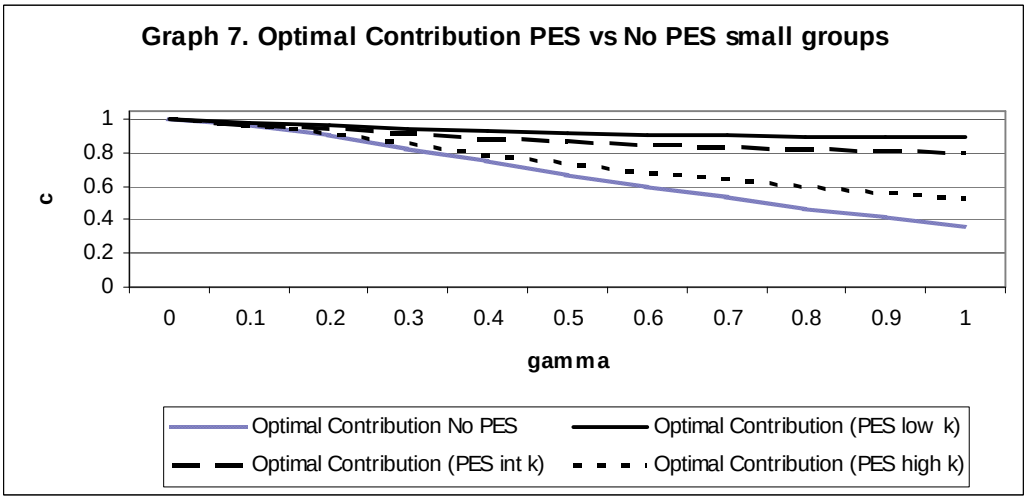
[17] This assumption is not far from the truth. The PSA and PSAH programmes in Costa Rica and Mexico, the two largest PES programmes in Latin America, are managed by the government.

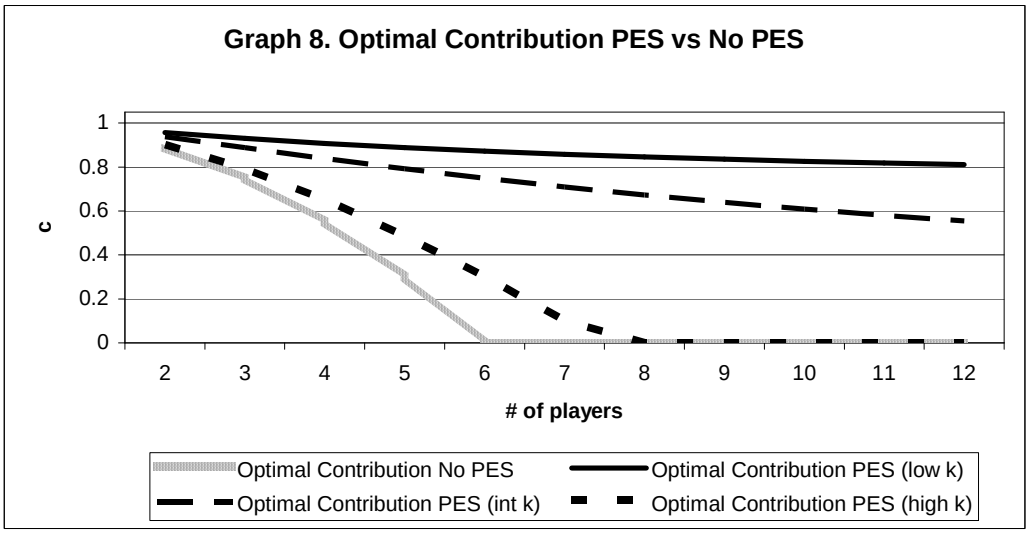
[18] For instance, transaction costs that stem from negotiation and monitoring.

[19] The marginal return of the public good was set at $\alpha = 2.5$; the number of players is $N = 4$; and there are three different costs of PES participation: low $k = 0.1$, intermediate $k = 0.5$, and high $k = 0.9$.

Finally, observe that there is a negative relation between the cost of participation and the optimal contribution to the public good, and that when Sense of Place is strong the optimal contribution is quite insensitive to changes in the cost of PES participation[20].

