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Facilitating complementary inputs and scoping economies in the joint supply of health and environmental services in Aboriginal central Australia

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ABSTRACT

Two concerns of national relevance in central Australia are the continuing decline in Aboriginal health status relative to the rest of the Australian population, and the loss of environmental services. We draw on literature from a number of disciplines to show that not only are these two concerns interrelated but that dealing with them is inextricably connected through consideration of the psychosocial determinants of health. Involvement by Aboriginal people in land management can promote the joint supply of environmental and health services. We show that Aboriginal control of land management can result in economies through the joint supply of environmental and health services. However, because Aboriginal people derive little benefit from the provision of public goods generated through land management, they have little incentive to provide a socially optimal supply of these goods. The

policy issue for government is the selection of the appropriate policy tools to facilitate the involvement of Aboriginal people in land management and the optimal supply of health and environmental services. The cost-effectiveness plane is used to provide a simple framework to guide the selection of an appropriate policy tool.

Key words: Aboriginal land management, caring for country, cost-effectiveness plane, policy tools, private good, public good, social determinants.

Introduction

The poor status of Aboriginal health in Australia in general and in central Australia in particular is well documented[1-4]. The status of Aboriginal health in central Australia is not unrelated to concern for the environmental status of the central Australian rangelands. To the first non-Aboriginal settlers in central Australia, the then existing vegetative cover gave the erroneous impression of high productivity to which they responded with the introduction of domestic livestock. This resulted in ecological degradation manifested in soil loss, decreased vegetative cover, and loss of native species[5,6]. Further ecological impacts resulted from the invasion of feral species such as camels, horses, donkeys, foxes, cats and buffel grass (*Cenchrus ciliarus*) and changed fire regimes. While some Aboriginal people maintained links to country, non-Aboriginal settlement in central Australia has resulted in a changed relationship for many Aboriginal people with their country, and has contributed to a decline in ecosystem services and to poor Aboriginal health. Even with the re-establishment of Aboriginal access to traditional country, the uptake and application of culturally accepted practices has been disjointed. This is due, in part, to a sense of powerlessness from a history of dispossession[7] and a history of externally driven and constantly changing government policy.

Increasing recognition is being given to the importance of re-establishing traditional land management practices. At the same time there is increasing loss of Aboriginal social memory and physical capacity to manage country due to poor health and premature death, and the changing priorities of Aboriginal youth[8]. In many areas we see a negative feedback loop between country and health leading to a downward spiral of poor relative human health and poor ecological health of country.

In this article we explore some of the interrelationships of health outcomes for Aboriginal people in central Australia and the supply of central Australia-based environmental services. In particular we provide economic argument for how, under certain conditions, the joint supply of environmental and health services by a single provider results in scoping economies (see table 1 for a glossary of economic terms). Such economies are characterised by the supply of two or more services through a single provider costing less than would be the case were each service provided by a separate provider. This interconnection between environmental and health services, and the economic efficiency issues in how they may be best supplied, is relevant at the higher levels of government policy-making in decisions about budget allocations across sectors.

Aboriginal participation in land management is less than what is socially desirable because of market failure due to poor market signals (prices). Because Aboriginal people do not enjoy the full benefit of the public goods generated through their participation in land management, these public goods (such as biodiversity) are under-supplied. Governments, among others, can correct for this by providing appropriate incentives.

