1.0 INTRODUCTION

The need for this research comes in the light of the intention of Government, as stated in the Waste Strategy 2000 (DETR 2000), to extend Regulations under the Waste Framework Directive to cover agricultural wastes. Whilst conventional packaging is currently covered by the Producer Responsibility Regulations, farm films such as silage wrap, crop and tunnel covering materials are not. These non-packaging plastics, the annual use of which is estimated at between 25k to 50k tonnes (Marcus Hodges Environment 2001), are mainly disposed of by burning or burying on farm. These may become "controlled" wastes which can only be disposed of by approved methods and will be subject to recycling obligations by diversion from landfill.

In all UK industry sectors, some 200k tonnes of plastic packaging is recycled through over 70 processing plants (Environment Agency 2001). Only one of these (BPI) is taking agricultural plastics and this is of concern as it may place current recycling schemes at risk and subject them to non-competitive market forces.

Contamination is given as the chief reason for the reluctance of processors to take agricultural plastics. Soil, water and fodder residues can significantly increase the weight to be transported, the number of processing (washing) operations and, therefore, cost. Evidence from work in the USA (Vermont) has demonstrated that development of standards and good practice for the handling, storage and transport of agricultural plastics can significantly reduce contamination and whole process costs (Starr 1997). This study therefore investigated ways in which farm and collection practices can be improved to provide a cleaner material that is more acceptable to reprocessors.

2.0 SCIENTIFIC OBJECTIVES

The project will examine and identify technical and economic issues relating to the recycling of agricultural plastics within several existing UK schemes, specifically the project will:

2.1 Review the Welsh and Cumbrian Schemes (and other similar schemes within the UK) including economics;

2.2 Examine contamination of silage plastics and identify any cost effective improvements;

2.3 Assess the scope for other improvements to handling, storage, collection and delivery systems;

2.4 Make recommendations for cost effective and sustainable improvements to scheme design.

3.0 ATTAINMENT OF THE OBJECTIVES

All the above objectives, as originally set out in the CSG 7, have been fully met. The completion of objectives 2.1, 2.2 and 2.3 allowed the recommendations required in 2.4 to be formulated. The results from this work will support DEFRA's policies to promote sustainable recycling and provide information on best practice to the agricultural industry.

4.0 METHODOLOGY

The methodology was split into three areas:

1) Review of the Welsh, Cumbrian and other schemes
2) Research into the contamination of silage plastics
3) Evaluation of farm handling and storage practices

4.1 Review of the economics and logistics of the Welsh, Cumbrian and other schemes

4.1.1 Initial contact

The scheme managers were contacted individually in order to explain the objectives of this research project and how the information they would provide was to be used. At this stage, published material was requested and a date to visit the scheme managers was arranged. The scheme managers of the CFPRS and Solway Recycling were asked to identify suitable farmers to visit in order to collect and weigh plastic, or to provide lists of the farmers that use their scheme that ADAS could then contact. Farmers from Wales were identified through ADAS Pwellpeiran.

4.1.2 Pro forma

To ensure that the information gathered for each scheme was consistent and comparable, a pro forma was developed that was used during the interview process. A copy of the blank pro forma can be found in Appendix 1.

The pro forma was designed in order to gather the following information:

- The scheme's objectives
- An overview of the scheme's structure
- How the scheme operated
- Economic information

Flow charts of the material flow from farmer to reprocessor via the collection scheme were drawn up and agreed with the scheme managers.

4.1.3 Economic evaluation

In order to gather economic information, the scheme managers were asked for published financial reports where available. If these were unavailable, they were asked to provide figures for outgoings and income and to break them down into constituent parts.

4.2 Research into the contamination of silage plastics

4.2.1 Sampling

Farmers were selected from the initial lists provided, to give, as far as possible, a representative sample of:

- Farm type
- Baled and clamp silage
- Waste plastic management methods
- Membership or non-membership of a recycling scheme

Wraps and clamp sheeting were collected from five different farms in each of the three pre-determined areas: Wales, Cumbria, and Dumfries and Galloway (six farms in Wales). Samples were collected from the storage areas used by the farmers, so as to be representative of the wraps or sheeting samples present. A minimum of five wraps was taken from each farm, up to a maximum of ten. The number varied depending upon the conditions on the individual farms, i.e., if a farmer stored his plastic in a number of areas, more samples were taken.

Where possible two samples were taken from the top of the pile of waste plastic, two from the middle and two from the bottom. This ensured that any variation in the water content and contamination levels was accounted for.

The pro forma shown in Appendix 3 was used to collect essential information on the storage and handling of the silage plastic on the farm. Farmers could then be split into the following categories, shown in Table 1:

Table 1: Categories used to evaluate on-farm handling and storage practices

Bales inside, waste undercover	
Bales outside, waste undercover Bales outside, waste outside Bales outside, waste outside in liner Bales outside, waste undercover in liner	Bales on clean hardstanding, waste undercover Bales on clean hardstanding, waste outside Bales on dirty yard area, waste undercover Bales on clean yard area, waste outside
Bales outside, waste contained in bin	
Clamp outside, waste undercover Clamp outside, waste outside	
Clamp inside, waste undercover Clamp inside, waste outside	

4.2.2 Measurement of contamination

A typical sample comprised of a single waste silage wrap or a strip of clamp sheeting. Each sample was bagged, sealed and given an individual reference number before being weighed using a calibrated digital scale on the farm. Careful note was made of the location of each sample on the stack and general notes about the storage of the samples prior to collection. All plastic was then taken to Gleadthorpe Research Centre for analysis.

Plastic was washed, dried and re-weighed in order to analyse the following:

- Overall levels of contamination
- Different contaminant types present
- Water holding capacity

A detailed description of the methodology used can be found in Appendix 4 These collection methodologies were initially trialed at ADAS Pwellpeiran prior to being taken out onto farms and were found to be successful after a little refinement.

The results from the above analyses allowed preliminary conclusions to be drawn as to the best way to store waste silage plastic in order to minimise the level of contaminants.

4.3 Evaluation of Farm Handling and Storage Practices

Information on handling and storage for each farm was extracted from the pro forma that was at Appendix 3.

These categories were used in conjunction with the data from the weighing results to enable an evaluation of the on farm storage techniques in relation to levels of contamination.

5.0 RESULTS

5.1 Review of Welsh, Cumbrian and Other Schemes

Appendix 5 shows copies of material published by each of the three principal recycling schemes (Second Life Plastic Wales (SLPW), Cumbria Farm Plastic Recycling Scheme (CFPRS) & Solway Recycling). Appendix 6 shows the material flow through each of the schemes, from farm to reprocessor.