The comparison of the optimal contribution with and without PES is depicted in graph 8 for the same marginal return of the public good and material payoffs weight and for a given cost of PES participation. Introducing a PES increases players' optimal contribution no matter the number of players. Notice that the introduction of a PES with high cost of participation might have no effect on players' contributions to the public good[21]. Thus, when Sense of Place is not strong a PES increases optimal contributions from players in a large group, only if the cost of participation in the programme is not high.





A more interesting result is that of the interaction between Sense of Place and the effectiveness of the PES. How does the introduction of such programme affect the

[20] When PES participation is costless, $c^*_{i\,PES} = 0.98$. And when the cost of participation is at its highest ($k = 0.9$), then $c^*_{i\,PES} = 0.96$.

[21] For $N \geq 8$ the introduction of a high cost PES does not increase optimal contributions.

endogenous selection of the psychological payoffs weight? Alternatively, how does the introduction of a PES affect the salience of the Sense of Place of individuals?

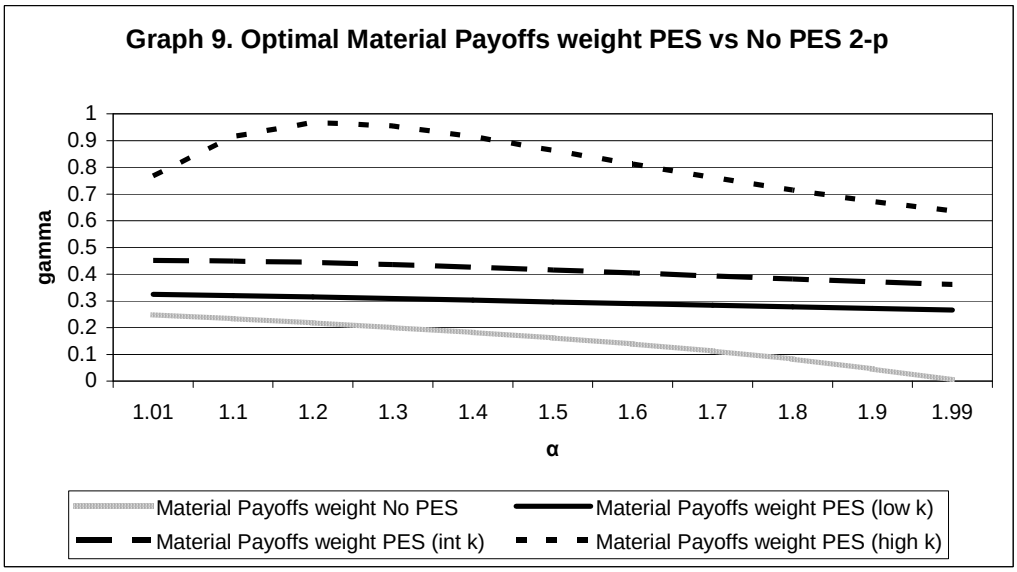
Consider again that nature chooses the psychological payoffs weight to maximize the sum of payoffs across players at the Nash Equilibrium of the game. Then, once players have been confronted with the decision process of (12) and they have computed their optimal contribution, the relevant problem becomes:

$$\max_{0\le\gamma\le1}\sum_{i=1}^{n}U_i\left(c^*_{i\,PES}(\gamma),c^*_{-i\,PES}(\gamma)\right) \tag{14}$$

Again, since the game is symmetric $c^*_{1\,PES}=...=c^*_{i\,PES}=...=c^*_{n\,PES}$. Thus, the last expression turns into:

$$\max_{0\le\gamma\le1}\gamma N\left(\sqrt{1-c^*_{i\,PES}}+\alpha\left(c^*_{i\,PES}\right)\right)+N(1-\gamma)\left(c^*_{i\,PES}-1\right) \tag{15}$$

The optimal material payoffs weight is such that $\gamma^*_{PES}(\alpha,N,k)\neq1\ \ \forall c^*_{i\,PES}>0$ [22].



In the *2*-player case, there is still a positive relation between the marginal return of the public good and the optimal psychological payoffs weight as long as the cost of participation in the PES is not high. If this is the case then it has the same pattern as the one which prevailed before the PES and for large groups, i.e. increasing the marginal return of the public good enhances the material payoffs weight at first, but after reaching some level it reverses and enhances Sense of Place in turn.