Table 1: Glossary of economic terms

Term	Explanation
Complementary	Occurs when for technical reasons two or more goods or inputs should be used together, such as with a left shoe and a right shoe. The economic consequence of not using complementary inputs together is that the economic efficiency of the input being provided will be less than it would be were the other complementary input/s also provided. The social determinants of health are complementary to biomedical inputs to health.
Cost effectiveness plane	Is an analytical tool used to choose between alternatives when at least two factors need to be accounted for when assessing a) the final net benefit and b) the policy response. In this instance, it is used to assess the policy response and selection of the appropriate policy tool according to the net summation of private goods and bads and public goods and bads that may result from Aboriginal land management.
Equity, horizontal and vertical	Horizontal equity involves treating those equally who are in an equal or simular condition. Vertical equity means that when choosing between two people (say) according to wealth or health condition the choice is made in favour of the least wealthy or the worst health condition. Such criteria are not un-ambiguous depending on how we measure the prior condition – is it income or health condition or is it cost of treatment or health outcome?
Externality	An externality is when the consequences of a decision or action have not been fully taken into account. An example of this when we make a decision to drive to work, the cost of the fuel used does not include the impact of the resulting greenhouse gases on health and other impacts. That is, such costs are external to the cost accounting.
Marginal cost	This is the additional cost that occurs as a result of an incremental increase in input to the production process or supply of a commodity, good or service such as health service.
Marginal value	Is the value of the additional or incremental increase in the supply of a commodity, good or service, such as health service. A necessary condition for economic efficiency is that is that marginal cost of providing goods and services is not more than the marginal value.
Marginal social opportunity cost	Economists often use the term 'social' to make clear that economic costs means that the choices available to society will be less – or there is a social opportunity cost. For example, a marginal increase in expenditure on health could result in a decrease in expenditure on roads, with a possible marginal social opportunity cost of increased morbidity and mortality.
Private Good	These are goods or services that are rivalrous in consumption. That is, the consumption of that good by one person decreases the amount available for others; e.g. food.
Public goods	These are goods or services that are non-rivalrous in consumption. That is, the enjoyment of that good by one person does not decrease the amount available for others; e.g. information.
Scoping economies	Such economies come about when two or more benefits can be provided at a price that is less than they would be if they were provided separately.

The issue for the government decision-maker is the selection of the appropriate policy response to facilitate the optimal joint supply of health and environmental services. We propose the cost-effectiveness plane as a simple framework to guide selection. We then discuss the importance of ensuring the incentives provided are consistent with the cultural norms of Aboriginal people.

Issues and interrelationships in health outcomes

Predisposing factors to poor health

The causes of excess morbidity and mortality in the Aboriginal population of central Australia are complex.

They include upstream, social determinants, as well as downstream behavioural factors[4]. The downstream risk relates to behavioural factors affecting the prevalence of chronic disease such as smoking, alcohol abuse, poor diet, lack of physical activity and injury, including interpersonal violence.

Pearson[9] has argued a 'radical centrist' view that Aboriginal people not only have rights to health, but that they must also take responsibility for current circumstances in order to take control and modify the behavioural factors affecting their health. Because of the predisposing psychological and social determinants of health[10-12] Aboriginal people do not always have adequate opportunity or capacity to address such behavioural factors. It is therefore important to address the predisposing determinants of health in cooperation with and in support of Aboriginal people taking control of the behavioural factors affecting their health.

Social determinants of health

There is a large international volume of work on the social and psychological determinants of health – for example the collection of papers edited by Marmot and Wilkinson[12] and the steps taken by the World Health Organization in setting up the Commission on Social Determinants of Health[11]. The social determinants particularly relevant to this article are those set out by Krieger[13].

A small but significant body of literature provides evidence of the observed health benefits of Aboriginal people living on country and undertaking land management on their country, including harvesting and eating bush foods[14-18]. Cass et al.[10] described the link between disadvantage and end-stage renal disease for Aboriginal people. Carson et al.[19] reviewed the factors linking Aboriginal health outcomes with their social determinants. However the joint relationship between Aboriginal land management and improved health is poorly accounted for.

The social benefits of addressing Aboriginal health

There is a national commitment from the Australian state to its citizens to ensure delivery of a shared base-level of social services, including education, communications, housing and health. In addition there are strong horizontal and vertical equity and human rights arguments for addressing Aboriginal health, as acknowledged in the National Indigenous Health Equality Targets[20].

A number of economic studies provide an indication of the probable value of improved health outcomes for disadvantaged populations. Internationally, the Commission on Macroeconomics and Health estimated that raising the life expectancy of people in low income developing countries from 59 to 68 years of age would result in an annual increase in economic growth of 0.5%[21]. The Canadian Royal Commission on Aboriginal Peoples estimated an annual loss due to the marginalisation of Native Americans of 1% of gross national production[22]. This was based on social costs associated with the economic marginalisation of aboriginal people (foregone income) and costs incurred by governments in attempting to address social problems through remedial programs.

