THE ECONOMICS OF A PAYMENT FOR WATERSHED SERVICES IN THE WESTERN BAIVAANSKLOOF[1]

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Abstract

The economics of a Payment for Watershed Services (PWS) is examined as a way to finance the restoration of the Baviaans catchment. The proposed PWS consists of Gamtoos-valley farmers "buying" watershed services from upstream farmers in the Western Baviaanskloof, who need to change their farming practices to ensure the delivery of this service. The economic valuation of the watershed services is discussed and it is found that, although more quantitative and scientific research is necessary, the downstream farmers will reap economic benefits and that both parties are willing to participate in the scheme. This is a synthesis paper written for PRESENCE.

This paper is a synthesis of the work done in the Baviaanskloof by PRESENCE (Participatory Restoration of Ecosystem Services and Natural Capital, Eastern Cape), looking specifically at the economics of a Payment for Watershed Services (PWS) as a means to finance the restoration of the Baviaans catchment. The proposed PWS consists of the downstream irrigation-based farmers in the Gamtoos valley "buying" the watershed services from the upstream farmers in the Western Baviaanskloof, who need to change their farming practices to ensure the delivery of these services.

In order to establish the economic benefits of the restoration, the improved ecosystem services, including increased water supply and water security, flood and drought protection as well as improved water quality and decreased sediment yields, need to be evaluated. Using van der Burg's (2008) and de Paoli's (2009) theses, it is found that upstream farmers are willing for the restoration to take place and the downstream farmers are willing to pay for the service delivery. Although the economic feasibility study shows that the total discounted economic benefits of the restoration only outweigh the total costs in the best-case scenario, this study does not capture all the economic benefits of the restoration and furthermore, underestimates the true value of the improved watershed services. The underlying reason for this is the unavailability of scientific information and simplified economic assumptions and valuation methods.

1. EVALUATION OF ECOSYSTEMS

Human existence is totally dependent on the health of ecosystems. Function analysis, the process whereby ecosystems' functions and internal complexities are translated into a range of ecosystem goods and services which either directly or indirectly affects humans, is needed so that economic valuation can take place (de Groot, 2006:175). This means

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that the two disciplines of ecology and economics need to work hand in hand (Bockstael *et al*, 1995:144).

There are four main categories of ecosystems' functions and since this article focuses on the Baviaans catchment, the functions (regulating, supporting, provisioning and information) will be demonstrated in terms of watershed services. The regulatory functions of watersheds include the provision of 'free gifts' such as the retention, storage, purification and supply of fresh water (van der Burg, 2008:11). These functions provide the basis for human life and its survival; and safeguard the health of the essential life support systems, including the regulation of hydrological flows such as ground water recharge as well as natural hazard mitigation and erosion control (de Groot *et al*, 2002:395 and de Paoli, 2009:4).

Ecosystems' supporting (or habitat) function provides the natural conditions for refuge and reproduction of all plant and animal species. The maintenance and preservation of habitats is a prerequisite for the supply of ecosystem goods and services and hence, this function only affects humans indirectly (de Groot *et al*, 2002:400).

The provisioning function refers to the photosynthesizing and nutrient processes which are necessary to create the carbohydrate structures which supply ecosystem goods (de Groot *et al*, 2002:395). The use of biotic resources provides humans with edible plants and animals, medicines and materials with which to either consume directly (for example: fish or fruit) or with which manipulate in order to create some new good (for example: timber) (MA, 2003:57). In the case of this research, provisioning functions relate to the delivery and availability of water.

The information function encompasses aesthetic, cultural and spiritual services varying from cultural and historic information to scientific education and insight into human evolution (de Groot *et al*, 2002:397).

a. Importance of Valuation

Economists are often criticised for trying to put a value on nature and on natural ecosystems, however, every time a choice is made or a trade-off is implied, valuation of that ecosystem has taken place (Costanza *et al*, 1998:68). Ecosystems' contribution to the social and economic wellbeing of society is revealed through the valuation of ecosystem goods and services; thereby highlighting how ecosystems are critical to human welfare and human life and revealing their relative importance (Pritchard *et al*, 2000:36).

Economists recognise market failure as a driving cause for ecosystem degradation and this is because most ecosystem services are public goods and are therefore provided for free (Wertz-Kanounnikoff 2006:5). In the rare occasions where ecosystem services are in fact traded and ascribed a price, this price is often underpriced as it does not capture the true social costs and benefits of that service (MA, 2003:131). It is hoped that the economic valuation of ecosystems will lead to the optimal use of ecosystems and that this value will signal their true and relative scarcity, condition and importance (Daily *et al,* 2000:395).

Valuation is critical in facilitating and guiding informed social decisions (Toman, 1998:59). When there are conflicting demands and needs for the ecosystems, valuations can be used to guide decisions, by assessing the relative impacts of all alternative options (Bishop *et al*, 2004:18). Valuation, not only identifies who the major stakeholders are, but also exposes how and why ecosystem services are used and through quantifying the importance of ecosystems, it alerts stakeholders to the consideration that human consumption of natural capital often surpasses the carrying capacity of ecosystem goods and services (Blignaut and Aronson, 2008:12).