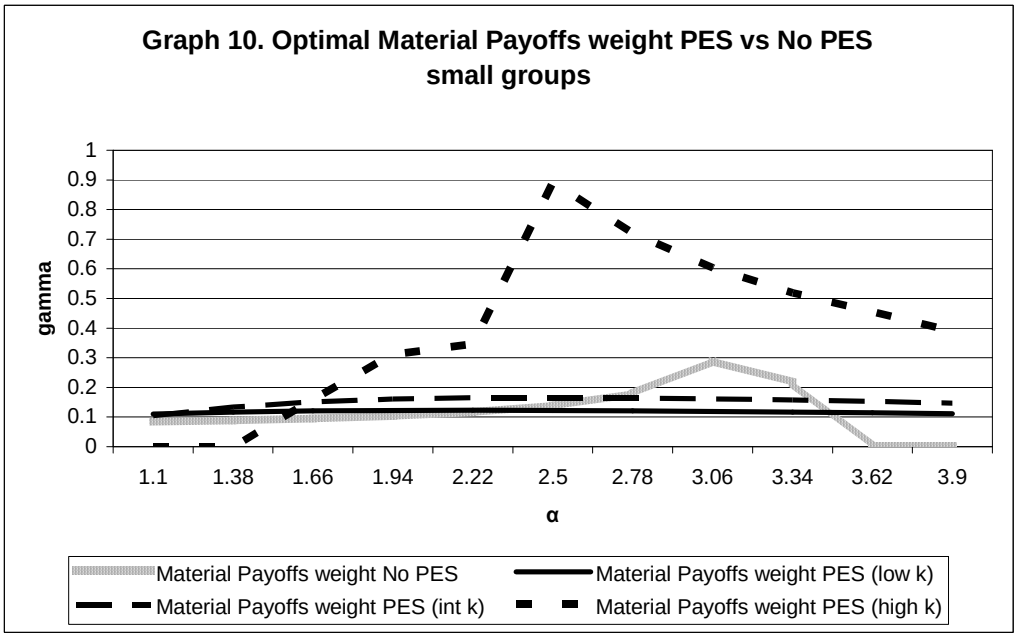
A more interesting result from graph 9 is that for any marginal return of the public good, introducing a PES scheme increases the optimal weight on material payoffs, i.e.

[22] The actual value of γ^*_{PES} can be found in the Appendix.

it deters Sense of Place. The costlier it is for individuals to participate in a PES programme, the more it destroys their Sense of Place[23].

From the small and large group cases contained in graphs 10 and 11, it can be concluded that unlike in the *2*-player case, it is not true that individuals will hold less Sense of Place under the PES than without it regardless the cost of participation. There are three patterns that can be drawn from such graphs:

- If α is high, regardless of k, introducing a PES deters Sense of Place for both group sizes.
- If α is not low and k is high, the PES deters Sense of Place for both group sizes.
- If α is low, regardless of k, introducing the PES fosters Sense of Place for large groups only.



Graph 12 shows that under a PES scheme, the positive relation between the number of players and the optimal psychological payoffs weight for a given cost of participation and marginal return of the public good still holds[24]. It is apparent that for small groups, the optimal psychological payoffs weight is higher when there is no PES programme than when there is. The reverse is true for large groups.

However, this result should be carefully interpreted because the underlying Nash Equilibrium of the game is such that $c^*_{i\,PES}(\gamma) > 0$. Hence, increasing the number of participants in the PES scheme, or alternatively, increasing the number of contributing players in the game, increases the optimal psychological payoffs weight, or in other words, makes Sense of Place more salient.