Second Life Plastic Wales

Second Life Plastics Wales
P&M Birch
The Old Sawmills, Pencrug, Carmarthen Rd, Llandeilo, Carmarthenshire, SA19 6RS
Tel: 01558 824590
Email: BIRCH@SLPW.freeserve.co.uk

A meeting was held with Marilyn & Peter Birch, directors of Second Life Plastic Wales in mid December 2001.

Second Life Plastic Wales (SLPW) began in October 1999 following the collapse of the original scheme in 1989 when it was known as Second Life Plastic and organised by Anaplast, a division of British Polythene Industries.

The scheme has received active support and funding from a number of environmental bodies and also receives contributions from farmers in the form of membership fees and tonnage payments. The collections take place from farmers all over Wales, but the area most successful for collection is in South Wales as it is here that the scheme originated.

The scheme works by collecting waste plastic from individual farmers which is then taken back to the central collection point to be sorted and baled. The plastic is then transported to bpi.recycled products in Dumfries for recycling. The farmers pay an annual membership fee which covers the first 700kg of plastic to be collected. Subsequent quantities of plastic to be collected are then charged at £40.50/tonne.

Farmers are asked to keep the bale wrap and sheeting separate and as free from netting and string as possible but not specifically to keep it clean, although it is mentioned that the dirtier the plastic, the higher the cost of recycling. It is recommended to the farmers that the plastic be gathered into one heap to aid loading.

Farm Penetration

According to the 1999 census figures, there are 20,215 registered beef and sheep and dairy holdings in Wales. 4,500 farms use the scheme giving a penetration percentage of 22%, assuming that all registered holdings make silage.

Cumbria Farm Plastic Recycling Scheme

Cumbria Farm Plastic Recycling Scheme (CFPRS)
Anderson Court, Sullart Street, Cockermouth. CA13 0EB
Tel: 01900 82400
Email: farmplastic@aol.com

A meeting was held with Carol Douglas, Project Officer for CFPRS in mid December 2001.

CFPRS was established in January 2000 following the collapse of the Farm Film Producers Group. It is a partnership project, which has been established through several different organisations and individuals and a number of different funding streams. The aim of the scheme is to provide a practical, sustainable solution to the problem of farm plastic disposal by developing a system which will give farmers in Cumbria the opportunity to recycle their plastic waste.

16 collection points are distributed around Cumbria and range from auction markets to farmers' premises. Collections are held up to three times a year from the most successful collection points. Farmers take their waste plastic to a collection point which is manned by volunteers of the CFPRS. The volunteers make a visual assessment of the quantity of plastic bought in by the farmer and charge the farmers on the basis of £10 per 200 wraps. The plastic is tipped by the farmer at the collection point and the mechanically loaded onto a lorry to be taken up to bpi.recycled products in Dumfries by Solway Recycling. In some cases, the collection points may operate over two days, therefore the plastic is left on site overnight.

The cost to CFPRS to recycle one tonne of plastic is £46.35 plus £31/tonne gate fee, farmers contribute approximately £10.84/tonne and the remainder of the costs is met through funding from numerous bodies including local councils, charitable bodies and Cumbria Waste Management Environment Trust.

Farmers are asked to store their plastic free from string, net wrap and foreign bodies such as metal, stones and tyres. They are also asked to store the plastic as cleanly as possible by storing it on a hard surface or in a container, and if possible, avoid mixing different types of

plastic. The scheme is about to provide transparent LDPE bags to their farmers to store waste plastic. It is perceived that the storage of plastic is the point at which contamination occurs.

If, at the collection point, one of the scheme's volunteers sees that there are foreign bodies in the plastic the farmer will be asked to remove it and to check for others. If the levels of contamination are very high, the plastic will not be collected.

Farm Penetration

According to the 1999 census figures, there are 4,880 registered beef and sheep and dairy holdings in Cumbria. 350 farms use the scheme, giving a penetration percentage of 7%, assuming all registered holdings make silage.

Solway Recycling

Solway Recycling
Rigghead, Shawhead, Dumfries, DG2 9SH.
Tel: 01387 730666
Email: info@solwayrecycling.co.uk

A meeting was held with Roy Hiddleston and Chris Hartshorne of Solway Recycling in early February 2002.

Solway Recycling originated in 1994 as Second Life Plastics. At the time, the enterprise was run by Roy Hiddleston in conjunction with a general agricultural contracting business. In 1998 the agricultural contracting business was separated from the recycling business and then in 2001 Solway Recycling became a limited company.

Primarily, the company collects waste agricultural plastics and sends them to be recycled: this constitutes 75% of the business. The remaining 25% of the business comes from horticultural plastics, fisheries plastics and commercial plastics. Solway Recycling also manufacture and sell their own bin liner system.

The scheme operates all over Scotland and in some parts of northern England, collecting from 450 farmers. In Dumfries and Galloway (where the scheme originated) Solway Recycling collects plastic from individual farmers which is then taken back to Solway's base to be sorted and baled before being sent off to the appropriate recycler. The farmers are now required (as of 1st February 2002) to use the Solway bin liner system. This consists of either a metal frame or enclosed bin, into which a transparent bin liner is placed. The farmer is required to store silage wraps or silage sheeting separately. The liner can also be provided to the farmer without a frame or bin.

In other areas, the scheme uses what it calls 'hubs'. These are collection points from which Solway Recycling subsequently collects the plastic. The 'hubs' could be farmers who can generate extra income from the enterprise.

Prescriptive exclusions are in place preventing foreign objects from being put into the bin and requiring that wrap and sheet are separated. Cleanliness of the plastic is also an important issue, which brought about the liner system. If a farmer is seen to be ignoring the exclusions their plastic will be refused.

Farm Penetration

According to the 1999 census figures, there are 2,175 registered beef and sheep and dairy holdings in Dumfries and Galloway. 450 farms use the scheme, giving a penetration percentage of 21%*. In the whole of Scotland (Solway's potential market) there are 15,372 registered holdings which gives a penetration rate of 3%* (*in both cases, assuming that all registered holdings make silage).

5.2 Economics

The economics of each of the three established schemes was evaluated, based upon the information given by each of the scheme managers. A summary of this evaluation is shown in Table 2.

Table 2: Summary of income and costs for recycling schemes examined

	INCOME						**COSTS**	
	Grants		**Farmers Contribution**		**Subtotal**			
	£/t	**£/wrap***	**£/t**	**£/wrap***	**£/t**	**£/wrap***	**£/t**	**£/wrap***
Second Life Plastic Wales	59 (51%)	0.12	55	0.11	114	0.23	145	0.29
Cumbria Farm Plastic Recycling Scheme	70 (86%)	0.14	11	0.02	81	0.16	57	0.12
Solway Recycling (Dumfries)**	0	0	75	0.15	75	0.15	75	0.16
Solway Recycling (collections 100-250 miles from Dumfries)**	0	0	125	0.25	125	0.25	111-123	0.22-0.24
Solway Recycling (collections >250 miles from Dumfries)**	0	0	150	0.30	150	0.30	124	0.24

*Based on ADAS' figure of 500 dirty wraps per tonne (average weight of a dirty wrap = 2kg)
**Excludes liner costs @ £2.50 each, i.e. £6.25 per tonne, £0.01 per wrap.