While there is no direct economic study of the costs of poor Aboriginal health in central Australia, Barnes et al.[23], using the same approach as used in the Canadian study, estimated the annual cost to the Northern Territory (NT) of the social disadvantage suffered by Aboriginal people in 2001 as $1.4 billion. Further, the NT Government and its agencies have identified Aboriginal disadvantage as a key parameter influencing labour productivity and gross state productivity[24].

Being 'on country'

For Aboriginal people, involvement in managing country can result in confirmation of identity and cultural authority, social activities, provision of purpose, teaching and sharing

knowledge, exercise and food. Contemporary Aboriginal peoples' attachment to country is expressed in various ways including: living on traditional country; visiting their country; and carrying out land management practices, sometimes in collaboration with government or non-government bodies.

Properly initiated and supported, linkages by Aboriginal people with their traditional country have the potential to support the maintenance and reintroduction of land management practices that draw from Aboriginal tradition, and reverse the negative feedback between health and the environment. It is important that Aboriginal people have ownership of how activities that express their relationship with their country and environmental management are set up, managed and run. This is because a sense of control over one's life is a psychosocial determinant of health, and is also critical to motivation and institutional stability, as recognised in the broader economic development literature[25].

The practices that Aboriginal people undertake in managing country may include patch burning, control of feral animals, maintenance of language and intergenerational transmission of the ecological knowledge embedded in language and art. The public receives a number of environmental benefits from such practices. For example patch burning acts to mitigate intense, more destructive fires which pose greater risks to fire sensitive habitats and will generate relatively higher rates of greenhouse gas release. By promoting habitat diversity, patch burning contributes to the maintenance of biodiversity, while promoting the regeneration of fire-adapted species.

The private benefits to Aboriginal people from engaging in land management practices on their country may include food and exercise, income from the supply of arts and crafts, and from contracted land management. Enhanced emotional and psychological health as a result of improved cultural knowledge and status within the community can lead to greater capacity to assert control.

Consideration of a holistic approach to Aboriginal health

The importance of a holistic approach is often emphasised in discussion of the achievement of improved Aboriginal health and wellbeing. The medical use of the term refers to the treatment of the whole person. Clapham et al.[26] observed that '... a large number of health determinants lie outside the formal health sector', and that '[s]olutions to Indigenous health and development problems need to come from many sectors, not just the health sector' (p.272). Lutschini[27] has commented on the lack of cohesion in the '... meanings attached to Aboriginal holistic health [sic]'. Here we rely on a coherent and testable application of 'holistic' as it may be applied to achieving improvements in Aboriginal health.

The economic meaning of a holistic approach

According to common explanations, an advantage of a holistic approach is due to the existence of synergies. Synergies are assumed to exist when the whole (outcome) is greater than the sum of the parts (inputs). In such situations economies of scale are achievable. However, the economies that may be achieved using a holistic approach are not limited to synergies. Indeed, there are circumstances in which the economies of a holistic approach to Aboriginal health are the result of complementary inputs rather than synergies.

Complementary inputs

Complementarities normally occur as a result of a technical link between various inputs that require those inputs to be used in combination. A range of relationships are possible where complementary inputs exist. At one extreme, production will not be possible unless all inputs are present. In other situations, production will occur but productivity will be less than it would be if all complementary inputs were provided at an optimal level. For example, if you have doctors but no clinics or medical equipment, some health

outcomes will be achieved, but these will be much less than if the requisite infrastructure were also available.

An economic test of complementary inputs is when a price increase for one of the inputs, such that demand for that input falls, results in a corresponding *decrease* in the quantity demanded for the complementary inputs. This differs according to the existence of substitutable inputs where a price increase for one input results in an *increase* in the quantity demanded of the alternate inputs.

The poor outcomes and high cost of health delivery to Aboriginal people in remote central Australia, relative to the situation for the rest of Australia as a whole and to the rest of the remote central Australian community, is consistent with a failure to provide complementary inputs. Notwithstanding any improvements in health service infrastructure and staffing, Aboriginal health and wellbeing will be sub-optimal unless the social and psychological determinants of health are also addressed. This is because the psychosocial determinants of health are complementary inputs to Aboriginal health and wellbeing.