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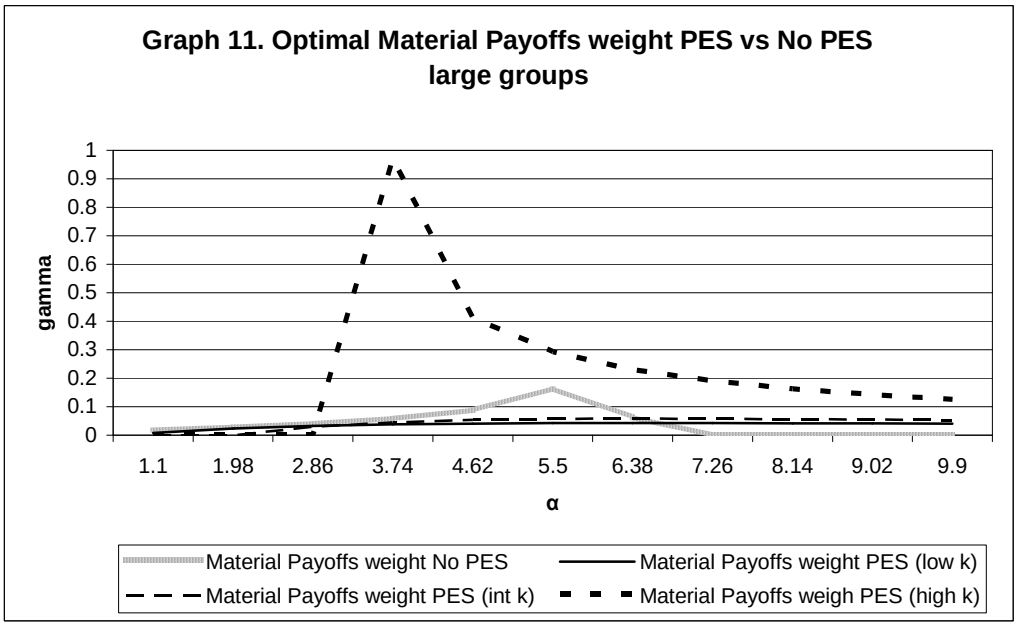
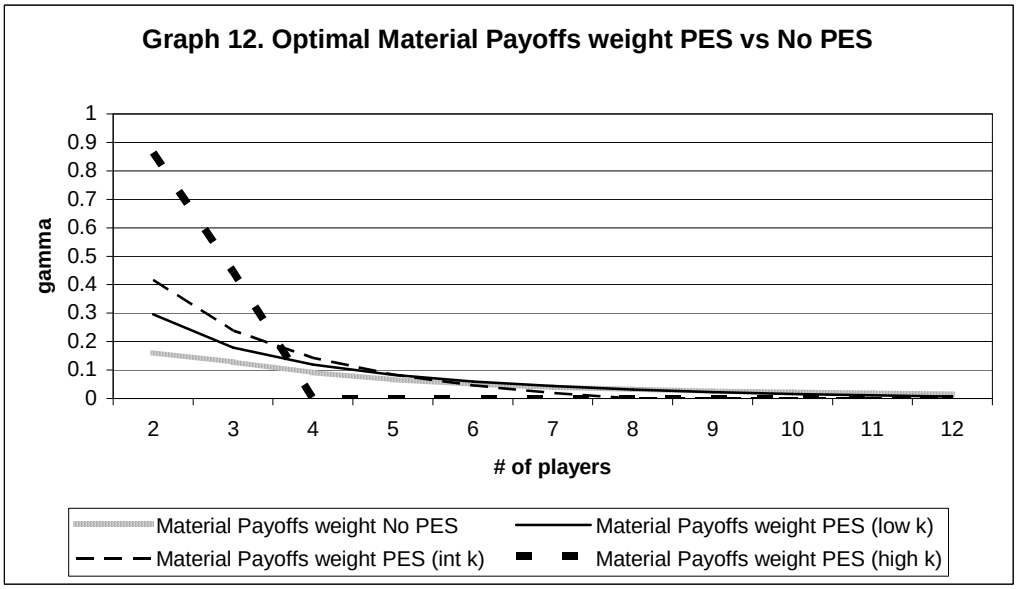
[23] For example, if the marginal return of the public good is $\alpha = 1.5$: $\gamma^* = 0.16$, $\gamma^*_{PES}(lowk) = 0.29$, $\gamma^*_{PES}(\text{int}\,k) = 0.41$, and $\gamma^*_{PES}(highk) = 0.86$.

[24] The marginal return of the public good is fixed: $\alpha = 1.5$.





In sum, players' Sense of Place is affected by the introduction of a PES scheme under certain conditions regarding the marginal return of the public good, the cost of participation, and the number of players in the game. Although the cost of participation in the scheme plays a role in the impact of a PES on individuals' Sense of Place, it seems that the marginal return of the public good is determinant[25].

For large groups, if the marginal return of the public good is at low levels, introducing a PES scheme will foster players' Sense of Place. Hence, the greater the social dilemma, the more fruitful the PES will be in increasing players' contributions and in enhancing their commitment and identity with their place.