Through economic valuation, opportunities arise where incentive and market based mechanisms can be used to finance conservation and restoration. Novel ideas are desperately needed to finance conservation, as limited work can be done with the diminishing funds. Incentive based schemes such as Payments for Ecosystem Services (PES) or specifically Payment for Watershed Services (PWS), is capable of mobilising new support, especially in the private sector (Wunder, 2006: 23). Economic valuation needs to ensure that the benefits brought about by the restoration are greater than the costs, in order to warrant an economically viable project.

b. Baviaans catchment

The Baviaanskloof River supplies about 20% of the water to the Kouga Dam which in turn supplies water to the Gamtoos valley and the Nelson Mandela Metropolitan Municipality (NMMM) (Jansen, 2008:14). The degradation of the Western Baviaanskloof is therefore not only damaging on site but furthermore, has detrimental repercussions for the Kouga Dam and the downstream users (de Paoli, 2009:19). Figure 1 provides a schematic drawing of the Gamtoos valley and illustrates the linkages between the Baviaans catchment and the downstream users.

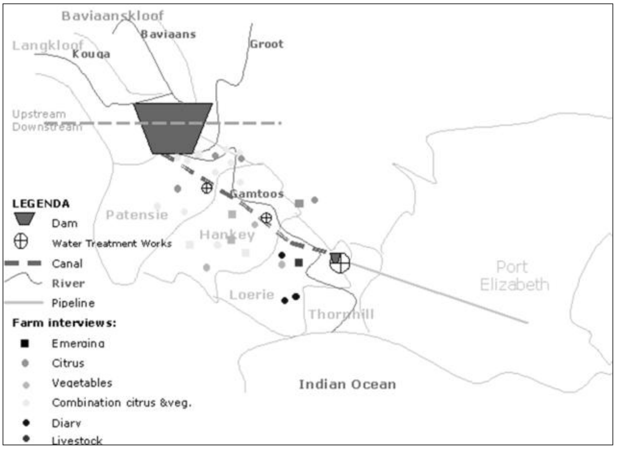

Figure 1: A schematic drawing of the Gamtoos valley. Source: (van der Burg, 2008:7)

The research concentrates on the subtropical thicket restoration of the Baviaans catchment and thus the watershed services provided by this catchment need to be discussed. This paper deals with both upstream and downstream users and so the Baviaans catchment services associated by both groups will be discussed. Table 1 clearly illustrates the benefits obtained from ecosystems in the Baviaans watershed.

Through the evaluation of ecosystem services, the major stakeholders are identified. In the case of the Western Baviaanskloof, there are 15 upstream farmers (only 11 participated in interviews) and the two communities of Zaaimanshoek and Sewefontein who depend on the watershed services (de Paoli, 2009:9). The Kouga Dam supplies water to an estimated 250 farmers in the Gamtoos valley, NMMM and the towns of Hankey and Patensie, which fall under the Kouga Municipality and the Loerie Dam (van der Burg:2008:20).

Table 1: Watershed services provided by the Baviaans catchment both on site and downstream (adapted from de Paoli, 2009:30 and van der Burg, 2008:11)

	Direct use on site	Indirect use on site	Direct use downstream	Indirect use downstream
PROVISIONING				
Fresh water	✓		✓	
Crop & Food production	✓		✓	
Livestock production	✓			
REGULATING				
Natural hazard mitigation or disturbance regulation		✓		✓
Hydrological regimes: groundwater recharge and discharge.		✓		✓
Erosion protection or control: retention of soils		✓		✓
Sediment supply and regulation		✓		✓
Water purification: pollution control and detoxification	✓			✓
Buffer runoff		✓		
Soil water infiltration		✓		
INFORMATION				
Landscape aesthetic		✓		

Evaluation of the watershed services is important because it increases beneficiaries' awareness and appreciation for the ecosystem. The restoration of the thicket vegetation and the watershed catchment can only be sustainably managed when the true value of the services is understood (De la Flor, 2008:19). Economic valuation is important when faced with conflicting land uses and this is prevalent in the Western Baviaanskloof whereby current livestock farming activities could potentially be in conflict with the Baviaanskloof Mega Reserve Project which envisages moving towards environmentally friendly tourism (eco-tourism) and sustainable wildlife management (de Paoli, 2009:20). In order to make informed decisions and compare proposals, the economic valuation of ecosystem services is critical.

Restoration of the Baviaans catchment will lead to improved provisioning and regulatory services and these improvements are evaluated. The economic valuation of the improved watershed services for the downstream users is essential as it serves as a negotiation basis for the implementation of an incentive based mechanism, PWS (van der Burg, 2008:12). It is necessary to describe the benefits of the restoration in monetary terms so that they can recognize the value of restoration and be willing to pay for it.

Ecosystem services are not used efficiently or sustainably due to market failure and therefore the true benefits and costs are not taken into account. In the case of the supply of water for upstream farmers, water is undervalued at R0.008/m^3 for irrigation and is free for livestock and domestic consumption and downstream farmers pay R0.18/m^3, which is little compared to the R0.53/m^3 fee that the urban dwellers of NMMM pay. (De la Flor, 2008:53 and van der Burg, 2008:57). The communities of Zaaimanshoek and Sewefontein do not pay anything because South African law insists that household water is free to rural households (De la Flor, 2008:53). Undoubtedly, the market price of water does not capture the true value of water.

c. Water

Water is a crucial commodity to South Africa and its scarcity makes it highly tradable (Turpie *et al*, 2008:789). South Africa is heavily dependent on her neighbouring countries for the supply of surface water and the shortage of this commodity has huge development constraints to the region. The high costs involved in the maintenance and engineering of supply side systems means that it is essential to find innovative and different possibilities. In a situation where water is scarce and the health of the catchment has an impact on the supply and security of water, there is a potential market for the preservation of the catchment (Turpie *et al,* 2008:789). The supply of water is often seen as an "umbrella service" for other conservation objectives and that through the PWS scheme, the restoration and preservation of other ecosystem goods and services can be achieved. The supply of water is often chosen as an "umbrella service" because it is relatively easy to identify and define the advantages of the service and because financing mechanisms are often already established in the form of water bills (Turpie *et al,* 2008: 795).

