Payment for Ecosystem Services Pilot Project: The Fowey River Improvement Auction

Final Report

Submitted to the Department for Environment, Food and Rural Affairs

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The Fowey River Improvement Auction - Final Report

Report prepared for the Department for Environment, Food and Rural Affairs

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# The Fowey River Improvement Auction - Final Report

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EXECUTIVE SUMMARY

This document reports on a pilot Payment for Ecosystem Services (PES) project funded by South West Water in the catchment of the River Fowey in Cornwall. The scheme looks to fund capital investments on farms that will serve to improve water quality in the River Fowey. South West Water indicate that reducing pollution at source rather than investing in engineering solutions to treat polluted water downstream has a benefit-cost ratio of some 65 to 1.

This report follows and documents the process of designing and implementing that PES mechanism. It also provides an evaluation of the successes and failures of that process with the intention of providing insights into issues that might arise in developing PES schemes more generally across the UK.

The PES scheme in the Fowey was part of South West Water’s Upstream Thinking Initiative. As part of that initiative, the Westcountry Rivers Trust had been charged with distributing money to farmers for capital investments delivering water quality improvements in certain strategically important catchments. The process by which that distribution had been effected was through the efforts of Westcountry River Trust’s expert farm advisors. Those advisors would search the catchment visiting farms in an attempt to identify projects eligible for funding through the scheme. Where projects were identified, farmers were offered a fixed-price deal in which South West Water would pay 50% of the costs of the capital investments.

In implementing Upstream Thinking in the Fowey catchment, Westcountry Rivers Trust teamed-up with the University of East Anglia in order to explore alternative ways in which a PES mechanism could be operationalised. Two big questions motivated that exercise; (1) could an auction mechanism be used to distribute the funds to farmers? and (2) could other purchasers be encouraged to contribute funds to be distributed through the PES scheme?

The auction designed by this partnership had a straightforward design. In the first place, all farmers in the Fowey catchment were contacted and provided with a list of capital investments eligible for funding under the scheme. Farmers were asked to enter bids indicating which of those were required by their farm business and the grant they would need from South West Water to proceed with the investment. For each bid, an environmental improvement score was calculated based on how greatly the proposed project would improve water quality. The auction simulates competition between farmers by only funding bids that offer the best value for money for South West Water. In this case, ‘value for money’ was determined by dividing a bid’s environmental improvement score by the grant request.

The Fowey River Improvement Auction opened for bids on 20th August 2012. Six weeks later and following three rounds of bidding the auction closed on 26th September 2012. As far as the authors of this report are aware, this was the first example of a reverse auction being used in a PES mechanism of this type in the UK. The auction had £360,000 of funds to distribute but was considerably oversubscribed, receiving bids for £776,000 of investment. The project has demonstrated that an auction-based PES mechanism can successfully distribute funds to farmers for investment in capital items that improve water quality.

Comparison with the fixed-price mechanism used previously in the distribution of Upstream Thinking funds indicates that the auction significantly increases the efficiency with which funds are allocated to projects: that is to say, the auction offers greater environmental
improvements for every pound spent than an alternative fixed-price scheme offering to pay half of the costs of capital investments. In particular, the Fowey River Improvement Auction delivered between 20% and 40% better value for money than the fixed-price alternative.

In addition, in comparison to a scheme in which farm advisors identify projects for funding, an auction mechanism that encourages farmers to propose their own projects offers savings in administration costs and extends the possibility of participating in the scheme to a wider constituency. On the other hand, the advisor-led mechanism has advantages in simplifying participation for farmers and in allowing accurate definition of the particular projects that should be funded. This evidence suggests that the two mechanisms are best employed in rather different situations;

- **Advisor-Led PES Mechanisms** are to be preferred when an advisor’s expert judgement is needed on the ground to distinguish between diverse projects whose benefits differ according to site-specific considerations. In addition, advisor-led mechanisms are likely to fare best where the scale of the scheme is small and where advisors have good local knowledge with which to target farms likely to yield good investment opportunities.

- **Auction-based PES Mechanisms** are to be preferred in distributing funds when the benefits of investments can be estimated reasonably accurately without site-specific knowledge. Auctions also have a considerable advantage in that they scale-up with relatively little additional cost. Accordingly, an auction might be preferred for large scale schemes, particularly where there is little detailed local knowledge of a region through which farms can be effectively targeted.

Hybrid schemes that incorporate elements of both an auction and the on-site intervention of an expert advisor may be appropriate in many circumstances.

An original objective of the project had been to explore the possibility for encouraging other organisations to engage in the auction so as to provide additional streams of revenues to that provided by South West Water. In the event that aspiration did not come to fruition, though a central objective of the research programme remained studying the possibilities for developing and implementing a multiple-purchaser PES mechanism.

Through a series of theoretical and experimental investigations, the project explored some of the issues in developing PES mechanisms that allow for multiple purchasers. Those investigations revealed that without specific attention to how such a mechanism overcomes incentives to free-ride it is likely that participation will be limited to the single purchaser who stands to gain most from the actions being funded through the scheme. One route forward is to create an institution within which potential purchasers can make binding commitments to contributions decided upon in a process of negotiation.

The Westcountry Rivers Trust engaged with a range of organisations across the Fowey to ascertain whether they had interests contributing to a PES mechanism that paid farmers to improve land management practices. That research revealed that across that range of organisations awareness of how they might be benefited from such a scheme was very low. None of those contacted expressed an interest in participating in such a scheme.

It appears that the only near-term possibility for a multiple-purchaser PES mechanism in the Fowey would be one that brought together already existent funding streams; particularly government funds (e.g. from stewardship schemes, flood alleviation schemes or the Forestry Commission) with those provided by South West Water.
1 INTRODUCTION

1.1 Ecosystem Services and Payment for Ecosystem Services

The idea of nature as ‘service provider’ has established itself as a useful characterisation for understanding the role the environment plays in the economy and how environmental issues should be prioritised in policy-making. That characterisation is summarised in Figure 1.1; actions or events can bring about changes in the flow of ecosystem services and those outcomes have direct impacts on the welfare of consumers and producers in the economy.

![Figure 1.1: The Ecosystems Services Paradigm](image)

Much effort has been exerted in attempting to understand the natural processes delivering ecosystem services and to quantify the changes in benefits that result when those ecosystem service flows change (National Ecosystems Assessment, 2011). Of course, quantifying the relationships between ecosystem services and benefits flows is only one part of the story. In order to operationalise the ecosystems service paradigm a second fundamental question must be addressed; how do we motivate actors to do the actions that deliver beneficial changes in ecosystem service flows. One possible model for that delivery mechanism is Payment for Ecosystem Services (PES).

As shown in Figure 1.2, The PES model recognises the fact that in many circumstances changes in ecosystem service provision result from the actions of individuals or organisations in the economy. We shall refer to those individuals or organisations as ecosystems service providers. PES envisages a mechanism whereby the consumers and producers that might benefit from enhanced ecosystem service flows directly pay these providers to take the actions that precipitate that enhancement.

In essence, PES is simply an extension of the standard market mechanism for service provision to that of ecosystem service provision. The key difference with those standard markets is that with ecosystem service provision, the actions of the service provider tend to be remote from the receipt of benefits by the purchaser. While markets are likely to spring up naturally where the relationship between action and benefit is clearly defined (for example, in getting a mechanic to service your car, or having a dentist treat your toothache) that is unlikely to be true for ecosystem service provision where those relationships may be separated in both space and time by complex and possibly stochastic natural processes.

For that reason, many of the PES mechanisms that have been developed thus far have been the outcome of interventions by government agencies making payments to ES providers.
using public funds (e.g. the BushTender Scheme funded by the Victorian State Government, the Georgia Irrigation Reduction Auctions funded by the Georgia State Government).

Figure 1.2: The Payment for Ecosystem Services Model

In contrast, relatively few PES mechanisms have been developed on the initiative of the private sector. One rare example is the scheme set up by the mineral water manufacturers Perrier-Vittel to pay farmers in the Vosges Mountains of north-eastern France to reduce diffuse pollution (Perrot-Maitre, 2006).

This document records the design and implementation of another private sector PES initiative. In this case the PES mechanism has been developed on the behest of a large regional water company, South West Water. Not unlike the Perrier-Vittel example, the scheme seeks to make payments to farmers in certain strategically important catchments so as to change their agricultural practices. Those changes are designed to deliver improvements in river water quality such that the company can avoid extra expenses in purifying the water they abstract to supply households and businesses across the region.

South West Water indicate that pursuing a scheme that reduces pollution at source rather than investing in engineering solutions to treat polluted water downstream has a benefit-cost ratio of some 65 to 1.\(^1\) Accordingly, the case for intervention for the company is quite clear

cut. The key question that this document addresses is how a PES mechanism might be designed to put the scheme into operation.

1.2 PES Mechanism Design

As illustrated in Figure 1.3 the design of PES mechanisms is not a straightforward task. For example, frequently a provider might be able to undertake one or more of several different actions. In the case of the farmers that South West Water wishes to engage in a PES mechanism, those actions might include making capital investments such as installing adequate slurry storage or fencing stock out of river courses. Alternatively those actions could be changes in operational activities such as limiting the levels of applications of pesticides or fertilisers. The big question for the PES mechanism designer is which actions should be prioritised for payment through the scheme.

![Figure 1.3: Issues in PES Mechanism Design](image)

The answer to that question depends to a large extent on how greatly each action is likely to deliver improvements in ecosystem service flows and that in turn will depend on many factors such as the location in which the action is taken and the current conditions at that location. In the case of farmers in South West Water, for example, fencing stock out of rivers may be a top priority, but the value that action delivers will depend on the quantity of stock that are excluded and where in the catchment that exclusion takes place.
A further complication in paying some outside agents to undertake actions that deliver ecosystem service flows is that there have to be practical ways of monitoring that those actions have been or are being performed. For example, a big issue with water quality is the spreading of slurry on fields during wet conditions. A PES mechanism could be designed to pay farmers to not spread slurry during certain times of the year. Of course, monitoring whether farmers are complying with such arrangements is extremely hard. In contrast, investing in a new slurry store that ensures a farmer has enough storage to see them through the wet months of the year is an easily verifiable action. Accordingly, which actions are included within a PES mechanism must also pay attention to the question of monitoring of compliance.

To complicate things further, it is often the case that there are many different providers capable of delivering actions. In the South West Water case, all of the farmers in the company’s strategic catchments could potentially undertake actions that would benefit water quality. Of course, some of those farmers, say those farming along the river near to the company’s abstraction point, are likely to be of greater concern than others, say those farming up in the headwaters. Accordingly, a PES mechanism must usually have some procedure for selecting which of the many potential providers to target with funding.

Another key decision in PES mechanism design is in establishing how much different providers should be paid for undertaking actions to deliver ecosystem services. Payments might be in the form of some set of fixed or discriminating prices. They might be individually negotiated with each provider. They might be established in a competitive market or through a bidding mechanism such as an auction. Also the mechanism designer has to decide whether those payments should be simply for actions or whether they should be related to the outcome in terms of delivery of ecosystem services or possibly some combination of both.

Finally, it may be the case that more than one group or organisation benefits from the increased flows of ecosystems services brought about by providers taking actions. If that is the case, then a PES mechanism might be designed that sought to elicit contributions from all those beneficiaries.

1.3 South West Water and the Upstream Thinking Initiative

South West Water provides water for Devon and Cornwall as well as parts of Dorset and Somerset. South West Water has 82 licensed abstraction points across the region; the vast majority of which are reservoirs and rivers. The company incurs substantial costs in treating water abstracted from those sources. Given the predominantly rural nature of the region, a key source of pollution problems for South West Water is the agricultural sector. Accordingly, as part of the 2009 pricing review, South West Water obtained permission from OFWAT to invest £9.1 million in a programme of works addressing pollution problems at source. That pilot scheme is known as the Upstream Thinking Initiative.

To deliver one strand of that programme, South West Water teamed up with the Westcountry Rivers Trust. Provided with a budget totalling £3.26 million over three years, the Trust were charged with identifying and implementing water-improvement projects that could be undertaken on farms in four of South West Water’s strategic catchments; the Tamar, Roadford, Wimbleball and the Upper Fowey.

One limitation of the funding provided by South West Water was that it came from their capital expenditure budget. Accordingly, any investments made through the scheme would
have to be associated with items of physical, non-mobile capital that could be ascribed to the company’s capital assets.

1.4 Advisor-Led PES Mechanism

To allocate the Upstream Thinking funds, Westcountry Rivers Trust developed a mechanism which drew on their long experience of offering tailored, one-to-one advice to farmers, particularly advice outlining the steps farmers could take to reduce the environmental impact of their farming activities. The Trust employs a number of highly experienced farm advisors for the purpose of providing that sort of advice and it was these farm advisors that were the key players in turning the Upstream Thinking Initiative into an operational PES mechanism.

When starting work in a new catchment, Westcountry Rivers Trust’s farm advisors would head out into the region to talk directly to individual farmers. The process by which farmers were targeted was somewhat ad hoc; the advisors drew on their local knowledge to target those who they thought might have need of investments or they simply cold-called a selection of farmers in the catchment. In the Roadford, a relatively small area, the advisors tried to make contact with each and every farmer in the catchment.

Once a farmer has been targeted, an advisor would pay a half-day visit to the farm and subsequently prepare a “farm report” for the farmer. That report was confidential and described all the improvements that the farmer could make to their farm management practices in order to reduce their environmental impact. The report covered a variety of topics; it pointed out where farmers are in risk of breaching environmental regulations, tried to identify “win-wins” where some change in practices could improve farm profitability, directed farmers to various funding sources (e.g. HLS, ELS, FFIS, CSF Capital Fund etc.) and identified capital investments that were needed on the farm to reduce impacts on water quality.

As part of the report, Westcountry Rivers Trust would offer to help pay for those capital investments that were eligible for funding under the Upstream Thinking Initiative. While early on in the programme, the level of contribution was decided through a negotiation between farmer and advisor, the Trust soon settled on a system where contributions were offered at a fixed rate of 50% of the capital costs of the investment. Some flexibility remained in the system inasmuch as the percentage contribution could be increased if the farmer also agreed to take on certain operational changes designed to reduce water pollution; for example, a farmer might additionally agree to restrict stocking rates to the limits set by Defra for Nitrate Vulnerable Zones.

A farmer who wished to accept the Trust’s offer would then have to collect 3 quotes for the construction of that item. Westcountry Rivers Trust reviewed those quotes to ensure that they were “reasonable” and would then agree with the farmer which to take forward. Those quotes along with the farm report, evidence of necessary consents, the completion invoice, before and after photographs and the signed contract were bundled up in an “evidence folder” that was lodged with South West Water for auditing and as proof of their investment.

The farmer (and possibly the freeholder of the farm land), South West Water and Westcountry Rivers Trust would then sign a contract relating to the capital investment project. That contract detailed, amongst many things, how the farmer was to spend the money and included as “On-going Obligations” any operational changes agreed to by the farmer. The
length of the contract related to the “lifetime” of the capital. So the contract for a new slurry pit would be 25 years, but that for new fencing only 10 years. The length of time of operational changes could be fixed within this contract as being the full length of the contract or for some shorter period. For larger, long term investments the farmer may also have had to attach a covenant to the land deeds. That covenant stipulates that any future owner of the farm must also adhere to the terms of the contract.

The advisor-led PES mechanism has a number of distinct advantages. In particular;

- Individual farmers were approached directly, so participation in the scheme was not dependent on farmers taking the initiative.
- Farmers’ involvement in the scheme was mediated by a farm advisor familiar with the local circumstances. The procedure was personalised and local.
- Trained farm advisors were able to assess the specific conditions on each farm and recommend the particular capital investments that were likely to offer the greatest improvements in river water quality.

Despite those obvious merits, the advisor-led procedure also suffers from certain limitations;

- The procedure is advisor intensive, relying on advisors to both identify which farms to approach and what investments should be made. That level of advisor input is costly especially when considering scaling-up such schemes to run over a large region.
- Generally, it is not practical for advisors to visit all the farms in a region. This means that not all farms are necessarily given an opportunity to benefit from funding from the scheme.
- Grants are offered sequentially according to the order in which farms are visited. Accordingly, really important projects may not be funded if the budget is exhausted before those farms are visited. The set of all possible projects is not compared simultaneously so as to ensure that the limited funds are directed only to those projects offering the best investment opportunities.
- Grants are determined according to the cost of the project; farmers are generally offered a standard 50% of the costs of the capital works. That procedure does not, however, recognise the water quality improvements that might come from a particular capital investment nor the financial situation of any particular farmer. Accordingly, important investments may be passed over because a farmer is unable or unprepared to commit to a 50% contribution. Likewise, less important investments may be funded at 50% when farmers may be prepared to contribute significantly more to the capital items.

One of the key motivations of the project recorded in this report was to investigate whether an alternative allocation mechanism could be developed that could overcome some of those short-comings.

1.5 Auction-based PES Mechanism

In late 2011, Westcountry Rivers Trust were beginning to consider how to implement the Upstream Thinking Initiative in the last of their four catchments; the River Fowey (see Figure
1.4). The River Fowey originates high on Bodmin Moor and runs through a mostly agricultural landscape for about 30 miles until it reaches the sea. In its headwaters South West Water maintains two reservoirs, Colliford and Siblyback Lakes. Those lakes are mostly used for storing water that is released by the water company at times of low flow so as to maintain levels of abstraction at their water treatment plant situated just north of Lostwithiel. The Fowey is of particular importance to South West Water since it is the source of the vast majority of water for the County of Cornwall.

Figure 1.4 The Fowey Catchment North of Lostwithiel

In planning how to implement Upstream Thinking in the Fowey, the Westcountry Rivers Trust teamed-up with academic economists from the University of East Anglia. After considerable debate, it was decided that the Fowey provided an opportunity to trial an alternative PES mechanism. The mechanism chosen for investigation was that of an auction. As far as the research team are aware this was the first time such an auction-based PES mechanism had been implemented in the UK.

The auction-based mechanism contrasted with the advisor-led mechanism in a number of respects;
In an auction mechanism, all farmers are contacted and asked to propose projects for funding and indicate the grant required to undertake that work. Projects are then assessed simultaneously, with those offering the best value-for-money receiving financing.

Compared to the advisor-led procedure, the auction process places far greater emphasis on farmers to initiate participation in the scheme and to propose capital investment projects that deliver on water quality improvements. Whether farmers are both capable and motivated to identify appropriate projects is one of the key research questions for the pilot.

With the auction process, the level of grant is not fixed but determined by competitive pressures. Again, an important research question is how effective competition is in driving down the levels of grant requests.

At the same time, the Westcountry Rivers Trust had been working locally and more widely to ascertain whether other organisations or groups might stand to gain from improvements in water quality in the River Fowey. The hope at the outset was that some of those groups might be brought into the PES mechanism to provide additional streams of revenues to that provided by South West Water. In the event that aspiration did not come to fruition, though a central objective of the research programme remained studying the possibilities for developing and implementing a multiple-purchaser PES mechanism.

1.6 Objectives of the Research

The key objectives of the Fowey Payment for Ecosystem Services (PES) pilot project were threefold;

(1) To design and implement a reverse auction for PES in the catchment of the River Fowey in Cornwall.

(2) To compare that auction-based mechanism to an advisor-led mechanism implemented in other catchments

(3) To explore, in the context of the Fowey scheme, the issues that would arise in extending a PES mechanism so as to allow the participation of multiple purchasers.
2 THE FOWEY RIVER IMPROVEMENT AUCTION

Following a week of open meetings introducing and explaining the scheme, the Fowey River Improvement Auction opened for bids on 20th August 2012. Six weeks later and following three rounds of bidding the auction closed on 26th September 2012.

The auction was the culmination of six months of intensive work in which the teams from the Westcountry Rivers Trust and University of East Anglia explored a myriad of possible designs in an attempt to arrive at a mechanism that would work as a functioning auction, but would also be practical to implement in the field.²

2.1 Auction Design

Fundamentally, the Fowey River Improvement Auction had to provide a mechanism through which the funds made available by South West Water could be allocated to farmers in return for those farmers taking actions that improve water quality in the River Fowey. In deciding exactly how that end should be achieved, at the outset, three key principles were agreed upon to guide the design of the auction:

- **Fairness**: The auction needs to achieve the goal of improving river water quality in a way that is both acceptable to farmers and delivers value for money for South West Water. To meet those two, sometimes conflicting, objectives requires the auction to be designed so as to:
  - encourage farmers to enter credible bids that provide them with reasonable but not inflated returns.
  - select only those bids offering the best ‘value for money’ in terms of the trade-off between bid cost and the level of water quality improvement delivered.

- **Truthfulness**: The Fowey River Improvement Auction must not knowingly provide respondents with false or deliberately misleading information. In addition to the intrinsic desirability of truthfulness, the auction has the added responsibility of pioneering this form of PES allocation mechanism in the UK. Accordingly, it is important that the auction does nothing to undermine farmers’ trust in such auction mechanisms.

- **Simplicity**: Since none of the participating farmers will be familiar with this auction format, the Fowey River Improvement Auction must, wherever possible, err on the side of design simplicity

The rules of the final auction format are provided in Appendix A and summarized in Box 2.1. Buried in those rules are a number of important design decisions. In the following we review key elements of the auction design and justify those decisions.

² In that process the teams received invaluable input from, amongst others, Professor John Rolfe and Dr Jill Windle from the Central Queensland University, Professor Jeff Bennett from the Australia National University and Professor Alistair Munro from the National Graduate Institute for Policy Studies in Japan.
Box 2.1: Summary of the Rules of the Fowey River Improvement Scheme

Participants
- Farmers and land managers with management control over eligible farms (henceforth, farmers) will be able to apply for grants for capital investments under the scheme.
- Farms eligible for funding comprise active agricultural land holdings in the Fowey catchment that are upstream of Lostwithiel and greater than 15 ha (37 acres) in size.

Funding
- South West Water have provided a fixed budget of £360,000 for distribution as grants to farmers through the Fowey River Improvement Scheme.
- The budget will be allocated through a competitive bidding process in which farmers will enter bids for funding for capital works.
- By entering a bid in the scheme farmers qualify for a £50 participation fee whether their bid is successful or not.

Bids
- Farmers will construct their bids by identifying the capital investments required on their farm, then proposing the size of grant that they would like from the scheme as a contribution to the cost of those capital works.
- Only certain capital works will be eligible for funding through the scheme. Those capital works must be new investments that improve river water quality. The scheme will co-fund (but not double fund) investments part-funded from other sources.
- A list of eligible capital items will be provided to farmers on the bid form that they will be asked to complete in order to submit a bid.
- The scheme will pay up to, but no more than, 100% of the actual cost of those capital works with a maximum grant for any one farm of £50,000.
- Farmers may also include in their bids commitments to make particular changes to their FMPs. Committing to such changes for a duration of 5 years will increase the chances of a bid securing funding.

Bid Evaluation
- Bids are evaluated on the basis of value-for-money, with bids offering higher value-for-money being considered for funding before bids offering lower value-for-money.
- A bid’s value-for-money is calculated using a formula that takes account of the size of the grant request, the type and quantity of capital works, the commitments to change FMPs and a farm’s location in the catchment.
- All else equal, farmers can improve the value-for-money of their bid by reducing the grant requested, offering to undertake a larger quantity of eligible capital works or committing to more eligible changes in FMP.
- To receive funding, bids must exceed a pre-set minimum value-for-money threshold.
• Successful bids will be identified by ordering bids from that providing the most value-for-money down to that providing the least. Starting at the top of the list and working down, affordable bids will be accepted for funding up until the point at which the budget is exhausted or the threshold value-for-money is reached.

The Bidding Process

• Bids are entered in the scheme by filling out the secure online bid form available on the scheme website or by completing a paper version and entering this by post.

• Bidding in the scheme will take place over a six-week period, divided up into three rounds with farmers receiving feedback between rounds on the likely success of their bid.

<table>
<thead>
<tr>
<th>Round</th>
<th>Opens</th>
<th>Closes</th>
<th>Feedback Sent</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Mon 20th Aug, 00:00</td>
<td>Wed 29th Aug, 23:59</td>
<td>Fri 31st Aug</td>
</tr>
<tr>
<td>2</td>
<td>Mon 3rd Sep, 00:00</td>
<td>Wed 12th Sep, 23:59</td>
<td>Fri 14th Sep</td>
</tr>
<tr>
<td>3</td>
<td>Mon 17th Sep, 00:00</td>
<td>Wed 26th Sep, 23:59</td>
<td>Fri 28th Sep</td>
</tr>
</tbody>
</table>

• Farmers can bid, or revise a previous bid, up to once in each round. If a farmer does not submit a revised bid in a round, then their bid from the previous round remains active.

• At the end of the 3rd round all active bids will be evaluated and successful bids identified.

Follow-up, contracts, covenants and payment

• Farmers will be informed whether their bid has been accepted and will be sent a follow-up questionnaire to complete. On returning the completed questionnaire, farmers will be sent £50 as a participation fee irrespective of the success of their bid.

• Successful bidders will be visited by a WRT farm advisor to verify the content of their bid and begin the

• Farmers will be asked to collect three independent quotes for the capital works and to proceed with that offering the best value.

• The maximum payment received from the scheme will be the grant requested in the bid but may be lower if the capital works are less expensive than anticipated.

• Farmers will sign a contract with WRT and South West Water where the conditions and duration of that contract are determined by the nature of the capital works.

Action or Outcome-Based Payments

A fundamental design decision concerned whether the payments that farmers would receive if they were successful in the auction were to be paid according to actions or outcomes (Gibbons et al., 2011).
An outcome-based design would make the payment a farmer received conditional on the levels of improvement in water quality resulting from that farmer’s actions. Such a design had the clear advantage of ensuring South West Water only paid for verified improvements in water quality. It also raised a number of serious difficulties;

- The technology for monitoring the independent contribution of one farmer to changes in water quality is not available in the River Fowey.
- Water pollution outcomes are highly variable depending not only on farmer actions but also on a variety of stochastic natural processes. As a result, farmers would have only limited control over the levels of payments they might receive. A mechanism where payments are unpredictable is likely to discourage farmer participation.

For these and other reasons, an outcome-based auction was rejected as being impractical for the Fowey River Improvement Auction.

Accordingly, in the Fowey River Improvement Auction the payment received by a farmer relates to their commitment to undertake certain actions (e.g. installing capital items or changing farm management practices). An actions-based auction overcomes some of the limitations of the outcomes-based design;

- Monitoring is simplified since the object in need of verification is observable (e.g. installation of capital item or changes in management practices).
- Payments are non-stochastic greatly reducing the risk perceived by the farmer in participating in the auction.

An actions-based auction has at least two important implications;

- **Outcome Risk**: In an actions-based auction South West Water would pay farmers for actions that have the potential to deliver water quality improvements. That, of course, is relatively riskier for South West Water since those payments are made independent of the level of improvement in water quality experienced in reality.
- **Additionality Risk**: The possibility exists that farmers might bid in the auction for actions that they planned to do irrespective of payment from South West Water. Clearly such payments would yield no additional improvements in water quality.

An important design priority for the Fowey River Improvement Auction was to minimise South West Water’s exposure to these risks.

**Capital or Operational Actions**

Two qualitatively different types of action could be undertaken by farmers in order to deliver water quality improvements in the Fowey;

- **Capital Investments**: Farmers could install certain types of on-farm capital; for example by increasing slurry storage facilities or by erecting fencing to keep stock out of rivers.
- **Operational Activities**: Farmers could change their farm management practices; for example by not cultivating river banks to create buffer strips or by reducing fertiliser and pesticide applications.
Neither capital nor operational actions were seen as inherently more advantageous in terms of the improvements they could deliver. The Fowey River Improvement Auction was constrained, however, in one major regard; it had to function within the restrictions dictated by South West Water’s funding. In particular, in accordance with the stipulations of the regulator, payments South West Water made through the scheme had to come from their Capital Expenditure budget and hence had to be linked to the purchase of (non-mobile) items of farm capital.

Early on in the project, a design was considered in which the focus of bids was for commitments to undertake operational activities (particularly limiting pesticide and fertiliser use). To comply with the funding restrictions, those payments would have to be made in the form of farm capital investments. In that design, the particular form of those investments was not considered overly important since the investments were merely the vehicle through which the farmer would be paid for changing their operational activities.

Ultimately the operational activities design was shelved when it became clear that such an auction would likely encourage considerable adverse selection. In particular, farming practices in the Fowey are quite diverse; some dairy farmers, some arable farmers, some organic farmers etc. And of those farmers, some will be doing relatively more to control water pollution and others relatively less. For any particular operational commitment there would likely be a significant proportion of farmers for whom making that commitment entailed little or no cost. So, for example, committing not to use the harmful pesticides used by arable farmers is no cost to dairy farmers. Likewise, dealing with slurry properly is no cost to arable farmers. Accordingly, the lowest bids in the auction would be received from those farmers for whom the commitment meant no changes in farming. If definitive information were not available on each bidder’s farming type, then those low bids would likely be selected for funding despite them offering very little in the way of water quality improvements. Alternatively, if information were available to discriminate between farmers of different types then complex rules would have to be introduced to define who is entitled to bid on which operational commitment.

In contrast, a capital-focused auction provided far greater certainty over additionality. Compared to operational activities, it would be far easier to verify the need for a capital item, to confirm that that item was currently not on a farm, to check that it had been constructed or installed and to monitor its on-going existence.

As part of the Upstream Thinking Initiative, Westcountry Rivers Trust’s farm advisors had been active in farms across the Upper Tamar, Roadford and Wimbleball catchments identifying projects for investment. Those projects had funded a large variety of different capital investments. One of the first steps in implementing the Upstream Thinking Initiative as an auction in the Fowey was attempting to simplify that diversity into a succinct set of clearly defined types of capital investment. Those types had to be sufficiently precisely defined that farmers could clearly distinguish which capital investments were relevant for their particular situation. At the same time, the number of types of investment could not be so prolific as to overly complicate the bidding process.