If on the contrary, the social dilemma is weak, in the sense that the MRPC is slightly lower than the marginal return of the private good, introducing a PES scheme deters

[25] Of course, as with the model in general, this issue requires empirical validation.

Sense of Place no matter how costly it is to participate in such programme. The following part discusses a possible explanation for this result in terms of its policy implications.

4. Policy Implications

When playing the *Sense of Place game*, and under a given set of conditions, a *sustainable equilibrium* exists in which all individuals cooperate to the provision of the public good. Additionally, when confronted to such game, players actually place a positive weight on their psychological payoffs. Thus, regulators should prescribe policy responses to environmental threats which consider agents hold both an affective bond to the place they live in and a Place Identity.

However, the current economic policy prescriptions for the depletion of natural resources do not make such consideration. They seek to influence human behaviour that has detrimental effects on ecosystems and the services they provide. With a set of instruments, policymakers can establish markets, offer monetary and financial incentives to the social actors involved in the natural resources management, or even affect relative prices. Three commonly hinged on policies and their effects on individuals' Sense of Place will be discussed next.

Command and Control

Suppose the government designates a watershed basin as a Natural Protected Area. This place disruption will affect the player decision in two respects within the *Sense of Place game*. Firstly, it will reduce his affective bond to the place, which in turn will reduce his contribution to the public good, i.e. his commitment towards the place. Secondly, his Place Identity will be deteriorated. Therefore, the individual will react to the measure by putting a higher weight to his material payoffs. But if he does that, all individuals will react in the same fashion and will stop contributing to the public good. The game will then arrive to a *defective equilibrium*.

Now, if the authority does not have perfect monitoring abilities and enacts such command and control measure, the individual will try to make use of the watershed basin with a deteriorated Sense of Place[26]. So, it is more likely that he would make an unsustainable use of the resources because he has lost both the commitment and identity with respect to the watershed basin.

The negative effect of command and control measures on Sense of Place is supported by empirical evidence which shows that externally imposed policies that resemble command and control measures produce a place disruption which derives in a negative response by the individuals towards projects imposed by local or national authorities[27].

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[26] If the authority does have perfect monitoring capabilities, then the individual would probably have to make a living by using environmental services from a natural resource strange to his Place Identity. This might affect the provision of the public good in another place and induce depletion of such resource because the individual might hold a different $\tilde{Z}$ to the one held by local inhabitants.

[27] The concept of Place Interference was coined by Brown & Perkins (1992). Consequences of such process are discussed in Sharpe & Ewert (2000) and Bonnes *et al* (2006). Negative emotional effects

Voluntarism-based instruments

This type of response is the product of a new approach to face environmental threats in natural resources management (Dietz & Stern, 2002). Its mechanisms rely on information provision and education, and on voluntary formal agreements between the regulator and the agents involved in the management of the ecosystem service.

Thus, on the one hand it seeks to provide individuals with knowledge of the consequences of behavioural changes towards pro-environmental attitudes, and on the other it establishes explicit agreements between the regulator and the involved actors or between actors, in a non-enforceable fashion as opposed to what happens in a command and control measure.

Suppose that in the same watershed basin, a group of individuals play a *defective equilibrium*. Hence, they place a positive weight on their psychological payoffs, but Sense of Place is not salient enough so as to achieve the provision of the public good. If governmental informative and educational programmes delivered to individuals involved in natural resources management are introduced, and they achieve to make their Place Identity more salient, it will make for them costlier to keep their commitment to their place in such low levels or further reduce it. Then, these voluntary measures will foster individuals' Sense of Place.

Even though this is a positive feature in that it improves the decision-making of natural resources managers, a shortcoming of voluntarism-based instruments is the embedded risk they pose for the policymaker given their non-enforceable nature. Therefore, they ought to be used as a complement to other responses to environmental threats.

Incentive-based instruments

People respond to incentives. In this spirit, economics-oriented policymakers have encouraged the establishment of markets for environmental services with an incentive mechanism commonly known as Payment for Environmental Services (PES).

In terms of the *Sense of Place game*, a PES scheme might foster the affective bond of individuals with the place by financing conservation activities through the payment from buyers to sellers of the ecosystem service. After all, who would be against "protecting his own home" and being paid for doing it? Moreover, this has a reinforcing effect on Place Identity and therefore on strengthening the individuals' Sense of Place by placing a higher weight to their psychological payoffs. Hence, under this perspective, a PES scheme has an opposite effect to command and control measures on agents' Sense of Place[28].