Water is a scarce commodity in the Baviaanskloof and the Gamtoos valley and the livelihoods of the inhabitants are heavily dependent on it for their farming activities and for domestic consumption. Rainfall is erratic, and on average they receive 300mm annually and this forms the main source of water for the Baviaans catchment as it does not receive substantial groundwater inflow (Jansen, 2008: 41-42). Water shortages in the region are likely to increase due to an increase in future demands. Presently, irrigated agriculture in the Baviaanskloof consists of an estimated 468ha and this gives rise to a total of approximately 1.75 million m^3/year of water (Jansen, 2008:36-37). Agriculture in the Gamtoos valley has more extensive irrigation and therefore demands a higher quantity of water. Farmers in the area experience water constraints and cannot cultivate their desired quantity of crops as only 45-47million m^3 is delivered from the dam per year (Jansen, 2008:39). The NMMM is the largest domestic user of water and this is expected to expand due to an anticipated increase in its population. The domestic water consumption in Sewefontein and Zaaimanshoek is a fraction of the irrigation usage and the towns of Patensie and Hankey are below their given water quotas (Jansen, 2008:39-40).

The health of the Baviaans catchment affects the supply and the quality of water and therefore restoration of the catchment will bring hydrological benefits to downstream users. The degraded thicket diminishes the infiltration capacity from 60% of an intact site to 0.6% at a degraded site and this has far reaching consequences (van der Burg, 2008:27). Flash floods carry a high sediment yield and an increased infiltration rate, caused by restoration of the thicket, decreases the peak discharge and decreases the extreme runoff and erosion. The restoration therefore protects the areas in the Baviaanskloof to some extent and this is important because, due to climate change, rainfall is likely to become more intense and irregular in the future (van der Burg, 2008:28). The reduced sediment yield will decrease turbidity, improve water quality and increase water supply to downstream users. It is important to note that this increase in water supply is due to decreased sediment and not because of increased runoff volume. The impact of thicket restoration on runoff is uncertain and in the case of this research, it is assumed that thicket restoration has a positive effect on water runoff (van der Burg, 2008:26-28). It is possible to create a market for conservation as it is clear that the state of the Baviaans catchment has an effect on the water supply and quality downstream and therefore bring hydrological benefits to the downstream users. Nevertheless, the unknown hydrological effect of restoration on water supply is a major drawback as the true economic benefits cannot be quantified.

2. ECONOMIC VALUATION OF RESTORATION BENEFITS

It is necessary to translate the hydrological impacts into economic benefits, therefore presenting a monetary value to the downstream beneficiaries. A cost-benefit analysis can also be performed once economic valuation has taken place.

a. Direct market valuation

Direct use values usually include goods and services provided by the provisioning functions of ecosystems, such as consumptive items which include the production of food, timber for fuel or construction or plants used for medicinal uses (de Groot *et al,* 2002:404). Direct use values incorporate goods and services from information functions such as recreational areas and places linked with tourism. (Bishop *et al,* 2004:9) The exchange value of these goods and services are usually easily obtained because these goods are traded within an existing market (Winkler, 2006:84). The valuation of increased water supply and security fall under the direct market valuation because there is an existing market for water.

Increased water supply

Given that there is no scientific evidence regarding the increase in the supply of water, some crude assumptions were made. Van der Burg (2008:63) hypothesised that the increase base flow rate would be equal to the increase in the infiltration rate and therefore the amount that would be extracted by nature and humans is ignored. These amounts are given in table 2. The scenarios represent the different percentages of the watershed restored and the additional water supply is negative in the worst case scenario because of the high evapo-transpiration rate.

Table 2: Estimated additional water supply and its value at different restoration scenarios. Source: (adapted from van der Burg 2008:62)

Scenarios	Additional water supply	Value of additional water supply
Worst (0.24%)	-1624.6m³/y	-R584.856/y
Medium (0.94%)	8685.8m³/y	R3126.89/y
Best (1.88%)	65090.1m³/y	R23432.44/y

The additional value of water is based on the market value of water. The water price for additional irrigation, also known as the capital value of water, is R2.93/m^3 (van der Burg, 2008:41). Dairy farmers usually take part in long-term trading as they need the additional water for their production. The annual rental value on the other hand is R0.23/m^3 and the current downstream agricultural water price is R0.18/m^3 (van der Burg, 2008:41). This would be the price of water if it was allocated for production and made available for renting. Van der Burg used the average price of raw water sales in the Gamtoos valley (R0.36/m^3 to value the increased water supply and this can be seen in table 2. It should be noted that these prices do not incorporate the full economic value of water and therefore the economic benefit of increased water supply is underestimated.

If there was an open market, the most economically efficient way to allocate this water would be to base it on the economic 'crop water productivity' (cwp) indicator. The indicator is the net production value per unit water consumed which is measured by multiplying the gross yield produced with the market price of that production and then subtracting the total production costs (van der Burg, 2008:56). Based on the cwp, the market value for water would be R6.02/m^3. This price is a better reflection of the economic value of water, but is of course highly subject to the market prices of the different crops.

The economic valuation of the increased water supply depends on how the additional water is allocated. It is thought that the additional water will either be stored in an ecological reserve or it allocated to emerging farmers (van der Burg, 2008:63). Given that the allocation depends on political decisions, van der Burg assumed that the additional water would be used to increase the supply assurance (stored in Kouga dam).