The tension between those two counteracting requirements was not easily resolved. After considerable effort, 12 types of capital item were defined. Those can be seen listed on the front of the Bidding Form depicted in Figure 2.1a. Within those types, however, it was clear that there was a diversity of investments with very different characteristics. For example, the
“update slurry storage” included a variety of investments that could apply to a number of different types of slurry storage. Likewise, the “separate dirty from clean water” covered a multiplicity of investments from bunds across roads to new guttering on barns.

One immediate observation is that an auction format for a PES mechanism is much more readily amenable to a situation in which the focus is constrained to one or a few well-defined actions (e.g. capital investments) by the provider. In the Fowey River Improvement Auction the lack of precision in the definition of the items made it considerably more difficult to make accurate assessments of the relative merits of different bids.

While payment was constrained to investments in capital items, another objective of the project was to investigate the possibilities for getting farmers to simultaneously commit to changes in their farm management practices. Indeed, a novel feature of the auction was that it allowed farmers to augment their bids by committing to take on one or more of three Farm Management Packages (see back of bid form in Figure 2.1b) for a duration of 5 years.

The packages focused on practices that improved nutrient, pesticide and watercourse management respectively. By signing up to a package, farmers increased the competitiveness of their bid in a manner to be explained subsequently. This element of the auction provided a means by which operational activities could be tied in to an auction that was focused on the installation of capital items. It also provided a means by which farmers in relatively more constrained financial positions could register competitive bids.

**Monitoring and Enforcement**

One considerable advantage of having the auction focus primarily on capital items is that monitoring of compliance becomes less problematic. In particular, payment can be withheld until documentary evidence is presented proving that capital items funded through the scheme have been properly installed or constructed.

The auction adopted most of the legal apparatus developed by the Westcountry Rivers Trust for their previous work on the Upstream Thinking Initiative. In particular, all farmers would be required to sign a contract with Westcountry Rivers Trust and South West Water before payments under the scheme could be made. Those contracts stipulate that, for the duration of the contract, the capital items purchased would have to be used for the agreed purpose, be properly maintained and insured against damaged. The contract length would depend on the particular capital item; 25 years for more substantial longer-lived investments (e.g. slurry storage, roofing) and only 10 years for shorter-lasting capital items (e.g. fencing and concreting).

Farmers committing to one or more farm management packages would have those commitments added as a clause to the contract. Apart from this legal stipulation, however, no further mechanisms were created to ensure on-going compliance with those operational commitments.

Finally, to ensure that South West Water’s investments would be maintained for the duration of the contract, grants of over £5,000 would require a covenant being added to the land deeds of the farm property. That covenant would require future land owners and/or land managers to abide by the terms of the contract.
Figure 2.1a: Front Page of the Bid Form

Fowey River Improvement Scheme
Summer 2012

Bidding Form

To enter a bid in the Fowey River Improvement Scheme, please complete ALL THE STEPS on this form. Alternatively, complete the online form on the scheme website. Before completing this form you should familiarise yourself with the rules of the scheme. For help in filling out this form refer to the "Quick Guide to the Scheme" document.

### STEP 1: Complete the NECESSARY column with: "Yes" if item is needed; "Some" if need more; "No" if have sufficient; "N/A" if item is irrelevant for your farm.

### STEP 2: Review the CONTRACT terms for each item identified as 'needed' in STEP 1. Use the UNITS shown, to fill in the QUANTITY for which funding is sought.

### STEP 3: Provide an ESTIMATED COST for each item identified in STEP 2 using either the suggested UNIT COSTS or drawing on your own information.

### STEP 4: Sum the estimated costs for all items, add a 5% contingency to give the ESTIMATED COST OF THE CAPITAL WORKS for which funding is sought.

<table>
<thead>
<tr>
<th>CAPITAL ITEM</th>
<th>CONTRACT</th>
<th>QUANTITY</th>
<th>UNITS</th>
<th>UNIT COSTS</th>
<th>ESTIMATED COST</th>
</tr>
</thead>
<tbody>
<tr>
<td>Update slurry storage</td>
<td>25 years</td>
<td>n/a</td>
<td>buckets</td>
<td>£550</td>
<td>£</td>
</tr>
<tr>
<td>New manure storage</td>
<td>25 years</td>
<td>m³</td>
<td>£80</td>
<td>£</td>
<td>£</td>
</tr>
<tr>
<td>Roof slurry/ manure/silage</td>
<td>25 years</td>
<td>m²</td>
<td>£60</td>
<td>£</td>
<td>£</td>
</tr>
<tr>
<td>Separate dirty/clean water</td>
<td>25 years</td>
<td>m</td>
<td>£ you estimate cost</td>
<td>£</td>
<td>£</td>
</tr>
<tr>
<td>Cover feeding/collecting area</td>
<td>25 years</td>
<td>m²</td>
<td>£60</td>
<td>£</td>
<td>£</td>
</tr>
<tr>
<td>Overwintered cattle facility</td>
<td>25 years</td>
<td>m²</td>
<td>£80</td>
<td>£</td>
<td>£</td>
</tr>
<tr>
<td>Pesticide wash-down area</td>
<td>10 years</td>
<td>units</td>
<td>£4,000</td>
<td>£</td>
<td>£</td>
</tr>
<tr>
<td>Concrete track /yards</td>
<td>10 years</td>
<td>m²</td>
<td>£50</td>
<td>£</td>
<td>£</td>
</tr>
<tr>
<td>Watercourse fencing</td>
<td>10 years</td>
<td>m</td>
<td>£5</td>
<td>£</td>
<td>£</td>
</tr>
<tr>
<td>Troughs and pipework</td>
<td>10 years</td>
<td>units</td>
<td>£200</td>
<td>£</td>
<td>£</td>
</tr>
<tr>
<td>Livestock crossing /drinking</td>
<td>10 years</td>
<td>points</td>
<td>£500</td>
<td>£</td>
<td>£</td>
</tr>
<tr>
<td>Re-site or stored gateways</td>
<td>10 years</td>
<td>gates</td>
<td>£300</td>
<td>£</td>
<td>£</td>
</tr>
<tr>
<td>Other (describe below)</td>
<td>10-25 years</td>
<td>£ you estimate cost</td>
<td>£</td>
<td>£</td>
<td></td>
</tr>
</tbody>
</table>

Contract terms:
* Use for agreed purposes, maintain and insure
* Must comply with SEFF regs & have EA consent
5% contingency: £

ESTIMATED COST OF CAPITAL WORKS: £
**The Fowey River Improvement Auction - Final Report**

**Figure 2.1b: Back Page of the Bid Form**

<table>
<thead>
<tr>
<th>PACKAGE</th>
<th>FARM MANAGEMENT PRACTICE (FMP)</th>
<th>STATUS</th>
<th>CONTRACT</th>
<th>INCLUDE PACKAGE IN BID</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Nutrient Management Package</strong></td>
<td>Soil test all fields over 2ha, twice over a 5 year period</td>
<td></td>
<td>5 years</td>
<td>YES/NO</td>
</tr>
<tr>
<td></td>
<td>Ensure 5 months slurry/manure storage for stocking units</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Rough cultivate maize within 24 hours post harvest</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Only grow maize varieties that can be harvested before mid October</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Plant grass reseeds only in the spring or summer</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Incorporate slurries and manures within 24 hours of application on bare soils and stubbles</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Have and implement a RB209 nutrient management plan</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Pesticide Management Package</strong></td>
<td>Use an BACCS approved pesticide contractor for in field spraying</td>
<td></td>
<td></td>
<td>YES/NO</td>
</tr>
<tr>
<td></td>
<td>Use a PA1 and PA6 certified operator for in yard spraying</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Ensure adequate protected pesticide storage</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Designate an appropriate wash down area</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Establish a 5m watercourse pesticide buffer for all spraying</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Have and implement a pesticide waste management plan</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Watercourse Management Package</strong></td>
<td>Exclude livestock from all watercourses (except drinking/access points &amp; moorland streams)</td>
<td></td>
<td></td>
<td>YES/NO</td>
</tr>
<tr>
<td></td>
<td>Ensure 5m watercourse buffer on slopes (≥5°) arable field ≥ 2ha</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Have and implement a hill grazing/feeding management plan</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>1</th>
<th>ESTIMATED COST OF CAPITAL WORKS</th>
<th>£</th>
<th>2</th>
<th>GRANT REQUESTED</th>
<th>£</th>
<th>3</th>
<th>PERCENTAGE GRANT RATE</th>
<th>%</th>
</tr>
</thead>
</table>

**Declaration:**
I confirm that I have read the rules of the Fowey River Improvement Scheme and declare that the information provided in this bid form is true and complete, and understand that any false statement or omission may result in my exclusion from the scheme.

Signed: ___________________________ Date: _______________

**Return bid form to:** Fowey River Improvement Scheme, CSERGE, School of Environmental Sciences, UEA, Norwich, NR4 7TJ.

**Direct Queries to:** Westcountry Rivers Trust on 01579 372 140

**Stephen Thinking**

A South West Water Initiative

UEA INVESTIGATION
Budget

The budget was fixed at £360,000. This was the figure that had been allocated for investment in the Fowey catchment as a result of discussions between Westcountry Rivers Trust and South West Water at the start of the Upstream Thinking Initiative and well before the idea of running an auction in the Fowey had been conceived.

The project team debated whether this budget should be revealed to farmers participating in the auction. Revealing the budget, it was argued, might deter participation if farmers’ felt that the pot was not large enough for them to entertain a serious chance of winning funding. On the other hand, revealing the budget would ensure that farmers were aware that the pot of money available for funding was meaningfully constrained and discourage inflated bids. Ultimately, the latter argument prevailed.

Bidding Rules

The advisor-led mechanism implemented by Westcountry Rivers Trust in other catchments in the region had offered a fixed rate investment of 50% of the costs of capital works. That 50% figure is typical of capital grant schemes in the agricultural sector. In allowing for bids of up to 100% of costs, the Fowey River Improvement Auction represented a significant departure from that precedent. The reasoning behind that decision was quite straightforward. The key argument for using an auction-based mechanism is that it removes the necessity for a fixed rate for investments. In particular, competition between participants in the auction does the job of keeping bids low, while the mechanism can widen participation by admitting the possibility of funding worthwhile investments in which the farmer requires greater than 50% of costs.

Of course, opening the auction up to 100% bids risked the funds being allocated to just a very small number of farmers. To avoid that eventuality, it was also decided that grants paid out from the auction would be capped at a maximum of £50,000.

Coverage

Under an advisor-led mechanism, coverage of the scheme is limited to those farmers that are approached by an advisor. Again a key purpose of trialling an auction was to explore a mechanism allowing for much greater coverage. Accordingly, it was agreed that all farmers active in the Fowey (with the exception of those on very small holdings) should be invited to participate in the auction.

Sealed or Open Bids

In accordance with the majority of PES auctions implemented previously (e.g. the EcoMarket Tender scheme in Victoria Australia, the Georgia irrigation auctions in the United States), the Fowey River Improvement Auction was run as a sealed bid auction. It is generally argued that sealed bid auctions promote participation, are less prone to collusion and make it significantly more difficult to bid strategically. On the other hand, lack of information regarding the level of bids being posted in the auction may reduce competitive pressures in the auction. We shall return to consider how that issue was addressed in the subsequent discussion of ‘bidding rounds’.

Uniform or Discriminatory Pricing

Auctions may use a uniform price or discriminatory price format and these two formats have quite different incentive properties.
**Uniform price** auctions pay a fixed price to all successful participants, where that price is usually determined by the bid of the marginal bidder (i.e. a Vickery auction). This format encourages bidders to truthfully reveal the minimum amount they would need to be paid to take a particular action.

**Discriminatory price** auctions pay successful participants exactly what they bid. This format encourages bidders to shade up their offers, particularly those that believe they have a competitive advantage since they can deliver the action at relatively lower costs.

It cannot be predicted with certainty whether a uniform price or a discriminatory price auction will deliver more environmental improvement for a fixed budget (Schilizzi and Latacz-Lohmann, 2012). In this case, it was decided that the Fowey River Improvement Auction would be run as a discriminatory price auction. The reasons for that decision were as follows;

- **Additionality Risk**: Discriminatory pricing provides some protection against the additionality risk. In a uniform price auction, farmers for whom the cost of undertaking some action is low (perhaps because they intended taking that action already) might get a high payment despite offering very little additional benefit. Alternatively, provided it is difficult for farmers to second guess the value of their action to South West Water, discriminatory pricing should help encourage reasonably low bids from these farmers.

- **Transparency**: With discriminatory pricing, farmers either get what they said they wanted or get nothing. Since it was anticipated that farmers would find the auction mechanism quite unfamiliar, that feature had some advantages over a uniform price auction. In particular, the amount a farmer would get paid if they were successful in the auction would be clear to them from the moment they bid. There would be no confusion concerning how the payment amount was determined and no disappointment that might have arisen if the uniform price had turned out to be lower than anticipated.

**Bidding Method**

The auction was designed to run through two media; bids could be registered by post or through a secure bidding facility on a custom-designed website. There were considerable advantages to receiving bids through the online facility. In particular, those bids could be pre-checked by the software for completeness and errors ensuring only valid bids were entered by participants. In addition, bids through the website could be processed automatically reducing the need for administrator time in handling paper bids received through the post. All the same, it was deemed necessary to allow for postal bidding since it was not at all clear how many of the farmers in the Fowey had internet access. In the end, those fears proved well founded, the majority of bids received arrived through the post.

**Bid Selection Rule**

While the auction format was discriminatory (farmers would be paid what they bid), success in the auction was not determined simply by selecting those making the lowest grant request rate; that is, those who asked for the smallest percentage of the costs of the proposed works. Rather each bid was given an environmental improvement score according to how greatly the proposed project would contribute to improvements in water quality. Accordingly, bids were evaluated on the basis of a value-for-money measure calculated by
dividing the environmental improvement score for a bid by the quantity of money requested as a grant from South West Water.

Another novel feature of the auction is that it allowed farmers to augment their bids by committing to take on one or more of three Farm Management Packages (see back of bid form in Figure 2.1b). The packages focused on practices that improved nutrient, pesticide and watercourse management respectively. By signing up to a package, farmers received additional points on their environmental improvement score and hence increased the competitiveness of their bid.

While the original intention had been to use spatially explicit models to devise the environmental improvement scores, it became evident that no model existed with the sophistication to accurately score the detailed projects being proposed by different farmers in the auction. Instead an expert-determined scoring method was developed with the help of Westcountry Rivers Trust’s team of experienced farm advisors. Those advisors had been assessing and overseeing the implementation of hundreds of farm capital investment projects across the region and were well placed to judge the relative merits of different types of project on different types of farm. The input of the farm advisors was formalised into a formula that returned an environmental score for any proposed project. Amongst other things, that formula took account of:

- The particular capital works proposed in the bid,
- The farm management packages included in the bid,
- Stocking densities on the farm,
- Crops grown on the farm,
- Farm location in the catchment.

The scoring method was tested and verified by using it to rank projects previously undertaken on farms outside of the Fowey. The ranking of those projects suggested by the scoring method was compared to that independently determined by the farm advisors. Adjustments were made in the scoring system until those rankings closely corresponded.

**Reserve ‘Price’**

Again, based on the perceived quality of those previously undertaken projects, a minimum *value-for-money score* was determined (where, as mentioned previously, ‘value for money’ is calculated as environmental improvement score divided by grant request). Given the uncertainties inherent in scoring bids based solely on the limited information provided by farmers in their bids (and not by a thorough assessment as part of a farm visit), that minimum value-for-money threshold was set reasonably high at a figure of 0.5 (the units have no clear interpretation due to the arbitrary scaling of the environmental improvement score).

It was understood that holding the minimum threshold at a high level might mean that the entire budget was not allocated through the auction mechanism. That outcome was seen as desirable by Westcountry Rivers Trust as it left them with the opportunity to allocate some funds through an advisor-led mechanism if the auction failed to deliver projects of a suitable quality.

**Number of Bidding Rounds**

Rather than a one-shot auction, the project team decided that the auction should run over three two-week rounds, a format similar to that employed in the Georgia irrigation auctions. The reasons behind choosing that format centred on a desire to provide feedback.
to farmers regarding the likelihood of their bid receiving funding. In particular, at the end of each round bidders were sent feedback relating whether their bid was of high, medium or low interest.

- **High interest bids** were those that had a ‘value-for-money’ score above 1 (twice the minimum threshold).
- **Medium interest bids** were those that had a ‘value-for-money’ score between 0.25 and 1.
- **Low interest bids** were those that had a ‘value-for-money’ score less than 0.25.

For bidders in the medium and low interest categories, the feedback sent between rounds detailed a number of different ways in which they could improve their bid so as to move it up to the next interest category. Amongst those suggestions was an indication of how much the grant request would need to be reduced to move up an interest category. Bidders were also informed as to how committing to the farm management packages would improve the competitiveness of their bid.

A multiple round format was chosen for two reasons. First, we anticipated that farmers might find it difficult to judge where to pitch their bid in order to make them competitive. By providing feedback between rounds it was hoped that farmers would become progressively better informed as to the levels of value for money that were required to be successful in the auction. Second, and more practically, having multiple rounds afforded us a justifiable reason to contact those farmers that had not yet participated in the auction. As the auction progressed the letters we sent to non-participants were designed to relate the fact that other farmers in the region were putting themselves in a position to get funding through the scheme and to progressively increase the sense of urgency relating to the need to enter a bid. We hoped that that repeated contact might increase participation.

**Participation Fee**

Finally, by way of inducement to participate in the auction, farmers were offered a £50 participation fee. That participation fee was payable to all farmers that entered at least one bid in the auction and participated in the post-auction survey.

### 2.2 Auction Implementation

Preparation for the auction began in spring 2012. Using information from previous projects, the Westcountry Rivers Trust compiled a database listing the names, addresses and, in some cases, telephone numbers of farmers they believed to be active in the Fowey catchment. At the same time, the University of East Anglia team designed then built a custom website to act as a portal to the auction. The website provided access to brief descriptions of the auction, as well as the auction’s detailed rules (see Appendix A). Farmers could register for the auction through the website as well as post bids using secure online bidding facilities. Hard copies of registration and bidding forms could also be downloaded from the site.

In late July 2013 letters were sent to the 140 farmers in the Westcountry River Trust’s database. Those letters briefly outlined what farmers stood to gain from participating in the auction and invited them to attend one of a series of open meetings that were described as ‘Pie & a Pint’ evenings.
Figure 2.2: ‘Pie and a Pie’ night at the Halfway House, Two Waters Foot on 15th August, 2012

Four ‘Pie & a Pint’ evenings were held in venues across the Fowey catchment on the 13th, 14th, 15th and 16th August, with some 62 farmers choosing to attend. On arrival at a meeting, farmers were provided with a personalised information pack. That pack contained a ‘Quick Guide’ summarizing key dates and details of the auction and providing them with a unique login and password for the website, a registration form (see Appendix B) and a hard copy of the bidding form. The evenings began with a short presentation explaining the details of the scheme. Subsequently, over food and drinks, members of the auction team fielded questions on the auction and discussed with each individual farmer their particular circumstances and the possibilities open to them for attracting funding through the auction. The information pack was posted to all farmers that did not attend a ‘Pie & a Pint’ evening in advance of the auction opening for bids on 20th August 2012. The auction then ran for three rounds of two weeks, with bidders receiving feedback between rounds on the likelihood of funding of their current bid. The auction closed on 26th September, 2012. The steps in implementing the auction are summarised in Box 2.2.

Box 2.2: Timeline of Actions in the Fowey River Improvement Auction

<table>
<thead>
<tr>
<th>Date</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tues, 31 July</td>
<td>• Send out invite to each farmer in the Fowey catchment. Letter signed from WRT but the actual posting from UEA.</td>
</tr>
<tr>
<td></td>
<td>• Letter personally addressed and provides brief explanation of the opportunity presented by the auction &amp; explains UEA and WRT’s roles.</td>
</tr>
</tbody>
</table>
With the letter is an ‘Important Information’ sheet with the farmer’s unique username and password.

Letter directs farmers to the Fowey Auction website where they can sign up for a pie and pint evening using their username and password.

Letter alternatively directs farmers to call WRT where they can sign up over the phone; providing an email address for communication (if possible) and choosing a farmer session to attend.

Mon 1 Aug to Thurs 9 Aug

- Farmers sign up to attend a session.

Fri, 10 Aug

- Follow-up telephone calls from WRT encouraging attendance at sessions.

Thurs 9 Aug

- Confirmation emails/letters sent acknowledging farmer has signed up and giving details of the farmer session they are booked in to attend.

‘Pie & a Pint’ Evenings

<table>
<thead>
<tr>
<th>Date</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tues, Wed, Thurs &amp; Fri, 14-17 August</td>
<td>Farmers attend chosen evening for detailed brief of auction rules. Each farmer provided with pack containing summary, how to bid information, registration sheet, bid sheets, description of commitments and capital items.</td>
</tr>
<tr>
<td>Week Mon 13 August</td>
<td>Full farmer pack sent to all invited farmers who are not able/ or didn’t attend a ‘Pie &amp; a Pint’ evening.</td>
</tr>
<tr>
<td>Week Mon 13 August</td>
<td>Farmers invited to register for the auction by completing the registration sheet with info on the size and type of the farm. Farmers can do this in person at a session; on the website using their unique username and password or by post.</td>
</tr>
</tbody>
</table>

Auction: Period 1

<table>
<thead>
<tr>
<th>Date</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mon 20 August</td>
<td>Auction opens.</td>
</tr>
<tr>
<td>Mon 20 Aug to Wed 29 Aug</td>
<td>Farmers can register bids by;</td>
</tr>
<tr>
<td></td>
<td>- Post: returning a bid sheet included in the farmer pack. Must arrive no later than Wed 29 Aug or counted as a 2nd round bid.</td>
</tr>
<tr>
<td></td>
<td>- Internet: using online form on Fowey Auction website, must be sent before 23:59 on Wed 29 Aug.</td>
</tr>
<tr>
<td></td>
<td>- Bids acknowledged by return email for online bids or by phone for those without email.</td>
</tr>
<tr>
<td>Fri 24 Aug</td>
<td>Send emails and/or 1st class letters reminding those that have not bid that 1st round of bidding will finish on Wed 29 Aug.</td>
</tr>
<tr>
<td>Wed 29 Aug</td>
<td>First round of bidding closes at 23:59.</td>
</tr>
<tr>
<td>Thurs 30 Aug</td>
<td>Send emails and/or 1st class letters/ phone call informing participants with feedback on their bid and information as to how it might be changed to increase the chances of funding.</td>
</tr>
<tr>
<td></td>
<td>- Remind farmers they can update bids in second round.</td>
</tr>
</tbody>
</table>
### Auction: Period 2

<table>
<thead>
<tr>
<th>Date</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mon 3 Sept</td>
<td>Second round of bidding opens.</td>
</tr>
</tbody>
</table>
| Mon 3 Sept to Wed 12 Sept | Farmers can register bids by;  
  - Post: returning a bid sheet that must arrive no later than Wed 12 Sept or counted as a 3rd round bid.  
  - Internet: using online form on Fowey Auction website that must be sent before 23:59 on Wed 12 Sept.  
  - Bids acknowledged by return email for online bids or by phone for those without email. |
| Fri 7 Sept         | Send emails and/or 1st class letters reminding those that did not bid in the 1st round of bidding that the 2nd round will finish on Wed 12 Sept. |
| Wed 12 Sept        | Second round of bidding closes at 23:59.                                                                                                                                              |
| Thurs 13 Sept      | Send emails and/or 1st class letters providing participants with feedback on their bid and information as to how it might be changed to increase the chances of funding.               |

### Auction: Period 3

<table>
<thead>
<tr>
<th>Date</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mon 17 Sept</td>
<td>Final round of bidding opens</td>
</tr>
</tbody>
</table>
| Mon 17 Sept to Wed 26 Sept | Farmers can register bids by;  
  - Post: returning a bid sheet that must arrive no later than Wed 26 Sept or will not count in auction.  
  - Internet: using online form on Fowey Auction website that must be sent before 23:59 on Wed 26 Sept.  
  - Bids acknowledged by return email for online bids or by phone for those without email. |
| Fri 21 Sept        | Send emails and/or 1st class letters reminding those that have not bid previously that the auction will finish on Wed 26 Sept.                                                        |
| Wed 26 Sept        | Final round of bidding closes at 23:59.                                                                                                                                              |

### Post Auction

<table>
<thead>
<tr>
<th>Date</th>
<th>Description</th>
</tr>
</thead>
</table>
| Thur 27 Sept       | Letter posted to all participants containing letter explaining whether;  
  - Bid selected: Letter explains how WRT will contact to formalise commitment and move to payment and implementation.  
  - Bid rejected: Letter thanking for participation |
| Mon 1 Oct          | Auction outcome handed over to WRT to implement commitments with selected farmers.                                                             |
2.3 Auction Outcome

Over the six weeks in which the auction was open, 52 bids were received from 42 different farmers. As shown in Figure 2.3, 14 of those bids were received in the first round, 12 in the second round and 26 in the final round. Of the 14 bids received in the second round, 2 bids were revisions of first round bids. Likewise of the 26 bids received in the final round, 8 were revisions of bids received in earlier rounds.

As the auction progressed, the total quantity of grants requested from the auction budget increased from £273,000 in Round 1, to £450,000 in Round 2, reaching £776,000 by the end of the final round of bidding (see Figure 2.4). Accordingly, by the time the auction closed, grant requests had been received that totalled some 2.2 times the auction budget of £360,000.
The grants requested in the auction ranged from a minimum of £945 up to a maximum of £48,800. Of course, no bids exceeded the maximum grant set at £50,000. As shown in Figure 2.5, bids from across that range were successful in the auction extending from £945 to £40,100 with an average grant for successful bids of £13,500.

![Figure 2.5: Final Grant Requests](image)

As per the auction rules, bids were evaluated on the basis of ‘value for money’, with a minimum threshold established at a score of 0.5. Of the 42 bids received, 16 were above the minimum value-for-money threshold. A further two bids were sufficiently close to that threshold to also be approved for funding. The 18 bids approved for funding comprised grant requests totalling £242,000. The average grant rate for those bids was 59% with two bids being approved at 100% grant rates. The average value-for-money of accepted bids was 0.875 environmental improvement points per pound.

The next three bids in the ranking were affordable within the £360,000 budget, but they had an average value-for-money score of 0.40 and, if approved for funding, would have dropped the average grant rate for approved bids to 65%. These bids were not approved for funding.

Bids were accepted that proposed a wide variety of different capital investment projects. Some 56% of successful bidders suggested more than one project with the average number of capital items per bid being a little under 2.5. The only type of permissible capital item not represented in the approved bids was for new pesticide wash down areas.
Figure 2.6: Bids by Grant Rate and Value for Money

Table 2.1 provides greater detail on the types and size of projects approved for funding through the auction. The most frequently funded projects were those for the covering of feeding or collecting areas for farm animals (8 projects covering 2,194m² of such areas) as well as the fencing of river courses (7 projects and almost 4km of new fencing). Given the difference in the costs of the various projects, the proportion of the allocated budget spent on various capital investments differs from the quantities. Almost half the allocated budget was spent on just two types of projects; updating slurry storage and covering feeding/collecting areas.

Finally, all but two of the successful bidders also committed to taking on commitments to change their farm management practices. Two thirds of the successful farmers committed to the nutrient management package, 56% committed to the pesticide management package and 78% to the water management package.

2.4 Auction Evaluation

To better understand the response of farmers to the auction PES mechanism, two follow-up surveys were carried out.

- First, in early October 2012 the University of East Anglia team contacted all the farmers that had registered bids in the auction. The survey was carried out on the telephone and interviews were recorded and later transcribed so as to allow detailed analysis of responses.
All 42 bidding farmers were called but, despite repeated efforts, two farmers could not be contacted. A technical fault meant that one of the 40 conducted interviews was not recorded.

Table 2.1: Capital Projects Funded through the Fowey River Improvement Auction

<table>
<thead>
<tr>
<th>Project</th>
<th>Quantity</th>
<th>Number of Bids</th>
<th>Percentage of Total Payments</th>
</tr>
</thead>
<tbody>
<tr>
<td>Update slurry storage</td>
<td>440 cows</td>
<td>2</td>
<td>20.8%</td>
</tr>
<tr>
<td>New manure storage</td>
<td>403 m²</td>
<td>3</td>
<td>11.4%</td>
</tr>
<tr>
<td>Roofing for slurry, manure or silage storage</td>
<td>404 m²</td>
<td>3</td>
<td>13.3%</td>
</tr>
<tr>
<td>Projects to separate dirty &amp; clean water</td>
<td>678 m</td>
<td>5</td>
<td>1.7%</td>
</tr>
<tr>
<td>Covering for feeding or collecting area</td>
<td>2,194 m²</td>
<td>8</td>
<td>23.7%</td>
</tr>
<tr>
<td>New facility for overwintering cattle</td>
<td>910 m²</td>
<td>2</td>
<td>11.8%</td>
</tr>
<tr>
<td>New pesticide wash down area</td>
<td>0</td>
<td>0</td>
<td>0%</td>
</tr>
<tr>
<td>Concreting of tracks or yards</td>
<td>1,800 m²</td>
<td>3</td>
<td>10.1%</td>
</tr>
<tr>
<td>Fencing of river courses</td>
<td>3,903 m</td>
<td>7</td>
<td>3.9%</td>
</tr>
<tr>
<td>Watering troughs to replace river drinking</td>
<td>15 troughs</td>
<td>3</td>
<td>0.5%</td>
</tr>
<tr>
<td>New livestock crossing or drinking points</td>
<td>5 crossings</td>
<td>4</td>
<td>0.5%</td>
</tr>
<tr>
<td>Re-siting or hard-coring of gateways</td>
<td>33 gates</td>
<td>4</td>
<td>2.4%</td>
</tr>
<tr>
<td>Total:</td>
<td>44</td>
<td></td>
<td>100%</td>
</tr>
</tbody>
</table>

Each telephone survey took between 20mins and an hour to complete and was carried out using a semi-structured interview technique using the questions recorded in Appendix C. On completion of the telephone survey, farmers were rewarded with a £50 fee for participating in the auction.