Table 3 below shows the comparative costs of farmers using a local landfill to dispose of their waste plastic. When these costs are compared against those shown in Table 2 it can be seen that recycling scheme costs to the farmer may be higher than disposing to landfill.

Table 3: Costs of disposing of waste plastic to landfill

	COST TO FARMERS	
	£/t	**£/wrap***
Landfill disposal costs	30	0.06
Transport costs	20	0.04
TOTAL	50	0.10

*Based on ADAS' figure of 500 dirty wraps per tonne (average weight of a dirty wrap = 2kg)

5.3 Other Collection Schemes

Royal Scottish Agricultural Benevolent Institution (RSABI)

The RSABI manages a collection scheme in Scotland, using two hauliers to collect, bale and deliver the plastic to bpi.recycled products. All plastic is collected in liners, which are provided free of charge from bpi. Volunteers including farmers, FWAG advisers and NFU secretaries distribute liners to farmers.

Approximately 1,000 farmers use the scheme from across Scotland. Farmers are asked to separate bale wrap from other farm plastics including pallet covers, feed bags and fertiliser bag liners, which are all collected. Farmers are also asked to separate metal, paper, string and farm rubbish.

It is recommended that liner holders are made by forming a crate from five old pallets. Farmers are asked to be prepared to store their plastic until there is a collection announced for their area. Plastic should be stored in the liners that are sealed and labelled for traceability. Farm collections may be made, or central collection points set up.

Farmers are asked to pay £15 for each liner. This includes transport and recycling costs and a contribution to the charity. Other funding comes from landfill tax credits (Shanks McEwan). For every bag collected, the scheme needs £30 of landfill tax credit funding in order to be viable. Therefore the cost of removing a full liner is £45.

Yorkshire Dales

A collection scheme has been run in the Yorkshire Dales, collecting silage plastic from over 600 farms. Funding for the collection scheme came to an end earlier this year and therefore it ceased to operate in February 2002. The unique element of this collection scheme was that two vehicles entered the farm to collect plastic, one was a portable baler and the other picked up the bales for transportation.

Farmers were asked to make a dedicated compound in which to store their plastic, preferably undercover. However, excess water was squeezed out of the plastic on the farm during the baling process.

Developing Schemes

There are no other known collection schemes operating within the UK. There are however a number of schemes that are in the developmental stage. These are listed below in Table 4, in descending order of development:

Table 4: Plastic Recycling Schemes in the Developmental Stage (March 2002)

Name of Proposed Scheme	**Brief Summary**
Farm Plastic Recycling (Lancashire)	This collection scheme is due to begin within a matter of weeks of this report being written. The scheme will be funded over three years, collecting farm plastic from Lancashire. Farmers will be charged an annual membership fee of £10 in addition to £45-47/tonne of plastic collected. The plastic will then be stored prior to collection by Solway Recycling who will take it to BPI.
Gloucestershire Recycling Scheme	In March 2000 the Environment Agency and the Farming and Wildlife Advisory Group in Gloucestershire formed a partnership to investigate the issues surrounding waste plastic on Gloucestershire farms with a view to set up a viable and sustainable recycling scheme. A reprocessing plant called Plasmega will be used. The plastic does not need to be free from contaminates as the process requires the addition of other materials to form an inert product. The resulting product can be moulded into a number of products and it is claimed that it has a greater tensile strength than timber and has a greater crushing strength than concrete. Logistics have yet to be finalised. Currently under investigation is the most effective way to run a collection scheme and how the scheme will work economically. As soon as these issues have been ironed out, the scheme is set to be up and running in Autumn 2002.
Silage Bale Wrap Recycling Scheme, Yorkshire Dales	A project receiving funding that has a plastic recycling scheme as one element.
National Trust, Northumberland	A pilot collection scheme was begun in 1998, using 14 tenant farms. The National Trust paid for the collections to take place. The scheme was put on hold with the outbreak of foot and mouth disease but is due to resume in the Winter 2002. The scheme needs to become sustainable and work is being done with other bodies to try to expand the scheme as the National Trust is unable to fund the entire project.
FWAG, Tyne Tees	A feasibility study is being carried out for the collection and recycling of agricultural plastic. Bpi.recycled products have suggested that they would not be in a position to take this plastic so an alternative reprocessor is sought.
Land Reclamation, South Yorkshire	A feasibility study is underway to look at the issue of recycling waste farm plastics and developing facilities to deal with it.
East Riding of Yorkshire Council	A report has been commissioned looking at the quantities of plastics generated on farm and options for treatment, disposal and minimisation.

5.4 Reprocessors

Currently the only plastic reprocessor operating within the UK capable of handling waste farm plastics on a significant scale is bpi.recycled products in Dumfries. There are a number of other reprocessors who are developing new technologies to be able to use this plastic, but these are still in the developmental stage.

Bpi.recycled Products
College Rd, Dumfries. DG2 0BU
Tel: 01387 247110

A meeting was held with Lance Hamer, Site Director, of bpi.recycled products at the Dumfries plant in mid December 2001.

BPI (British Polythene Industries Plc) is made up of eight polythene businesses, one of which is bpi.recycled products. It employs 3,000 people in total. Bpi.recycled products have nine sites across the UK manufacturing refuse sacks, aprons, construction film and wood replacement materials and its major markets include the National Health Service, Local Authorities and the construction industry.

The site in Dumfries is one of the major sites in Europe with the capability to wash and process waste agricultural films. This provides a recycled feedstock for inclusion into a range of Group products. The plant was built in 1995 at a cost of £3.2 million. Dumfries was chosen as the site for the plant due to the availability of water. The plant uses 100m^3 of water every hour and sits on three boreholes. This water is available for abstraction free of charge to the factory, which significantly reduces running costs. If this was not the case, the factory would have had to install additional water treatment works costing in the region of £125,000.

A gate fee of £31/tonne was introduced to help to cover the escalating costs of processing the contaminated plastic. As 50% of all material that enters the plant leaves as contaminated or unusable material, a cost has been incurred in processing and then disposing of this waste and until the gate fee was introduced, these costs were not being met.

The introduction of a levy scheme backed with legislation would give the factory an extended operating lifetime in the UK. The key points are as follows:

- Inputs

The sources of supply to bpi.recycled products from the UK are inadequate in terms of quantity and it is for this reason that there is a strong possibility that BPI could move its operations to Southern Ireland where there is a more guaranteed supply due to the levy system.