A key issue regarding the success of a PES market and cooperation in natural resources management is their long-term impact on the individuals' behaviour. On the

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on individuals because of Place disruption are documented in Mazumdar & Mazumdar (1993), Fried (2000), and Rogan *et al* (2005).

[28] Remember from the *Sense of Place game*, for a PES scheme to foster Sense of Place we require the social dilemma to be stringent, i.e. a low marginal return on the public good and a large group will suffice.

one hand, PES markets might not be financially viable in the long-term and there is the possibility that individuals will overexploit the resource once the monetary rewards stop flowing to them. On the other hand, if during their operation, PES markets really affect Sense of Place positively, it is plausible that they have already induced a cooperative behaviour in the individuals even after disappearing so as to uphold a *sustainable equilibrium* henceforth.

Yet, an important concern of PES schemes is the monetary reward itself. Such reward might induce the individuals to treat the natural resource as a commodity, which would result in them placing a higher weight to their material payoffs and lead to a *defective equilibrium*. Related to this issue, the theory of *motivation crowding* (Frey, 1997; Benabou & Tirole, 2003 and 2006) suggests that the payments delivered by PES schemes would be an external intervention that undermine agent's potential intrinsic motivation to perform a certain task, in this case sustainable use of the resource, and have unintentional adverse effects, in this case defection[29].

Which effect, the boost on Sense of Place or the commodity-treatment or crowding-out effect of the monetary reward will dominate? A departure point for an answer is found in experimental evidence and the choice of the optimal material payoffs weight from the *Sense of Place game*.

Experimental evidence of the consequences of introducing a market-based mechanism into a PG game is provided by Reeson & Tisdell (2008). They show that once the market institution is removed, players' contributions decline to levels which are lower to the ones that prevailed before its introduction[30].

From the *Sense of Place game,* the introduction of a PES increases participants' contribution to the public good unequivocally. However, if the marginal return of the public good is low, the PES will promote participants' Sense of Place, whereas if the marginal return of the public good is high, the PES will deter players' Sense of Place, and such deterrence will be greater the costlier it is to participate in the programme[31]. In the latter case, if the PES is then removed from the game, the underlying Sense of Place of the players will be lower, and so their contributions.

In sum, the *Sense of Place game* provides no definitive answer regarding a PES fostering or deterring players' Sense of Place. Although there is experimental evidence that suggests the latter might be more likely because of the monetary nature of the PES, empirical research is required to ascertain a conclusive answer.

[29] Prominent experimental evidence of undermining intrinsic motivation in the Psychology literature is found in Deci *et al* (1999). Experimental evidence of positive rewards on pro-social behaviour is provided by Gneezy & Rustichini (2000). Evidence on pro-environmental behaviour can be found in Coad *et al* (2009). In the PES literature the motivation-crowding is referred to as *substractional effects*; these are discussed in Vogel (2002), Sengupta *et al* (2003), Romero & Andrade (2004), Karsenty & Nasi (2004), Wunder (2005) and Wunder *et al* (2008).

[30] More motivation-crowding evidence is found in Heyman & Ariely (2004). For a survey of experimental evidence and a highly sceptic view on the topic, see Eisenberg & Cameron (1996).

[31] This result accommodates to Gneezy & Rustichini (2000) advice: "Pay enough or don't pay at all".

5. Conclusions

Understanding the interaction between individuals and their place, defined as a setting which provides them with an identity and for which they hold and affective bond, conveys valuable information on the process through which individuals might decide to make a sustainable use of natural resources as opposed to depleting them.

The *Sense of Place game* provides some lessons not previously acknowledged. Players' contributions to the provision of the public good depend on how salient their Sense of Place is. If the choice of such saliency is made to maximize the welfare of players in the game at the Nash Equilibrium it is always optimal to hold a certain Sense of Place, i.e. albeit minimal, individuals will display a Sense of Place when confronted to make a decision regarding the management of natural resources.

With respect to the model's policy implications, the currently used responses to environmental threats have different effects on individuals' Sense of Place. In the case of command and control measures, being centralized instruments which restrict access to the natural resources, they are most likely to be perceived as a place disruption by the inhabitants. This type of response has a negative effect on the individuals' welfare since it negatively affects their affective bond with the place, which would entail a loss of commitment towards it and a loss of identification as well. This is more likely to drive them to place a higher weight on their material payoffs with negative consequences on cooperation for the provision of the environmental services.