- Second, in February 2013, the Westcountry Rivers Trust attempted to contact farmers in the Fowey who had not participated in the auction. Again the survey was conducted over the telephone.

Telephone contact details were available for 41 of the 98 farmers in the Fowey catchment that had not engaged with the auction. Contact was made with 26 of those farmers with the remaining 15 unable or unwilling to participate in the survey.

The non-participants telephone survey was shorter and more highly structured than that used for participants. Interviews took between 5 and 10 minutes with information being recorded by the interviewer. Farmers were not offered any monetary reward for participating in this survey.

The final source of information used in the evaluation of the auction came from follow-up farm visits made to each successful bidder. Those visits were carried out from November 2012 through to February 2012 by one of Westcountry Rivers Trust’s experienced farm advisors. At each farm, the advisor reviewed the projects identified in the bid to ensure that they conformed with the requirement in the auction rules of improving water quality and being new investments (retrospective payments were not allowed). The advisor also
inspected the farm so as to identify whether other capital investments might be made on that farm which had not been identified in the farmer’s bid.

**Coverage & Participation**

In contrast to an advisor-led PES mechanism, the auction mechanism afforded each and every farmer the opportunity to seek funding through the scheme. In the event 42 out of the 140 farmers approached in the Fowey took up that opportunity, a 30% participation rate.

It is almost certain that that percentage rate is a considerable underestimate. Analysis of responses to the non-participant survey revealed at least three reasons why that might be so;

1. **Not the Land Manager:** While 140 farmers were approached, it was not possible to verify that the addresses used in making that approach were current or correct. Responses indicating that the wrong individuals had been approached included; “We’ve not been the tenants on that land since Easter 2012”, “We let that land out to someone else now”, “I’m retiring and selling the land on so won’t be making any investments in it myself”, “I only rent that land, you need to talk to the landlord”.

2. **Farm Not Eligible:** At least some of those contacted ruled themselves out on the grounds that they did not comply with the eligibility criteria of running an active farm of over 15 hectares upstream of the water treatment works at Lostwithiel. Responses include; “I rang someone at the Westcountry Rivers Trust and discovered that my land is beyond the treatment plant”, “the farm has 3 areas but the area where I want to put an overwintering facility for my cows is not in the Fowey”, “we’ve only got 7 acres so we don’t qualify for the scheme”.

3. **No Eligible Capital Works:** Along the same lines, some of those contacted ruled themselves out on the grounds that capital investments on their farms would not yield improvements in water quality either because their farms were not located near to water courses or because they had already made the necessary investments. Responses included, “couldn’t see any point applying as we are three sites up from any land that touches or’s near the water”, “we’re on SSSI land and are not intensive so not really much could do”, “we’ve already done all the work that needs doing on our farm”.

Table 2.2 provides a breakdown of the relative quantities of respondents answering the non-participant survey in different ways. Of the 26 farmers responding to the survey 54% gave answers suggesting that they had not participated because they were either the wrong person to contact, their farm was ineligible or had no need of funding through the scheme. Extrapolating that figure to the entire set of 98 non-participants, suggests that only 45 of them were actually eligible to register a bid in the auction. Accordingly, the actual participation rate was probably nearer a value of 48% (42 out of an estimated 97 eligible farmers).

Table 2.2 also provides information as to why the remaining 53% of eligible farmers failed to register a bid in the auction. Most notably just over 10% of the non-participants surveyed (3 out of 26) rejected the scheme. The reasons given for that rejection were as follows (the quotes are somewhat paraphrased);

“I really didn’t like the idea of bidding against my neighbours. If they wanted to help they should just give a lump sum to everyone instead of making us compete against each other.”
“I was put off by the idea of having South West Water on a covenant on my land deeds. I did not like the idea of South West Water having rights or a say in the land.”

“I did not like the idea of South West Water walking around my business and getting involved with my farming practices.”

Accordingly, the key issue with regards to rejecting the scheme appears to have revolved around a reluctance to involve South West Water in the farm business.

Table 2.2: Reasons for Non-Participation

<table>
<thead>
<tr>
<th>Reason</th>
<th>Percentage of Non-Participant Survey</th>
</tr>
</thead>
<tbody>
<tr>
<td>Not the Land Manager</td>
<td>19.2%</td>
</tr>
<tr>
<td>Farm not eligible</td>
<td>15.4%</td>
</tr>
<tr>
<td>No eligible capital works</td>
<td>19.2%</td>
</tr>
<tr>
<td>Eligible but failed to participate:</td>
<td></td>
</tr>
<tr>
<td>Rejected the scheme</td>
<td>11.5%</td>
</tr>
<tr>
<td>Other reason</td>
<td>34.6%</td>
</tr>
</tbody>
</table>

From Table 2.2 it is also clear that over a third of non-participants could have participated in the auction, but did not do so. Of those individuals, with almost equal frequency, three reasons were given for not entering a bid:

1. **Time Limitations:** A number of farmers commented that they simply had not had the time to enter a bid and that this had not been helped by holding the auction at a particularly busy time of year. A typical response was “the time limits were a real hassle ... I work all day and do not have time to read paperwork and fill in forms for a particular hand-in date”.

2. **Complexity of Forms:** For some non-participants, particularly elderly farmers, the bidding procedure was seen as too complex and deterred them from participating.

3. **Identifying Projects:** Allied to the previous comment, many respondents indicated that they had found it difficult to identify which particular capital investments they might make on their farm. Indeed, many felt that they would need the help of a trained farm advisor in order to identify suitable projects.

It appears that the key issue in deterring participation relates to the additional complexity and workload that an auction PES mechanism places on farmers. Unlike an advisor-led PES mechanism, the difficult work of identifying suitable projects and bidding for those in an auction had to be undertaken by the farmer themselves. For many, this burden was sufficient to outweigh the possible benefits of participation. Indeed, extrapolating from the non-participant survey it appears that approximately 25% of farmers in the Fowey decided not to participate for these reasons.

Of course, for an even greater proportion of farmers in the Fowey, the possible benefits of participation appeared large enough to warrant the effort of bidding in the auction. As part of the participant follow-up survey, questions concerning those farmers’ reasons for participation were also explored.
With that intention, participating farmers were asked why they had bid for capital items in the auction. In their responses some 79% farmers suggested that they had been primarily motivated by the desire to make improvements to their farm business. Amongst the other key motivations was the desire to increase water quality or improve the land.

Since farmers had been offered a £50 participation fee for bidding in the auction and completing the post-auction survey, they were also asked how greatly this had influenced them in their decision to participate. While, some 17% of participants suggested that it had been a factor in their decision to bid (for example respondents said “it was a good locker [sic]”; “yes, but I would have applied without it”; “it made me look at it”) none of the farmers suggested it had been the deciding factor. For many, the £50 participation fee was of little importance with respondents emphasising the fact that a) their primary interest was in securing the capital investments and b) the participation fee was negligible compared to the £50,000 maximum bid.

The post-auction questionnaire also explored how the terms of the contract required by South West Water, particularly the duration of those contracts (10 or 25 years depending on capital item) and the need for a covenant for investments over £5,000, had been received by farmers. Some 40% of respondents expressed concerns regarding the length of the contracts. That concern was particularly evident amongst tenant farmers who faced the additional difficulties of needing permission from the landlord to make the investments and faced the risk of not getting back any money they contributed towards a capital investment at the end of their tenancy.

Despite the covenant information being clearly explained in all the background material and on the bidding instructions, 40% of farmers contacted in the participants survey remained unaware of this detail of the funding. Having explained the covenant to all of the farmers, 35% subsequently expressed concerns. Again the greatest concerns were amongst tenant farmers who felt this significantly increased the likelihood that their landlord would not accept the terms of the funding.

Finally, most funding available to farmers comes as public money. Accepting investment money from a private company such as South West Water would have been relatively unfamiliar territory for most farmers. All bar two farmers, however, expressed the opinion that it did not matter where the money came from; they were happy to bid into either a private scheme or a government scheme.

Overall, the auction appears to have been reasonably successful in encouraging participation; it is estimated that around half of those in a position to participate in the auction registered a bid. Amongst those farmers that did not enter a bid the key issue deterring participation appears to have been the difficulty of having to personally identify suitable projects and the complexity of bidding. Amongst farmers entering a bid, the central motivation has been to improve farm businesses though reservations were expressed regarding the contract lengths and the need for a covenant particularly amongst tenant farmers.

Bidding Behaviour

One of the central motivations for using an auction-based PES mechanism is to harness the powers of competitive bidding in order to drive down the purchaser’s costs. In this case, it was hoped that competition between farmers would replace the inefficiency of requiring a single grant rate (50% in Upstream Thinking) imposed across all projects.

Clearly there are many factors that may play a role in an individual farmer’s choice of bid. In the Fowey Auction, we might expect at least some of the farmers to be limited by the resources they have available to contribute to the purchase of new capital items. An
auction that created very high levels of competitive pressure would drive bids down, pushing farmers closer and closer to that maximum contribution. The lower the competitive pressures, the more likely it is that farmers will shade their bids attempting to elicit a larger contribution from the purchaser.

Reviewing the data shown in Figure 2.6, it is noticeable that while a quarter of the bids ask for a 100% contribution from South West Water the majority do not. Clearly, the auction engendered some competitive pressures. At the same time, however, it is noticeable that many bids fall on what we might term focal grant rates; five bids are at exactly a 50% grant rate, three at exactly 60%, three at 75%, and a further five at 80%. For these farmers, the focus on grant rates indicates that bids were not forced down to some minimum contribution but rather were arrived at by considering an amount that was thought to represent a reasonable split of costs between the farmer and South West Water.

In the post-auction survey, questions were asked to shed more light on the factors that had shaped respondents bids. Responses to that question are summarised in Table 2.3. The first thing to note about Table 2.3 is that many farmers suggested more than one motivation such that the values in the final column do not sum to 100%. To aid interpretation, the responses in Table 2.3 have been grouped into five categories. Those are highlighted in italics with the percentage of farmers mentioning that motivation in their response also italicised in the final column.

<table>
<thead>
<tr>
<th>Reason for bid amount</th>
<th>Percent of Participants (36 in total)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Consideration of other farmers - competition:</strong></td>
<td>39%</td>
</tr>
<tr>
<td>Make bid competitive so as to improve chances in auction</td>
<td>39%</td>
</tr>
<tr>
<td><strong>Consideration of other farmers - fairness:</strong></td>
<td>19%</td>
</tr>
<tr>
<td>Didn’t want to look too greedy</td>
<td>11%</td>
</tr>
<tr>
<td>Not much money in pot so thought about what each farm might get</td>
<td>8%</td>
</tr>
<tr>
<td><strong>Consideration of relative contribution - farmer pays maximum:</strong></td>
<td>19%</td>
</tr>
<tr>
<td>Maximum could afford to put in themselves</td>
<td>19%</td>
</tr>
<tr>
<td><strong>Consideration of relative contribution – funder pays maximum:</strong></td>
<td>24%</td>
</tr>
<tr>
<td>Wanted South West Water to pay full costs</td>
<td>24%</td>
</tr>
<tr>
<td><strong>Consideration of relative contribution – farmer and funder divide costs:</strong></td>
<td>44%</td>
</tr>
<tr>
<td>Reasonable contribution from the funder</td>
<td>28%</td>
</tr>
<tr>
<td>‘Compensation’ needed for work that didn’t benefit them directly</td>
<td>14%</td>
</tr>
<tr>
<td>‘Compensation’ for the inconvenience of the contract and covenant</td>
<td>5%</td>
</tr>
<tr>
<td>‘Compensation’ for work already done</td>
<td>3%</td>
</tr>
</tbody>
</table>

The first two categories in Table 2.3 concern responses that indicated a bid that had been framed by consideration of other farmers in the auction. Observe that 39% of
respondents stated that their bid had been shaped by the desire to make it competitive against other farmers’ bids. Clearly, while an important consideration, competition was by no means the only motivating force. Indeed, 19% of respondents gave responses that suggested they had been motivated in their bid by the desire to ensure some fair distribution of the funds across farmers.

The final three categories in Table 2.3 record the frequency of responses indicating a focus on how the cost of the capital item should be divided up between the farmer and South West Water. At one extreme, 19% of respondents indicated that their bid had been determined by the maximum they could afford to contribute towards the purchase of new capital items. At the other extreme, 24% of respondents indicated that their bid had simply asked South West Water to cover the full cost of the capital investments. While the first case is strongly suggestive of competitive pressure in the auction, the latter is not, though it is impossible to rule out the possibility that a 100% contribution from South West Water is indeed the minimum contribution required to interest the farmer in the scheme.

The final category describes explanations that justify some level of division of the costs between South West Water and the farmer. By far the most common justification in this regard was to receive a “reasonable” contribution from the funder. Again it is not possible to exclude the possibility that what was deemed “reasonable” was driven by competitive pressures, though it could equally have been motivated by fairness considerations.

Overall, it appears that many farmers responded to the competitive pressures of the auction, but that competition for funding was by no means the only or even most significant consideration in deciding on the level of bids to register in the auction. Significantly, the rate of success amongst those that stated consideration of competitive pressures as a key motivation in shaping their bids is substantially higher (58%) than those that did not (36%). In selecting successful bids on the basis of value for money, the auction process naturally favours those that respond to the competitive pressures by bidding low.

To provide further insights into the degree to which competition had driven down bids in the auction, respondents to the participants’ survey were asked if their contribution to their bid was the maximum amount that they could have contributed. The interviewer stressed that the farmer’s reply to this question could not affect the outcome of the scheme, before asking, ‘if you had to, how much extra money could you have put in?’ Of course, in response to that question, there is a distinct possibility that farmers will tend to under-report. Indeed, almost a third of those interviewed avoided the question or refused to answer it. All the same, responses were forthcoming from 25 farmers and those are summarised in Figure 2.7.

In Figure 2.7 each bar represents 100% of the total costs of investments proposed in a farmer’s bids. The different coloured segments of those bars represent the proportions contributed by different parties. In particular, the dark shaded segments show the proportion actually contributed by the farmer. The two lighter shaded segments show the proportion actually contributed by South West Water. Importantly, the darker of those two segments indicates the proportion of the bid that farmers stated they would have been prepared to pay themselves, but instead asked South West Water to pay. So the first column on the left of the Figure shows a bid that asked South West Water to pay 100% of the costs of the proposed project and where the farmer would not have been prepared to offer any contribution of their own. In contrast, the 4th column in the Figure also shows a bid asking for a 100% contribution from South West Water but, in this case, the farmer would have been prepared to pay the whole costs themselves. As a final example, those columns with segments of all three colours are bids where the costs were divided between
the farmer and South West Water, but the farmer would have been prepared to contribute some more to the costs.

![Diagram showing Participating Farmers' Final Bids]

**Figure 2.7: Relative Contributions to Bids with Farmers Actual and Potential Contributions**

The first thing to note from Figure 2.7 is that a little over half of the farmers would have been prepared to offer more to the costs of their proposed projects than they committed to in their bid. On average, it appears that farmers could have contributed to the tune of an additional 18% of the costs of a project. Clearly, the competitive pressures in the auction have not driven all of the surplus out of farmers bids.

A second clear message from Figure 2.7 is that farmers making larger contributions were significantly more likely to get funded. Again, the selection of bids based on value for money ensures that farmers prepared to contribute more of their own funds to projects are more likely to secure funding through the auction.

The auction was designed to run over a series of rounds. In between rounds bidders were given feedback on their bids telling them the scale of the changes in their grant request and/or in the composition of their proposed project that would put them in a better position to secure funding. Of course, that information could be seen as useful in that it informed on the level of bids of other farmers such that incentives existed to bid in the earlier rather than later rounds of the auction. From Figure 2.3, however, it is evident that many delayed bidding until the final round. Accordingly, in the post-auction survey farmers that had bid only in the final round were asked why they had not bid earlier. By far the most common response (80%) was that they “just hadn’t got round to it”.
Of the 24 farmers that entered bids in Rounds 1 or 2, 58% did not revise their bid in a subsequent round. In the post-auction survey two reasons were proffered for not making any changes; either the first bid had been their final offer or they did not have time to revise their bid.

The remaining 42% of bidders in Rounds 1 and 2 did submit revised bids, though none revised their bid more than once. Those revisions always acted so as to reduce the size of the grant requested from South West Water. Indeed, on average, revised bids asked for a grant that was £9,600 lower than the grant request in the original bid. That general downward trend in grant request hides a more complex set of responses upon which Figure 2.8 attempts to cast more light.

Figure 2.8 provides information on the nature of changes in each of the revised bids. The dark columns show how greatly the revision changed the grant requested from South West Water. Notice that in all cases the grant request was revised downwards. The light columns show how greatly the same revisions changed the contribution to the total costs of the project being paid by the farmer. Accordingly the sum of the two columns indicates how the revision changed the overall cost of each project.

For the two leftmost bids in Figure 2.8 both bars are negative. Accordingly, both the farmer and South West Water were paying less after the bid was revised. It follows that the revision in these bids sought to reduce the overall size of the bid by significantly scaling back on the quantity or size of investments in the proposed projects. For those two bids the contributions from the farmer and South West Water were scaled back by approximately equal quantities, resulting in grant rates after the revisions similar to those before. The revisions to the next three bids shown in Figure 2.8 also suggest a reduction in the scale of
the proposed projects, but those changes are made without significantly adjusting the size of the farmer’s monetary contribution to the projects. Accordingly, the grant rates for these bids tended to fall after revision. For the remaining five bids, the revisions resulted in the farmer actually contributing more to the bid after revision than before.

Overall, revised bids asked for a grant rate that was 12% lower than the original bid. While the picture is complicated by farmers revising both their grant requests and the composition of their proposed projects, the general picture is one in which the process of revision has resulted in cost savings for South West Water; after the revision of bids, farmers tended to take on a greater share of the costs of projects.

Finally, the post-auction questionnaire sought to establish whether the farmers’ bids had been shaped in any way by processes that might be described as collusion. Only 18% of farmers indicated that they had talked to others about their bid, though those comments were often qualified by stating that they had only discussed the auction in general and their plans for projects, but not their actual bids.

The apparent lack of collusive behaviour is not particularly surprising given the limited information available to farmers as to how collusion on bids might increase their payoffs.

**Projects Funded**

The key measure of success for the Fowey River Improvement Auction will be the degree to which the projects funded through the scheme deliver additional improvements in water quality. Assessing success according to that criterion is complex. In this regard, two critical issues, particularly with respect to the use of an auction-based PES mechanism, are the degree to which the projects proposed by farmers in their bids are:

- investments that best deliver water quality improvements.
- additional to investments that farmers would have made of their own volition to benefit their farm business

To assess the first issue, a Westcountry Rivers Trust farm advisor visited each of the 18 successful bidders. As listed in Table 2.1, 44 investments had been identified by those farmers in their winning bids. On inspection some of those individual items were found to be aspects of the same project of improvement. For example, putting up fencing to keep stock out of the river while installing pipework and troughs to provide alternative drinking facilities, were all deemed parts of a single project of improvement. Once categorised in this way, the 44 individual capital investments constituted 29 different projects.

The advisor reviewed each of the proposed projects assessing whether they would have been identified as a priority for investment by the advisor themselves. While some were seen as higher priority than others, the advisor confirmed that each proposed project was worthy of investment. Figure 2.9 illustrates some of the issues seen on those farms that South West Water’s investments will serve to correct.

In addition, the farm advisor explored each farm looking for other potential problems likely to negatively impact on water quality in the Fowey. Importantly, the advisor spotted a large number of such problems, identifying a total of 25 projects (additional to the 29 proposed in the farmers’ bids) that would have been eligible for investment under the scheme. It appears that in bidding in the auction, farmers had only acknowledged 54% of the projects that could deliver water quality improvements from their farms.
From discussions with those farmers, the advisor relayed a qualitative assessment of why farmers had failed to bid for those projects;

- **Knowing which Projects Qualify for Funding**: One central issue was that a number of farmers did not have a clear idea of what projects would be acceptable in the scheme. The omission of certain projects reflected this uncertainty.

- **Business Priorities**: A second crucial issue was that the farmers’ over-riding priority was to make investments in areas that had positive impacts on their farm businesses. Several projects were not included in bids since farmers felt they were not business priorities and were not prepared to invest sufficient of their own money in those projects to make bids for those items competitive.

Further evidence to support the second of these reasons was collected in the post-auction survey. In that survey, farmers were asked whether the capital investments proposed in their bids would ever be made without the funding from South West Water. Some 62% of respondents indicated that they had plans to undertake the investments irrespective of the funding from South West Water. For example, one farmer explained;

“Well I just thought I’m way down the pecking order, there’s bigger issues out there so I just thought, well, I’ve put my bid in and I’d love to have it and so forth but if I don’t, you know, I’m going to do it anyway.”
While over half of the farmers said that they were intending to do the proposed work anyway, all but two of those farmers qualified that with one of a number of significant caveats. Amongst those caveats were that the work would be done but:

- only when, and if, alternative finance became available to fund it,
- not now and probably a number of years in the future,
- to a lower standard than proposed in the bid

Clearly, for many farmers the projects they proposed for funding in the auction were investments that they hoped to make on their farms anyhow. All the same, the scheme had the effect of making those plans a reality much sooner than would have been the case without funding from South West Water.

Along similar lines, the post-auction survey investigated the degree to which commitments to the packages of Farm Management Practices were additional. Of the two thirds of successful bidders that elected to sign up for one or more packages, most (72%) said that adhering to those practices would not cause them additional costs. For those farmers that anticipated additional costs, half said that they had included those costs in their bid whilst the remainder stated that the costs would be absorbed by the farm.

The analysis of projects funded through the scheme reveals an important general insight into how auction-based PES mechanisms are likely to work in the field. An auction places the responsibility for identifying projects in the hands of farmers. Unsurprisingly, the projects they propose for funding in such schemes are those from which they stand to gain the most. While each farmer may have a suite of eligible projects, they will tend only to propose those likely to most improve the farm business.

That insight reveals an unanticipated tension created by the design of the Fowey River Improvement Auction. Farmers could bid for any number of capital investments, but the design of the auction forced them to identify a single grant from South West Water to pay for that entire set of investments. Since success in the auction was determined on the basis of value-for-money, an obvious strategy for farmers would be to make their bids competitive by only proposing investments towards which they were prepared to make substantial contributions; that is, to propose those investments where there was a good business case for making the investment. Investments that improved water quality but not the business could easily be ignored.

In retrospect, a better design might have been for farmers to enter a bid containing the whole suite of capital investments needed on their farm to improve water quality. Then, rather than asking for one grant to cover all that work, farmers could enter separate grant requests for each item (or project containing a series of items). With that design, a bid might include some investments that are of little benefit to the farm business and that require a 100% grant rate while others that may be of substantial benefit and be entered at a grant rate lower than 100%. The value-for-money evaluation process in the auction would select which of those different capital projects was worth South West Water’s investment. Likewise, farmers would not risk the possibility of missing out on investment by bundling together in the same bid capital items that would get funded with those that wouldn’t. Of course, asking farmers to consider the grant required for each capital item adds somewhat to the complexity of the auction, though farmers should have made those calculations in arriving at the combined grant request entered under the current auction design.
2.5 Comparison of the Auction-based and Advisor-Led Mechanism

Coverage and Participation

A clear advantage of the auction-based mechanism is that it allows a large number of farmers to be engaged in the process simultaneously. The Fowey River Improvement Auction appears to have prompted significant levels of participation with nearly all farmers in the Fowey claiming that they were supportive of the initiative even if they had not themselves posted a bid.

Coverage with an advisor-led mechanism is necessarily less extensive. Over a period of 3 years farm advisors from Westcountry Rivers Trust managed to visit some 168 farmers in the other catchments in which the Upstream Thinking Initiative was being implemented. That number represents at best a quarter of the farms in that region.

At the same time, the advisor-led mechanism allowed effort to be directed in a targeted manner. For example, in priority areas such as the reservoir catchments of the Roadford and Tamar Lakes, advisors made sure that all farmers were visited. Moreover, the single biggest deterrent to entering a bid in the Fowey River Improvement Auction was that, without the guidance of a trained farm advisor, farmers found it difficult to identify suitable investment projects and were put off by the time commitments and perceived complexity of entering a bid in the auction.

Conclusions:

While not all farmers bid in the auction, participation rates appear to have been reasonably high. Clearly some farmers were put off by the additional responsibility and effort that an auction mechanism placed on them when compared to an advisor-led mechanism. Indeed, that fact highlights the key dimension of contrast between the two mechanisms. An auction mechanism widens coverage (all farmers are invited to participate) but in asking farmers to do the hard work of identifying projects and formulating bids, deters some from participating. In contrast, an advisor-led system narrows coverage (only those that are approached get to participate) but makes participation very easy.

As a result, auction mechanisms will have a clear advantage when a scheme has to cover a very large number of farmers, especially when there is little local knowledge regarding which of those farmers is a priority. In contrast an advisor-led system will be more practical where the extent of the scheme is relatively small or when there is good local knowledge as to which farms or locations should be targeted. In reducing the time costs and complexity of entering a bid for funding, advisor-led schemes have the added advantage of increasing the likelihood of participation amongst targeted farmers.

Costs of Projects

The advisor-led mechanism, like many similar schemes including the Catchment Sensitive Farming Capital Grant Scheme, promised to pay farmers a fixed 50% of the costs of capital investments made through the scheme. In contrast, the auction mechanism allowed for payments of up to 100% of costs. In selecting successful bids on the basis of value-for-money, however, the auction sought to generate competitive pressures that it was hoped would encourage low bidding. Accordingly, the auction format offers a potential advantage over fixed price mechanisms but also introduces a potential risk;

- **Advantage:** Investments offering large improvements in river quality may not be funded in a fixed price scheme if a farmer is unable or unwilling to participate in the scheme at a 50% contribution. The auction opens up the possibility of funding
such projects at a greater than 50% contribution provided they offer good value for money.

- **Risk:** Competition in the auction may not be sufficient to drive down bids. Farmers may bid for over 50% of costs even if they would have been prepared to undertake the work with just that contribution.

Let us deal first with the risk of inflated bidding in the auction.

Returning to the bid data described in Figure 2.6, recall that in the auction only seven of the eighteen projects for which funding was approved had grant rates of 50% or lower. Indeed, two of the projects were deemed to be of sufficient interest to South West Water that they were funded at a 100% grant rate. Accordingly, the average grant rate of bids funded through the auction was 59%, exceeding the 50% fixed rate of the advisor-led mechanism.

Several factors may be at play in explaining the relatively higher grant rates of projects funded through the auction mechanism.

- **Additional Commitments:** Most of the successful bids included additional commitments to implement improved farm management practices. While those commitments might be expected to have increased costs, very few farmers claimed to have included those costs in their bids.

- **Competition:** There is no doubt that cost competition played a part in determining bids. For a start, the vast majority of bids were for less than the maximum allowable 100% grant rate. Moreover, running the auction in multiple rounds had the effect of adding further downward pressure on bids. That evidence is supported by information gathered in the post-auction survey where participants confirmed that competition was a major contributing factor determining how much to ask for in a bid. At the same time, it is apparent that competition was not so intense so as to drive all of the surplus from farmers’ bids. Indeed, responses to the post auction survey suggest that on average farmers would have been prepared to contribute 18% more to the capital investments than they committed to in their bids.

- **Anchoring:** It is noticeable that very few bids dropped below the 50% grant rate familiar to farmers from a number of other capital grant schemes. Accordingly, we suspect that for many farmers that familiar contribution rate may have represented a natural lower bound for their bid. Farmers, for example, may have discounted bidding below a 50% grant rate on account of the possibility that schemes offering that grant rate might, at some future date, be extended to the Fowey. Moreover, the post-auction survey suggests that many farmers were motivated by having the funder make a “fair” contribution to the investment (see Table 2.3). Since other schemes offer a 50% grant rate the definition of “fair” to farmers may have been taken to be that 50% contribution.

**Conclusions:**

It appears that competition was an important factor in determining the grant rates asked for by farmers bidding in the Fowey River Improvement Scheme. At the same time, many farmers did not feel compelled to bid for the minimum amount that they would need in order to undertake the capital works. While some of the additional money requested from the funder may have been to cover the costs of management practices committed to as part of the bid, there is little doubt that many farmers were prepared to risk shading up their bids in order to claim a surplus from the transaction. The possibility of access to future alternative funding options may have made that risk seem insubstantial.
Value-for-Money

Of course South West Water is not motivated simply by the desire to fund cheap projects. Rather the fundamental purpose of the scheme is to fund projects that deliver improvements in river water quality at a reasonable cost: that is to say, to fund those projects offering the best value for money.

An essential difference between fixed grant rate schemes, such as that implemented in the Advisor-Lead Mechanism, and an auction is that the latter select projects specifically on the basis of value for money. The Fowey River Improvement Scheme, for example, selected for funding the 18 projects that offered the highest value for money. The average value for money of those selected projects was 0.875 environmental improvement points per pound (henceforth, pts/£).