- Outputs

The products made from recycled farm plastic are useful commodities but could soon be reaching their peak. They are also heavily reliant on the market for virgin plastic – as the price of virgin plastic decreases in line with oil prices, so too does the value of recycled plastic.

- Effects of contamination

There is no doubt that the levels of contamination that can be found on agricultural waste plastic are prohibitive to the sustainability of the recycling process (see comments above regarding gate fees).

There are, at the time of writing, a number of reprocessing schemes and projects in the planning stage across the UK that potentially could use agricultural waste plastic. These are outlined in Table 5:

Table 5: Reprocessing schemes in the developmental stage

Name of Reprocessor	Brief Summary
Green Business Network	The Green Business Network has developed a technique whereby up to six different polymers of plastic are mixed in order to form a rigid product. The rigidity of the plastic enables products such as paving tiles, pallets and coil carriers. Currently the scheme is working with Avesta Polarit and developing a method that takes Avesta's waste plastic and makes coil carriers, therefore significantly reducing the quantity of waste that Avesta need to dispose of. This process needs the addition of LDPE which is hoped can be sourced from waste silage plastic. This work under trial. It is thought that the process will require an annual throughput of 3,000 tonnes of silage plastic. The plastic does not have to be completely free of contamination (organic matter such as paper and sawdust will be added to the process) but it does have to be free of stones and other material that would effect the plant. The business allows for money to subsidise collection schemes to take silage plastic, which will operate in north, east and south Yorkshire if the trials prove to be successful. Work is also being carried out in Lancashire with the Lancashire Environment Fund.
Econoplas	In order to deal with waste silage plastic, an innovative treatment method has been investigated that gives a very rigid end product, which has been used as an alternative material for pipe drainage. A market has been found for the drainage with golf courses. The process has the potential to process several hundred tonnes of waste silage plastic every year. The significant advantage of this process is that it can deal with contaminated waste silage plastic, however, the plastic must not hold too much water.
Axion Recycling	A method of extracting oils by pyrolysis is currently under investigation by Axion. The end product would be a 'green diesel' that is low in Sulphur but having a high calorific value. The feasibility of using agricultural waste plastics is being assessed, as the process does not require the plastic to be free from contamination. The process would involve heat to crack the polymers in the plastic to form an oil. Any contaminants would remain as an ash, which may then be landfilled. This process could also be used for a number of different plastic types e.g. end of life vehicles and packaging. Providing a consistent supply of components can be obtained and following an analysis of contamination, it is thought that agricultural plastics may be utilised successfully in this process. If this type of fuel were to receive tax reductions in the same way as biofuels, then Axion would be in a position to pay farmers for their plastic.

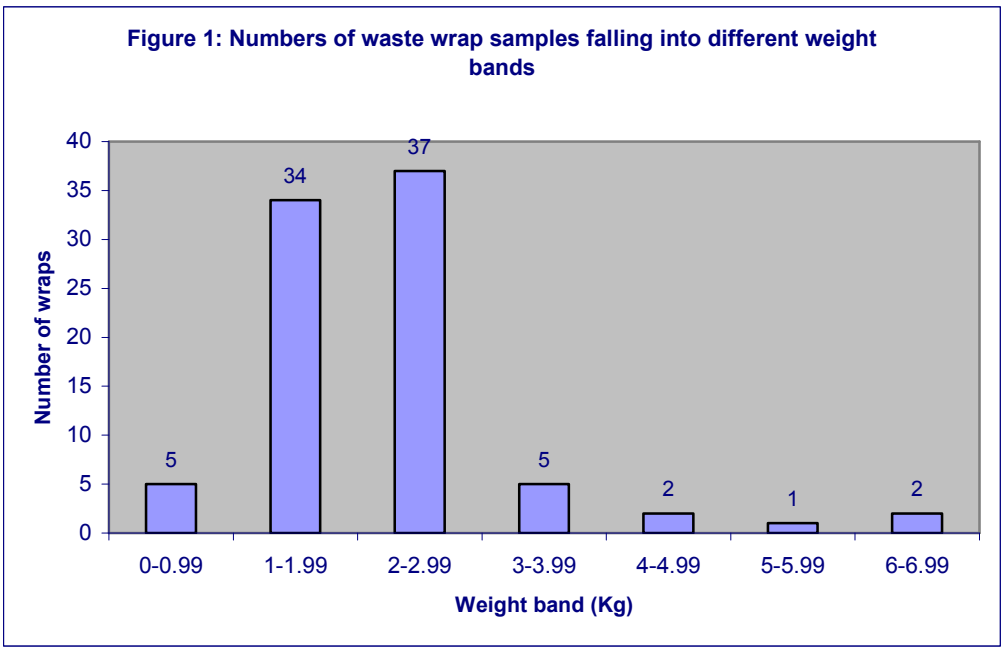
5.5 Contamination of Silage Plastics

The results were expressed as a percentage weight loss, due to contamination. After the wraps were cleaned, dried and weighed, the resulting weight loss was calculated as a percentage figure of the weight as collected from the farm, giving an indication of how much of the original wrap weight can be attributed to contamination.

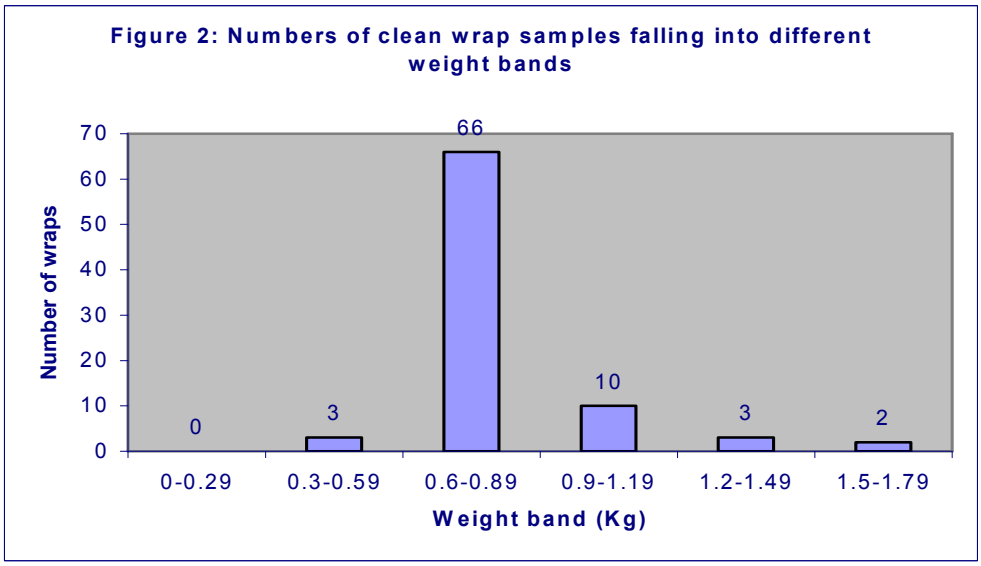
Overall Weights

Using a sample size of 95:

The average weight of a dirty silage plastic sample was 2kg, (range 0.75-6.65kg).