Increased water security

Due the above assumption and the additional water saved by reduced overflow from the Kouga Dam, there will be an increased availability of water in the Kouga dam, leading to an increase in water assurance and security. A higher assurance of water supply means there would be less frequent and shorter periods of restriction as well as lower drought intensity. Van der Burg (2008:44) assumed restoration would lead to a 10% decrease in curtailment levels and this in turn would lead to an increase in 5% supply assurance. The annual value of extra water supplied would be the extra water supplied multiplied by the raw water price and this would be:

2.98million m^3 (extra water supplied for irrigation) * R0.18 = R536 700 and

0.10million m^3 (extra water for urban) * R0.18 = R52 100.

In order to avoid double counting, these values were excluded by van der Burg as it was felt that they had already been recorded in the evaluation of increased water supply.

In order to establish an economic value of improved water security, the production factor method should be adopted as it represents the change in future production costs and benefits (van der Burg, 2008:13). However, the change in farmers' management practices was only qualitatively recorded and no quantitative figure was established. Farmers said that they would increase their production, plant more high yielding crops and invest in crops with higher input costs if there was higher water security. Presently, farmers either choose to plant low value crops in times of drought or they retain the surplus water rights to use in times of droughts; however the vulnerability does vary between farming sectors (van der Burg, 2008:45).

It must be reiterated that these valuations are based on simplistic scientific estimates and market prices and therefore do not denote the true economic benefits. Efforts should be made to quantify the change in farming production practises so that increased water assurance can be measured. However, care needs to be taken as a range of factors, other than water assurance, also influence farmers' production decisions.

b. Indirect market evaluation

Indirect use values of ecosystems are derived from goods and services which are used as inputs in the intermediate production for the final goods and services. (MA, 2003:133). These goods and services fall under the regulatory and habitat functions provided by ecosystems, such as carbon sequestration and water regulation (de Groot *et al,* 2002:404).

There are often no explicit markets for these goods and services or market prices do not capture the true value of the ecosystems and thus alternative methods need to be used (Bishop *et al,* 2004:11). The services of flood and drought protection, decreased sediment yields and water purification fall under this category.

Flood and drought protection

The improved watershed services will lead to a reduction in the damage caused by floods. Seeing as though there is no market for the regulatory service of flood protection, van der Burg (2008:48) measured the economic value using the avoided damage/cost approach. This approach entails calculating an economic cost for the damages that occur after a flood and then advocating that the cost would not be incurred or would be substantially less when the "flood control service of the Baviaanskloof watershed was improved" (van der Burg 2008:14).

The economic cost was based on the 2007 flood and through interviews with 26 farmers, van der Burg (2008:48) learnt that the damages came to over R2 065 700. This included lost farm area, lost production area as well as the cost of broken fences and destroyed roads. This amount was extrapolated for the 65% of Gamtoos valley which amounted to R10million. Only 65% of the respondents in the Gamtoos valley claimed they had suffered damage from the flood, although it should also be mentioned that there is a high variability in vulnerability and therefore not all farmers face damages to the same degree. The flood protection service of the improved watershed is therefore valued at R10million.

Van der Burg (2008:49) adopted the same method to evaluate the drought protection service and the data was based on the 2005-2006 drought. It was discovered that 42% were adversely affected by drought restrictions and the economic cost of the damages amounted to R4 462 000. Costs involve missed revenue (from not planting crops due to drought); lost profit (costs of having to buy feed and rent water rights) and partly unrecovered fixed costs (fixed costs spread among less area). Some respondents claimed that they benefited from the drought and this is because the vegetable market price rose (van der Burg, 2008:50). Had these benefits been quantified, they would have to have been subtracted from the damages. Hence, the economic value of the drought control service comes to R4 462 000.

Decreased sediment yield

The economic value of decreased sediment yield can be assessed by valuing the additional annual dam storage due to decreased sedimentation. Using the proposition that 1.5ton of sediment is equal to $1m^3$ of lost water storage and the knowledge that the cost of dredging is $R15/m^3$, the economic valuation of decreased sediment yield can be calculated.

Table 3: Mitigation cost of decreased dam sedimentation at different restoration scenarios. Source: (adapted from van der Burg, 2008)

Scenarios	Reduced Sediment Yield	Additional Storage Capacity	Economic value of decreased sediment
Worst (0.24%)	1.5 tons	$1.0m^3$	R15/y
Medium (0.94%)	24.1 tons	$16.1m^3$	R241.0/y
Best (1.88%)	100.4 tons	$67.0m^3$	R1004.3/y

The economic value of decreased sediment yield is insignificant; and it does not seem economic viable to even include these calculations. The core of this problem lies in the uncertainty of scientific evidence and therefore these figures are merely rough calculations. Again, it is recommended that further scientific data is collected as valid results cannot be attained until scientific data is reliable.

Improved water quality

The decreased sediment yield also improves the quality of the water and it can be seen that there is a positive relationship between the high levels of turbidity and the treatment time and costs (van der Burg, 2008:52). A crude cost ratio was developed by van der Burg (2008:63) to determine the cost of treatment because this cost will indicate the economic value of improved water quality as a result of decreased sediment. It is recommended that a superior cost ratio is constructed. Table 5 highlights the results.