In regard to voluntary-based measures, awareness and educational programmes on sustainable resources management as well as voluntary prearrangements between the regulator and the targeted individuals are likely to foster the placement of a higher psychological payoffs weight and hence the development of a Sense of Place among them. Yet, since the nature of this type of response to an environmental threat is not enforceable, policymakers should not rely solely on it and treat it as a complement to other type of responses.

Finally, on the subject of incentive-based mechanisms, particularly PES schemes, there are two possible conflicting effects. On the one hand, as PES provide the incentive for the manager of the natural resource to undertake environmentally conservative measures, it might strengthen his affective bond towards the place, and his identification with it as well; thus, a PES scheme is likely to increase the individuals' weight on their Sense of Place. On the other hand, the monetary reward that the manager of the natural resource receives as part of the PES programme might crowd-out any intrinsic motivation that he had about protecting the place from the environmental standpoint. Then, the introduction of the PES increases his material payoffs weight, and once the payment stops flowing to him, it is likely that his ecological stewardship has already been deteriorated and that he will deplete the natural resource. The determination of which effect will dominate is of empirical nature.

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Appendix

I. Optimal material payoffs weight (endogenous selection)

$$\gamma^* = \frac{8\alpha^2 + 4N\alpha - 16\alpha + N^3 + 2N^2 + 8 - 4N\alpha^2 - \xi}{N\left(2N - 8\alpha^2 + 4\alpha^3 - N^2\alpha - 2N\alpha + N^2 + 4\alpha\right)}.$$

And:

$$\xi = \sqrt{64 - 256\alpha^3 + 64\alpha^4 - 256\alpha + 384\alpha^2 + 4N^4 - 8N^3\alpha^2 - 4N^4\alpha^2 + 4N^4\alpha + 4N^5 + N^6 + 8N^3\alpha}$$

II. Optimal material payoffs weight under PES (endogenous selection)

$$\gamma_{PES}^{*}=-\frac{1}{3}\left(\sqrt[3]{3}\frac{N\left(\Phi+\sqrt{3}\Gamma\Omega\right)\sqrt[3]{\left(\Upsilon+\mathrm{T}\right)^{2}}}{\left(\Omega\left(\Upsilon+\mathrm{T}\right)\right)-\frac{1}{3}\Sigma N3^{2/3}}}{\Omega\left(N\left(\Phi+\sqrt{3}\Gamma\Omega\right)\sqrt[3]{\left(\Upsilon+\mathrm{T}\right)^{2}}\right)-\frac{1}{\Omega}}\right).$$

$$\Gamma=\sqrt{\frac{\left(\Delta+\Lambda\right)N}{\Upsilon+\mathrm{T}}}$$

$$\Delta=8+124N-270N^{2}-8\alpha+216k^{3}N^{2}+109N^{3}\alpha+324k^{2}N-222N^{2}\alpha+324N^{3}k^{2}-363N^{3}k-108k^{3}N^{3}+432\alpha kN^{2}+108\alpha k^{2}N$$

$$\Lambda=-216\alpha k^{2}N^{2}+108\alpha k^{2}N^{3}+8N^{4}k-216N^{3}k\alpha-108k^{3}N+146N^{3}-8N^{4}-216\alpha kN+708N^{2}k+120\alpha N-352kN-648k^{2}N^{2}$$

$$\Upsilon=4\alpha^{3}-4\alpha^{2}+8\alpha^{2}N-8\alpha^{2}kN-4\alpha^{2}k-8\alpha kN^{2}+4\alpha k^{2}N^{2}+8\alpha k+3N^{2}\alpha+2\alpha N+8\alpha k^{2}N-8\alpha kN-4\alpha$$

$$\mathrm{T}=4-10N-4k+6N^{2}-4k^{3}N^{2}-8k^{2}N-13N^{2}k+16kN+12k^{2}N^{2}$$

$$\Omega=N-1+\alpha-kN$$

$$\Phi=9\left(N-kN+N^{2}k-N^{2}\right)$$

$$\Sigma=\alpha N-2\alpha-kN-2N^{2}+2+2N^{2}k$$