The average weight of a plastic sample that has been washed and dried was 0.75kg, (range 0.35-1.43kg)



Analysis for Contamination

The average overall percentage weight loss after washing and drying was 62%. The range of percentage weight losses measured on samples from the individual farms ranges from 21% - 74%, with seven out of the 16 having an average percentage weight loss between 60% and 68% as shown in Figure 3.

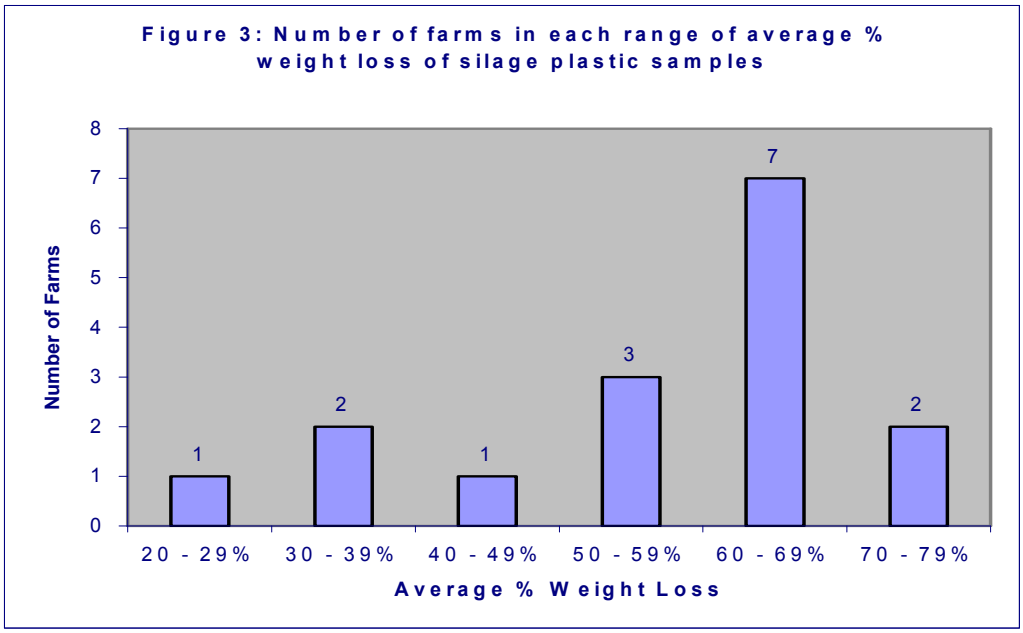
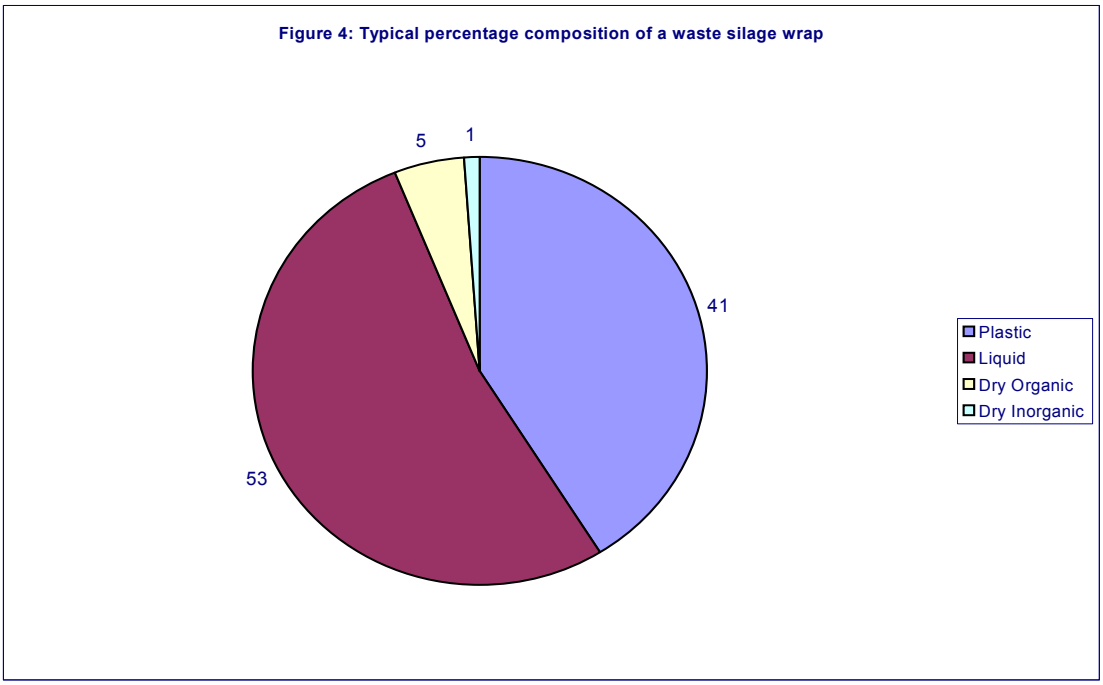


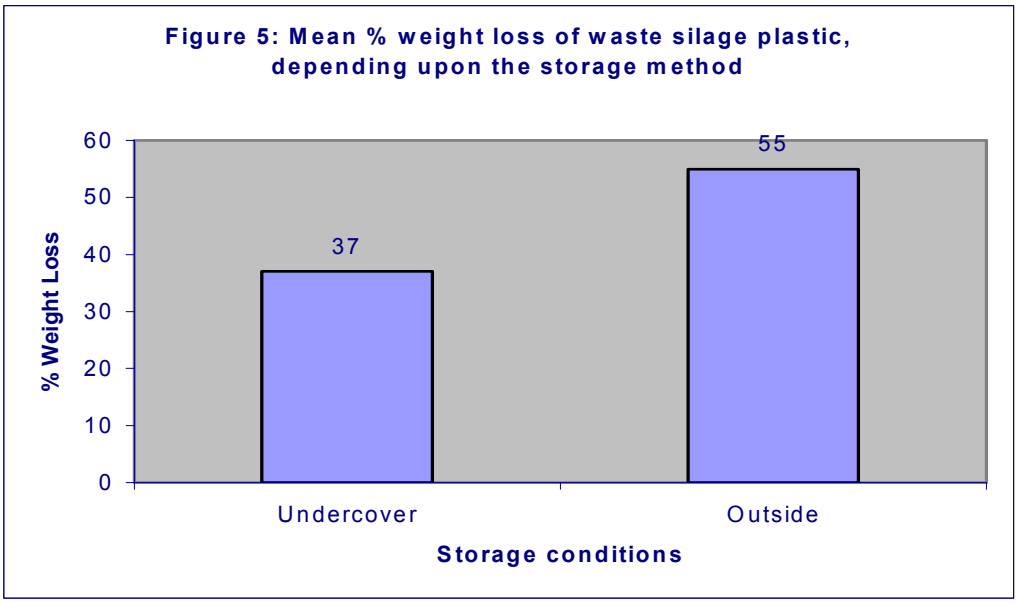
Figure 4 below shows the percentage make-up of a waste silage wrap in terms of types of contamination and plastic.