Table 4: The economic costs of water treatment express the economic value of improved water quality. Source: (van der Burg, 2008:62)

Scenarios	Raw water treatment costs
Worst (0.24%)	R646.8/y
Medium (0.94%)	R10 348.4/y
Best (1.88%)	R43 118.1/y

c. Feasibility

The costs of restoration was not in the scope of this research, nevertheless, using van der Burg's (2008) Unit Reference Value (URV) results, which are founded in a cost-benefit framework, the economic feasibility of the restoration can be assessed. Van der Burg (2008:64) compared the economic benefits to the total cost of the restoration, using discounted net present benefits and net present costs. The 'medium' scenario represents the most plausible case suggests that R2.10 is required to produce R1 of total benefits. This shows that the costs of restoration outweigh the benefits. The 'best case' scenario suggests that R0.35 is required to produce R1 of total benefits (van der Burg, 2008:64). The benefit of carbon sequestration credits, which has not been discussed in this paper, needs to be included to make the project viable at least in the best scenario.

The on-site economic benefits have not been quantified and therefore a true economic comparison cannot be performed. A lack of scientific data and quantification difficulties mean that there are economic benefits that have also been excluded from the study. These include the health spillover effects from improved water quality as well as the unknown impact that restoration has on water supply. This implies that the economic valuation underestimates the true value of the watershed services. It is also proposed that the benefits of alien clearing are incorporated into the economic feasibility study as the hydrological benefits and thus economic benefits are easily attainable and thought to be significant.

Blignaut and Aronson (2008:15) have also questioned the usage of positive discount factors. In the case of this study a discount factor of 8% and 12% was used for the 'medium' and 'best' scenarios respectively. A positive discount factor implicitly assumes that benefits brought about in the future are increasingly worth less over time. The opposite is true for the benefits brought about by the restoration as they will gradually increase over time. It would be worth using a negative discount when valuing the economic benefits as the more an ecosystem is restored, the more people will benefit from it and therefore the more people would be willing to pay. Blignaut and Aronson (2008:15-16) state that the cost of restoration today is always likely to be less than the future as the cost of restoration will continue to increase the more degraded the ecosystems become.

Nevertheless, economic valuation is merely a negotiation platform in the implementation of PWS and seeing that economic benefits can be acquired, a PWS should be explored.

3. PAYMENT FOR WATERSHED SERVICES

Payments for Ecosystem Services (PES) involve voluntary transactions where landowners are compensated for adopting land management practises that secure the supply of ecosystem services (Perrot-Maitre 2006:6). A contract is made between the supplier of the ecosystem services and the buyer of the ecosystem service. The user pays the provider on condition that the ecosystem service is secured (Wertz-Kanounnikoff 2006: 4). It is derived from the Coase theorem which states that in a free market, in which clearly defined property rights are established, bargaining between two parties will ensure an efficient outcome (Kosoy *et al*, 2007:446). Like the applications of the Coase theorem, PES is more workable when there are a limited number of parties or groups involved in the negotiation process.

There are five characteristics which describe PES and these were provided by Wunder (2005:3) "A PES is

1. a voluntary transaction where
2. a well defined ecosystem service (or land-use likely to secure that service)
3. is being "bought" by at least one ecosystem service buyer
4. from a minimum of one environment service provider
5. if and only if the environmental service secures the service provision."

A voluntary transaction signifies that a PES scheme should arise from a negotiated arrangement rather than from being enforced on landowners and beneficiaries (Kosoy *et al,* 2007:447). In the case of the Baviaanskloof, the ecosystem services in question are watershed services and therefore it is called a Payment for Watershed Services (PWS). The possible PWS scheme in the Baviaanskloof has been founded in a basis of negotiations and trust among the participating parties. It has included both the landowners and future service beneficiaries in the process and therefore development is a result of their willingness to participate in the process.

It is important that the ecosystem services are well defined so that beneficiaries can observe the benefits of the change in land practises and so that they are measurable. Even though the economic valuation is sketchy, it illustrates that benefits will arise to downstream users as a result of the restoration. According to Wunder (2007:50), the benefits of hydrological services are often based on perceived rather than factual linkages and this applies in the Baviaanskloof case.

The PES approach improves the provision of indirect ecosystem services, and thus the ecosystems are given more attention when land-use decisions are being made (Wertz-Kanounnikoff 2006: 4). The crux of the matter is that it increases landowners' engagement in the restoration process and bridges the interests of conservationists and landowners (de Paoli, 2009:21). PES is based on economic incentives and thus aims at inducing landowners to change their behaviour towards more desirable land-use actions (Ruhweza and Masiga 2007:4).

It can be compared to 'polluter pays' methods and Pigouvian taxes, where industries or businesses are punished for polluting and damaging the environment; yet the difference is that PES works on a reward basis. In contrast to Pigouvian taxes, it is those who represent a threat to the service provision that can be compensated for changing their behaviour and practises (Wunder, 2005:12). It is a potentially sustainable system because, through self-interest, it generates its own funding (Pagiola, 2007). The approach is unique as it combines both demand side and supply side innovation (Wunder *et al,* 2008:350-351). Due to the conditionality that is attached to the payments for ecosystem services, the PES approach is much more cost efficient and it allocates spending more economically. All the same, the conditionality clause poses a challenge to the success of PES schemes as this means that both parties must be able to pull out of the PES agreement if the other party is not fulfilling their part of the deal (Wunder 2007:50).

Conservation is usually seen as governments' responsibilities and yet, PES allows for the parties who use ecosystem services to have a say in how they should be valued and how they should be distributed. PES is also more efficient as it is often "user-financed" rather than "government financed" (Wunder *et al,* 2008:351).