Assuming for the moment that the bids entered in the auction represent the minimum grant rate acceptable to farmers, then the advisor-led scheme would only have funded those seven projects that requested a grant rate of 50% or less. The average value for money of those seven projects was 0.717 pts/£. Accordingly, in terms of the value generated for each pound spent by South West Water, the auction generated a 20% better outcome than a fixed rate scheme.

Of course, that conclusion rests on the assumption that the competitive pressures in the auction have forced farmers to request the minimum contribution from South West Water. As we have seen, that is not the case. More likely, some of the farmers that bid for greater than 50% of the costs may have been prepared to go forward with their projects even if they had only been offered a 50% grant rate. Indeed, as revealed by the data from the post auction survey illustrated in Figure 2.7, this was true of at least 4 of the farmers that bid in the auction. Accordingly, our best guess is that around 11 projects would have been funded under a fixed 50% grant rate scheme. Interestingly, the average value for money of this expanded set of projects when financed at a 50% grant rate is only 0.533 pts/£. In other words, even though those additional projects meet the 50% grant rate criteria they actually represent relatively poor value for money for South West Water.

Conclusions:

The Fowey River Improvement Scheme serves to highlight a central failing of many fixed grant rate schemes: the focus on choosing low cost projects may fail to deliver good value for money. In the case of the Fowey, the auction mechanism delivered an outcome that delivered up to 40% better value for money than might have been forthcoming from a scheme selecting projects purely on the basis of meeting a 50% farmer-contribution threshold. Indeed, we suspect that farmers’ lack of familiarity with the auction mechanism employed in the Fowey River Improvement Scheme resulted in relatively risk averse bidding. It is possible that auction mechanisms could induce even greater competitive pressures than realised in this case study and, as a result, deliver even greater improvements in value for money when compared to fixed grant rate schemes.

Costs of Administration

The Westcountry Rivers Trust undertook some rough calculations to compare the operational costs of the advisor-led scheme and the auction under five important cost categories. The results of the analysis were as follows.

Advisor-led scheme:

- Targeting Farmers: In the advisor-led scheme advisors would begin by reviewing historic data, catchment maps as well as driving around a catchment to establish the
issues and pressures within the area. This was ordinarily done at the same time as reviewing other potential farm projects but in the example of the Fowey 20 days would have been sufficient to cold call problem farms to set up farm visits. At an average £300 day rate for the advisor that cost equates to £6,000.

- **Farm Visits Successful**: A review of farm projects from a database of 65 farm projects run through the other Upstream Thinking catchments has shown that they required 340 visits to complete the work; averaging at 5.2 visits per project. This roughly equates to 1 initial visit, 1 visit to negotiate the project, 1 visit to sign up contracts, 1 visit during works and 1 visit after works to collect paperwork for payment. At the £300 day rate for the advisor this equates to £1,560 per farm in terms of visits plus £30 per visit in travel costs equates to £156. This means each farm project costs on average £1,716 in visits.

- **Farm Visits Unsuccessful**: In the other Upstream Thinking catchments, 168 farm visits were made with 84 (50%) of those resulting in projects being successfully funded. For the 18 projects funded in the Fowey, therefore, a farm-advisor led scheme might have expected to have made 36 farm visits. At half a day per farm visit and using the £300 day rate that cost amounts to £2,700.

- **Farm Plans**: Each farm project has a farm management plan that sets out the opportunities for improving farm management and infrastructure. This is a fixed cost per farm and does not vary across the two mechanisms.

- **Advisor Management**: A line manager manages the process of developing projects but this cost will be fixed per project and, therefore, not vary across the two mechanisms.

**Auction-based mechanism:**

- **Targeting Farmers**: The advisor costs are minimal here as the work was done by auction staff and as such costs relate to workshops to advertise the project. In the case of the Fowey this equated to 1 day in total. At the average advisor day rate this equates to £300.

- **Farm Visits Successful**: As costs are already negotiated the visits through the auction can be reduced by 1.5 days (remaining visits are roughly apportioned for 1 initial visit to confirm the project and request invoices, 0.5 visit to sign up contracts, 1 visit during works and 1 visit after works to collect paperwork for payment). At averaged £300 day rate for the advisor this equates to £1,110 per farm in terms of visits plus £30 per visit in travel costs equates to £111. This means each farm project costs on average £1,221 in visits.

- **Farm Visits Unsuccessful**: Since successful bids were determined through the auction process, it was not necessary to make any visits to farms where projects would not be funded.

- **Farm Plans**: Costs no different to the advisor-led scheme.

- **Advisor Management**: Costs no different in administering projects to the advisor-led scheme. The auction mechanism demanded greater management time which is estimated at an additional 10 days at £400 day rate is £4,000.

The auction-based mechanism reduces the costs of administration in both identifying farmers (saving of £5,700) and in avoiding visits to farms where projects would not be funded (saving of £2,700). Alongside those differences, farm visits to successful bidders are cheaper under the auction based system by a quantity of £495 per farm project (£450 time
and £45 travel). Multiplying that up by the 25 farm projects being developed as a result of the Fowey River Improvement Auction suggests an overall saving of £12,375 over an advisor led approach. On the other hand, higher management costs have been incurred in running the auction of around £4,000. Therefore, it is estimated that the running of the auction in the Fowey resulted in cost savings for Westcountry Rivers Trust of around £16,775.

**Conclusions:**

While very approximate, the calculations suggest that an advisor-led scheme would have been around 30% more expensive to run in the Fowey than the auction. Of course, those figures do not include the set-up costs of developing either mechanism. In this regard we suspect that the auction is more costly particularly in the expense incurred in developing custom software to allow for online bidding.

The key difference in administrative costs between the two mechanisms, therefore, appears to be in terms of the relative balance between fixed and variable costs. The added upfront cost of developing an auction provides a mechanism that can be scaled-up with little additional cost. In contrast, the advisor-led scheme will be relatively cost-effective in schemes covering a relatively small population of farmers but those costs rise linearly as the size of the target population increases.

**Projects identified by the auction:**

The sorts of actions that farmers can undertake on their farms to improve water quality are many and varied. Given the diverse nature of those items, and the inclusion of additional operational commitments, the biggest single challenge in implementing the auction was in designing a scoring method that allowed comparison across the diverse range of bids received. In the Fowey River Improvement Auction, that challenge was met through a formula derived primarily through the expert input of Westcountry Rivers Trust’s farm advisors. It would certainly have helped to have complemented that input with more sophisticated tools perhaps based on hydrological modelling of the catchment, though that was not possible within the timeframe of this project. The development of a rigorous scoring method is undoubtedly a critical challenge in implementing an auction-based PES mechanism when the nature of projects is diverse and the benefits of projects highly dependent on particular local conditions.

Encouragingly, visits to successful bidders’ farms revealed that the projects the farmers had identified for investment would all have been identified by a farm advisor as worthy of funding in an advisor-led scheme. On the other hand, those same visits revealed a large number of additional issues that had not been addressed through the projects included in the farmers’ bids. Indeed, the projects identified by the farmers themselves represented only 54% of the capital items that would have been identified by a farm advisor in an advisor-led scheme.

It appears that, while farmers are capable of identifying eligible investments, in an auction they may fail to bid for all the investments that would be deemed desirable in addressing water quality issues. The evidence suggests that the omission of these additional investments from farmers’ bids is usually because the farm business priorities which motivate the farmer do not perfectly coalesce with the environmental objectives of the scheme.

**Conclusions:**

The auction-based mechanism has been reasonably successful in identifying capital investments that will improve water quality without the need for detailed intervention from farm advisors. At the same time, the advisor-led system has the great advantage of
being able to identify all projects and prioritise those from the point of view of the funder and not the farm business. The auction-based mechanism may well miss relevant projects though an auction design in which farmers bid separately for different capital investment projects may help in encouraging bids for items that are of less direct benefit to the farm business. Likewise in using a remotely calculated formula to judge the benefits of a project, the auction approach may do a poor job at picking up on the particular local conditions determining the value of a project to South West Water.

Accordingly, we suspect that in terms of identifying appropriate investment opportunities, an auction-based mechanism will fare relatively well when the range of projects under consideration is small and the benefits of those projects are less dependent on highly specific features of the local environment in which they are executed. In contrast, in situations where projects are diverse in nature and the benefits they generate highly site-specific, the identification of appropriate projects may be better achieved through the on-site inspection allowed by an advisor-led system.

2.6 Conclusion: Lessons for PES Mechanism Design

The project has demonstrated that an auction-based PES mechanism can successfully distribute funds to farmers for investment in capital items that improve water quality.

Comparison with an advisor-led PES mechanism run in similar circumstances reveals that the advantages of the auction format are that (for any particular set of projects) it delivers better value for money, it offers savings in terms of administrative costs and extends the possibility of participating in the scheme to a wider constituency. In contrast, the primary advantages of an advisor-led mechanism are that it simplifies participation for farmers and allows more accurate definition of the particular projects that should be funded.

In the opinion of the project team, this evidence suggests that the two mechanisms are best employed in rather different situations;

- **Advisor-Led PES Mechanism**: The great strength of the advisor-led mechanism is the ability of the advisor to identify the exact set of projects requiring investment on each farm visited. That ability is likely to be most needed when there are a large variety of different investments that might yield ecosystem service benefits and where the size of those benefits differ across farms according to site-specific considerations. Superior identification of projects comes at a cost, particularly in advisor time. Moreover, an entirely advisor-led mechanism limits the number of farms that can be approached to participate in the scheme. Accordingly, advisor-led mechanisms are likely to fare best where the scale of the scheme is relatively small and where advisors have good local knowledge with which to target farms that are likely to yield good investment opportunities.

- **Auction-based PES Mechanism**: The primary strength of the auction-based mechanism is that it has the potential to deliver funders with better value-for-money. That result depends primarily on how accurately the environmental benefits of projects can be identified without the on-site intervention of a farm adviser and how well competitive pressures in an auction act to drive down the level of grant requests from farmers. Accordingly, auction mechanisms are likely to fare best when there are large numbers of farmers competing for funding and where the benefits of projects can be estimated reasonable accuracy without detailed site-specific knowledge. In addition, auction-based mechanisms offer the possibility of greatly widening participation. And, since responsibilities for project identification and bid
formulation are passed over to the farmer, the auction has lower costs of administration. Indeed, as the scale of a scheme increases these features of allowing wide-participation and while maintaining low administrative costs are likely to greatly favour auction-based mechanisms. Those merits will be enhanced if there is little detailed local knowledge of a region through which farms could be effectively targeted.

Of course, one can imagine any number of hybrid schemes that incorporate elements of both an auction and the on-site intervention of an expert advisor. For example, the bidding procedure in an auction could be broken down into a series of stages. Farmers could first outline the set of commitments they are prepared to undertake under a scheme and once those proposals have been reviewed and approved enter into a subsequent round of bidding. Alternatively, much greater support could be given during the auction with advisors visiting farmers and helping them in the formulation of their bids. Such input would not only help farmers but also advantage funders in ensuring that appropriate and accurate bids are entered in the auction. Of course, increasing advisor input increases the costs of implementing an auction thus negating one of its primary merits over an advisor-led mechanism.
3 MULTIPLE PURCHASERS

3.1 Introduction

Over recent years, more and more PES schemes have sprung up across the globe. Amongst the better known examples are the various forest conservation PES schemes in Costa Rica (Zanchez-Azofeifa et al. 2007), the Bushtender PES scheme in Australia (Stoneham et al., 2003), the irrigation reduction auctions in Georgia in the US (Petrie et al., 2004) and the water quality improvement PES schemes protecting spring water sources in north-east France (Perrot-Maitre, 2006). The one thing that all these PES mechanisms hold in common is that in each there is only one buyer (Salzman, 2006). In Costa Rica, that buyer was the Global Environment Facility, in Australia and Georgia that buyer was a regulator acting on behalf of the regional government and in north-east France it was the bottled water company Perrier-Vittel.

In the language of economics, these PES mechanisms are examples of a market structure described as a monopsony. In a monopsony there is one dominant buyer and multiple sellers. In such a market structure, the common outcome will be for the single buyer to exploit their market power to drive down prices so as to maximise profits. Indeed, one might think of the auction mechanisms employed in some PES schemes, including the Fowey River Improvement Scheme, as the buyer manipulating the market so as force down prices and claim the lion’s share of the surplus.

A question that has not yet been addressed in the literature is why PES schemes have not developed with other market structures. In this section, we present a first attempt to explore some of the issues that might arise in developing PES markets with more than a single dominant buyer.

The section begins with an academic investigation of the potential obstacles in moving to the development of multiple-purchaser PES mechanisms. Through theoretical modelling, that investigation reveals that one of the key obstacles to developing multi-purchaser market structures is the issue of free-riding. The investigation goes on to detail a series of experiments undertaken at the University of East Anglia that explore whether the free-riding problem in a multiple-purchaser PES mechanism might be overcome by getting purchasers to commit to contributions through a process of negotiation. In the final section, we report on the work that has been carried out to investigate the potential for developing a multiple-purchaser PES mechanism in the context of the Fowey.

3.2 Theoretical and Experimental Investigations of Multiple-Purchaser PES Mechanisms

To more readily understand the complexities of PES mechanisms with more than one buyer, we begin by greatly simplifying the problem. The objective is to create a stylised representation of the situation that allows the essential elements of the problem to be explored using various methods of economic analysis.

To that end, we begin by considering a situation in which, rather than just one buyer, we have two ecosystem service purchasers. We shall refer to them as Purchaser 1 and Purchaser 2. Purchaser 1 is interested in acquiring more of particular service flow a \((SF_a)\), while purchaser 2 wants more of service flow b \((SF_b)\). We assume that both those service flows can be acquired by investing in some particular action. We label this action, action C.
To fix thoughts imagine that one of the purchasers is a water company (Purchaser 1) wishing to improve water quality in a particular river (SF a) and that the other is a harbour authority (Purchaser 2) wishing to reduce levels of siltation in the estuary of that same river (SF b). For the sake of argument, imagine that both of those desires can be met by paying farmers to plant 10 metre forested buffer strips along river banks (action C). So in this model, action C plays the role of an action that might be financed through a PES mechanism.

At the same time, both purchasers have the opportunity of acquiring that same service through some other method. SF a can be acquired by investing in action A while SF b can be acquired by investing in action B. Note that these alternative methods of provision do not necessarily require the service flow to be delivered through natural processes. Also, the alternatives may simply be doing the same action as action C, but in some other location. To extend our motivating example, action A might be the chemical treatment of polluted water abstracted from rivers, while action B might be periodically dredging the estuary to reduce siltation.

Our primary interest in examining this problem is to establish whether, and under what circumstances our two purchasers might be prepared to make investments in action C. In our motivating example, our purpose might be in trying to establish a PES mechanism whereby these two purchasers paid farmers to plant forested buffer strips along river banks.

As we shall see, the key tension here is that action C has some public good properties. In buying action C, a purchaser not only benefits themselves through increasing the flow of the service flow from which they gain value but also benefits the other purchaser through increasing the other service flow as well. Accordingly, like any public goods problem, what we might expect to see is under-investment in action C as a result of free-riding behaviour.

In order to simplify and to provide a clear focus on the purchaser side of the market, let us assume that each of the actions can be bought at some constant unit price. In particular, £1 of investment by a purchaser in action A gives $x_a$ units of SF a, £1 of investment in action B gives $x_b$ units of SF b, while £1 of investment in action C yields $\lambda_a x_a$ units of SF a and $\lambda_b x_b$ units of SF b. Those service flows are summarised in Table 3.1.

<table>
<thead>
<tr>
<th>Action</th>
<th>Service Flow</th>
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<tbody>
<tr>
<td></td>
<td>$a$</td>
</tr>
<tr>
<td>A</td>
<td>$x_a$</td>
</tr>
<tr>
<td>B</td>
<td>0</td>
</tr>
<tr>
<td>C</td>
<td>$\lambda_a x_a$</td>
</tr>
</tbody>
</table>

Here $\lambda_a$ and $\lambda_b$ are non-negative scaling coefficients that tell us how much more or less of each service flow is provided by investing in Action C as compared to the other possible outcomes. For example, if $\lambda_a > 1$ then for the same investment, a purchaser gets more of SF a by buying Action C than from buying Action A. We would say that Action C is more cost-efficient than Action A. Indeed, different values for $\lambda_a$ and $\lambda_b$, define a number of possible cases;
Case 1 \[ \lambda_a > 1 \text{ and } \lambda_b > 1 \] C is more cost efficient than A and B

Case 2 \[ \lambda_a > 1 \text{ and } \lambda_b < 1 \] Or \[ \lambda_a < 1 \text{ and } \lambda_b > 1 \] C is more cost efficient than A but not B

Case 3 \[ \lambda_a < 1 \text{ and } \lambda_b < 1 \] and \[ \lambda_a + \lambda_b > 1 \] C is more cost efficient than a mix of A and B

Case 4 \[ \lambda_a < 1 \text{ and } \lambda_b < 1 \] and \[ \lambda_a + \lambda_b \leq 1 \] C is less cost efficient than a mix of A and B

We can express those same cases on a diagram as depicted in Figure 3.1.

Figure 3.1: Four different cases regarding the relative merits of buying Action C over alternatives

The parameters \( \lambda_a \) and \( \lambda_b \) are crucial for this analysis since they determine the relative merits of investing in action C; in other words, participating in the PES mechanism. So if, for example, \( \lambda_a > 1 \), then action C always gives a better return per £ than action A. In that case, Purchaser 1 would only ever invest in action C. Likewise, if the opposite is true and \( \lambda_a < 1 \), then Purchaser 1 will have strong incentives only to purchase quantities of action A. A similar argument holds for \( \lambda_b \) and Purchaser 2’s decisions as to whether to invest in action C or B.

**Non-Cooperative Outcomes: A Theoretical Investigation**

With our simplified model in place, we can now apply techniques of economic analysis to begin to understand the obstacles and opportunities for developing a PES mechanism that encourages the purchasers to invest in Action C.

To do that, we posit a payoff function for each purchaser which is increasing (at a declining rate) in the levels of service flow and use methods of non-cooperative game
theory to explore how the purchasers will behave under different market set-ups and in response to different mechanisms and interventions.

The discussions that follow report the intuition of the findings of those analyses while the rigorous mathematical workings are relegated to Appendix E.

**PES Market Institution I: Free Market**

We begin by considering whether a multiple-purchaser market for Action C will develop naturally; that is without the creation of mechanisms or institutions to promote such exchanges. In effect, action C is simply introduced to the economy as an alternative commodity that can be purchased instead of, or in addition to quantities of actions A and B.

Given our model set-up the key factor influencing outcomes is the values taken by $\lambda_a$ and $\lambda_b$ since those determine the relative benefit that the purchasers get from investing in Action C rather than the alternative action available to them.

- **CASE 1:** $\lambda_a > 1$ and $\lambda_b > 1$

In this case, Action C is more cost efficient than the alternative for both purchasers. Accordingly, if they decide to purchase anything at all, both players will only purchase quantities of action C. What we discover by working through the maths is that in this case, the game results in a Nash Equilibrium in which either Purchaser 1 or 2 (depending on the relative sizes of the parameters of their payoff functions) completely free-ride on the other’s purchases of action C.

The intuition here is straightforward. Imagine Purchaser 2 gets more value from units of action C than Purchaser 1. Imagine too that Purchaser 1 starts out ignoring what Purchaser 2 is going to do and buys as much of action C as would make sense for them to do if they were the only purchaser. Of course, Purchaser 2 benefits greatly from the units of action C that have been bought by Purchaser 1. Now, since Purchaser 2 values action C more highly than Purchaser 1, their optimal response would be to also invest some of their own money and buy some additional units of action C. Since Purchaser 2 is now buying some action C, however, it no longer makes sense for Purchaser 1 to buy as much as they had planned to originally. Accordingly, we would expect Purchaser 1 to decide to buy less of action C. Unfortunately, for Purchaser 2 that means that they are not gaining as much as previously from Purchaser 1’s funding of action C. Their best response is to buy yet more of action C, which again encourages Purchaser 1 to reduce their contribution. That sequence of events would continue until Purchaser 1 is buying no units of action C, but merely free-riding on the units funded by Purchaser 2.

Our first conclusion then is that in a simple market structure, even when action C is cost efficient for both players it is likely that only one purchaser will end up paying for action C.

- **CASE 2:** $\lambda_a > 1$ and $\lambda_b < 1$

In this case action C is more cost efficient than alternative actions for one of the Purchasers (by way of illustration we choose that Purchaser to be Purchaser 1), but less cost efficient for the other.

In this case we find that Purchaser 1 buys their optimal quantity of action C and this is independent of Purchaser 2’s actions. In contrast, Purchaser 2 only buys action B, but only when Purchaser 1’s purchases of action C are insufficient to fulfil their desires for $SF b$.

Again the conclusion is that only one player will have incentives to invest in action C.

- **CASE 3 & 4:** $\lambda_a < 1$ and $\lambda_b < 1$


In the final case, Action C is less cost efficient than either A or B. Accordingly the optimal plan for Purchaser 1 is to buy only action A and for Purchaser 2 to buy only action B. No units of action C are bought.

Our (admittedly simplified) analysis reveals a very important insight; without further structure to the market mechanism, the public good nature of actions delivering ecosystems services are likely to lead to only one purchaser investing in those actions. That purchaser will be the purchaser that gains the most value from those actions ... other purchasers will simply free-ride.

PES Market Institution II: Matching mechanism in C

One potential solution to the problems of free-riding identified in the simple market institution discussed above is for the purchaser gaining the most value from action C to stipulate some rule governing their contributions to the purchase of that action. For example, that purchaser might commit to a matching rule in which they promised to buy a certain quantity of action C for every unit of action C bought by another purchaser (Boadway et al., 2007).

For the sake of simplicity let us assume that Purchaser 1 is that lead purchaser and that they commit to a matching rule in which they will buy one unit of action C for every unit bought by Purchaser 2.

The interesting thing about this mechanism is that it reduces the free-rider problem, encouraging contributions to Action C even in situations where \( \lambda_a \) and \( \lambda_b \) are less than one. The requirement for equal matching is not necessary and the contributions could be in any ratio\(^3\). Focusing on the equal matching example, however, consider the following situations;

- **SITUATION 1: \( \lambda_b > \frac{1}{2} \)**

Let us assume that Purchaser 1 is the lead purchaser who has strong motivations to purchase action C. Under the mechanism discussed previously, Purchaser 2 would make no contributions to the purchase of action C. Confronted with Purchaser 1’s commitment to a matching rule, however, their incentives change.

Since \( \lambda_b > \frac{1}{2} \), it now makes sense for Purchaser 2 to invest in action C. Every unit of action C they buy is matched by Purchaser 1. In effect the value of \( \lambda_b \) is doubled and, since it was greater than a half to begin with, this effective value of \( \lambda_b \) will be larger than unity.

It turns out that the best thing for Purchaser 2 to do is to buy around half of the units of action C that they would have purchased if they were the only buyer. Purchaser 2 then matches those investments, which gives them a level of provision of action C around their optimal level.

For Purchaser 1, that outcome might turn out to be better or worse than the pure free-riding outcome. For example, if Purchaser 1’s optimal level of purchases of action C is only a little higher than that of Purchaser 2, then this outcome is rather good. They end up with a level of provision of action C close to that which they would choose on their own, but at half the cost. Alternatively, if Purchaser 1’s optimal level of action C is very much more than that of Purchaser 2, then committing to the matching mechanism turns out to be highly restrictive; the cost savings are outweighed by the

\(^3\) Indeed, choosing the ratio \( \lambda_a : \lambda_b \), contributions to the purchase of C could be encouraged for any \( \lambda_a, \lambda_b \) provided \( \lambda_a + \lambda_b > 1 \) (Cases 1, 2 and 3)
fact that the level of provision of action $C$ is far below that which would be of most benefit to them.

- **SITUATION 2: $\lambda_B < \frac{1}{2}$.**

  That bad outcome is demonstrated in the extreme when $\lambda_B < \frac{1}{2}$. In this case, even with matching payments from Purchaser 1, the effective value of $\lambda_B$ remains below unity such that it still makes more sense for Player 2 to buy only intervention $B$.

  Accordingly, if Purchaser 1 had truly committed to the matching mechanism then they would end up in a situation where absolutely no units of action $C$ are purchased. Through their adherence to a matching rule, Purchaser 1 forces themselves into a position where their only option is to invest in the cost-inefficient action $A$.

Evidently, the most important element of designing a matching mechanism to overcome the free-riding problem will be in settling on the ratio of matching that ensures the most desirable outcome. Of course, that may not be an easy task if the payoff function for other purchasers is not known. Also it is not at all clear that Purchaser 1’s commitment to a matching mechanism is credible. For example, Purchaser 2 may anticipate that Purchaser 1 has a lot to lose if little action $C$ is purchased. Accordingly, offering up a negligible or zero contribution to the purchase of action $C$ may prove a good strategy. Purchaser 1, observing such a low level of provision of action $C$, will have strong incentives to abandon the matching mechanism so as to purchase the quantities of action $C$ that they desire.

**Cooperative Outcomes: An Experimental Investigation**

The public goods nature of the problem analysed above leads to an all too familiar finding of free-riding and under-investment in action $C$. Of course, both purchasers are likely to recognise that free-riding may be an issue and in the real world might seek solutions by working together.

In particular, we could imagine the two purchasers entering a process of negotiation with each other over how much each should contribute towards purchases of action $C$. Of course, such a solution can only succeed if both parties are confident that the contributions agreed to in that negotiation will be the actual amounts paid toward the purchase of action $C$. In the language of economics, the agreement coming out of the negotiation has to form a binding commitment. Of course, if either purchaser could agree to some level of payment and then subsequently renege on that commitment, then the two purchasers would quickly regress into the free-riding problem of the non-cooperative set up. In the context of PES mechanisms at the national scale, there is every reason to believe that binding commitments are possible, perhaps backed up by the legal formalisation of the agreement into a contract.

Once we move into a world of negotiation and cooperation, the solution tools of non-cooperative game theory are no longer relevant. Accordingly, to shed further light on the sorts of outcomes that might arise when negotiations with binding commitments are possible between purchasers, the University of East Anglia team devised a series of pilot experiments that were run over early 2013 in the labs of the Centre for Behavioural and Experimental Social Sciences.

**Experiment Overview**

The experiments involved student subjects undertaking a series of tasks on computers. In each task, each subject teamed-up with two other participants to make a group of three people. Subjects did not know the identities of the other members of their group and the composition of groups changed from task to task.
In each task the members of the group engaged in a negotiation in an attempt to reach a deal. Their payment for participating in the experiment was determined by whether they reached a deal and what particular deal they agreed upon.

In each task, one member of the group took the role of the ecosystem service provider, while the other two subjects were the purchasers. As can be seen in the detailed instruction for the experiment that are provided in Appendix F, in the experiment itself neutral labels were employed; so instead of ‘provider’ and ‘purchaser’, the subjects were simply Player’s 1, 2 and 3. Whether a subject was a purchaser or a provider changed from task to task.

In brief, a task consisted of the two purchasers teaming-up to make an offer to the provider. In so doing they had to negotiate with each other over how much each was going to contribute to that offer. If the offer was good enough, then the provider might accept it, in which case a deal is done. If the provider rejected the offer, then the purchasers may have had the chance to make another offer, though a task could also end without a deal being reached.

In each task, all three subjects started out entitled to some Default Payment. Alternatively, provided each of the 3 subjects in a group agreed to the idea, then instead of each member getting their Default Payment they got their Deal Payment instead.

For the two purchasers, the Deal Payment was always greater than their Default Payment such that they were always incentivised to reach a deal. In contrast for the provider the Deal Payment was always nothing.

That somewhat abstract set-up, closely mimics the set-up of the model described in the previous section;

- For the purchasers the Deal Payments represents the payoffs they would enjoy from Action C; that is, from getting the provider to supply the ecosystem service. The Default Payment, on the other hand, represents the payoff they would enjoy from Action A (or Action B, depending on purchaser); that is, from some alternative method of receiving the same service flow.

- For the provider, the difference between their Deal Payment and Default Payment represents the costs of undertaking Action C. In other words, if the provider agrees to the deal they forego their Default Payment such that that payment is tantamount to the cost of agreeing to undertake the action.

To persuade the provider to incur that cost, the two purchasers were given the opportunity to team-up and offer him/her some money. Obviously, the most it would ever make sense for one purchaser to contribute to such a payment is the difference between the Deal Payment and their Default Payment. Of course, for each purchaser the free-riding incentive is to offer to contribute as little as possible in the hope that the other purchaser will be prepared to contribute enough to push through a deal.

A task began with the two purchasers negotiating with each other regarding how much each would contribute towards an offer to the provider. If agreement was reached, then that offer (the sum of the two contributions) was passed to the provider who could accept or reject it. If the offer was accepted by the provider, then all three subjects had agreed and a deal was done. If the provider rejected the offer then the onus switched back to the purchasers who would then try to negotiate another offer.

Accordingly, negotiations proceeded through a series of rounds in which objections could be raised either by a purchaser who did not like the levels of contribution proposed by the other purchaser or by the provider who felt that an offer made by the purchasers...
was not sufficiently generous. To represent the cost of negotiating and to limit the rounds of negotiation, raising an objection and blocking a deal in a round of negotiation came with a risk of the negotiations failing. In the experiment that risk was randomly realised by the computer each time an objection was raised, with odds of failure being clearly displayed to the subjects. If the negotiations failed then every subject had to content themselves with their default payment. Those odds of failure increased as the rounds of negotiation progressed putting increasing pressure on the subjects to reach a deal.