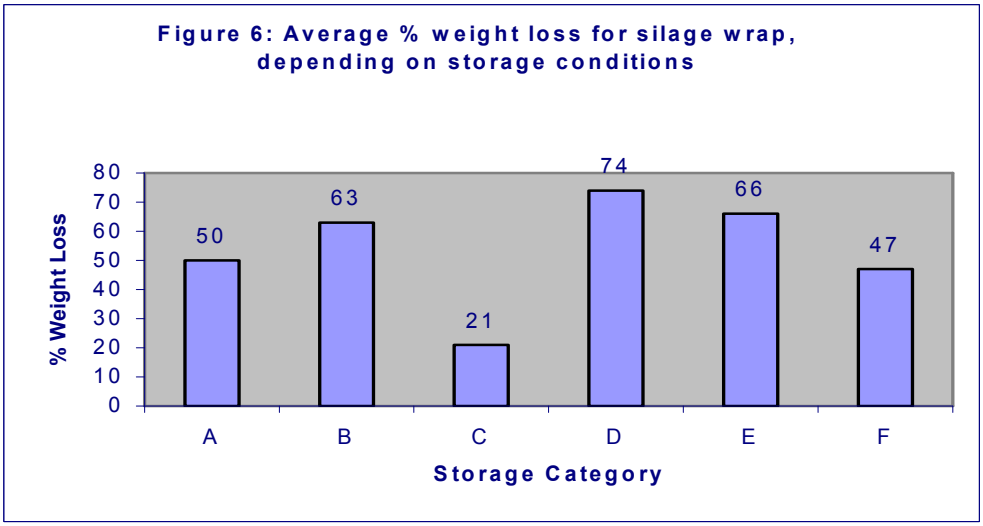
Influence of On-Farm Storage Techniques

Contamination levels were assessed in relation to methods used on the farm to store both the baled silage and the waste silage plastic.

The mean percentage weight loss resulting storing the waste plastic undercover (sample size 35) and outside (sample size 62) is shown in Figure 5.

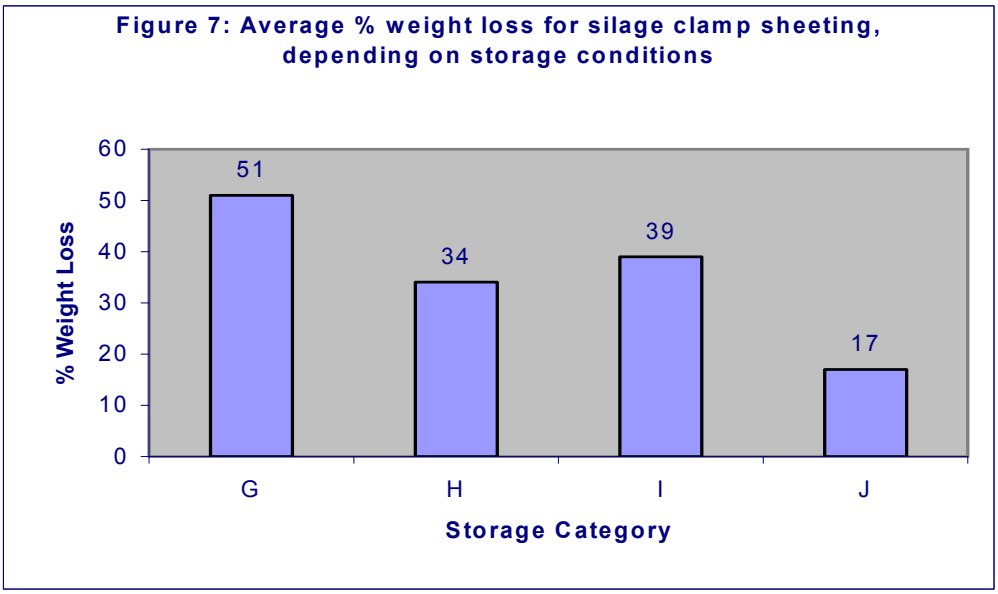


The combination of storage method for the waste plastic and the storage of the silage bales prior to use affected the percentage weight loss as shown in Figure 6. Similar effects were observed for silage clamp sheeting (Figure 7).



Key:

A	Bales outside, waste inside (16)	D	Bales outside, waste in contained bin (5)
B	Bales outside, waste outside (48)	E	Bales outside, waste in liner outside (6)
C	Bales inside, waste inside (5)	F	Bales outside, waste in bag inside (5)



Key:

G	Clamp outside, waste outside (6)	I	Clamp inside, waste outside (2)
H	Clamp inside, waste inside (2)	J	Clamp outside, waste inside (2)

It was apparent that one method of storing waste wrap outside was more successful than other methods. This was to roll the wrap up very tightly before stacking it. One farmer (six samples) used this method and gave an indication that this method results in lower percentage weight losses for the wraps. Rolling the wraps gave a percentage contamination loss figure of 51%, compared to 65% for wraps stored outside without rolling.

Water Retention

The results of saturating samples of clean, dry plastic with water show that a wrap's weight, on average, was increased by 85% by water retention.