According to Kosoy *et al* (2007:446), in order for a PES system to be economically efficient it needs to ensure that the compensation of upstream landholders is at least equal to the opportunity cost of the endorsed land practices and impacts of restoration. The payment or compensation should also be lower than the economic value of the environmental service. The opportunity cost can entail the forgone net profits from land-use activities as a result of changed land-practices or it could be the landholders' willingness to accept a "fair price" (Kosoy *et al,* 2007:447). In essence, the opportunity cost is the cost involved in adopting the promoted land practices.

There have been cases in which the payment or compensation is less than the opportunity cost, thus resulting in a negative "degree of compensation." Case studies taken in Los Negros, San Pedro, Jesus de Otoro and Heredia provide evidence for this claim (Kosoy *et al*, 2007:452). The evidence challenges the economic foundation of the PES scheme, since in order for PES to be economically efficient; compensation should be at least equal to the value of forgone benefits. It can therefore be deduced that the economic valuation of the improved ecosystems is in fact not the only consideration, nor the most important, when designing and implementing a PWS. Instead perceptions, local institutions, social relations and bargaining power are deemed to be more useful inputs in the PWS design (Kosoy *et al*, 2007:454). It emphasizes the importance of the landowners' perceptions of the compensation.

d. Downstream Buyers

The contingent valuation method was used to assess whether the farmers would be willing to pay for the restoration. Contingent valuation falls under stated preference methods, often useful in gauging the value of indirect use values (Barkmann *et al,* 2008:49). Contingent evaluation involves interviewers describing a depiction of the ecosystem good or service under examination to a carefully selected sample of respondents and asking them what value they place on the good or service; however in the case of the Baviaanskloof, farmers were merely asked whether they would be willing to pay (Heal, 2000:28). Contingent valuation was used as a way to understand the farmers' attitudes and preferences for the proposed PWS.

Seventy-seven percent of the downstream farmers responded by saying that they would be willing to pay for the watershed services. Of these, 73% are interested in a higher availability of water, 65% would be willing to pay for improved water security, 58% are interested in improved quality of water and 50% would be willing to pay for a decrease in storm flow and therefore flood damages (van der Burg, 2008:34). Even though the farmers had preferences over the individual watershed services, they were satisfied with the "whole package of benefits" as they realise that the benefits are not mutually exclusive. They did not have a preference for full scientific data and this is in line with Wunder (2007:50) who stated that "perceived linkages" are often more important. The farmers are willing to pay on condition that:

1. they are included in negotiation process,
2. the process is based on trust,
3. there is clear hydrological rationale,
4. there is proof of perceived benefits
5. there is reliable service delivery

Based on the research, it would be reasonable to presume that the farmers will be willing to pay for the services, although hydrological impacts still need to be ascertained.

The 23% not willing to pay are nearly all emerging farmers and, although they would benefit from the watershed restoration (specifically from the decrease in storm flow as their farms are largely situated on the lower lands), they do not have the financial means to do so (van der Burg, 2008:35).

Gamtoos Irrigation Board (GIB) is the requested facilitator for the PWS. As the intermediary it would be GIB's job to reduce the transaction risks and costs involved. GIB is a private organisation and is a water service authority (Noirton, 2008:40-41). GIB distributes the water from the Kouga Dam for irrigation and domestic use in the Gamtoos Valley. GIB is interested to participate in, and contribute towards the restoration process as they are eager to learn about less expensive ways to increase water supply (van der Burg, 2008:65).

In order to for the PWS to be economically viable, the payment by the buyers should also be lower than the economic value of the environmental service (Kosoy, 2007:446). However, it has been shown in the feasibility study that only in the 'best case' scenario do the economic benefits of restoration outweigh the costs. It shows that the hydrological benefits are not sufficient to pay for the restoration and that the benefits of carbon sequestration and possible alien clearing, need to be included to make the 'best case scenario' viable.

A serious problem is the time lag. It has been suggested that the threshold of the ecosystem benefits will be reached after 15 years (van der Burg, 2008:77). PWS is based on a conditionality clause and therefore downstream farmer will not be willing to pay for services they only start to enjoy 15 years down the line. This is a serious problem for the economic viability of the PWS, as an upfront and initial funding is needed. It has been suggested that the Baviaanskloof state funds could be used to cover these costs and ensure the feasibility of the project. GIB is also an interested party and will possibly be able to contribute towards the restoration costs.

e. Baviaanskloof service providers

Eleven of the Baviaanskloof landowners took part in the interviewing and negotiating process. It was found that six landlords are mainly engaged in farming practices, while five are engaged in mostly tourism activities. Of the income, 56% can be attributed to farming whilst 35% to tourism (de Paoli, 2009:37).

Kosoy *et al* (2007:452) reasons that landowners are content with a "negative degree of compensation" because they perceive the payment as merely a gesture of support or a token incentive. It is therefore important to understand landowners' perceptions and preferences in order to determine what motivates their economic behaviour and to gain an understanding of their opinion of the PWS process. Using a Multiple Criteria Decision Analysis (similar to contingent ranking and rating), de Paoli (2009:22) was able to comprehend the Baviaanskloof landowners' preferences and perceptions of the restoration process as well as the different compensation possibilities.

It is remarkable that the majority of landowners were in favour of restoration regardless of the compensation possibilities. In a process whereby landowners were asked to rank the possible policy choices - the option of having no restoration scored near the bottom in most cases and 10 farmers ranked it as their lowest preference (de Paoli, 2009:60). This is in line with the argument made by Kosoy *et al* (2007:452), whereby the benefits provided by the ecosystems are appreciated by the landowners and they incorporate this awareness in their compensation. De la Flor (2008) translates the benefits brought about by the thicket services into monetary terms and it therefore makes sense that most of the landowners want the restoration to take place. De la Flor (2008:78) found that the Gross Annual Value of thicket services (excluding hydrological services) is approximately R615 760 per farmer and that contributes 61% to tourism and 39% to fodder. These represent the economic value the thicket services before the restoration process takes place; nevertheless it demonstrates the importance of thicket. It is suggested that the on-site benefits brought about by the improved Baviaans watershed should be quantified so that the total economic benefits from the restoration can be measured.