Scoping economies

A further economic characteristic of some complementary inputs is when the joint provision of goods and services results in economies of scope. Scoping economies in the supply of health and environmental services can occur when the cost of providing certain health services in conjunction with the supply of environmental services is less than the cost of providing these services through separate approaches to health service delivery and environmental management.

Scoping economies normally occur as a result of shared inputs. In the provision of health and environmental services, the potential for scoping economies occurs as a result of the technical relationship between the means used to provide environmental services and the derived health benefits. That is, the technical relationship occurs because Aboriginal people are providing knowledge and labour inputs to the supply of environmental services through the use of land management practices that drawn on their cultural traditions. In doing so, Aboriginal people receive a range of biophysical health benefits (such as through exercise) and psychosocial health benefits (such as enhanced self esteem through recognition by others of the value of their knowledge and effort). In this way, health services and environmental services are produced jointly.

Private provision of public goods: The private supply of public goods will depend on the application of appropriate policy tools, which will vary according to the economic characteristic of the services provided and the sum of private and public benefits less costs.

Public goods and private goods: Economists differentiate goods and services according to whether they are private or public goods. A public good is one that is non-rivalrous in consumption or use, such that the enjoyment of a good by one individual does not reduce the amount available to another individual. As a result, the marginal social opportunity cost of consumption is zero. Television signals, information, and defence are examples of public goods. In contrast, private goods are those goods which, when consumed or used, are no longer available to others, and are said to be rivalrous in consumption. In this case, the social opportunity cost of consumption is greater than zero. Food and fuel are examples of private goods.

The provision of health services often involves the joint supply of public and private goods. For example, a treatment that cures someone with an infectious disease has private benefit for that individual and public benefits through the removal of a potential source of infection to the population. In addition, the public may decide to maintain the health of the public at some minimal level.

Environmental services can also involve the joint supply of public good benefits (such as biodiversity) and private good benefits (such as food and firewood). In addition many land management practices jointly provide environmental and health services, which may occur as both private and public goods. An example of this is Aboriginal cleaning and

fencing of waterholes in central Australia to exclude feral animals, to protect and conserve water. In addition to cultural benefits, this will result in private benefits through improved quantity and quality of water and an increase in the numbers of native food species. This activity can also result in private health benefits from exercise, improved food and reaffirming of cultural associations. At the same time, public good benefits for the broader community will occur as a result of a more effective public expenditure on meeting socially desirable standards in Aboriginal health and the maintenance of biodiversity.

Are health benefits an externality to the provision of environmental services?

An externality is a benefit or cost due to an activity that is not accounted for when assessing the benefits and costs of the activity. Externalities may be positive, such as when health benefits generated through participation in the supply of environmental services by Aboriginal people are not taken into account by government policy makers. Externalities may also be negative, such as when overgrazing, which results in an increased incidence of dust storms with consequent health impacts[28], goes unpriced.

Failure to include health benefits, when accounting for the benefits of Aboriginal land management, will result in land management being under supplied. As a result, the joint supply of health and environmental services will be sub-optimal. Alternatively, goods and services that result in negative externalities will be oversupplied, as per the overgrazing example above.

An example of a positive externality is patch burning, such as is used by Aboriginal women in some central Australian communities to assist them in food collection[29]. While this activity is carried out to obtain private benefits, it can also generate public environmental benefits such as through the reduction in the risk of intense wild-fires.

A number of government programs have been initiated to facilitate Aboriginal land management practices to increase the supply of public good environmental services[30]. Public good health benefits are usually not included in the accounting for such government funding. Unless such benefits are fully accounted for, the provision of Aboriginal land management practices will be undersupplied.

This is particularly important within the current policy debate concerning the movement of Aboriginal people from the smaller remote settlements into larger population centres[31]. While this movement may result in efficiencies in service delivery, it is also likely to result in disengagement from traditional country, intercommunity conflict and resulting poorer health and environmental outcomes. Inter alia, an understanding of the economic relationships between engagement in land management practices and health outcomes has been missing from this debate. For policy-makers interested in generating evidence-based policy, it is important that the information shortfalls concerning this relationship are addressed.

Facilitating the optimal supply of private and public goods

A necessary, though not sufficient, condition for the optimal supply of goods and services is that they continue to be supplied as long as the social benefit of an additional (marginal) unit is at least equal to its cost. Because the cost of providing a public good to an additional person is zero, there is an economic argument to not charge for the supply of public goods. A possible government role is to either supply public goods directly or to provide appropriate incentives for their private provision.