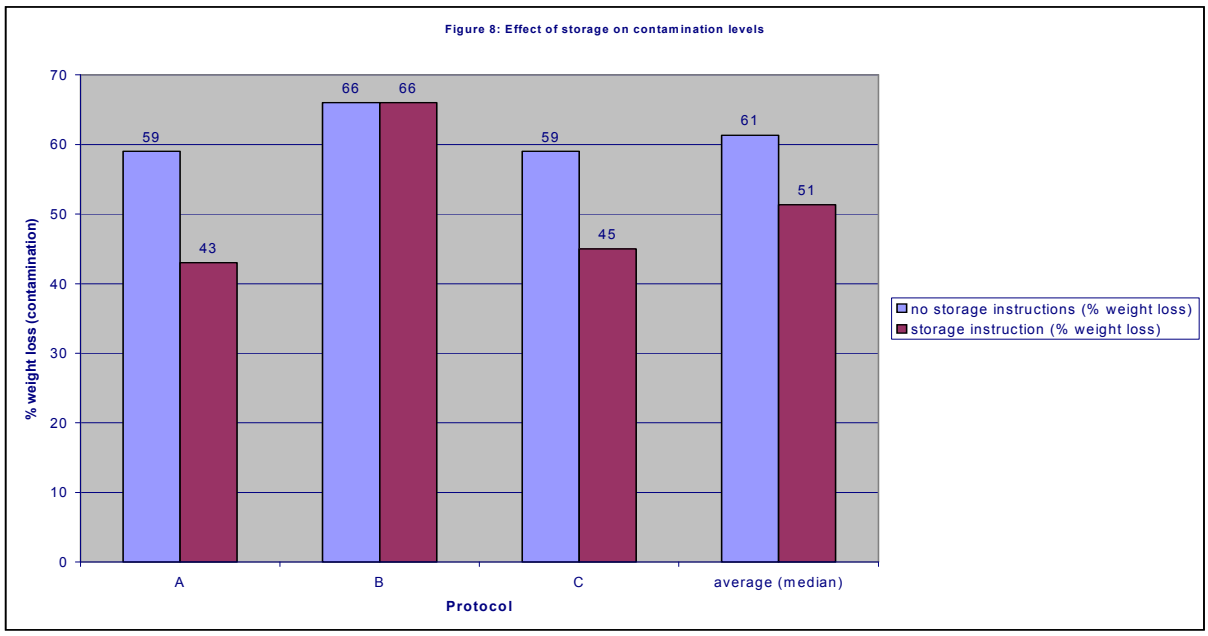
Protocol Results

Three methods (see Table 6) giving the lowest percentage contamination were identified. Protocols were then drawn up (see Appendix 2) reflecting these methods. Three farmers were approached and asked to store their waste silage plastic for 12 days according to the set protocol. Plastic was then collected and processed as previously described.

Table 6: Waste plastic storage methods giving lowest contamination

Option	Typical % Weight Loss
1. Store the plastic on clean hardstanding when on bales and waste plastic undercover, in a liner (Protocol C)	47%
2. Store the plastic on clean hardstanding when on bales and store waste undercover (Protocol B)	49%
3. Store the waste plastic outside, tightly rolled up (Protocol A)	51%

The results of using the protocols are shown in Figure 8. It can be seen each of the protocols has made a reduction in percentage contamination and that the median reduction in percentage weight loss is 10%.



6.0 DISCUSSION

6.1 Scheme Operation Method

The schemes all operate in different ways and therefore influence the material flow from farm to reprocessor as shown in the flow charts in Appendix 6. Arguably, the most efficient collection methods used are the 'hub' and 'bring centres'. The onus is then on the farmers to take responsibility for the transport of their plastic, reducing haulage costs for the collection schemes.

Two levy schemes operating in Europe include the IFFPG scheme in the Republic of Ireland and a scheme run in Holland. In Holland the levy only pays for the reprocessing of the plastic. Farmers can get their plastic collected by the scheme operators, but at an extra charge. This encourages them to take their plastic to a collection point as this is seen as the most efficient means of collection.

In terms of cleanliness, the liner system employed by Solway Recycling and now the CFPRS is one of the most effective methods of reducing contamination and containing the plastic (see Figure 8). This conclusion is also backed up by the RSABI scheme. Scheme rules should be encouraged to become more prescriptive in what can be collected in a similar way to Solway's scheme. A fine balance needs to be found between being prescriptive enough to reduce contamination levels and not discouraging farmers from using the scheme. Education and awareness-raising within the farming community should be able to overcome this, as has been demonstrated by Solway Recycling.

6.2 Scheme Economics

The costs of, and incomes to the different schemes vary considerably. This is not dependent upon grant funding. It appears that SLPW is making a loss in the region of £31/tonne. This loss is equivalent to the gate fee charged by bpi.recycled products in Dumfries.

It appears that CFPRS is a profitable scheme from the figures shown in Table 2. However, in conversation with the scheme manager recently, it became apparent that in the current financial year, the scheme will make a loss due to differences in expected tonnage and actual tonnage to be recycled.

Solway Recycling, the only fully commercialised business, is showing a profit on collections that are a considerable way from Dumfries. The scheme operating in the Dumfries and Galloway area is breaking even. However, the figures that are not shown are those for the cost of the liners used by Solway. The farmer is required to pay £2.50 per liner, which is the equivalent of £6.25/tonne or £0.01 per wrap. Solway will take an undisclosed profit from the sale of these liners. Solway also sell bins and frames to compliment the use of the liners.

The difference in the costs for each of the schemes can be attributed to differences in operational methods, but is more likely due to logistics as SLPW has the highest costs of all the schemes but also the furthest distance to travel.

Currently, the estimated cost to the farmer to use a local landfill site is in the region of £50 per tonne or 10 pence per wrap. This compares favourably with using the schemes, which to the farmer currently cost between £0.02-0.15 per wrap. This effect will be greater when the short-term funding provided to some of the schemes comes to an end. Costs range from £0.12-0.29 per wrap. There will then be little incentive to the farmers to use the schemes currently operating, when using cost as the decision factor.

Average contamination levels in the region of 62% add significant costs onto the running of the schemes. Table 7 shows the haulage costs that SLPW and CFPRS have to pay whilst transporting additional weight caused by contamination.

Table 7: Attribution of haulage costs to clean plastic and contamination

	Haulage Costs £/tonne		
	Contamination	Plastic	Total
SLPW	27.90	17.10	45
CFPRS	18.91	11.59	30.50

Based on the figures in Table 7 alone, it would pay for the schemes to put stricter requirements on the cleanliness of the plastic and even provide liners to the farmers. The liners will not eliminate contamination but do reduce it considerably (see Figure 8 in protocol results).

6.3 Contamination of Silage Plastic

Overall Weights

Considerable variation was seen in the weights of dirty silage wrap (0.75-6.65kg) with the median being in the 2-2.99kg band. This large weight variation can be attributed to a number of factors:

a) Contamination levels, which vary according to:
- Storage techniques of the baled silage
- Storage techniques of the waste silage plastic
- Handling techniques of the baled silage and waste silage wrap

b) Number of layers of wrap used

However, the factor with the greatest effect on weight variation was contamination level, as the cleanest wrap weighed 0.75kg and the dirtiest 6.65kg.

Analysis for Contamination

There was variation between weights of plastic after they had been through the cleaning process although this variation was not as great as that for the dirty wraps. The majority of

wraps fell between 0.6-0.89kg with a range of 0.35-1.43kg. This variation can be attributed to the number of times the silage bale was wrapped and the tension used affecting the amount of plastic wrapped around the bale.

The average percentage weight loss due to contamination was found to be 62%. Therefore, 62% of a waste silage wrap was made up of contamination and only 38% was useful recyclable material i.e. plastic. The range of percentage weight loss figures was 21 to 74%.