Experimental Design

The fundamental objective of the experimental exercise was to establish whether purchasers could reach negotiated agreements to fund payments to providers in a PES mechanism. In addition, we wished to explore how differences in the circumstances of the negotiation changed the ease with which a negotiated agreement was reached and the nature of the deal agreed upon. To that end, we explored five different issues;

- **Size of surplus in the deal;** by increasing the size of the deal payments, we were able to explore how negotiated agreements changed as the benefits the purchasers realised from making a deal increased. We were interested to see whether deals were reached more easily or more quickly in these circumstances and the extent to which the provider was able to claim some of that increased surplus by holding out for a higher payment.

- **Asymmetry in the benefits of a deal;** in many circumstances we might expect one of the purchasers in a PES market to do relatively better out of a deal than others. We wished to explore whether such asymmetry would result in difference in contributions towards the negotiated payments. In the experiment that meant including treatments in which purchasers shared the same Default Payment but had different Deal Payments.

- **Asymmetry in the ‘wealth’ of purchasers;** along similar lines, while purchasers may not differ in terms of the additional benefits they stand to realise from a deal, they may differ in terms of the overall level of benefits they enjoy. In a PES market that might correspond to having one purchaser that is a large, high-profit company and another that is a small, low-profit company. In the experiment, that meant including treatments in which purchasers had different Default Payments but the difference between those Default Payments and Deal Payments was identical.

- **Benefits of deal are private information;** in the real world, it is unlikely that purchasers, negotiating over contributions towards payments to be made to a provider, will reveal to the other provider the level of benefits they stand to enjoy from a deal being done. To explore that issue, treatments were included in the experiment in which Deal Payments were private information.

- **Benefits of the deal are stochastic;** in the real world, the level of service flow enjoyed by purchasers when a provider takes a particular action may not be certain. Often natural processes mediate the relationship between action and service flow in such a way that the benefits realised by paying for the action are stochastic. To explore issues regarding stochastic outcomes, treatments were included in which the purchasers had the possibility of two different Deal Payments. In negotiating the Deal the purchasers did not know which of those deal payments would turn out to be the actual deal payment only that there was a 50% chance it would be one of those payments and 50% chance that it would be the other. In these stochastic treatments, purchasers had to decide how much they were going to contribute to payments to the provider in each of the two possible states of the world.
Accordingly, an experimental design was devised consisting of the eight treatments detailed in Table 3.2.

**Table 3.2: Treatments in the Dual-Purchaser Bargaining Experiment**

<table>
<thead>
<tr>
<th>Treatment</th>
<th>Default Payments</th>
<th>Deal Payments</th>
<th>Role</th>
<th>Default Payment</th>
<th>Deal A Payment</th>
<th>Deal B Payment</th>
</tr>
</thead>
<tbody>
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<td>Symmetric</td>
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<td>Purchaser 1</td>
<td>£ 7.50</td>
<td>£15.00</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Purchaser 2</td>
<td>£ 7.50</td>
<td>£15.00</td>
<td>£0</td>
</tr>
<tr>
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<td></td>
<td></td>
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<td></td>
</tr>
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<td></td>
<td>Purchaser 2</td>
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<tr>
<td>3</td>
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<td>Asymmetric</td>
<td>Purchaser 1</td>
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<td>£18.00</td>
<td></td>
</tr>
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<td>Full Information</td>
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<td>£12.00</td>
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</tr>
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<td>Full Information</td>
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</tr>
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<td>Provider</td>
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<td>£0</td>
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</tr>
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<td>£18.00</td>
</tr>
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<td>information</td>
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<tr>
<td>7</td>
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<td>£0</td>
</tr>
<tr>
<td>8</td>
<td>Asymmetric</td>
<td>Full Information</td>
<td>Asymmetric</td>
<td>Purchaser 1</td>
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<td>£12.00</td>
</tr>
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<td></td>
<td></td>
<td></td>
<td>Private</td>
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<td>£10.50</td>
<td>£9.00</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Information</td>
<td>Provider</td>
<td>£ 7.50</td>
<td>£0</td>
</tr>
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</table>

**Experimental Results**

Table 3.3 details the results of the negotiations for the six non-stochastic treatments. Since this was run as a pilot exercise, the sample sizes in each treatment are low. As a result, our discussion of the findings will be largely qualitative and must be qualified by the caveat that they are not supported by the statistical rigour that would be possible with larger samples.

To understand the format of the data, consider the results for Treatment 1 presented in the first row of Table 3.3.
For convenience, the first six columns of the table simply repeat the information in Table 3.2. So in Treatment 1, all subjects have a Default Payment of £7.50 and the two Purchasers are symmetric in so much as they both have Deal Payments of £15. In this treatment those Deal Payments are public information.

The next two columns show us that in the experiment 21 groups undertook negotiations faced by this set of payments and 100% of those negotiations resulted in a deal being agreed.

The next column displays the average number of rounds it took groups to reach a deal. In Treatment 1 this was just 2.38 rounds suggesting subjects found it relatively easy to reach a deal under this structure of payments.

The final three columns describe the deal that was done by the three subjects.

- The first of those columns shows the average contributions to the payment to the provider made by each of the two purchasers. In Treatment 1, for example, on average the deal agreed upon required Purchaser 1 to contribute £4.68 and Purchaser 2 to contribute £4.76.

- The second of those columns shows how those payments translate into average payoffs for the three subjects. In the case of Treatment 1, the average payoff for Purchaser 1 was their Deal Payment, £15.00, minus their contribution to the payment to the Provider, £4.68, giving a payoff of £10.32. The same calculation for Purchaser 2 reveals an average payoff of £10.24. The Provider’s payoff is simply the sum of the two contributions coming from the two purchasers; an average payoff in Treatment 1 of £9.44.

- The final column describes the way in which the deal has shared the possible payoffs between the 3 subjects. In Treatment 1, the Deal Payments to the two purchasers are £15.00, giving a total pot of money to be distributed between the three subjects of £30.00. Dividing the average payoff for each subject by this total shows the average share of that pot received by that subject. In this case Purchaser 1 gets a 34.4% share, Purchaser 2 a 34.1% share and the Provider 3 a 31.5% share. Note that since the average payoffs will not necessarily add to £30.00 it will not necessarily be the case that these shares will sum to 100% (though for Treatment 1 they do).

Taking a moment to look at the results for Treatment 1 as a whole, suggests some preliminary conclusions.

- First, since 100% of negotiations successfully completed with a deal, it is clear that (within a highly simplified) dual-purchaser PES market, negotiated deals can be reached to avoid free-riding problems. Indeed, given that it took only 2.38 rounds of negotiation to reach a deal (on average), subjects appear to have found it relatively easy to reach agreement.

- Second, with symmetric Deal Payments the purchasers arrive at deals in which they make roughly equal contributions towards the payment to the provider; an average £4.68 for Purchaser 1 compared to an average £4.76 for Purchaser 2.\(^4\)

\(^4\) A detailed analysis of the bidding patterns over rounds might shed more light on this issue, but that was not possible within the time constraints of this project.
Table 3.3: Results of Non-Stochastic Dual-Purchaser Bargaining Experiments

<table>
<thead>
<tr>
<th>Treatment</th>
<th>Treatment Description</th>
<th>Role</th>
<th>Default Payment</th>
<th>Deal Payment</th>
<th>Observations</th>
<th>% Completing a Deal</th>
<th>Avg. Rounds till Deal</th>
<th>Deal Outcome</th>
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<td>1</td>
<td>Symmetric Full Information</td>
<td>Purchaser 1</td>
<td>£ 7.50</td>
<td>£15.00</td>
<td>21</td>
<td>100.0%</td>
<td>2.38</td>
<td>£ 4.68</td>
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<td></td>
<td></td>
<td>Purchaser 2</td>
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<td>£12.21</td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>Symmetric Asymmetric Full Information</td>
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<td>£18.00</td>
<td>39</td>
<td>87.2%</td>
<td>4.88</td>
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<td>£11.00</td>
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<td>Purchaser 2</td>
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<td>£ 9.86</td>
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<td>Symmetric Asymmetric Private Information</td>
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<td>£18.00</td>
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<td>£ 7.50</td>
<td>£12.00</td>
<td></td>
<td></td>
<td></td>
<td>£ 3.56</td>
<td>£ 8.44</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Provider</td>
<td>£ 7.50</td>
<td>£0</td>
<td></td>
<td></td>
<td></td>
<td>£ 9.42</td>
<td></td>
</tr>
<tr>
<td>6</td>
<td>Asymmetric Full Information</td>
<td>Purchaser 1</td>
<td>£ 4.50</td>
<td>£12.00</td>
<td>30</td>
<td>73.3%</td>
<td>7.64</td>
<td>£ 3.68</td>
<td>£ 8.32</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Purchaser 2</td>
<td>£10.50</td>
<td>£18.00</td>
<td></td>
<td></td>
<td></td>
<td>£ 5.63</td>
<td>£12.37</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Provider</td>
<td>£ 7.50</td>
<td>£0</td>
<td></td>
<td></td>
<td></td>
<td>£ 9.31</td>
<td></td>
</tr>
</tbody>
</table>
Finally, while a payment of just over £7.50 should be sufficient to encourage the provider to agree to the deal, the average deal offered the purchaser substantially more than that. Indeed, the data show evidence of a tendency to agree on roughly equal payoffs, over half the groups in this Treatment agreed on a deal that gave them each the same payoff of £10. Note that this analysis does not tell us whether that equal outcome was driven by a sense of fairness in the motivations of the subjects or by the Provider exercising bargaining power to claim a larger share of the pie.

Treatment 2 differs from Treatment 1 only in so much as the Deal Payments for the two purchasers are larger; £20.00 instead of £15.00. Again, with symmetric Deal Payments we observe the two purchasers making roughly equal contributions towards the payment to the provider. The interesting question here, however, is whether the increased benefits the purchasers realise from a deal will translate into increased payments to the provider. In this case, the answer is ‘yes’. The average deal sees the two purchasers realising payoffs of £13.88 and £13.92 and the provider a payoff of £12.21. While the provider’s payoff is some £1.70 lower than that of the purchasers, it is substantially larger than the minimum payment of £7.50 and that from Treatment 1 of £9.44.

Treatment 3 introduces asymmetry in the payoff of the purchasers; in this case, Purchaser 1 has a deal payment of £18.00 while Purchaser 2 has a deal payment of £12.00. The first thing to note about the asymmetric case is that subjects find it significantly harder to make a deal. In this treatment only 87.5% of negotiations ended in a deal and those negotiations took an average 4.88 rounds to negotiate.

The asymmetry in Treatment 3 also presents Purchaser 2 with strong incentives to free ride since Purchaser 1 could easily afford to cover the costs of the provider all on their own. Indeed, in the data we now observe asymmetry in contributions, Purchaser 1 contributes an average of £7.00 to the provider’s payment while Purchaser 2 contributes only £2.50. Those differences in contributions ensure that the payoffs from the negotiations are reasonably similar though Purchaser 1, the subject bringing most of the benefit to the negotiating table, tends to realise the highest final payoff (some 5% higher than either Purchaser 2 or the Provider).

The purpose of Treatment 4 was to test whether it made any difference as to who opened the negotiations. In the experiment, it was always Purchaser 1 who began the negotiations by making a first proposal of payments to be made to the Provider. Accordingly, in treatment 3 it was the Purchaser with the higher, £18.00, Deal Payment that began the negotiations. Treatment 4 is identical to Treatment 3 except for the fact that the Deal Payments of Purchaser 1 and Purchaser 2 have been swapped. Accordingly in Treatment 4 it is the subject with the lower, £12.00, Deal Payment who opens the negotiations. Reviewing the data in Table 3.3 it is clear that changing the order of negotiations had no substantive impact on the deals that are agreed.

Treatment 5 presents subjects with the same asymmetric payments that were offered in Treatment 4. The big difference between Treatment 4 and Treatment 5, however, is that in the latter a purchaser’s Deal Payment is private information.

The first notable difference between these two treatments is that the introduction of private information appears to make negotiating a deal more difficult. Subjects still reach a deal (97% of the time), but it takes an average 7.8 rounds of negotiation to do so as compared to 4.9 in the full information case. Moreover, when information is not presented regarding the relative size of Deal Payments, the size of contributions made by the two purchasers turns out to be more similar to each other (£5.86 and £3.56) than is the case in the full information treatment (£7.00 and £2.50). Notice that the purchaser receiving the higher Deal Payment still ends up contributing more. One might speculate that with private
information the tendency to hold out for a fair distribution of payoffs, or for that matter feel obliged to offer such a distribution, is removed. Subjects might instead be drawn towards a deal in which the purchasers make equal contributions towards the payment to the Provider. The fact that those payments are not equal suggests that in the process of negotiation the purchaser deriving relatively small surplus from the deal is motivated to drive a harder bargain than the purchaser with the higher Deal Payment.

In nearly all respects Treatment 6 is identical to Treatment 5; one purchaser gets a Deal Payment of £12 and the other a Deal Payment of £18, and the size of those Deal Payments is private information. Treatment 6 differs, however, in so much as the purchaser getting the higher Deal Payment also had a higher Default Payment, £10.50, while the purchaser getting the lower Deal Payment also has a lower Default Payment, £4.50. Accordingly, both purchasers stand to make the same gain from agreeing a deal, £7.50, though one is less likely to come out with an overall lower payoff.

Subjects found this treatment the most difficult in which to agree to a deal; only 73% of negotiations ended in success. Interestingly, when negotiations were successful the deals that were agreed upon were very similar to those realised in Treatment 5; so in Treatment 5 the contributions of the low Deal Payment and high Deal Payment purchasers were £5.86 and £3.56 respectively, while those in Treatment 6 were £5.63 and £3.68. Previously we speculated that the difference in payments between low and high Deal Payment purchasers was due to the relatively greater need for the low Deal Payment player to hold out for a lower contribution. In the case of Treatment 6, that argument no longer holds; both purchasers stand to make the same gain if the deal goes ahead. We suspect that a second force is at work in these results, relating to the difference in Default Payment between the two payers. In particular, the negotiations may be shaped by the information that one of the purchasers stands to end up with an absolutely greater payoff than the other. The deals arrived at by the purchasers suggest that they will agree to payments in which this ‘better-off’ purchaser makes a large contribution.

Table 3.4 presents data relating to the negotiations for the two stochastic treatments. Recall that in these treatments, having agreed to a deal, two possible states of the world might transpire, state of the world A and state of the world B. There is 50% chance that reality will turn out to be state of the world A and 50% chance that it will turn out to be B. Which of those events turns out to be the reality matters to purchasers since their Deal Payments differ across the different states of the world.

In both Treatments 7 and 8 the information on Deal Payments is public information. Also the payments are designed to maintain an asymmetry between the purchasers; Purchaser 1 has opportunities for Deal Payments that are as large if not larger than those of Purchaser 2. For both purchasers the Deal Payment in one state of the world is larger than that in the other. The key design feature that distinguishes Treatment 7 and 8 is that in Treatment 7 Deal Payments are positively correlated; both Purchaser 1 and Purchaser 2 get their higher payment in state of the world A and their lower payment in state of the world B. In contrast, in Treatment 8 Deal Payments are negatively correlated; Purchaser 1 realises their high payment when Purchaser 2 realises their low payment and vice versa.

Much of the detail in the negotiated outcomes in these two treatments follows the same patterns observed in the non-stochastic treatments discussed above. What is worth pausing to consider, however, is the differences between these two treatments with respect to how the subjects share the risk of differing outcomes.
Table 3.4: Results of Stochastic Dual-Purchaser Bargaining Experiments

<table>
<thead>
<tr>
<th>Treatment</th>
<th>Treatment Description</th>
<th>Role</th>
<th>Default Payment</th>
<th>Deal Payment A</th>
<th>Deal Payment B</th>
<th>Obs</th>
<th>% Completing a Deal</th>
<th>Average Rounds till Deal</th>
<th>Deal Outcome</th>
<th>Average Proposal A</th>
<th>Average Proposal B</th>
<th>Average Payoff A</th>
<th>Average Payoff B</th>
</tr>
</thead>
<tbody>
<tr>
<td>7 Purchaser 1</td>
<td>£ 7.50 £21.00 £15.00</td>
<td>£8.52 £6.37 £12.48 £8.63</td>
<td>31</td>
<td>87.1%</td>
<td>5.22</td>
<td>£9.34 £4.95 £11.66 £10.05</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>8 Purchaser 2</td>
<td>£ 7.50 £15.00 £9.00</td>
<td>£2.67 £1.75 £12.33 £7.25</td>
<td>26</td>
<td>96.2%</td>
<td>3.88</td>
<td>£1.00 £4.81 £8.00 £10.19</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Provider</td>
<td>£ 7.50 £0 £0</td>
<td>£11.19 £8.12</td>
<td>£10.34 £9.76</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
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<td></td>
</tr>
</tbody>
</table>
First, observe the outcome of Treatment 7 where Deal Payments are positively correlated across states of the world. Rather than offering the Provider with the same payment no matter what the state of the world, the deal that the purchasers agree to is one where they pay the Provider more, £11.19, if things turn out well and they both get their high payments (state of the world A) and less, £8.12, if things turn out badly and they both get their low payments (state of the world B). In effect, in this treatment the purchasers push some of the risks of a bad outcome onto the Provider.

In contrast, observe the outcome of Treatment 8 where Deal Payments are negatively correlated. In this case, the Provider gets very similar payments in both states of the world, £10.34 and £9.76. The purchasers, on the other hand, arrange their payments quite differently. Compared to positively correlated case, they pay more when they are the purchaser to enjoy the good state of the world (such that the other purchaser experience their bad state) and relatively less when they are the purchaser to enjoy the bad state of the world (such that the other purchaser experiences their good state). In effect, in this treatment the purchasers share the risk of different possible outcomes between themselves rather than with the Provider.

**Insights from the Theoretical and Experimental Investigations**

While the theoretical and experimental work presented here may appear a long way from reality, it provides some important insights into the sort of issues that might arise in the creation of PES mechanisms for more than one purchaser.

First amongst those is that multiple-purchaser PES mechanisms must overcome the free-rider problem. Without specific attention to how the mechanism will address free-riding it is likely that participation will be limited to the single purchaser who stands to gain most from paying providers to take actions that deliver ecosystem services.

One approach is for that lead purchaser to create rules, such as committing to match contributions from other purchasers. For such a mechanism to be credible it must be the case that the lead purchaser can commit to not paying anything themselves unless contributions are forthcoming from other purchasers. Of course that commitment is difficult to maintain given the strong incentives that the lead purchaser has to see the ecosystems services delivered.

An alternative mechanism would be a PES mechanism in which purchasers could commit to make contributions decided upon in negotiations. The key to such a solution is that the commitments are binding perhaps backed by the force of law. We show in our experimental work that in very simplified cases such negotiated agreements can be obtained and free-ridding avoided.

We explore different arrangements of markets in a series of experiments and discover that the level of contribution agreed upon in negotiations appears to be increasing in how much a purchaser stands to gain from the agreement and also, perhaps, on how much they stand to earn in absolute terms. We suspect that such results would carry over to genuine negotiations in a PES market, but that is an empirical question.

Finally, we observe that multiple-purchaser PES markets afford an opportunity for purchasers to share the risks emanating from the stochastic nature of the delivery of ecosystem services. Perhaps of most interest is the insight that if opportunities exist for purchasers to fund actions in which the ecosystem service outcomes they are interested in are negatively correlated, then they can share the risks with each other. In particular, a purchaser commits to paying relatively more when the outcome turns out to be good for them and relatively less when it turns out to be bad. Since their outcomes are negatively correlated another purchaser making the same commitment ensures that the overall
payoffs that can be made to providers in the two states of the world are enough to encourage their participation.

### 3.3 Legal Issues in Binding Agreements for Multiple Purchaser PES Mechanisms

Our theoretical and experimental analysis shows that multiple-purchaser PES mechanisms are only likely to prosper in the event of the parties being able to make binding agreements in which purchasers commit to their contributions and providers commit to the actions they will undertake. As part of the project, Westcountry Rivers Trust investigated the possibilities for expanding the legal framework they had put in place for the Upstream Thinking Initiative to allow for multiple purchasers.

Clearly, legal agreements are a key tool for formalising payments for any works either between a buyer and a seller or via an intermediary. These may take the form of contracts, covenants, easements or other appropriate legal instruments. Agreements should cover:

- who will pay for the identified costs and as well as on-going management and monitoring costs;
- who is responsible for what actions;
- what management interventions and/or ecosystem service outcomes are anticipated;
- how results will be demonstrated and who will be responsible for monitoring, evaluating, verifying and potentially certifying them;
- payment terms including amounts and timeframes; and
- how risks and the burden of proof will be apportioned.

Agreements should be proportionate to the scale of the PES scheme and its associated risks. For this reason, all interested parties should assess and negotiate:

- Projected costs that may be incurred during implementation of the deal (such as required capital investments and/or on-going maintenance costs);
- Projected revenues and whether these are sufficient to cover the costs, including the opportunity costs, of implementing the deal;
- Intangible benefits such as training, technical assistance, etc.;
- Potential risks and their remedies;
- Ideal ‘checkpoints’ in PES implementation and scheduling of payments;
- Agreed auditing and enforcement mechanisms; and
- Arrangements necessary to involve all parties with an interest in ecosystem management.

Legal Agreements are a key part of any PES scheme and depend heavily on the nature of the ecosystem service, the co-benefits derived, the number and type of buyers and the number and type of sellers. As such agreements tend to be bespoke and adapt as a project develops to accommodate unforeseen circumstances that naturally occur in a novel market or PES setting.

As part of their work with South West Water in the Upstream Thinking initiative, Westcountry Rivers Trust have developed an outline *Conditional Grant Agreement* which is updated with the specific details of each grant issued to a farmer. The legal document describes the commitments and responsibilities of Westcountry Rivers Trust, South West Water and the farmer and is signed by all three parties. Importantly, for all grants in excess of £5,000 the agreement is also enshrined in a covenant on the deeds of the property for
the life of the capital investment. The covenant is a personal agreement between the covenantor (WRT & SWW) and a covenantee (the farmer) to ensure the Conditional Grant Agreement is kept in place and re-signed in the event of property changing hands. The system has already been tested by farmers changing ownership and through other alterations in deeds. The Trust is informed of the change by both the farmers and through the land registry. Whilst this system is working it is limited by the fact that it is a personal covenant and not a typical covenant, which is between properties. This is due to the fact that the in the case of Westcountry Rivers Trust and the Farmer the land does not ‘touch and concern’ each other and as such only a personal covenant is possible. There is scope to extend the ‘touch and concern’ principle to South West Water downstream water treatment abstraction point but would only be developed through common or case law rather than civil law.

Alongside the pioneering of covenants under the Upstream Thinking programme the Westcountry Rivers Trust have also studied the use of conservation easements, the use of which have been growing exponentially within the United States of America. The main reason for this growth is that the Federal Government allowed the selling of conservation easements to be offset against income tax, however this looks to have recently been revoked. The UK Law Commission have not used easements for conservation purposes (they are mainly used for access) but are currently consulting on conservation covenants, as a way of creating a more flexible and longer term legal approach applicable to PES. The use of covenants will be an important tool in the contracting of long term agreements for either single or multiple purchases but in the experience of the Trust can present a significant barrier for sellers. One way round this for long term covenants is the use of a medium term ‘get out clause’ where the seller can pay back the payment, index linked, to get out of the covenant over the first x years.

3.4 Potential PES purchasers in the Fowey

In developing the Upstream Thinking Initiative, the Westcountry Rivers Trust had been working locally and more widely to ascertain whether other organisations or groups might stand to gain from improvements in water quality in the River Fowey. The hope at the outset was that some of those groups might be brought into the PES mechanism to provide additional streams of revenues to that provided by South West Water. In the event the tight timescales under which the Fowey River Improvement Auction was executed meant that aspiration did not come to fruition. As part of this project, however, Westcountry Rivers Trust engaged the services of Alex Inman, an independent consultant, to complete a detailed analysis of the potential for encouraging participation in PES schemes on farms in the Fowey from these other organisations. The findings of his investigation are reported in this section.

Engaging with Potential PES Purchasers

Organisations that were either directly connected to the Fowey (local groups), closely connected to the Fowey (area groups) or loosely connected to the Fowey (regional groups) were identified and contact details researched. Organisations were then approached to agree to a telephone interview. These interviews aimed to include a wide variety of stakeholders from different entities in the catchment including: Town Councils, Anglers, Boating interests, Fowey Harbour Commission, users of the port (Imerys).

Qualitative interviews were undertaken which followed the following format.
The Fowey River Improvement Auction - *Final Report*

- **Introduction** - Describing the concept of ecosystems services and the potential benefits that might arise from developing schemes that pay land owners to provide these ecosystems services.

- **Q1** - What ecosystem services do you derive from the Fowey river catchment?

- **Q2** - Who would you say provides these (and other) ecosystem services in the Fowey?

- **Q3** - How healthy do you think the Fowey ecosystem (environment) is?

- **Q4** - Are you impacted financially by a degradation of ecosystem services in the catchment (e.g. dredging costs, flood damage)?

- **Q5** - Have you ever thought of the reasons why these impacts are occurring?

- **Q6** - Have you ever thought about a way of preventing these problems from occurring/enhancing particular ecosystem services?

- **Q7** - Would you be prepared to pay? If not, why not. If yes, would you have any concerns and would there be any barriers to you investing resources?

Thirty-three organisations were contacted that were either directly connected to the Fowey (23 local groups), closely connected to the Fowey (6 area groups) or loosely connected to the Fowey (4 regional groups) (see Table 3.5). Of those, 13 agreed to be interviewed but 5 agreed too late to be included within the report (see Table 3.6).

**Table 3.5: The organisations contacted but did not agree or did not respond:**

<table>
<thead>
<tr>
<th>Scale</th>
<th>Name of organisation</th>
<th>Response</th>
<th>Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Local</td>
<td>Maurice Hunkin</td>
<td>No</td>
<td>Passed on to the Harbour commission</td>
</tr>
<tr>
<td>Local</td>
<td>Williams Boatyard</td>
<td>No</td>
<td>Passed on to the Harbour Commission</td>
</tr>
<tr>
<td>Local</td>
<td>Penmarlam Campsite</td>
<td>No</td>
<td>Closed</td>
</tr>
<tr>
<td>Local</td>
<td>Sal Diving Co</td>
<td>No response</td>
<td></td>
</tr>
<tr>
<td>Local</td>
<td>Fowey Pilots</td>
<td>No response</td>
<td></td>
</tr>
<tr>
<td>Local</td>
<td>Denholm Barwil</td>
<td>No response</td>
<td></td>
</tr>
<tr>
<td>Local</td>
<td>Westcountry Mussels of Fowey</td>
<td>No response</td>
<td></td>
</tr>
<tr>
<td>Local</td>
<td>Fowey Gallants Sailing Club</td>
<td>No response</td>
<td></td>
</tr>
<tr>
<td>Local</td>
<td>Fowey River Class Association</td>
<td>No response</td>
<td></td>
</tr>
<tr>
<td>Local</td>
<td>Fowey Diving club</td>
<td>No response</td>
<td></td>
</tr>
<tr>
<td>Local</td>
<td>Fowey River Canoe club</td>
<td>No response</td>
<td></td>
</tr>
<tr>
<td>Local</td>
<td>Fowey Regatta committee</td>
<td>No response</td>
<td></td>
</tr>
<tr>
<td>Local</td>
<td>Lahydrock Estate</td>
<td>No response</td>
<td></td>
</tr>
<tr>
<td>Local</td>
<td>Trewithen Daries</td>
<td>No response</td>
<td></td>
</tr>
<tr>
<td>Area</td>
<td>Name of organisation</td>
<td>Agreement of Interview</td>
<td>Notes</td>
</tr>
<tr>
<td>---------------</td>
<td>---------------------------------------</td>
<td>------------------------</td>
<td>----------------------------------------------------------------------</td>
</tr>
<tr>
<td>Local</td>
<td>Fowey Mussel Farmers</td>
<td>Agreed</td>
<td>Interviewed</td>
</tr>
<tr>
<td>Local</td>
<td>Fowey Town Council</td>
<td>Agreed</td>
<td>Interviewed</td>
</tr>
<tr>
<td>Local</td>
<td>Fowey Yacht Club</td>
<td>Agreed</td>
<td>Interviewed</td>
</tr>
<tr>
<td>Local</td>
<td>Fowey Harbour Commission</td>
<td>Agreed</td>
<td>Interviewed</td>
</tr>
<tr>
<td>Local</td>
<td>Liskeard and Angling club</td>
<td>Agreed</td>
<td>Interviewed</td>
</tr>
<tr>
<td>Local</td>
<td>Lostwithiel Town Council</td>
<td>Agreed</td>
<td>Interviewed</td>
</tr>
<tr>
<td>Local</td>
<td>Fowey Maritime</td>
<td>Agreed</td>
<td>Interviewed</td>
</tr>
<tr>
<td>Local</td>
<td>River Fowey Association</td>
<td>Agreed</td>
<td>Linked to LAAC</td>
</tr>
<tr>
<td>Local</td>
<td>Fowey Ramblers Association</td>
<td>Agreed</td>
<td>Not interviewed</td>
</tr>
<tr>
<td>Area</td>
<td>IMERYs</td>
<td>Agreed</td>
<td>Interviewed</td>
</tr>
<tr>
<td>Area</td>
<td>Cornwall Inshore Fisheries &amp; Conservation Authority</td>
<td>Agreed</td>
<td>Not interviewed</td>
</tr>
<tr>
<td>Area</td>
<td>Port Health</td>
<td>Agreed</td>
<td>Not interviewed</td>
</tr>
<tr>
<td>Regional</td>
<td>Flood Risk Management</td>
<td>Agreed</td>
<td>Not interviewed</td>
</tr>
</tbody>
</table>

Table 3.6: Organisations with relevance to the Fowey that agreed to an interview (some were not interviewed as they agreed outside of the interview window):
Findings of the Potential PES Purchaser Survey

Of the remaining 8 interviews the responses are split into three sections:

- Perceived Ecosystem Services produced by the Fowey catchment and whether these are regarded as being compromised by environmental degradation
- Perception of who provides Ecosystem Services
- PES buyer potential in the catchment

1 - Perceived Ecosystem Services produced by the Fowey catchment and whether these are regarded as being compromised by environmental degradation

Respondents were asked to consider the services they felt their respective sectors (constituents) and other stakeholders derive from the Fowey catchment. It is very interesting to note that, across the sample interviewed, responses very much focused on aesthetic and recreational services stemming from ‘a beautiful landscape’. Provisioning and regulating services such as drinking water supply and flood regulation were not mentioned; with the exception of Imerys who rely on a navigable harbour to move the primary output from their business activities (china clay) out to world markets. However, the aesthetic value of the harbour and surrounding countryside is also important to Imerys who derive rent from cruise ships using the harbour (owned by Imerys). Cruise ships come to Fowey because of its scenic beauty.