Policy makers need to select a policy response to ensure that Aboriginal people, as private providers, supply land management practices at an optimal level. The available responses are incentives, disincentives, or doing nothing. One method for selecting the appropriate policy response is through the use of the cost-effectiveness plane, shown in

Figure 1. This policy decision tool has been used in a number of different policy arenas, including health[32], water resource management[33] and land management[34].

In using the cost-effectiveness plane we assume that the benefits to the broad Australian public from Aboriginal land management practices are public goods, and that the benefits to the Aboriginal people undertaking land management are private goods.

Figure 1 represents the full range of all possibilities attributable to Aboriginal land management practices. The vertical axis shows public benefits, which can be positive or negative. The horizontal axis shows private benefits, which can be positive or negative. Private benefits are the benefits less the costs incurred by Aboriginal people from their land management practices. Public benefits are the benefits that accrue to the broader public from Aboriginal land management practices less any costs that the broader public incur as a result of these practices.

Figure 1 is divided diagonally into two halves. Below the diagonal line the sum of private benefits plus public benefits result in a negative total social benefit. In the area above the diagonal line the sum of private benefits plus public benefits results in positive total social benefit. For example, points L and M represent two land management possibilities.

At L, located below the diagonal line (Fig1) there is a private loss of $0L_{private}$ and a public benefit of $0L_{public}$. The total social benefit of L, given by equation (E1), is shown to be negative:

$$\text{Social benefit L} = (0L_{public}) - (0L_{private}) < 0 \quad [E1]$$

For point M (located above the diagonal line) there is a private loss of $0M_{private}$ and a public benefit of $0M_{public}$. The total social benefit of M given by equation (E2) is shown to be positive:

$$\text{Social benefit M} = (0M_{public}) - (0M_{private}) > 0 \quad [E2]$$

Selection of policy mechanisms

In segment A quadrant 1 (Fig1), the private benefit to Aboriginal landowners from undertaking land management practices is negative (such as at point L) – that is, there is a private loss. Although there is a public benefit, the private loss exceeds the public benefit, so that the net social benefit is negative (E1). This is represented by this segment being below the diagonal line. Hence this land management practice should not be carried out.

In segment 1B a mix of private loss and public benefit continue to exist (such as point M). However in this segment, the public benefit exceeds the private loss, such that the net social benefit of undertaking the land management activities is positive (E2). Hence this land management practice should be carried out.

Nevertheless because there is a private loss, land management practices in this segment will not be undertaken by landowners without some form of incentive. The value of the incentive to the landowners will need to be at least as great as the private loss incurred from undertaking the necessary land management activities. The rate at which the incentive generates increased private land management will depend on the extent to which the value of the incentive exceeds the private loss. The marginal cost of applying the incentive will need to be no greater than the marginal value of the increase in public benefit.

In quadrant 2 landowners realise a private benefit from undertaking land management practices that also generate public benefit. As a result the net social benefit is positive, as indicated by the location of quadrant 2 above the diagonal line. Landowners will engage in these land management practices because of the positive private benefit, and no policy intervention is warranted.