It is unsurprising that landowners support the restoration process because according to the Multiple Criteria Decision Analysis, the health of the landscape and the safeguarding of water resources are regarded by landowners as their third highest influence in making an economic decision (de Paoli, 2009:61). This means that landowners are naturally concerned for the health of the ecosystems.

Although most farmers support the restoration, the highest policy preference was that of restoration together with financial incentives. The landowners' preferred this option as they want the financial security in order to overcome the risks of undertaking the restoration process (de Paoli, 2009:58). Although no quantitative analysis of the opportunity costs experienced by the landowners was undertaken, it was established that the potential increase in flood damage (as a result of the removal of erosion walls/*keerwalle* in the restoration process) is the biggest concern and risk factor. The situation of the farms influences the landowners' perceptions of risk. Farmers who grow crops on the floodplains are more susceptible to flood damages and therefore consider restoration more of a risk. Those who do not grow on the floodplains are more indifferent about the type of compensation they are given, although the option of financial incentives was still highest (de Paoli, 2009:69). The financial implications of the flood damages are not recorded and it is suggested that this takes place to help with the quantification of the payments.

De Paoli (2009:71) found that a marketing plan to promote tourism was ranked as the second best overall policy option as the payments do not necessarily have to constitute financial compensation. It is widespread thought that the farming sector in the Baviaanskloof cannot be expected to grow (especially not with degraded landscape, diminishing water availability and rising input costs); however tourism is seen as a viable alternative for the region. However, an increase in tourism can also have negative impacts due to concerns that it would increase the number of visitors and therefore change their current lifestyle (de Paoli, 2009:72).

A suggested payment would include part financial, with the rest of the funds being invested into a tourism marketing plan. Another possibility could be to use the funds to stimulate tourism growth and investment in the tourism sector (de Paoli, 2009:76). Ghazoul *et al* in de Paoli (2009:77) suggests the creation of a landscape labelling system and this would be focussed on both agricultural and local products.

4. CONCLUSION AND RECOMMENDATIONS

Through contingent valuation, it has been shown that the downstream farmers are conditionally willing to pay for the watershed services. Even though the research has focused on the Gamtoos valley farmers, parties such as GIB and potentially the NMMM could also be interested "buyers," and therefore the economic benefits that arise to them need to be assessed. The economic valuation has proved to the downstream farmers that there are economic benefits from the improved watershed services and this therefore corresponds with the conditionality clause. All the same, in order to make the valuation more accurate, more scientific information is needed, especially on the impact that restoration has on increased water supply. The valuation of water supply was also based on the average raw water price and therefore does not capture the true economic benefits. A better method needs to be established to measure improved water assurance, as this was excluded from the calculations for fear of double counting. A ratio for the cost of water treatment needs to be created as the method used was rudimentary (van der Burg, 2008:71). It can only be assumed that the compensation that the farmers are willing to pay will be in line with the true economic benefits they receive. The time delay of 15 years poses a serious threat to the success of the PWS as farmers will not be willing to pay for services they have not received. A source of initial funding is needed to combat this problem.

Upstream landowners in the Western Baviaanskloof are also willing to be compensated and it can be assumed that the payment will be equal to their opportunity cost of changing land practices because at this stage they are willing to accept a 'fair price' to cover the perceived costs. The opportunity costs that the farmers will incur needs to be quantified, so that the economic efficiency of the PWS can be established. De Paoli (2009) discovered that the upstream landowners support the restoration regardless of compensation and therefore the payments can be seen as a 'show of support' (Kosoy *et al*, 2007:452). Even so, the farmers would prefer financial incentives to help cover the risk involved with the restoration. It has been suggested that financial incentives go together with a tourism plan or a landscape labelling scheme as this will help diversify the landowners' income and is in line with the Baviaanskloof Mega Reserve Project.

The economic feasibility study, whereby the discounted net present benefits were compared to the total costs of restoration, shows that the restoration is only economically viable in the best-case scenario. However, as discussed, this does not include the total true economic benefits because, for example, the benefits that the upstream farmers will incur have not been determined. It is suggested that these benefits are quantified so that a true comparison and economic feasibility study can take place. The spillover effects including employment and health effects also should be quantified to determine a more precise sum of the total economic benefits of the restored watershed. The chosen positive discount value is also questionable and it is suggested that a negative discount value is used.

Dialogue and negotiations should continue as a Payment for Watershed Services is a promising way to address sustainability and finance the restoration of the Baviaans catchment. Further quantification and scientific data is critical before a true economic analysis can be undertaken.

5. REFERENCES

BARKMANN, J, GLENK, K, KEIL, A, LEEMHUIS, C, DIETRICH, N, GEROLD, G and MARGGRAF, R., 2008. Confronting unfamiliarity with ecosystem functions: The case for an ecosystem service approach to environmental valuation with stated preference methods. *Ecological Economics*. 65, 48-62.

BOCKSTAEL,N, CONSTANZA, R, STRAND,I, BOYTON,W, BELL,K and WAINGER,L.,1995. Analysis: Ecological economic modeling and valuation of ecosystems. *Ecological Economics.* 14, 143-159.