When considering in proportional terms who benefits from the aesthetic and recreational services provided within the catchment, several respondents felt it is tourism business owners and their customers (i.e tourists) who benefit most. There followed a suggestion that it is visitors and those who benefit most from them who should pay for the protection of the aesthetic and recreational services provided by the catchment.

A striking finding from the research, with clear implications for the viability of a PES scheme in the Fowey catchment, was that all respondents interviewed considered the natural environment to be ‘fundamentally in good order’. ‘Wildlife’ is seen as plentiful and habitats such as woodland and ‘wildflower meadows’ are considered widespread. Some respondents articulated their awareness of water quality problems but considered these to be a result of sewage outflows in times of high rainfall. Diffuse pollution from agriculture is not seen as a significant feature. An exception was the respondent from Fowey Harbour Commission, who does see sediment (and a subsequent need for dredging) as a problem but believes the issue is caused by climate change (via more extreme rainfall events) rather than land management activities within the catchment per se. The problem, therefore, is not seen within the gift of ecosystem providers (land managers) to solve.

Of note, none of the respondents believed either their own interests, or those of other stakeholders, are being financially impacted by environmental degradation in the catchment. Only when negative financial impacts become manifest did respondents think stakeholders in the catchment will ‘take note that there may be a problem’.

2 - Perception of who provides Ecosystem Services

Viable PES markets will depend on the buyers of services being willing to pay providers for the services they deliver. Buyers will need to understand who their suppliers are; and have faith that they have the ability to deliver the services in question. In terms of who delivers the ‘beautiful landscape’ which respondents appear to appreciate and value, there appears universally recognition that land managers in the catchment are the primary providers of this service. Interestingly, on more than one occasion, land managers were defined as institutional landowners such as the National Trust (Lanhydrock Estate) and the
Forestry Commission (Cardinham Wood) rather than private landholdings managed by individual farm businesses. However, there was a broad appreciation in the main that the aesthetic value of the catchment is created by a ‘patchwork quilt’ of land managers including independent farmers (owners and tenants).

There is very little - and in most cases no - appreciation of the provisioning and regulating services which land managers can both provide, and impact negatively on, within the catchment. In the town of Lostwithiel, one respondent described flooding impacts and silting up of the river as being ‘the talk of the town’ due to the wet summer of 2012; but remarked that none of these problems (and potential solutions thereof) were linked to land use in the upper catchment. The solution to these problems are very much being framed as an ‘end-of-pipe fix’ including increased dredging of the river channel to increase flow, raising flood defence walls, screening out debris from road gullies and introducing a telemetry based early warning system. Residents and their councillors are looking to the Environment Agency and South West Water to solve their problems where these become apparent i.e in the town. Farming and land management in the upper catchment is not seen as relevant.

3 - PES buyer potential in the catchment

**Fowey Town Council** - does not feel it is in a position to make any payments for ecosystem services within the catchment. Financial cutbacks from Cornwall County Council means the Town Council is ‘struggling to keep public toilets open let alone pay farmers to deliver services no-one understands’. Councillors believe the Fowey environment is in good shape; with any water quality problems being caused by inadequate sewage treatment infrastructure rather than land based issues. The respondent from the Council believed it would be necessary for the beach to be closed due to bacterial impacts from slurry before local tourism businesses would take any interest. And even then, it was felt tighter statutory controls on farming activities would be called for rather than an increased propensity to fund farm remediation schemes.

**Liskeard and District Angling Association and Fowey Rivers Association** - despite respondents from these clubs believing the concept of ecosystem payments to be a good one, it was felt raising money from the membership would be extremely difficult and would very likely result in ‘a 50% reduction in members overnight’. The majority of anglers believe they ‘already pay enough’ for their fishing and would not entertain paying more. It was felt some members might be prepared to make a voluntary contribution if they could be convinced the money would be ring-fenced within the Fowey catchment to deliver specific tangible outputs. However, it was suggested the proceeds from this exercise would be minimal.

**Lostwithiel Town Council** - the respondent from this Council remained unconvinced that investing in land management schemes would result in cleaner water and flood reduction within the catchment. A view was also expressed that farmers already receive public money for delivering environmental outputs so why should they be given more? Interestingly, it was suggested local people and tourists alike might be prepared to pay farmers for increased access to land. An example was given of a local woodland which had been opened to the public by the Forestry Commission. Accessible by car, income is generated from car park charges which people are ‘happy to pay for the privilege of walking in the woods’. Proceeds go towards tree planting and wetland creation.

**Imerys** - for this organisation, there appears no business case for investing in catchment management within the Fowey. Firstly, the sediment problem in the river is not...
considered bad enough to present a serious threat to the movement of china clay out of the
harbour. And secondly, the Fowey Harbour Commission currently dredges the harbour from
time to time which means for Imerys that ‘if there is indeed a problem, someone else is
taking care of it’. In effect, this might be considered a case of free riding. The respondent
from Imerys provided a very matter of fact summary: ‘we wouldn’t pay for catchment
management unless government gives us a piece of paper saying we have to in order to
keep operating’.

**Fowey Maritime (sailing school and yacht charter)** - customers of Fowey Maritime do
not perceive there to be a problem with the local environment. On the contrary, they view
it as a pristine recreational resource. The respondent from this organisation suggested that
on the ‘rare occasion’ his customers have noted ‘discolouration’ in the water, this has
‘disappeared within a couple of days’. There exists, therefore, no perceived incentive for
the organisation to make PES contributions. Customers might possibly make a voluntary
contribution but, given they will usually visit several ports during their visits to Cornwall,
they would probably wish to invest in a county wide PES initiative, not one with a specific
Fowey geography.

**Royal Fowey Yacht Club** - the respondent from this important recreational user group
was positive towards the idea of ecosystem payments on a philosophical level but was very
unsure how such a mechanism would work in practice. If sailors were going to be asked to
make payments, he felt they would need to be presented with a very strong case, clear
guidance on how their money would be spent and quantifiable outputs.

**Fowey Harbour Commission** - the Board of the Fowey Harbour Commission is of the
view that sedimentation in the harbour is an inevitable consequence of climate change and
sees no merit in PES. Investing in land use and/or management change would be nothing
more than a ‘token gesture’ in their eyes and would not solve the fundamental problem.
They do not appear to view PES as a potential means of lessening the impact of climate
change.

**Fowey Mussel farmers** - the response by Fowey mussel farmers to reduced water
quality in the estuary is particularly interesting. Experiencing significant problems to the
viability of their production sites in the Fowey estuary, they have invested heavily in
alternative sites in the St Austell bay which has significantly better water quality. They,
therefore, are no longer dependent on the Fowey for their mussel crop and do not appear
to have a major incentive to invest in the future of this catchment.

**Conclusions**

It is possible to draw a number of conclusions from the interviews undertaken with
stakeholders in the Fowey catchment. Firstly, when considering the range of ecosystem
services the catchment provides people living and working in the catchment, it is only the
aesthetic services which appear to be readily identified and valued by local stakeholders.
There is a willingness to pay for access to the environment to experience this aesthetic
value and a recognition that landowners provide ‘what is beautiful’ about the Fowey
catchment, and should therefore be paid to provide. However, key user groups, for
example anglers and walkers, believe they already pay for access to the Fowey countryside
(rents for fishing, car park charges) and appear reluctant to pay more. This represents a
difficulty from a PES viability perspective as farmers are, in the main, reluctant to open up
their land to public access; and will only be likely to do so if a significant premium payment
is offered (many multiples above current HLS stewardship rates). From an applied natural
resource management perspective, it is unclear how payments to landowners to provide
aesthetic value will result in the provision of other ecosystem services.
There is, currently, a very weak willingness to pay for provisioning and/or regulating services such as the provision of clean water or flood mitigation. These services are seen either as already in ample supply or nothing to do with land management i.e. land owners are not seen as providers of these services. To make PES markets for these services a reality, extensive dialogue with relevant stakeholders in the catchment will be required to raise awareness of the geophysical link between the ‘top’ (e.g. Bodmin Moor, Glyn Valley) and ‘bottom’ (e.g. Lostwithiel, Fowey town) of the catchment. Only then will stakeholders be in a position to reassess their willingness to pay for service provision and consider the cost:benefits of doing so. It is interesting to note that Fowey Town Council will soon be undertaking a public consultation exercise to assess willingness to pay for local municipal services; to bridge the gap caused by recent cuts in Cornwall County Council spending. The inclusion of attitudes towards paying for ecosystem services within this consultation process would seem a logical and timely step to developing PES markets in the Fowey catchment area.

The evidence from the interviews strongly suggests that a trusted local intermediary will be the most suitable entity capable of mobilising and sustaining such a dialogue. Several respondents cited the Fowey Harbour Commission as such a broker given its perceived longevity in the area and well regarded technical knowledge. However, the Fowey Harbour Commission regards itself as having a limited environmental remit with little expertise on the middle and upper reaches of the catchment and only a cursory understanding of land management issues.

Mirroring findings from previous PES buyer attitudes surveys (Inman 2012, Inman 2013), those respondents supportive of PES as a conceptual framework articulated a desire for a baseline of good farming practice beyond which farmers would become eligible for payments. Paying ‘farmers who are not demonstrating basic stewardship of the land’ is not seen as acceptable. This viewpoint indicates a need for appropriate enforcement of existing statutory environmental legislation and cross-compliance conditions before PES can become a viable market mechanism.

Based on discussions with various private sector businesses over the last three years, including recent market research undertaken within the Peatland Carbon PES Pilot, there would appear to be two factors influencing the propensity to invest in PES markets:

- **Geographical proximity to the PES delivery area** - businesses demonstrating a potential to invest in ecosystem service provision want to invest in schemes near locations where they have significant numbers of customers and/or staff present. The rationale here is that it is easier for a business to communicate the benefits of an investment to its staff (important for employee relations) and its customers (important for CSR) if the investment is made in an area where these stakeholders will have resonance (attachment).

- **A desire to demonstrate mitigation of damage from specific product lines** - businesses using natural materials within their products lines (e.g. peat within garden growing medium, wood within furniture manufacturing) are keen to demonstrate they are taking steps to mitigate the impacts of using these materials. Investing in schemes (e.g. woodland planting, peat restoration), which offer a method of making this link is potentially attractive to these businesses.

Based on the two ‘propensity to invest’ criteria above, it is likely that buyers (located outside the Fowey catchment) of ecosystem services delivered by the Fowey catchment are most likely to be Area or Regional Business with a strong customer/employee base within 30-50 miles of the catchment who can see a potential to offset the impacts of their product lines by investing in Ecosystem Service provision delivered by the Fowey catchment. Given
there are a huge number of potential competing schemes to the Fowey scheme, the likelihood that Area or Regional buyers can be attracted specifically to the Fowey is weak.

3.5 Conclusion: The Potential for Multiple-Purchaser PES Mechanisms

To date the vast majority of PES schemes have involved only one buyer. Whether PES schemes can be successfully designed to support multiple-purchasers is still a moot point. The research reported in this section provides some insights as to what the key obstacles may be in moving down that path.

At a very fundamental level, a prerequisite for engaging multiple groups or organisations as purchasers in a PES mechanism is that those potential purchasers are aware of how they are likely to benefit from participation in the scheme. Our survey of potential purchasers in the Fowey suggests that across a range of possible beneficiaries that awareness is very low.

In addition, as shown by the theoretical work, it must also be the case that paying for services through a PES mechanism is a financially more attractive option than acquiring that same service through some other means. In the case of the Fowey, for example, the PES mechanism makes a great deal of sense to the water company providing significant cost savings compared to engineered solutions to water quality issues. For the Harbour Authority, on the other hand, the cost-benefit calculus is not so clear. Levels of siltation in the Fowey estuary can be controlled by periodic dredging. The expense of that exercise is not enormous (less than £20,000 a year) and unfailingly delivers the desired service with immediate effect. It is not at all clear that paying farmers to deliver those same services through changing their land management practices provides a cheaper or more reliable alternative.

Even if purchasers recognise the benefits of, for example, getting farmers to change their land management practices, they may still need to be convinced that paying farmers to make those changes is an appropriate method of delivery. In our survey of potential purchasers in the Fowey, for example, one potential purchaser expressed the opinion that the appropriate means of delivering the required changes in land management practice should be through enforcement of existing statutory environmental legislation and cross-compliance conditions.

In the event that more than one purchaser is persuaded by the need for a PES scheme, there may still be some significant hurdles to overcome. First amongst those is the free-rider problem. Whether free-riding is likely to be an issue depends to a large extent on whether there is significant overlap in the actions that the various purchasers wish to buy through the PES scheme;

- If these actions are largely independent, then few issues will arise. Each purchaser will simply pay for the actions that are of importance to their organisation. In effect, a series of (perhaps unrelated) PES mechanisms for each individual action will successfully deliver the services desired by the purchasers.
- If these actions are highly correlated (or even the same), then free-riding is potentially a serious issue since any one purchaser will benefit from letting some other purchaser make a greater contribution to the buying of the actions.

As shown in our theoretical investigation, without specific attention to how the PES mechanism will address free-riding it is likely that participation will be limited to the single purchaser who stands to gain most from paying providers to take actions that deliver ecosystem services.
One route forward is to create an institution within which potential purchasers can make binding commitments to contributions decided upon in a process of negotiation. In the simple experiments reported above, that mechanism has been shown to work relatively well in encouraging contributions from more than one purchaser.

Of course, in the experiment there were only two purchasers and one provider. To scale-up that mechanism into a functioning PES scheme it would certainly have to be adapted to allow for many providers and potentially several purchasers.

One potential solution to dealing with the expansion of the negotiated mechanism to several providers would be to separate the provider negotiation from the purchaser negotiation. In particular, an auction could be run amongst the providers in which the pressures of competitive bidding were harnessed to ensure providers are proposing potential investment projects at competitive prices. With just a few purchasers, one simple way to proceed might be to order the bids in terms of value for money and then begin by negotiating contributions towards the funding of the best value-for-money project, before proceeding to the next best value-for-money project and so forth. Alternatively, the set of proposed projects could be distributed to the various purchasers who could then come to the negotiations ready to declare which projects they were prepared to fund all on their own and which they would wish to co-fund with other purchasers.

The original purpose of this research was to test how large purchasers might be able to incentivise and ‘lever’ other purchasers to contribute. Whilst this was touched on within interviews the majority of groups felt that they would only act if they thought their purchasing requirements were aligned with the larger purchaser but it was acknowledged that this could lead to free riding. It is the authors’ opinion that the main ‘leverage’ effect is upwards aimed at government funding rather than downwards at localised pots that are dwarfed by Water Company funding.

Since completion of this work the Catchment Based Approach has meant that these issues are being picked up within Cornwall through super-partnership between the Cornwall Local Enterprise partnership and the Cornwall Local Nature Partnership, called the Cornwall Environmental Partnership. The Westcountry Rivers Trust is working with this County partnership as well as the more localised groups to prepare potential purchasers. As Catchments unite the many goods and services that flow around the way water interacts with soil as well as acting as an ecological network, they are a key point around which to orientate future multiple PES schemes.

It seems that the only real possibility for such a multiple-purchaser PES to develop in the Fowey in the near future would be in the bringing together of government funding streams (e.g. from stewardship schemes, flood alleviations schemes or the Forestry Commission) with those provided by South West Water.
4  **INSIGHTS AND FUTURE DIRECTIONS**

PES mechanism design is complex. As documented in this report, there are a large variety of issues that must be assessed in the design process and the design choices that are most appropriate are likely to be highly influenced by the particular characteristics of the problem being addressed by the mechanism.

One key dimension in which PES schemes may differ concerns the way in which *projects are identified* for consideration for funding. At one extreme, that identification is driven almost entirely by the purchaser. Here experts employed by the purchaser seek out eligible projects. The advisor-led scheme used in the Upstream Thinking Project follows this model. At the other extreme are mechanisms in which projects are identified by the land managers themselves. The Fowey River Improvement Auction is an example of a PES mechanism following that model. The evidence presented in this report suggests that those two different mechanisms are best employed in rather different situations:

- **Identification by Advisors** is preferable when expert judgement is needed on the ground to distinguish between diverse or complex projects whose benefits differ according to site-specific considerations. In addition, advisor-led mechanisms are likely to fare best where the scale of the scheme is small and where advisors have good local knowledge with which to target farms likely to yield good investment opportunities.

- **Identification by Land Managers** may be preferable when the benefits (at least the relative benefits) of projects can be estimated reasonably accurately without detailed site-specific knowledge (e.g. schemes focused on establishing riparian buffer strips to separate agriculture from river courses). In addition, identification by land managers has the advantage of being a format that can scale-up with relatively little additional cost. As a result, the format might be preferred for large scale schemes particularly where there is little detailed local knowledge of a region through which farms can be effectively targeted.

Interestingly, according to those criteria the Fowey River Improvement Scheme possibly favoured a mechanism in which projects were identified by advisors. All the same, it appears that land managers entering bids in the auction were reasonably successful at identifying suitable capital investments. Our analysis suggests at least three ways in which the Scheme might have been better designed:

- First, in order to maintain simplicity the Fowey scheme forced land managers to bundle different capital investments into one bid. In retrospect that was a design mistake. Our follow-up work suggests that farmers reacted to the competitive pressures in the auction by trying to keep down the grant rate asked for in their bid. Since bids bundled projects, one way a farmer could achieve that goal was to only include projects towards which they were prepared to make a substantial contribution. The problem that arises, therefore, is that the projects excluded from bids because they offered little benefit to farm businesses might have been of great value to South West Water because they delivered substantial water quality improvements. One way to overcome that problem would be for farmers to make separate grant requests for each individual project. While that design would generate some extra work for farmers, it seems likely that it would also increase the number of projects proposed. In addition, resolving bids into their constituent projects would allow the scheme to direct funding only to the particular projects offering the greatest value for money for South West Water.
Second, again in an attempt to maintain simplicity, in formulating their bids farmers were asked to provide only the briefest of descriptions of the project they wished to undertake. Much of the uncertainty in establishing the environmental benefits of projects might have been avoided by providing farmers with the opportunity to flesh out their plans as part of their submission.

Finally, given the relatively limited information provided in bids, Westcountry Rivers Trust farm advisors often found it necessary to call farmers so as to better understand the exact nature of the projects proposed. That procedure could have been formally integrated into the mechanism with every bidder receiving a call to discuss their bid and establish whether all appropriate projects had been identified by the farmer. As part of that process, farm advisors could have made a judgement call as to whether a farm visit might also be required to better understand proposed projects or aid farmers in identifying eligible projects.

A second key dimension of the PES mechanism design is the means by which the cost of projects to the funder is determined. Again the two extremes are exemplified through the advisor-led mechanism and the auction mechanism. In the former, a fixed grant rate is established and only projects with which farmers will proceed at that level of contribution can be funded. In the latter, the level of grant is not fixed but determined by competitive pressures. The experience of the Fowey River Improvement Scheme indicates that cost competition was an important factor in driving down the grant rates requested by farmers in the auction. At the same time, very few of those requests dipped below the 50% rate familiar to farmers from other capital grant schemes. Likewise farmers reported that their bids had overstated the minimum grant required for them to undertake the investment by an average of some 18%. While neither of those findings are a serious source for concern (we would always expect the shading-up of bids in a discriminatory auction), it is clear that in designing PES auctions care must be taken to ensure a competitive bidding environment. Our observations with regard to that requirement include:

- An auction can only hope to successfully if there are many participants offering up competing projects for funding. When only a few farms are to be targeted by the scheme or certain projects clearly offer the greatest benefit to the funder, then lack of competitive pressures may lead to inflated grant requests. A fixed price mechanism or individually negotiated grants may be preferable in such circumstances.

- The Fowey auction provides some evidence to suggest that having multiple rounds of bidding helps to enhance competitive pressures though, of course, we lack a single-round counterfactual with which to confirm that suggestion. It was certainly the impression of the research team, that the multiple-round format contributed to a growing awareness of the scheme and, as such, may have facilitated greater competition by encouraging participation.

- In designing an auction, careful consideration must be given to the quantity of information revealed to participants concerning the value of their bids to the funder. Clearly, information revelation may drive down grant requests for marginal projects, but also push up grant requests from bidders with high-valued projects. The Fowey River Improvement Scheme took a conservative approach, only revealing limited information to each bidder on the value of their own proposals. Unfortunately, experience with this pilot project provides little insight as to whether greater transparency could have induced increased competition.
In the Fowey auction the fact that few bids dropped below a 50% grant rate suggests that farmers may have suspected that schemes offering that fixed rate (e.g. Catchment Sensitive Farming) might, at some future date, be extended to the Fowey. Indeed, competitive pressures in auctions may be compromised by the existence of alternative possible funding streams.

A final key dimension of contrast between the auction and the advisor-led mechanism concerns the way in which bids are selected for funding. In the advisor-led mechanism qualification for funding depends on a farmer being willing to pay 50% of the costs of a qualifying project. In contrast, an auction selects those projects that offer the best value for money. In the case of the Fowey, the auction mechanism delivered an outcome that delivered up to 40% better value for money than a fixed 50% grant rate scheme. That evidence provides strong support for mechanisms that focus on project selection on the basis of a value-for-money criterion.

Of course, the possibility exists for developing hybrid mechanisms that combine desirable features of both the auction and advisor-led mechanisms. The BushTender scheme in Victoria Australia (Stoneham, 2002) is an example of a PES that employs such a hybrid approach. In that scheme, land managers first express their interest to be considered for funding through the scheme. Subsequently, an expert advisor visits each land manager and together they identify the actions that are suitable for inclusion in a bid to the scheme. The land manager then enters a sealed bid stating the payment they wish to receive to implement those actions. Finally, bids are evaluated with the detailed onsite knowledge of the project as compiled by the expert advisor an important element in that evaluation process. In contexts such as the Fowey, a hybrid mechanism could well prove superior to a mechanism in which allocation decisions are made solely on the basis of an auction or solely on the basis of the inputs of expert advisors.

While the research in this report suggests PES mechanisms of various designs can be successfully implemented in contexts such as the Fowey, it paints a far less rosy picture regarding the possibility of encouraging more than one purchaser to contribute funding to such schemes. While a wide range of organisations that might potentially benefit from a PES scheme in the Fowey were approached, none expressed any interest in participating in the scheme. The key obstacle to participation amongst these organisations is that they perceived that the benefits that a PES scheme might bring to their organisation are small. Accordingly, wider participation of purchasers in PES mechanisms is only likely to be possible if strong scientific and economic evidence can be presented to those purchasers making a clear business case for their participation. A priority area for future research has to be in establishing that evidence base.

Looking to the future, the only near-term possibility for a multiple-purchaser PES mechanism in the Fowey would be one that brought together government funding streams with those provided by South West Water. Indeed, such an alliance is seen by the authors of this report as the potentially most important next step in the development of PES mechanisms in the UK.

Along those lines, one clear opportunity would be in developing a PES mechanism targeted at buffering agriculture from rivers. Since the focus of such a scheme is on a single, well-defined intervention an auction (or a hybrid system) might well be the preferred method for allocating funds. In such an auction, farmers would be able to bid for funding to fence off their river at 1m, 5m or 10m from the top of the river bank. They could further improve their bid by agreeing to plant trees on the land if their proposal was to fence at 10m from the river bank. An alternative direction for such a scheme would address the longevity of improvements and river corridor buffers. Currently fencing and buffering...
schemes offered by both HLS and the Westcountry Rivers Trust commit farmers to a 10 year agreement. An analysis of the total amount spent per hectare through HLS over a 10 year period for a 6m buffer including the administrative costs would show how close project costs are to the average value for marginal land. Through a process of GIS mapping and targeting parcels of marginal land buffers currently in agriculture could be identified and a reverse auction held for the length of time against costs that they would be required to accept an agreement.

Such projects would generate both the exclusion of stock for water quality (of interest to the Water Company) but also the provision of an ecological network (of interest to wildlife groups and Natural England’s Higher Level Stewardship scheme) as well as the provision of woodland (of interest to the Woodland Trust and Forestry Commission). A properly designed multiple-purchaser PES mechanism should deliver benefits to each of these groups at much lower individual costs than achieved by their currently independent funding initiatives.

Given the agreement of two or more of those organisations to participate in such a PES mechanism, the key issue would be in getting funding streams aligned so that funds become available at the same time. As things stand, South West Water is preparing for its PR14 programme that is likely to result in funds being available for investment through such a PES scheme some time in 2015. The challenge is to persuade the Government that monies from their ERDF funds (currently fed through Catchment Sensitive Farming scheme) or Higher Level Stewardship budget (available by reviewing their section 38 under their HLS agreements that would allow re-targeting of resources) should be channelled into such a PES mechanism. The research recorded in this report shows that the risks of committing to such a scheme are low, while the rewards may be substantial.
5 REFERENCES


6 APPENDICES

Appendix A: Detailed Rules of the Fowey River Improvement Auction

Fowey River Improvement Scheme
Summer 2012

Fowey River Improvement Scheme Rules

Summary:

- The Fowey River Improvement Scheme is funded by South West Water as part of their ‘Upstream Thinking Programme’. It seeks to distribute grants to farmers in order to fund new investments in farm capital that deliver improvements in water quality in the River Fowey.

- The scheme is being implemented by the Westcountry Rivers Trust with the help of the University of East Anglia.

- Farmers can seek funding for one or more capital items through the scheme. The scheme will pay up to, but no more than, 100% of the actual cost of those capital works. The maximum investment that can be made in any one farm is £50,000.

- The budget for the scheme is £360,000 which will be allocated through a process of competitive bidding. Farmers will construct their bids by identifying the capital investments required on their farm, then proposing the size of grant that they would like from the scheme as a contribution to the cost of those capital works.

- Bids will be assessed in terms of value-for-money. Here, value-for-money relates the size of the grant request to the benefit the associated capital investments will deliver for SWW in terms of improvements in water quality in the River Fowey.

- A threshold level of value-for-money has been established and only bids exceeding that minimum threshold will receive funding through the scheme.

- Bidding will proceed over a period of six weeks. During that period farmers will receive periodic feedback on the likely success of their current bid and will be allowed to adjust their bid if they so wish.

- In addition to changing the size of their grant request, farmers can adjust their bid so that it offers greater value-for-money by electing to take on commitments to change their farm management practices in ways that improve water quality in the River Fowey.

- Once the bidding period closes, farmers’ final bids will be collated and ordered from the bid providing the most value-for-money down to the bid providing the least. Starting at the top of that list and working down, affordable bids will be accepted for funding up until the point at which the budget is exhausted or the threshold value-for-money is reached.

- Farmers will be informed whether their bid has been accepted and will be sent a follow-up questionnaire to complete. On returning the completed questionnaire, farmers will be sent £50 in way of a payment for participation.

- Westcountry Rivers Trust will work with farmers who have been successful in the scheme to formalise the grant agreement and proceed with the installation of the new capital.
Objective

- The objective of the Fowey River Improvement Scheme (henceforth, the scheme) is to increase water quality in the River Fowey by distributing grants to farmers to fund investments in farm capital.

Funder and Administrators

- Funding for the scheme is provided by South West Water (henceforth, SWW) as part of their ‘Upstream Thinking Programme’.

- The scheme is being implemented by the Westcountry Rivers Trust (henceforth, WRT) with the help of the University of East Anglia (henceforth, UEA).

Administrator Responsibilities

- The Westcountry Rivers Trust (henceforth WRT) have overall responsibility for the scheme. WRT are responsible for engaging farmers in the scheme, and for implementing the outcome of the bidding process. WRT will work alongside farmers in realizing the commitments that have been agreed upon through that process.

- The University of East Anglia (henceforth UEA) will act as independent overseer of the grant allocation process. They will collate bids, implement the procedures for selecting successful bidders and inform participants of the process outcome.

Participants

- Farmers and land managers with management control over eligible farms (henceforth, farmers) will be able to apply for grants for capital investments under the scheme.

- Tenant farmers or those farming under contractual license will have to ensure that participating in the auction does not violate the conditions of their tenancy/license. The counter-signature of the landlord/landowner may be required before funding can be approved for certain capital works.

- Farms eligible for funding (henceforth, farms) comprise agricultural land holdings in the Fowey catchment that are:
  - upstream of Lostwithiel;
  - greater than 15 ha (17 acres) in size;
  - being actively farmed.

- For the purposes of the scheme, two or more holdings managed as a single unit, or in single ownership, or which to some extent have:
  - common management;
  - common financial accounts;
  - common livestock, machinery and/or feeding stores;
  - the same vendor or single business identifier (SBI) number

will be treated as one farm, with the right to enter a single bid in the scheme.
Funding

- SWW have provided a fixed budget of £360,000 for distribution as grants to farmers whose bids are accepted for funding through the Fowey River Improvement Scheme.