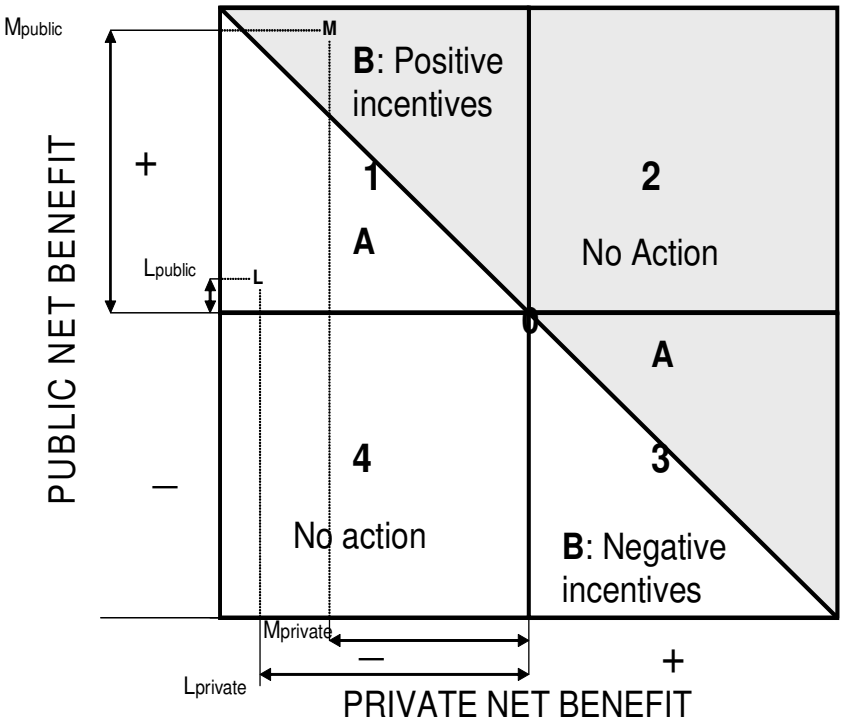

Figure 1: Cost effectiveness plane for resolving the application of private incentives.

In quadrant 3, there are positive private benefits from land management practices, but negative public benefits. For segment 3A, the private benefit from engaging in land management practices is greater than the public loss, as indicated by the location of this segment above the diagonal line. As a result the net total social benefit from land management practices located in this segment is positive. Thus, in spite of the public loss, it is appropriate for these land management practices to occur and no policy intervention is warranted.

In segment 3B the public loss is greater than the private benefit, such that the net social benefit is negative, as indicated by the location of this segment below the diagonal line. Landowners will implement the land management practices that are located in this segment because of the private benefit they gain, despite the social loss from the negative public benefit exceeds the net private benefit. The appropriate policy response, to avoid socially harmful land management practices, is to implement some form of negative incentive or sanction, such as a fine. To provide an effective deterrent, the cost to landowners from such

sanctions needs to be at least as great as their net private benefit from carrying out the practice multiplied by the probability of being caught and sanctioned.

In quadrant 4, both the private and public benefits from land management practices are negative – there are both private and public losses. Because private benefit is negative, landowners will not undertake land management practices located in this segment. Hence no policy intervention is required.

Behavioural incentives

The design of incentives – what they are applied to, their extent, timing and how they are applied – is critical if they are to be effective in the joint supply of environmental and health services. Incentives will need to be compatible with Aboriginal culture and preferences if appropriate responses from Aboriginal people are to occur.

The effectiveness of policy mechanisms aimed at optimising economic outcomes from the joint supply of environmental and health services depends on assumptions regarding human preferences and behaviour. Aboriginal people are likely to have different preference functions from the non-Aboriginal community. This highlights the importance of Aboriginal people having control over how environmental services and health services are provided. If we expect Aboriginal people to take responsibility for behavioural factors affecting their health[9], it is important that policy actions that aim to facilitate this are compatible with Aboriginal cultural practices.

Conclusion

Two important concerns in central Australia of national relevance are the continuing Aboriginal 'mortality gap' relative to all Australia, and the loss of environmental services including biodiversity. Not only are these two concerns interrelated, but dealing with them is inextricably connected through the psychosocial determinants of health.

Aboriginal control of land management can result in economies through the joint supply of environmental and health services. This holistic relationship is due to the existence of complementary inputs. Failure to deliver the complementary inputs that are offered by Aboriginal land management will result in sub-optimal effectiveness in the delivery of health services.

The benefits from joint supply of environmental and health services may take the form of private goods that are of benefit to the Aboriginal landowners, and public goods that are of benefit to the broader community. Because Aboriginal people derive little benefit from the public goods that they provide through land management, they have little incentive to provide a socially optimal level of land management. One way of correcting for this is for government or some other body to provide appropriate incentives.

The issue for government decision-makers is the selection of appropriate policy tools. The cost-effectiveness plane provides a simple framework to guide the design of policy responses. This approach is a step to addressing an outstanding research need. That is an economic assessment of the total national social benefit from Aboriginal engagement in land management, including a closer examination of the relative strengths and weaknesses concerning Aboriginal people in central Australia living in dispersed small settlements, relative to increasing centralisation.

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