BISHOP, J, PAGIOLA, S and VON RITTER, K., 2004. World Bank Assessing the Economic Value of Ecosystem Conservation. *The World Bank Environment Department Paper* 101: 1-33.

BLIGNAUT, J and ARONSON, J., 2008. Getting serious about maintaining biodiversity. *Conservation Letters*. 1: 12-17.

BLIGNAUT, J, ARONSON, J, MANDER, M and MARAIS, C.,2008. Investing in Natural Capital and Economic Development: South Africa's Drakensberg Mountains. *Ecological Restoration.* 26, 2: 143-150.

COSTANZA,R ,d'ARGE, R, de GROOT,R , FARBER,S, GRASSO,M, HANNON,B, LIMBURG,K, NAEEM,S, O'NEIL,R, PARUELO,J, RASKIN,R, SUTTON, P and van den BELT,M.,1998. Special Section: Forum on Valuation of Ecosystem Services The value of ecosystem services: putting the issues in perspective. *Ecological Economics* 25, 67–72.

DAILY, G and MATSON, P., 2008. Ecosystem Services: From theory to implementation. *Proceedings of the National Academy of Sciences.* 105, 28: 9455-9456.

DE GROOT, R, WILSON, M and BOUMANS, M., 2002. Special Issue: The Dynamics and Value of Ecosystem Services: Integrating Economic and Ecological Perspectives: A typology for the classification, description and valuation of ecosystem functions, goods and services. *Ecological Economics.* 41, 393–408.

DE GROOT, R., 2006. Function-analysis and valuation as a tool to assess land use conflicts in planning for sustainable, multi-functional landscapes. *Landscape and Urban Planning* 75, 3-4: 175–186.

DA LA FLOR TEJERO, I., 2008. *Valuation of the Goods and Services provided by the Thicket Ecosystem in the Western Baviaanskloof, South Africa* Unpublished MSc. Environmental Sciences thesis. Wageningen University.

DE PAOLI, G., 2009. *Options for a Payment for Watershed Services Scheme: A case study in the Western Baviaanskloof, South Africa.* Unpublished report part of Water for Food and Ecosystems. Wageningen University.

ENGEL, S, PAGIOLA, S and WUNDER, S., 2008. Designing payments for environmental services in theory and practice: An overview of the issues. *Ecological Economics.* 65, 663-674.

HEAL ,G., 2000. Valuing Ecosystem Services. *Ecosystems.* 3, 1: 24-30.

JANSEN, H., 2008. *Water for Food and Ecosystems in the Baviaanskloof Mega Reserve Land and water resources assessment in the Baviaanskloof, Eastern Cape Province, South Africa*. Alterra-report 1812. Wageningen University.

KOSOY, N, MARTINEZ-TUNA, M, MURADIAN, R and MARTINEZ-ALIER,J., 2007. Payments for environmental services in watersheds: Insights from a comparative study of three cases in Central America. *Ecological Economics.* 61, 446-455.

MILLENIUM ECOSYSTEM ASSESSMENT (MA).2003 *Ecosystems and Human Well-being* Washington: Island Press.

NOIRTIN, E., 2008. *Analysis of stakeholder interactions and involvement in thicket restoration, Western Baviaanskloof, South Africa Who is willing to restore and why?* Unpublished thesis. Wageningen University.

PAGIOLA., 2007. *Payments for Environmental Services: From Theory to Practice.* Unpublished Global Workshop on Payments for Environmental Services, Indonesia. Environment Department, World Bank

PERROT-MAÎTRE, D., 2006. *The Vittel payments for ecosystem services: a "perfect" PES case?* International Institute for Environment and Development. London, UK.

PRITCHARD, L, FOLKE, C and GUNDERSON, L., 2000. Valuation of Ecosystem Services in Institutional Context. *Ecosystems.* 3, 1: 36–40.

RUHWEZA, A and MASIGA,M., 2007. *Institutions for Payments for Environmental Services; Challenges and Opportunities in Uganda.* Unpublished paper prepared for the 9th BIOECON Conference. Cambridge: Kings College.

TOMAN, M., 1998. Special Section: Forum on Valuation of Ecosystem Services: Why not to calculate the value of the world's ecosystem services and natural capital. *Ecological Economics.* 25, 57–60.

TURPIE, J, MARAIS, C and BLIGNAUT, J., 2008. The working for water programme: Evolution of a payments for ecosystem services mechanism that addresses both poverty and ecosystem service delivery in South Africa. *Ecological Economics.* 65, 788-798.

VAN DER BURG, L. 2008. *Valuing the benefits of restoring the water regulation services, in the subtropical thicket biome: a case study in the 'Baviaanskloof-Gamtoos watershed', South-Africa* Unpublished MSc. Environmental Economics and Natural Resources thesis. Wageningen University.

WERTZ-KANOUNNIKOFF.,2006. Payments for environmental services – A solution for biodiversity conservation? *Idées pour le débat n°12/2006, Iddri.*

WUNDER, S.,2005. *Payments for environmental services: Some nuts and bolts.* Centre for International Forestry Research (CIFOR) Occasional Paper No.42.

WUNDER, S., 2006. Are Direct Payments for Environmental Services Spelling Doom for Sustainable Forest Management in the Tropics? *Ecology and Society.* 11, 2: 23.

WUNDER, S.,2007. The Efficiency of Payments for Environmental Services in Tropical Conservation. *Conservation Biology*. 21, 1: 48-58.

WUNDER,S, ENGEL,S and PAGIOLA,S.,2008. Taking stock: A comparative analysis of payments for environmental service programs in developed and developing countries. *Ecological Economics*. 65, 834-852.