Bids & Payment Amounts

- Farmers will be able to enter bids in the scheme by completing a bid form. A completed bid form will indicate the:
  - *capital works* for which funding is sought;
  - *expected costs* of those capital works;
  - *grant* requested through the scheme to fund those capital works;
  - *farm management package* that will be adopted by the farm in order to increase the value-for-money offered by the bid.

- The bid form also asks farmers to calculate the *percentage grant rate* implied by their bid; that is, to describe their grant request as a percentage of the expected costs of the capital works.

- Farmers can enter a null bid, by truthfully completing the bid form but making no grant request.

- Farmers face two limitations in deciding upon the grant request in their bid:
  - No bid can make a grant request larger than £50,000.
  - The percentage grant rate cannot exceed 100%; that is, the grant request cannot exceed the expected cost of the capital works.

- The payment received by farmers entering successful bids will be determined by the *actual costs* of the project which will likely differ from the expected costs estimated on the bid form. The scheme commits to pay successful bidders the percentage grant rate of the actual costs up to a maximum payment of the grant request. In other words:
  - If the actual costs of the capital works exceed the expected costs then the payment received by a successful bidder will be the grant they requested in the bid.
  - If the actual costs of the capital works turn out to be lower than the expected costs then the payment received by a successful bidder will be the percentage grant rate of those actual costs.

**Bid Evaluation**

- Bids are evaluated on the basis of value-for-money, with bids offering higher value-for-money being considered for funding before bids offering lower value-for-money.

- To calculate value-for-money a *river improvement score* will be calculated for each bid. A higher river improvement score indicates that a bid offers greater potential improvements in water quality in the River Fowey.
The river improvement score is calculated on the basis of the:
  - type and quantity of capital items in the bid;
  - farm management packages committed to in the bid and the extent to which those represent changes in farm management practice;
  - hydrological connectivity of the farm, that is to say, the extent to which changes in farm capital and farm management practices in a particular farm location result in improvements in water quality in the River Fowey.

Since each farm has a different level of hydrological connectivity, river improvement scores may differ across farms even if the capital items and farm management package elements of bids are identical.

So as not to unduly influence bidding, river improvement scores will not be revealed to farmers participating in the auction.

Value-for-money, measured in terms of units of benefit per unit of cost, is calculated as the river improvement score divided by the farmer’s grant request.

Accordingly, there are a number of ways in which a farmer can adjust their bid in order to improve its value-for-money. Those include;
  - reducing the grant request in the bid
  - increasing the quantity of capital items in the bid
  - committing to more farm management packages as part of the bid

Selecting Successful Bids

- A minimum threshold level of value-for-money has been established. In the first instance, bids offering lower value-for-money than that minimum threshold will not be considered for funding through the scheme.

- Bids exceeding the minimum value-for-money threshold will be collated and ordered from the bid providing the most value-for-money down to the one providing the least value-for-money. Starting at the top of that list and working down, affordable bids will be accepted for funding up until the point at which no more bids can be accepted given the limited budget.

- While working down the list, if a bid is unaffordable given what remains uncommitted from the budget then that bid will not be accepted.

- If two or more affordable bids offering the same value-for-money are the last bids to be considered for funding, then selection will be chosen by lottery.

- If a selected bid is subsequently withdrawn then the next highest unfunded, affordable bid in the list will be considered for funding provided it exceeds the minimum value-for-money threshold.
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Capital Works

- Farmers can seek funding for one or many capital items through the scheme.
- Only certain capital works will be eligible for funding through the scheme. Those capital works must;
  - improve river water quality;
  - be new investments; that is to say, funding cannot be made retrospectively.
- The scheme will co-fund (but not double fund) investments in receipt of grant funding from other sources.
- All farmers with successful bids will be visited by a farm adviser from the WRT to ensure that the capital works proposed in the bid are eligible for funding. Proposed works that are found to be ineligible will have their offer of funding withdrawn.
- Capital items likely to be eligible for funding include;
  - Update slurry storage: updates to existing slurry pits or new slurry pits that are compliant with SAFFO regulations and have Environment Agency (EA) consent.
  - New manure storage: manure stores that are compliant with SAFFO regulations and have EA consent.
  - Roof slurry/manure/silage: roofing of slurry/manure/silage stores that are compliant with SAFFO regulations and have EA consent.
  - Separate dirty/clean water: separation of clean water from barns from dirty water entering slurry stores by installing diverters and guttering.
  - Cover feeding/collecting area: roofing of feeding/collecting areas to separate clean water falling on the yard from dirty water entering slurry stores.
  - Overwintered cattle facility: new overwintered cattle facilities to stop cattle out-wintering and causing sediment loss.
  - Concrete tracks/yards: concrete tracks or yards to reduce the impact of livestock and tractor movement on soil loss to rivers.
  - Watercourse fencing: fencing to exclude livestock from rivers.
  - Troughs and pipework: troughs/pipe works for livestock drinking.
  - Livestock crossing/drinking: livestock crossing/drinking points.
  - Re-site or stone gateways: re-siting of stone gateways.
- Farmers are free to suggest alternative capital items, provided they can show that these will meet the eligibility criteria.
- The nature of the contractual arrangement that a farmer will enter into with WRT and SWW will depend to some extent on the type of capital works they are seeking to undertake (see Contracts and Covenants)
Farm Management Packages

- To improve the value-for-money offered by their bid for capital works, farmers may consider making additional commitments to change their farm management practices.

- The scheme offers farmers the opportunity to commit to one or more of three different farm management packages.

- Including a package as part of a bid involves committing to the stipulated farm management practices for a period of 5 years.

- The three farm management packages and the practices they involve are:
  - Nutrient Management Package:
    - Soil test all fields over 2ha, twice over 5 year period
    - Ensure 5 months slurry/manure storage for stock raising units
    - Rough cultivate maize within 24 hours post harvest
    - Only grow maize varieties that can be harvested before mid October
    - Plant grass reseeds only in the spring or summer
    - Incorporate slurries and manures within 24 hours of application on bare soils and stubbles
    - Have and implement a RB209 nutrient management plan.\(^1\)
  - Pesticide Management Package for 5 years
    - Use an BACCS approved pesticide contractor for in field spraying.\(^2\)
    - Use a PA1 and PA6 certified operator for in yard spraying\(^2\)
    - Ensure adequate protected pesticide storage\(^4\)
    - Designate an appropriate wash down area
    - Establish a 6m watercourse pesticide buffer for all spraying
    - Have and implement a pesticide waste management plan\(^5\)
  - Watercourse Management Package for 5 years
    - Exclude livestock from all watercourses (except drinking/access points & moorland streams)
    - Ensure 6m watercourse buffer on sloped (>5\(^\circ\)) arable fields >2ha
    - Have and implement a hill grazing/feeding management plan\(^6\)

---

\(^1\) RB209 is Defra’s New Fertiliser Manual. A FACTS (Fertiliser Advisers Certification and Training Scheme) advisor will be able to help create a nutrient management plan as part of the scheme.

\(^2\) BACCS = BASIS Advanced Contractors Certification Scheme. A BACCS approved contractor will give you records of all in field operations and these must be made available to WRU upon request.

\(^3\) Pesticides Application Courses PA1 and PA6 is a three day course covering pesticides application and knapsack spraying

\(^4\) Guidelines on adequate pesticide storage and wash down areas can be found by searching for pesticide storage on the Voluntary Initiative website - www.voluntaryinitiative.org.uk.

\(^5\) A BASIS and FACTS trained advisor will be able to help create a pesticide waste management plan as part of the scheme.

\(^6\) A trained advisor will be able to help create a hill grazing/feeding management plan as part of the scheme.
• In completing the bid form, farmers will be asked to declare which of these various farm management practices are relevant for their type of farming and whether they are currently standard practices on their farm or are not currently being followed.

• That information will be taken into account in calculating the river improvement score for a bid. In particular, committing to practices that are;
  o not relevant for the farm’s activities will not add to a bid’s river improvement score.
  o currently standard practices on a farm will add somewhat to a bid’s river improvement score, so as to reward current good practice.
  o not currently standard practices on a farm will add the most to a bid’s river improvement score.

The Bidding Process

• Bids can be entered in the scheme in one of two ways:
  o Post, by sending a bid form to:
    Fowey River Improvement Scheme
    CSERGE
    School of Environmental Sciences
    University of East Anglia
    Norwich
    NR4 7TJ
  o Internet, via the secure bidding form available on the scheme website:
    https://foweyauction.uea.ac.uk/

• Bidding in the Fowey River Improvement Scheme will take place over a six-week bidding period.

• The bidding period is divided up into three rounds so as to allow farmers to receive feedback on the likely success of their bid.

• Bids can be entered at any point during the bidding period, but farmers may only enter a bid, or revise a previously entered bid, once in each round.

• At the end of the first and second rounds, all bids entered up to that point in time will be evaluated and farmers will be given feedback on whether their bid would be successful if bidding were to stop at that point in time.

• For bids that would not be successful if bidding were to stop at that point in time, the feedback will also suggest ways in which the bid might be changed so as to improve its chances of funding.

• On the basis of that feedback, farmers can reconsider their bids and submit a revised bid in the next round.
• If a farmer does not submit a revised bid then their bid from the previous round is carried forward.

• After the third and final round of bidding, bids are evaluated for the last time and successful bids identified.

The Bidding Timeline

• The bidding period runs for the six weeks from Monday 20th August through to Wednesday 26th September.

• The first round of bidding:
  o Lasts for the 10 days from 06:00 of the morning of Monday 20th August when the bidding period opens to 23:59 on Wednesday 29th August when the first round of bidding closes.
  o Farmers can bid up to once in that period.
  o Internet and postal bids for the first round must arrive at UEA before the deadline of 23:59 on Wednesday 29th August.
  o Bids arriving after the deadline for the first round of bidding and within the period of the second round of bidding will be treated as second round bids.
  o Emails and/or letters providing feedback on first round bids will be sent out from UEA on Friday 31st August.

• The second round of bidding:
  o Lasts for the 10 days from 06:00 of the morning of Monday 3rd September to 23:59 on Wednesday 12th September when the second round of bidding closes.
  o Farmers’ bids from the first round carry over into the second round and, during this period, farmers have the opportunity to change those bids.
  o Farmers that did not enter a bid in the first round are still entitled to enter a bid in the second round.
  o Farmers may enter a bid or update a previous bid only once in the second round.
  o Internet and postal bids for the second round must arrive at UEA before the deadline of 23:59 on Wednesday 12th September.
  o Bids arriving after the deadline for the second round of bidding and within the period of the third round of bidding will be treated as third round bids.
  o Emails and/or letters providing feedback on second round bids will be sent out from UEA on Friday 14th September.

• The final round of bidding:
  o Lasts for the 10 days from 06:00 of the morning of Monday 17th September to 23:59 on Wednesday 26th September when the bidding period closes.
  o Farmers’ bids from the second round carry over into the final round and, during this period, farmers again have the opportunity to change those bids.
  o Farmers that did not enter a bid in the previous two rounds are still entitled to enter a bid in the final round.
Farmers may enter a bid or update a previous bid only once in the final round.

Internet and postal bids for the final round must arrive at UEA before the deadline of 23:59 on Wednesday 26th September.

Bids arriving after the deadline for the final round of bidding will not be considered for funding.

- Once the auction has closed, successful bids will be selected (see Selecting Successful Bids) and all participants will be sent a final letter informing them if they have been successful in securing funding in the auction. That letter will be posted out on Friday 28th September.

**Participation Fee**

- All farmers that participate in the Fowey River Improvement Scheme will be eligible to receive a participation fee of £50.

- Eligibility for the participation fee depends on two things: a farmer must have:
  - participated in the scheme, where participation means entering at least one bid in the auction even if that was a null bid;
  - returned a fully completed follow-up questionnaire.

- That follow-up questionnaire along with a participation fee claim form and a stamped-addressed envelope for their return to UEA will be sent to farmers along with the final letter informing of the outcome of their bid.

- On receiving a fully completed follow-up questionnaire and participation fee claim form, eligible farmers will be sent a cheque for £50 by post.

**Follow-up with Successful Bidders**

- A WRT farm adviser will visit all successful bidders to begin the process of formalising the bid into a contract and to outline the steps that will need to be followed to complete the capital works.

- In the event that a mutually agreeable arrangement for implementing the commitments in the bid is not forthcoming then either party is entitled to withdraw from the proposed transaction.

- The WRT farm adviser must first verify that the capital works requested by a successful bidder are indeed eligible for funding under the terms of the scheme (see Capital Works). If the works turn out not to be eligible, then the offer of funding under the scheme may be withdrawn.

- For bids in which a farmer has committed to one or more farm management packages, the WRT farm adviser will also verify that current farm practices conform to the statements made on the bid form.
Farmers with eligible funding offers will then be asked to gather three independent quotes for the capital works being undertaken under the scheme.

Those quotes will be reviewed by WRT and provided they are convinced that the quotes represent value for money, the farmer will be asked to proceed with the best value quote.

A contract will be signed between WRT, SWW and the farmer, and landlord/landowner if required. In addition, for grants over £5,000 a covenant will need to be added to the land deeds of the farm property.

A WRT farm adviser will visit after the capital works are completed to verify that they conform to expectations.

Grant payments are made once the capital works have been completed and verified by a WRT farm adviser.

Before the grant can be paid, farmers must produce the contractors invoice(s) for the works as well as documentary evidence of the payment of those invoices by the farmer.

For bids in which a farmer has committed to one or more farm management packages, WRT will make follow-up farm visits to ensure practices conform to those commitments and may request to see documentation verifying on-going compliance.

Contracts and Covenants

- All farmers will sign a contract with WRT and SWW before payments under the scheme can be made.
- Contracts with tenant farmers or those farming under contractual license will also require the counter-signature of the landlord/landowner.
- The key elements of that contract are that for, the duration of the contract, the capital items purchased using funds must be:
  - used for the agreed purpose;
  - be maintained;
  - be insured against damaged.
- The contract duration is related to the type of capital item being purchased.
- Longer-lasting capital items require a contract term of 25 years. Items falling into that category include:
  - Updated slurry storage
  - New manure storage
  - Roofing of slurry/manure/silage stores
  - Works to separate dirty/clean water
  - Covering of feeding/collection area
  - Overwintered cattle facility
- Relatively shorter-lasting capital items require a contract term of 10 years. Items falling into that category include:
  - Concreting of tracks/yards
  - Watercourse fencing
  - Troughs and pipework
  - Livestock crossing/drinking
  - Re-siting or storing gateways

- Farmers committing to one or more farm management packages will have those commitments added as a clause to the contract. The period of commitment to those farm management practices is 5 years.

- To ensure that SWW's investments are maintained for the duration of the contract, grants of over £5,000 will require a covenant being added to the land deeds of the farm property. That covenant will stipulate that future land owners and/or land managers abide by the terms of the contract.

Other Terms and Conditions

- WRT reserves the rights to change the rules of the scheme at any time and for any reason.

- WRT also reserves the right to cancel the scheme at any time.
# Appendix B: Fowey River Improvement Auction Registration Form

## 1. Contact Details

Complete /correct your contact details:
- **First name:**
- **Last name:**
- **Address:**
- **Town:**
- **Postcode:**
- **Tel:**

The quickest and most secure way for us to communicate with you is by email:
- **Email:**

## 2. Your Farm

- **Area of farm (hectares):**
- **Which best describes your main farming activity? (tick one):**
  - cattle & sheep
  - dairy
  - pigs
  - poultry
  - general cropping
  - cereals
  - mixed
  - horticulture

- **Is your farm primarily organic?**
  - yes
  - no

- **Which best describes the tenure of your farm? (tick one):**
  - owner-occupier
  - tenant
  - other

## 3. Cultivation

- **Average hectares committed to each of ...**
  - permanent grazing land
  - short-term silage leys
  - maize
  - potatoes
  - stubble turnips
  - cereals
  - other crops

## 4. Livestock

- **Average holdings at any one time ...**
  - beef cattle
  - sheep
  - dairy cows
  - followers
  - pigs
  - poultry
  - horses

### Declaration:

I declare that the above information is true and complete, and understand that any false statement or omission may result in my exclusion from the Fowey River Improvement Scheme.

### Signed: __________ Date: __________
Appendix C: Participants Follow-Up Survey

Introduction

Hello, can I speak to Mr XXXX please?

Hello, I am XXXX calling from the University of East Anglia. I’m calling about the River Fowey improvement scheme which you have just bid in.

We have received your bid, thank-you. The scheme is now closed and the bids have been scored. But before we release the results, we want to ask each of the farmers to give us some feedback on the scheme. Is now a good time for you to do that?

Firstly, I would like to make it clear that I am from the University of East Anglia. We are the people who designed the scheme and we are separate from South West Water and from the Westcountry Rivers Trust.

What I would like to do is take about 15 minutes of your time to ask you some questions. I want to make it clear that all your answers will be confidential; we’re not going to pass on any information to South West Water or WRT and we are not going to use your name in our report. In particular, there is no way that the answers you provide us in the survey will influence your chances of getting funded through this scheme or any future scheme.

Once we’ve done the survey, we’ll send you a cheque for £50 and this should be with you the week after next. To make sure we get it right, can I check the name you would like the cheque to be made out to and the address to which it should be sent.

It would really help me if we could record the survey … then I won’t have to scribble down your answers as we are going along. Is that OK with you?

A. Capital items

[Review capital items from bid document]

1. Why did you bid for these items?
2. Why not the others?
3. Did any of the following influence your decision?
   - Done or not needed
   - Available funds
   - Contract lengths
   - Covenant for over £5K grant request

B. FMPs

[Review FMPs from bid document]

4. [For each Package included] You signed-up to the … FMP, what difference do you think this will make to the way you run your farm?
   
   Do you think those changes would impose extra costs on your farm business? Roughly how much do you think those would be over the 5 year commitment?

5. [For non-included Packages] Why did you not sign up to the … FMP?
   - Didn’t understand commitments
   - Too costly for farm business (money & time)
   - Not relevant for farm
   - On-going monitoring of compliance
C. Finance

6. You could have asked for 100% payment up to 50K payment from this scheme, but you asked for ..., how did you decide upon the level of that grant request?
   - Personal funds had available for investment.
   - Competition from other farmers.

7. Your bid suggest that you will make a contribution of ... to the costs of the capital, if your bid is successful from where will you source those funds?
   - Other schemes

8. Without the money from South West Water available through this scheme would you have done this work anyway?
   [If yes] When do you think you would have done that work and how would you have funded it?

9. [If no] Remember that everything you tell me will be confidential and won’t be shared with WRT or South West Water ... and so cannot impact on the outcome of the scheme.

   We know that the scheme will benefit South West Water in terms of reducing their costs of cleaning up pollution in river water, but we also really want to get a feel for how much this scheme has benefitted farmers.

   So, you have committed to making a contribution of ..., but what do you think the very maximum amount you would have been prepared to pay towards the capital works is?

D. Bid Revision

We set up the scheme with multiple rounds, so that you could enter a bid and revise it in subsequent rounds given out feedback.

[Bidding round history]

10. [For bid changers] Why did you decide to change your bid?

11. [Non bid changers] What were you reasons for sticking with this bid?

12. [For Round 3 only] Was there any reason you didn’t bid in the earlier rounds?
   - Could have had feedback if bid in earlier round

E. Bid Revision

Some questions at finish off with

13. It was absolutely OK to discuss your bid with other farmers, did you do so? If you did, did that influence your bid in any way?

14. Would you still have entered a bid if we had not offered a £50 participation fee?

15. Apart from the single farm payment, in the last 5 years, have you participated in other schemes that have provided funding for your farm? If yes, which and what funding have you received? Examples, environmental stewardship (Entry Level Stewardship ELS and Higher Level Stewardship HLS), Catchment Sensitive Farming (CSF) Capital Grant Scheme, Farming and Forestry Improvement Scheme (FFIS run by Rural Development Programme for England RDPE).
16. This scheme was funded by South West Water, do you think your decision to enter a bid would have been different if this was a government funded scheme?

17. Do you have any other comments you would like to share with me about this scheme?

F. Participate in future design experiment?

Finally, we are hoping to use your feedback and that from other farmers to think of ways of designing new and hopefully better schemes similar to the FRIS. As we design those schemes, we would very much like to get your opinions on how well those schemes would work. We will have research funds available so should be able to pay you for your input ... probably a similar amount to the £50 you are receiving for responding to this survey. Would you be interested in helping us out in this way?
## Appendix D: Non-participants Follow-Up Survey

<table>
<thead>
<tr>
<th>Question</th>
<th>Answer</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. We sent you a couple of letters in August and September, inviting you to take part in the scheme….did you read those letters? 1a?</td>
<td></td>
</tr>
<tr>
<td>1.b Did you attend the Pie and Pint night?</td>
<td>Yes/No</td>
</tr>
<tr>
<td>2. The scheme offered grants for capital investments on farms to stop pollution getting into the River Fowey. Is there any work that you could do on your farm that could benefit from investment from a scheme like that? (Try to record capital items and their size. It may help to use codes below in recording answer)</td>
<td></td>
</tr>
<tr>
<td>(A) New slurry store</td>
<td>(F) Concrete tracks/yard</td>
</tr>
<tr>
<td>(B) New dung store</td>
<td>(G) Watercourse fencing</td>
</tr>
<tr>
<td>(C) Roof dung/slurry store</td>
<td>(H) Troughs</td>
</tr>
<tr>
<td>(D) Cover feeding area</td>
<td>(I) Livestock crossing points</td>
</tr>
<tr>
<td>(E) Overwinter cattle</td>
<td>(J) Stone gateways</td>
</tr>
<tr>
<td>3. (IF KNEW ABOUT SCHEME) Why did you decide not to bid in the scheme?</td>
<td></td>
</tr>
<tr>
<td>(Please record the main reason and any other reasons mentioned by the farmer using the codes)</td>
<td></td>
</tr>
<tr>
<td>(A) No capital investments of this type needed.</td>
<td></td>
</tr>
<tr>
<td>(B) Already made investments in capital works.</td>
<td></td>
</tr>
<tr>
<td>(C) The forms were too complicated/Didn’t understand how to fill in the bid</td>
<td></td>
</tr>
<tr>
<td>(D) Not enough time to prepare a bid/Run at the wrong time of year</td>
<td></td>
</tr>
<tr>
<td>(E) Not certain whether project I wanted to do would qualify for funding</td>
<td></td>
</tr>
<tr>
<td>(F) Needed advice (e.g. site visit) to identify suitable project.</td>
<td></td>
</tr>
<tr>
<td>(G) Needed &gt;£50K for project I had in mind</td>
<td></td>
</tr>
<tr>
<td>(H) Have to pay me more than costs of project to get me involved.</td>
<td></td>
</tr>
<tr>
<td>(I) I didn’t have enough money of my own to put in a competitive bid</td>
<td></td>
</tr>
<tr>
<td>4. If we ran the scheme again next year, what changes could we make that would encourage you to participate? (Please record the main reason and any other reasons mentioned by the farmer using the codes)</td>
<td></td>
</tr>
<tr>
<td>(A) Included different types of capital investment</td>
<td></td>
</tr>
<tr>
<td>(B) Payments for operational activities</td>
<td></td>
</tr>
<tr>
<td>(C) Site visit by farm advisor to help identify project</td>
<td></td>
</tr>
<tr>
<td>(D) Simplify bidding mechanism</td>
<td></td>
</tr>
<tr>
<td>(E) Provide more information on the scheme</td>
<td></td>
</tr>
<tr>
<td>(F) Run at different time of year (when?)</td>
<td></td>
</tr>
<tr>
<td>(G) Provide longer to enter bid (how long?)</td>
<td></td>
</tr>
<tr>
<td>(H) Allow for bids over £50K (how big?)</td>
<td></td>
</tr>
<tr>
<td>(I) Pay a larger participation fee.</td>
<td></td>
</tr>
<tr>
<td>(J) Allow for bids over capital costs</td>
<td></td>
</tr>
</tbody>
</table>
Appendix E: Models of Non-Cooperative Multi-Purchaser PES Mechanisms

Let us assume that the two purchasers have the following quadratic payoff functions;

Purchaser 1:
\[ \Pi_1 = a_0 x_a - \frac{1}{2} a_1 x_a^2 - C_1 \]

Purchaser 2:
\[ \Pi_2 = b_0 x_b - \frac{1}{2} b_1 x_b^2 - C_2 \]

where, \( x_a \) is the quantity of service flow \( a \) enjoyed by Purchaser 1 and \( x_b \) the quantity of service flow \( b \) enjoyed by Purchaser 2, \( C_1 \) and \( C_2 \) are costs incurred by Purchaser 1 and 2 respectively and \( a_0, a_1, b_0 \) and \( b_1 \) are parameters of the two payoff functions.

PES Market Institution I: All Goods For Sale

First imagine a PES market institution which allows Purchasers to purchase quantities of actions A, B or C. In this case using your quadratic specification, the payoffs functions are;

Purchaser 1:
\[ \Pi_1 = a_0 (R_1^A x_a + (R_1^C + R_1^S) \lambda_a x_a) - \frac{1}{2} a_1 (R_1^A x_a + (R_1^C + R_1^S) \lambda_a x_a)^2 - (R_1^A + R_1^C) \]

Purchaser 2:
\[ \Pi_2 = b_0 (R_2^B x_b + (R_2^C + R_2^S) \lambda_b x_b) - \frac{1}{2} b_1 (R_2^B x_b + (R_2^C + R_2^S) \lambda_b x_b)^2 - (R_2^B + R_2^C) \]

where \( R_1^A, R_1^B \) and \( R_1^C \) are the amounts that Purchaser 1 spends on actions A, B and C respectively. We simplify given the knowledge since rational Purchasers will not invest in an action that returns none of the ES service that they value such that \( R_1^A = 0 \) and \( R_1^B = 0 \).

The optimal choice of \( R_1^A \) and \( R_1^C \) for Purchaser 1 can be found by forming the Lagrange:

\[ L_1 = a_0 x_a (R_1^A + \lambda_a (R_1^C + R_1^S)) - \frac{1}{2} a_1 x_a^2 (R_1^A + \lambda_a (R_1^C + R_1^S))^2 - (R_1^A + R_1^C) + \gamma_1^A R_1^A + \gamma_1^C R_1^C \]

where \( \gamma_1^A \) and \( \gamma_1^C \) are the Lagrange multipliers on the non-negativity constraints on \( R_1^A \) and \( R_1^C \) respectively.

We get gradient conditions;

\[ \frac{\partial \Pi_1}{\partial R_1^A} = a_0 x_a - a_1 x_a^2 (R_1^A + \lambda_a (R_1^C + R_1^S)) = 1 - \gamma_1^A \] (1)

\[ \frac{\partial \Pi_1}{\partial R_1^C} = \lambda_a \left[a_0 x_a - a_1 x_a^2 (R_1^A + \lambda_a (R_1^C + R_1^S))\right] = 1 - \gamma_1^C \] (2)

Complementary slackness conditions;

\[ \gamma_1^A R_1^A = 0 \] (3)

\[ \gamma_1^C R_1^C = 0 \] (4)

And primal constraint conditions;

\[ R_1^A \geq 0 \] (5)

\[ R_1^C \geq 0 \] (6)

And dual constraint conditions;
Dividing (2) by (1) gives;

\[
\lambda_a = \frac{1 - \gamma_i^C}{1 - \gamma_i^A}
\]  

(9)

It follows that if \( \lambda_a > 1 \), then \( 1 - \gamma_i^C > 1 - \gamma_i^A \) which implies \( \gamma_i^A > \gamma_i^C \). Given the dual constraint conditions (7) and (8), that can only hold if;

- \( \gamma_i^A > 0 \) and \( \gamma_i^C = 0 \); which from (3) and (4) means \( R_i^A = R_i^C = 0 \) and Purchaser 1 buys no actions.
- \( \gamma_i^A > 0 \) and \( \gamma_i^C = 0 \); which from (3) and (4) means \( R_i^A = 0 \) and \( R_i^C > 0 \), such that Purchaser 1 only buys quantities of action C.

The intuition is clear, if \( \lambda_a > 1 \) then action C always gives a better return per £ than action A, so Purchaser 1 will only ever invest in action C.

In the contrary case when \( \lambda_a < 1 \), it follows from (9) that \( \gamma_i^A < \gamma_i^C \) such that Purchaser 1 will only ever buy quantities of action A (if he buys any actions at all).

The same principles hold for the analysis of the problem from the point of view of Purchaser 2.

So our first result is the obvious conclusion that any Purchaser who finds Action C more cost efficient than alternative actions will only ever invest in C. Likewise a Purchaser will never invest in Action C if it is less cost efficient than some alternative.

**CASE 1: \( \lambda_a > 1 \) and \( \lambda_b > 1 \)**

In this case, Action C is more cost efficient than the alternative for both Purchasers. Accordingly, \( R_i^A = R_i^B = 0 \) and \( \gamma_i^C = \gamma_i^C = 0 \) such that (1) or (2) reduce to;

\[
\lambda_a \{ a_0 x_a - a_1 x_a^2 (R_i^C + R_i^C) \lambda_a \} = 1
\]

(10)

From which we solve for the response curve;

\[
R_i^C = \frac{\lambda_a a_0 x_a - 1}{a_1 x_a^2 \lambda_a^2} - R_i^C
\]

(11)

Similarly for Purchaser 2 we get;

\[
\lambda_b \{ b_0 x_b - b_1 x_b^2 (R_i^C + R_i^C) \lambda_b \} = 1
\]

(12)

With response curve;

\[
R_i^C = \frac{\lambda_b b_0 x_b - 1}{b_1 x_b^2 \lambda_b^2} - R_i^C
\]

(13)

So in the case where action C is more cost efficient than both A and B, we have parallel response curves ... identical to the problem you analysed. The game results in a Nash Equilibrium in which either Purchaser 1 or 2 (depending on the relative sizes of the
parameters) completely free-ride on the other’s purchases of C. The example where Purchaser 2 free rides on Purchaser 1’s purchases of C is illustrated below.

\[ R_2^C = \frac{\lambda_a b_0 x_b - 1}{b_1 x_a^2 \lambda_b^2} \]

\[ R_1^C(R_2^C) \]

\[ R_2^C(R_1^C) \]

\[ \lambda_a b_0 x_b - 1 \]

\[ \frac{R_2^C}{R_1^C} \]

\[ \text{Nash Equilibrium} \]

\[ \frac{\lambda_a a_0 x_a - 1}{a_1 x_a^2 \lambda_a^2} \]

\[ R_1^C \]

\[ \text{CASE 2: } \lambda_a > 1 \text{ and } \lambda_b < 1 \]

In this case Action C is more cost efficient than alternative actions for one of the Purchasers (by way of illustration we choose that Purchaser to be Purchaser 1), but less cost efficient for the other.

- For Purchaser 1: Since \( \lambda_a > 1 \), we have from (9) that \( y_i^C > 0 \) and \( y_i^C = 0 \) implying \( R_i^C = 0 \) and \( R_i^C > 0 \). Purchaser 1 will only invest in action C.
- For Purchaser 2: Since \( \lambda_b < 1 \), the equivalent relationship gives \( y_i^B = 0 \) and \( y_i^C > 0 \) implying \( R_i^B > 0 \) and \( R_i^C = 0 \). Purchaser 2 will only invest in action B.

Using those values, we solve for the response curves;

Purchaser 1:

\[ R_1^C = \frac{\lambda_a a_0 x_a - 1}{a_1 x_a^2 \lambda_a^2} \] (14)

Purchaser 2:

\[ R_2^C = \frac{b_0 x_b - 1}{b_1 x_b} - \lambda_b R_1^C \] (15)

So in this case Purchaser 1 buys their optimal quantity of action C and this is independent of Purchaser 2’s actions. In contrast, Purchaser 2 only buys action B, but only when Purchaser 1’s purchases of action C result in less than \( (b_0 x_b - 1)/b_1 x_b^2 \) of SF b being provided.

Again, we can illustrate those two different possible outcomes in the form of response curves (this time with respect to \( R_1^C \) and \( R_2^C \).
CASE 3 & 4: $\lambda_a < 1$ and $\lambda_b < 1$

In the final case, Action C is less cost efficient than either A or B. So $R_1^C = R_2^C = 0$ and $\gamma_1^A = \gamma_2^B = 0$ and the optimum for Purchaser 1 is to buy only action A

$$R_1^A = \frac{a_0x_a - 1}{a_1x_a^2}$$

(16)

And for Purchaser 2 to buy only action B;

$$R_2^B = \frac{b_0x_b - 1}{b_1x_b^2}$$

(17)
PES Market Institution II: Matching mechanism in C

In this mechanism, the Purchasers are free to buy either Action A or B but quantities of Action C can only be purchased if they both contribute. For the sake of simplicity let us assume that the two Purchasers must contribute equally. In other words, to buy £1’s worth of action C we must get 50p from Purchaser 1 and 50p from Purchaser 2. Moreover, if Purchaser 1 contributes 50p and Purchaser 2 contributes £5, then still only £1’s worth of action C will be purchased.

In proposing this mechanism I’m imagining 2 Purchasers who could potentially go and purchase separate actions A and B to fulfil their respective needs. We come along as a mechanism designer and present them with a third option which is to purchase C, but they can only purchase that action if they split the costs between them.

Alternatively, one can imagine a “big player” pre-committing to such a mechanism by promising to match any contributions to Action C made by other Purchasers. That’s slightly different from the model I sketch below, but the outcomes will be similar.

The interesting thing about this mechanism is that it reduces the free-rider problem, encouraging contributions to Action C even in situations where $\lambda_a$ and $\lambda_b$ are less than one. The requirement for equal matching is not necessary and the contributions could be in any ratio. I suspect that by choosing the ratio $\lambda_a: \lambda_b$, contributions to the purchase of C could be encouraged for any $\lambda_a$, $\lambda_b$ provided $\lambda_a + \lambda_b > 1$ (CASE 3 in the table at the beginning of the paper).

Focusing on the equal matching example, the payoff functions for this mechanism can be written as:

Purchaser 1: $\Pi_1 = a_0x_a(R_1^A + 2\min(R_1^C, R_2^C)\lambda_a) = \frac{1}{2}a_1x_a^2(R_1^A + 2\min(R_1^C, R_2^C)\lambda_a)^2 - (R_1^A + R_1^C)$

Purchaser 2: $\Pi_2 = b_0x_b(R_2^B + 2\min(R_1^C, R_2^C)\lambda_b) = \frac{1}{2}b_1x_b^2(R_2^B + 2\min(R_1^C, R_2^C)\lambda_b)^2 - (R_2^B + R_2^C)$

To simplify the problem, we note that a rational Purchaser would never gain anything by investing more in Action C than the other Purchaser. For Purchaser 1, for example, that implies that as well as $R_1^C \leq R_2^C$, it must also be the case that $\min(R_1^C, R_2^C) = R_1^C$. Accordingly, it will always be correct that $\min(R_1^C, R_2^C) = R_1^C$.

Making that replacement and adding the additional constraint that $R_1^C \leq R_2^C$ we arrive at Purchaser 1’s Lagrangian;

$L_1 = b_0x_b(R_2^B + 2\min(R_1^C, R_2^C)\lambda_b) - \frac{1}{2}b_1x_b^2(R_2^B + 2\min(R_1^C, R_2^C)\lambda_b)^2 - (R_2^B + R_2^C) + y_1^A R_1^A + y_1^C R_1^C

- y_1^{CL}(R_1^C - R_2^C)$

From which we derive the FOCs;

$$a_0x_a = a_1x_a^2(R_1^A + 2\lambda_a R_1^C) = 1 - y_1^A$$  \hspace{1cm} (18)

$$2\lambda_a (a_0x_a - a_1x_a^2(R_1^A + 2\lambda_a R_1^C)) = 1 - y_1^{CL} + y_1^{CU}$$  \hspace{1cm} (19)

Dividing (19) by (18) gives;

$$2\lambda_a = \frac{1 - y_1^{CL} + y_1^{CU}}{1 - y_1^A}$$  \hspace{1cm} (20)
Consider first the situation where \( \lambda_a < \frac{1}{2} \) which from (23) implies;

\[
1 - \gamma_1^{CL} + \gamma_1^{CU} < 1 - \gamma_1^A
\]

Or

\[
\gamma_1^{CL} - \gamma_1^{CU} > \gamma_1^A
\]  

(21)

When \( \lambda_a < \frac{1}{2} \), it is clearly the case that a £ invested in A always provides a better return than a £ invested in C, so we would expect Purchaser 1 not to purchase any quantities of action C. Unfortunately, we have to do a little more work this time to reach that same conclusion from the maths;

- First note that the upper \((R_1^C \leq R_2^C)\) and lower\((R_1^C \geq 0)\) boundary constraints on \(R_1^C\) can hold simultaneously when \(R_2^C = 0\). In which case \(R_1^C = 0\).
- Alternatively, if it were the case that just the upper constraint holds such that\(R_1^C = R_2^C\), then \(\gamma_1^{CU} > 0\) and \(\gamma_1^{CL} = 0\). The condition derived in (24) reduces to \(-\gamma_1^{CU} > \gamma_1^A\) which is not a feasible solution since both \(\gamma_1^{CU}\) and \(\gamma_1^A\) must be non-negative. Accordingly, where \(\lambda_a < \frac{1}{2}\) we can rule out a solution in which\(R_1^C = R_2^C\).
- The only option left is for \(R_1^C < R_2^C\) in which case the upper constraint does not hold and \(\gamma_1^{CU} = 0\). From (24) we get \(\gamma_1^{CL} > \gamma_1^A\) and given the non-negativity of \(\gamma_1^{CL}\) it must be the case that \(\gamma_1^{CL} > 0\), a condition that only holds when the lower constraint is binding, i.e. when \(R_2^C = 0\).

Accordingly, when \( \lambda_a < \frac{1}{2} \) it must be the case that Purchaser 1’s optimal strategy is not to purchase any of Action C.

Of course if Purchaser 1 puts no money towards Action C then Purchaser 2 will also get no returns from investing in that action either and ends up only purchasing action B not matter what the value of \( \lambda_b \).

The same outcome would result if \( \lambda_b < \frac{1}{2} \), in which case, no matter how much money Purchaser 1 put into Action C, Purchaser 2 would still only ever want to invest in Action B.

More interesting is the case where \( \lambda_a > \frac{1}{2} \) and \( \lambda_b > \frac{1}{2} \).

Again let’s study the problem from the point of view of Purchaser 1. Since in this case \(2\lambda_a > 1\), from (20) we get;

\[
\gamma_1^{CL} - \gamma_1^{CU} < \gamma_1^A
\]  

(22)

As before let’s work through the possible cases;

- If \(\gamma_1^{CL}\) and \(\gamma_1^{CU}\) are both non-zero, then both the upper \((R_1^C \leq R_2^C)\) and lower\((R_1^C \geq 0)\) boundary constraints on \(R_1^C\) must hold simultaneously which can only happen when \(R_2^C = 0\). In which case \(R_1^C = 0\). Since \(\gamma_1^{CU}\) can be larger than \(\gamma_1^{CL}\) (Note: haven’t worked out how to show this yet), such a situation is commensurate with \(\gamma_1^A \geq 0\). So if \(R_2^C = 0\), then Purchaser 1 only buys Action A (if she buys anything at all).
- Now consider the case where \(\gamma_1^{CL} > 0\) but \(\gamma_1^{CU} = 0\), which signifies the lower boundary constraint is binding but the upper constraint is not; that is to say that \(0 = R_1^C < R_2^C\). From (22) we get \(\gamma_1^A > \gamma_1^{CL}\), which implies that \(\gamma_1^A\) must be positive and that the non-negativity constraint on \(R_1^A\) is binding. So a feasible solution exists in which neither A
nor C are purchased (though I think we can rule that out by judicious assumptions regarding the parameters of the payoff function. Note: Must work out how to show this).

- Alternatively, if \( \gamma_1^{CL} = 0 \) and \( \gamma_1^{CU} = 0 \) then \( 0 < R_1^C < R_2^C \) and Purchaser 1 buys some positive amount of action C. From (22) we get \( \gamma_1^A > 0 \), so the non-negativity constraint on \( \gamma_1^A > \gamma_1^C \) binds and Purchaser 1 does not buy any Action A. Intuitively, Purchaser 1 reaches their optimal level of provision of Ecosystem Service a purely through the purchase of Action C. Of course, if they wanted more they could buy more through purchasing more action C (since \( R_1^C < R_2^C \) ) and that would always make more sense than buying Action A (since \( \lambda_a > \frac{1}{2} \) ). From (19) we can calculate the level of purchase contribution to Action C to be:

\[
R_1^C = \frac{a_02\lambda_a x_a - 1}{a_14\lambda_a^2 x_a^2}
\]

- Finally, if \( \gamma_1^{CL} = 0 \) and \( \gamma_1^{CU} > 0 \) then \( 0 < R_1^C = R_2^C \) and Purchaser 1 buys a positive amount of action C equal to the contribution made to purchases of that action by Purchaser 2. From (22) we get \( \gamma_1^A > -\gamma_1^{CU} \), a result implying \( R_1^A \geq 0 \). So, in the case where Purchaser 1 matches Purchaser 2’s contribution to the purchase of Action C, that purchase can either just satisfy their demands for Ecosystem Service a, or it may be optimal for them to “top up” by purchasing more of that ecosystem service through Action A. From (18), assuming Purchaser 1 tops-up by buying some Action A, we get:

\[
R_1^A = \frac{a_0 x_a - 1}{a_1 x_a^2} - 2\lambda_a R_2^C
\]

And since \( R_1^A \) cannot be negative (24) implies;

\[
(R_1^C = R_2^C) \leq \frac{a_0 x_a - 1}{a_12\lambda_a x_a^2}
\]

Bringing the results of (23), (24) and (25) together we find that;

<table>
<thead>
<tr>
<th>Purchaser 2’s Decision Concerning</th>
<th>Purchaser 1’s Optimal Response</th>
</tr>
</thead>
<tbody>
<tr>
<td>( R_2^C )</td>
<td>( R_1^C ) \hspace{1cm} ( R_1^A )</td>
</tr>
<tr>
<td>( a_02\lambda_a x_a - 1 ) \hspace{1cm} ( a_14\lambda_a^2 x_a^2 )</td>
<td>( a_02\lambda_a x_a - 1 ) \hspace{1cm} ( a_14\lambda_a^2 x_a^2 )</td>
</tr>
<tr>
<td>( a_0 x_a - 1 ) \hspace{1cm} ( a_12\lambda_a x_a^2 )</td>
<td>( R_2^C ) \hspace{1cm} 0</td>
</tr>
<tr>
<td>( R_2^C ) \hspace{1cm} ( R_2^C )</td>
<td>( a_0 x_a - 1 ) \hspace{1cm} ( 2\lambda_a R_2^C )</td>
</tr>
</tbody>
</table>

In other words, Purchaser 1 will purchase Action C up to their optimal investment in that action or until they are matching Purchaser 2’s investment in Action C. There is never any benefit to Purchaser 1 of \( R_1^C > R_2^C \). If there purchase of Action C are capped by \( R_2^C \) then they may purchase additional ecosystem service by buying Action A.
Again, we can illustrate a possible configuration of response curves for purchases of Action C as follows;

\[
R_C^C \leq \min \left( \frac{a_0 x_a^2 - 1}{a_4 x_a^2}, \frac{b_0 x_b^2 - 1}{b_4 x_b^2} \right)
\]

The Pareto efficient Nash equilibrium is that at which;

\[
R_C^C = R_C^C = \min \left( \frac{a_0 x_a^2 - 1}{a_4 x_a^2}, \frac{b_0 x_b^2 - 1}{b_4 x_b^2} \right)
\]

And one would suspect that the Purchasers would arrive at that outcome given opportunities to coordinate their actions.
Appendix F: PES Experiment Script

Screen: Welcome
- Welcome to the experiment! We are about to start.
- Before we start, please could you put away any stuff that you have on your desks and turn off and put away your mobile phones. We will be paying you for your participation in this experiment and in return we expect that you will focus on that task for the next hour to an hour and a half.
- During that time you and the other participants in the room will be undertaking a series of 7 tasks on the computers.
- In those tasks you will be teamed-up with 2 other participants to make a group of THREE people. You won’t know who the other people are in your group and the members of your group will change from task to task.
- Each task will involve you negotiating with the other members of your group in an attempt to agree on a DEAL. Whether you reach a deal and what particular deal you agree upon will determine how much money you will be entitled to from that task.
- On your desk, you should have a document outlining the key elements of each task. You can refer to that as we walk you through how a task will be played out on your computer.

Screen: Task and Round Counters
- To do that, we are going to begin by introducing you to the basic elements you will see on the screen in each task. So, to the top left of your screen you should see a task counter, this will update as you work through each of the seven tasks.
- In each task you will go through a series of rounds of negotiation with the other members of your group. The counter to the top right will tell you which round of negotiation you have reached.

Screen: Timer
- The final element at the top of the screen is a timer. You should now be able to set that counting down.
- During the negotiations you will have to make decisions, but you will only have limited time to come to those decisions ... sometimes as little as 10 seconds. As soon as it is your turn to make a decision, the COUNT DOWN begins. If the countdown reaches zero then you will TIME OUT and forfeit your opportunity to make that decision ... which may have an impact on how much you get paid. As a result, you will have to think quickly during the experiment.

Screen: Default Payment
- In each task, each person in a Group of 3 is allocated to take the role of PLAYER 1, PLAYER 2 or PLAYER 3 ... which particular role you take on will change from task to task.
• Each player in your group starts out entitled to the same DEFAULT PAYMENT. This is the payment that you will get if your negotiations fail and the three members of your group cannot agree to a DEAL.

• The first box on your screen shows this payment. For all the tasks you will undertake today your DEFAULT PAYMENT will be £7.50.

• Alternatively, provided each of the 3 players in your group agrees to the idea, then instead of each member getting their DEFAULT PAYMENT they will get their DEAL PAYMENT instead.

[NEXT SCREEN]

Screen: Deal Payment 1 & 2

• The Deal Payments for Players 1 and 2 are shown in the two boxes that have now appeared on your screen.

• Notice that the role that you will be playing in any particular Task will be indicated to you by highlighting the title of that Player’s Deal Payment box in Blue. In this example, you are Player 2 … though remember which role you play will change from task to task.

• If you agree to a deal, then in some tasks there may be more than one possible outcome and you won’t know which of those outcomes will turn out to be your actual Deal Payment until after the negotiations have finished. We label those different Outcomes A and B. In the task we are considering here, however, there is only one outcome … outcome A. Accordingly, as Player 2 in this task, if your group were to agree to a Deal then you can be 100% certain that you will be due a Deal Payment of £19. The first few tasks will be just like this. Don’t worry, we’ll come back and talk you through Deals with more than one Outcome before you start on those tasks.

• Notice that as Player 2, your deal payment of £19 is considerably higher than your default payment of £7.50. The same is true for Player 1 who stands to make £14 if a deal is agreed as opposed to the default payment of £7.50. Indeed, in all the tasks Players 1 and 2 will always have Deal Payments that are larger than their Default Payments and, therefore, will be keen for all 3 Players to reach an agreement that allows them to claim their Default Payments.

[NEXT SCREEN]

Screen: Deal Payment 3

• The key obstacle in reaching an agreement, however, is that the Deal Payment for Player 3 is always zero. You should be able to see the Deal Payment box for Player 3 at the bottom of your screen.

• For that reason, the only way agreement can be reached is if the Players can negotiate a DEAL. That Deal involves Players 1 and 2 committing to share enough of their Deal Payments with Player 3 so as to convince Player 3 that it is worth their while agreeing to the Deal.

• Negotiations in a task always begin with Player 1 making a PROPOSAL to Player 2. In that Proposal Player 1 suggests how much of their own Deal Payment and how much of Player 2’s Deal Payment should be offered to Player 3. The sum of those two suggested contributions is the proposed payment to be made to Player 3.
• Player 1’s Proposal is passed on to Player 2 who must decide whether to REJECT or ACCEPT it. If Player 2 rejects the Proposal, they may get the chance to offer a COUNTER PROPOSAL … and negotiations may go back and forth between Players 1 and 2 until they finally agree on a Proposal to offer to Player 3.

[NEXT SCREEN]

**Screen: Reject Proposal**

• In this walk through, we join the negotiations part way through. In the left hand side of the Proposal Accept/Reject Box that has just appeared on your screen the Proposal History table which lists the last 5 proposals that have passed between Players 1 and 2.

• In this case, Player 1 started the negotiation by proposing that he pay £2.50 towards a payment to Player 3 while you, as Player 2, should contribute a further £7.50 … giving a total Payment to Player 3 of £10. In this case, you rejected that proposal (which is why it is coloured red in the table) and suggested a counter proposal in which Player 1 paid £5 and you paid £4 (a total Payment to Player 3 of £9). Unfortunately, Player 1 wasn’t happy with that proposal and rejected it, coming back with another proposal in which he pays £4 and you pay £8. Since that is the current proposal on the table, it is coloured black in the Proposal History table.

• You can see that current proposal written out in large in the right hand side of the box in red text and next to it a red decision button with the word “rejected” written on it. This is exactly what the screen will look like when you first receive a proposal to consider. The fact that the decision button says “rejected” and the text is red indicates that you currently intend to reject that proposal.

• By clicking on that decision button you can indicate, instead, that you would like to Accept the Proposal instead. Go ahead and try that now.

• Notice that the text has gone green and the decision button is now grey with the word “accepted” on it. That indicates that you currently intend to accept the proposal.

• To register your decision you MUST press on OK. Whatever word is written on the button when you press OK will be the decision you register in the negotiation. If you fail to press OK then the computer will not register your decision and just assume that you have rejected the Proposal.

• Now click on the decision button again to change it back to rejected. Observe the text that appears next to the OK button. This text is a warning, informing you that should you click OK and thereby reject the proposal then you run the risk that the NEGOTIATIONS WILL FAIL. If that happens then no Deal is reached and each player will have to content themselves with their DEFAULT PAYMENT.

• In this case the Probability of such a failure happening if you decide to reject the proposal is 1 in 30. If you were to go ahead and press OK, the computer would use its random functions and those odds to establish whether you have been unlucky and the negotiations have failed. During a negotiation those probabilities start out low at 1 chance in 500 … by the time 5 rejections have been made in a negotiation that probability is up to 1 in 100 … by the tenth rejection 1 in 15 … and by the fifteenth more than 1 in 2.

• Making this decision even harder is the fact that you have to do it against the clock. We’ve disabled that for the purposes of this walk through, but when you start the real
tasks, as soon as you see this screen the countdown clock will start clicking down. If you haven’t pressed OK to register your decision by the time the countdown clock reaches zero, the computer will simply assume that you are rejecting the proposal.

- Let’s, assume that you are sufficiently unhappy with this Proposal that you are prepared to take the risk of rejecting it. Make sure the decision button says “rejected” then press OK. Actually we’ve disabled that button as well, but we will move you on automatically from our master program.

[NEXT SCREEN]

Screen: Make a Proposal

- In this case you got lucky and the negotiations did not fail. You now have the opportunity to make a proposal of your own.

- To make your counter proposal you fill in the amounts that you think that you and the other player should make to Player 3 in the boxes provided. In entering those amounts, be aware that the units are in £s ... if you want to include a pence amount (which you are perfectly entitled to do) you will have to enter it after a decimal point.

- Since these amounts will be paid for out of Deal Payments you will never be able to suggest an amount that exceeds a Player’s deal payment.

- Please fill in the boxes with the following proposal: Player 1 pays £5, you pay £6. Now press enter to register your proposal. Notice that in deciding on a proposal, you will again be up against the clock. If the countdown reaches zero before you have pressed the Enter button, then the computer will simply assume that your proposal is that you both pay £0 to Player 3.

- Go ahead and press Enter to send you proposal off to Player 1 for them to consider ... though again notice that for the purposes of this walk through that we have disabled the Enter button and also have got the computer to ensure that you entered the amounts £5 and £6.

[NEXT SCREEN]

Screen: Waiting for the Other Player to Consider a Proposal

- Once you have sent your proposal to Player 1, you will move on to a waiting screen that will look like this. This shouldn’t take too long, but please do remain patient ... there’s nothing more you can do until Player 1 decides whether to accept or reject your proposal.

[NEXT SCREEN]

Screen: Accept Proposal

- In this case Player 1 decided to reject your proposal. You all got lucky in that the negotiation did not fail when they pressed reject ... and now Player 1 has come back with a new Proposal. In this Proposal Player 1 pays £4.50 and you contribute £6.50 towards a combined payment to Player 3 of £11.

- Notice that the Proposal History table has been updated to show your last proposal ... which Player 1 rejected … and Player 1’s new proposal.
Notice also that the risk of the negotiations failing if you reject has also gone up from 1 in 30 to 1 in 15.

Let’s imagine that you are now happy with the proposal and don’t want to take the risk of rejecting.

Toggle the decision button so it reads “accepted” and then press OK to accept the proposal and then we will move you on to the next screen.

[NEXT SCREEN]

Screen: Waiting for Player 3 to Consider an Offer

The proposal that you have agreed to with Player 1 is now sent over to Player 3 to consider. You will now have to wait to see whether Player 3 is going to accept your Offer. While waiting you will see a message like this.

If Player 3 does accept your offer, then everyone has consented and a Deal is done. If Player 3 rejects your Offer then you may get the chance to enter into fresh negotiations with Player 1 to see if you can agree to another Offer to put before Player 3.

At this point, let us change perspective and see how things look from the point of view of the participant playing Player 3.

[NEXT SCREEN]

Screen: Player 3 waiting for an Offer

While Player 1 and Player 2 have been busy swapping proposals in an attempt to come up with an Offer, Player 3 has been sat on a waiting screen like this one. Notice that since we are now looking at the negotiation through the eyes of Player 3, it is Player 3 whose name is highlighted in Blue.

Again, if you are Player 3, please be patient … it may take Players 1 and 2 a few rounds of proposal and counter-proposal before agreeing on an offer … provided negotiations don’t fail before they reach an agreement.

[NEXT SCREEN]

Screen: Accept/Reject Offer

When (and if) an offer arrives, Player 3 will see a screen containing an Offer Accept/Reject Box just like this. To the left is a table listing the offers that have been made to Player 3 in this task. To the right you can see the current offer and buttons allowing Player 3 to accept or reject that offer.

Notice that Player 3 only sees the total amount that Players 1 and 2 have agreed to pay, not their individual contributions.

The buttons on this screen work in much the same way as those we looked at previously. When the screen first appears to Player 3, the decision button will say “rejected” indicating an intention to reject the Offer. Again, rejecting an offer comes with a risk of the negotiation failing. That risk is written next to the OK button.

For the sake of argument, let us assume that you, as Player 3, are happy enough with this offer to think that it is not worth taking the risk of rejecting. Toggle the decision
button so that it goes from “rejected” to “accepted”, the text of the Offer should go green and, since you are now not planning to reject, the risk information disappears.

- Again in the real tasks you will be making this decision against the clock and you will have to hit the OK button to register your decision before the count down times out.

- Press OK now ... though remember for the walk through we’ve disabled that button and will move you on from our control program.

[NEXT SCREEN]

Screen: Deal Done Screen

- Since Player 3 has accepted an offer made by Players 1 and 2, this task ends with all three players agreeing to a deal. In this case, Player 3 has foregone the fall-back payment of £7.50 in favour of the £11 offered by Players 1 and 2. If, at the end of the experiment, this task was picked as the one as the one that counts for real for Player 3, then this will be the amount of money they earn from participating in the experiment.

- As a deal was done by this group, each will now see a screen showing what they stand to gain from that task.

- Before they can move on to the next task, they will have to wait until all the other groups finish. Once everyone has completed the task, the next task begins by teaming you up with a different set of two people to form a new group.

Stochastic Walk Through

Screen: Start

- As promised, we are now moving on to another set of tasks which are slightly more complicated than those you have just done in so much as the Deal Payments for Players 1 and 2 can take one of two possible values and which of those is the actual value is not known during the negotiations.

[NEXT SCREEN]

Screen: Information Boxes

- Those two possible deal payments are shown as Outcome A and Outcome B in the information boxes for Players 1 and 2. Notice that Player 3 always has a deal payment of £0 whatever the outcome.

- While you do not know which outcome will be the actual outcome, you do know that there is exactly half a chance (50% chance) it will be Outcome A and half a chance it will be Outcome B. In this case, if it turns out to be Outcome A, your deal payment as Player 2 will be £17 while the deal payment for Player 3 will be £20. If, on the other hand it turns out to be Outcome B, your deal payment will be £11 and Player 1’s will be £10.

[NEXT SCREEN]

Screen: Proposal Screen

- Now in making a Proposal you must consider what payments you think should be made to Player 3 in the event of Outcome A and what payments should be made to Player 3
in the event of Outcome B. You must fill those amounts in the boxes provided and then press Enter to send you Proposal to the other Player to consider. Again you will be making your decisions against the clock.

- In deciding on those amounts bear in mind that Player 3 might be prepared to take some of the risk and accept an offer in which payment in one of the outcomes is below £7.50, provided the payment in the other outcome was sufficiently high that they thought taking that risk was worthwhile.

[NEXT SCREEN]

Screen: Proposal Screen

- When you receive a Proposal the screen will now look like this. In making your decision you have a separate decision button for each Outcome. Accordingly, you could accept the proposed payments in Outcome A, but reject those for Outcome B.

- Try toggling the decision buttons for the two Outcomes to “accepted”. You should see the text of the proposal for an Outcome going green, when you toggle the decision button for that outcome to “accepted”.

- Notice that the risk associated with reject only disappears when you have accepted the Proposal for both Outcomes. If you were to do that then, the proposal would be passed on to Player 3 for their consideration.

- Alternatively, you may decide that you are happy with the payments for one Outcome, but not those for the other. In that case, the Proposal would be rejected and your decisions would be recorded in the Proposal History table to the left of the screen.

- For example, in the second to last row of the Proposal History table, you can see how Player 1 reacted to your last Offer. You suggested that in the event of Outcome A that they should pay £7.30 and that you should pay £4.50. They didn’t agree with that and hence those numbers are coloured red in the table. In contrast, you suggested that in the event of Outcome B that you should both pay £2.50. They accepted that part of the proposal and hence those numbers are coloured green in the table. Indeed, they have kept those suggested payments as part of the proposal they have sent back to you to consider.

[NEXT SCREEN]

Screen: Offer Screen

- Finally, when an Offer arrives with Player 3 they will see a screen like this, showing the payments that are being offered by Players 1 and 2 in the event of Outcome A and in the event of Outcome B.

- Player 3 can express their opinions on that Offer by toggling the decision buttons from “rejected” to “accepted”. Try that now.

- Of course, Player 3 only avoids the risk associated with making a rejection if the payments proposed for both Outcomes are accepted. If that happens then all 3 Players have agreed and a DEAL is done.

- At the end of the experiment, if this task is the one that is chosen for real, then we need to find out whether Outcome A or Outcome B is the actual outcome. To do that we will simply toss a coin. If the coin comes up Heads then Outcome A is the actual
outcome and you will get paid what you agreed to in the Deal under that outcome. Alternatively, if the coin comes up Tails then Outcome B is the actual outcome and you will get paid what you agreed to in the Deal under that outcome.