The majority of contamination was made up of water (53% of a waste wrap) which therefore implies that drier waste plastic weighs less and can therefore be said to be less contaminated.

Influence of On-farm Storage Techniques

Results from contrasting storage methods (undercover v outside) suggested that silage plastic stored as waste undercover, did indeed pick up less contamination that that stored outside.

The protocol results show that simple measures such as rolling the waste wraps prior to them being stored outside can reduce contamination levels by 15%. Similar results were gained for plastic stored undercover in a liner, giving a reduction in contamination levels of 14%. Simply storing plastic undercover has not been shown to be effective in these results as it reduced contamination by less than 1%.

The results show that handling, storage and management techniques vary hugely from farm to farm and impact upon levels of contamination picked up by the plastic. The very best management practices result in very low levels of contamination (21%). Conversely, a farm using poor management techniques can pick up significant levels of contamination can increase the weight of a silage wrap by up to 74%.

It is likely that the majority of liquid contamination is rainwater. However, some of the water will be silage effluent that has become trapped between the layers of plastic. Previous research carried out by ADAS (ADAS (2000)) found that upon opening, silage bales could contain up to 20 litres of effluent. This quantity varied with the position of the bale in the stack, the higher up the stack the bale was stored, the less effluent was retained. The effluent obviously has the potential remain within the waste wrap and therefore add to its weight. Reducing this type of contamination would be difficult. Increasing the dry matter content at ensiling does decrease effluent retention as too does storing the bales in single layers.

6.4 Biosecurity

Following the outbreak of Foot and Mouth Disease in 2001, consideration must be given to biosecurity measures used by the collection schemes.

Silage plastic, both sheet and wrap is exposed to organic material that is capable of carrying diseases such as foot and mouth. Silage plastic has the potential to come into contact with animal faeces and animals themselves.

If a collection vehicle travels from farm to farm, disease can be carried not only on the plastic, but also on the vehicle carrying the plastic.

Schemes operating a bring centre or hub can also risk acting as a collection point for disease. Disease could be bought in on one farm vehicle, deposited at the collection point, and picked up by other farmers using the collection point.

Existing Controls

Silage plastic that is collected using the Solway liner system has a lower disease transference risk than other systems as the silage plastic is put into a liner and sealed before being moved off the farm. The seal on the liner is not broken as it is baled and processed whole.

Farmers making use of collection points adhere to disease controls as set out by the collection point.

Weaknesses

Schemes such as SLPW, where there are no liner requirements and the collection vehicle travels from farm to farm pose the greatest risk of spreading diseases.

Some of the collection points or hubs do not require the farmers to follow any procedure with reference to disease risk minimisation.

Recommendations

In order to minimise the risk of spreading disease from farm to farm, it is recommended that the following points be considered:

- Silage plastic collected should be sealed and disinfected before leaving the farm.
- Farmers should use a collection point rather than having farm to farm collections.
- Biosecurity procedures should be in place for the farmers to follow when entering and leaving the collection centres.

6.5 Farm Assurance Schemes

The three principal farm assurance schemes for England Scotland and Wales were contacted and asked whether their standards required the responsible disposal of waste silage plastic. Farm Assured British Beef and Lamb (FABBL) currently do not make any reference to the disposal of silage plastic, but they do require farmers to follow the Codes of Good Agricultural Practice, therefore when burning silage plastic and creating black smoke would not be allowed. If there were to be a change in legislation to control non-natural farm waste, the requirements of the standard would be changed to reflect this.

The standards that Farm Assured Welsh Livestock (FAWL) operate to are currently under review and it is expected that following the revision process, there will be a requirement to dispose of non-natural waste responsibly.

The Specially Selected Scotch Assured Farm standard requires that farmers should have a waste management plan which should include the disposal of silage wrap.

> *"A waste management plan, verbal or written should include disposal of waste/empty containers, spent dip, medicines and silage wrap."*
> (Scottish Food Quality Certification Ltd, 2001)

Therefore, farmers need to demonstrate that they have given consideration to the best disposal means for their waste plastic.

At the time of writing, farm assurance schemes are starting to give consideration to the disposal of non-natural waste, which reflects the current change in policy development. They will therefore be well placed to deal with the changes that any new legislation may bring about regarding the control of agricultural waste.

7.0 CONCLUSIONS

The costs to farmers of recycling agricultural plastic vary considerably and are dependent upon the region they are farming in. Costs vary between £0.02 and £0.30 per wrap, however, this will rise to between £0.12 and £0.29 per wrap when external funding is removed.

If legislation is introduced to make non-natural agricultural waste a controlled waste, farmers will also have the option to dispose of their waste to landfill. This currently looks to be the most favourable option in terms of cost at £0.10/wrap.

If farmers can be persuaded to do all that they can to reduce levels of contamination found on the plastic, this will reduce the weight to be recycled. If the 62% contamination figure could be reduced to 25% (as was shown by one farmer), the costs of recycling start to improve. This would also give a reduction in reprocessing costs at the bpi.recycled products plant and contribute to the increase in sustainability of the recycling schemes and the recycling chain as a whole.

There are a number of drivers that are pushing farmers towards recycling agricultural plastic which include impending legislation to control agricultural waste, farm assurance scheme requirements and public perception as farming comes under closer scrutiny. Simple measures are available to help farmers reduce contamination levels on their plastic and therefore reduce the costs of recycling.

Encouraging alternative reprocessing techniques for waste silage plastic, whereby contamination can be included in the feedstock, would significantly improve the economics of recycling. If a scheme such as the Axion model could operate successfully, the recycling of agricultural plastics would be open to market forces and would be likely to become sustainable.

There is scope for improvement to the collection schemes, to help them to run more efficiently: the most significant of these is to encourage farmers to reduce levels of contamination on the plastic to help reduce transport and processing costs. The material flow charts shown in Appendix 6 highlight the areas where improvements in contamination reduction can be made which will help to reduce the contamination figure of 62%, improving efficiency.

8.0 RECOMMENDATIONS TO FARMERS ON MINIMISING CONTAMINATION FOUND ON WASTE SILAGE PLASTIC.

Plastic is an essential element in the making of silage. Once the plastic has finished its useful life it must be disposed of responsibly in order to reduce its negative impact upon the environment. One of the most effective means of disposal is to use a recycling scheme.

Silage wrap used on big baled silage costs in the region of 60p per bale (£1.00 per tonne) if applied as four layers of a 750mm wide film with a 50% overlap. In addition, standard contractor costs for wrapping big bales is a further 60p per bale. This cost is offset by the value of the silage it covers at £12-15.00 per bale (£20-25.00 per tonne). The cost of disposing of a wrap using a recycling scheme is in the region of 12-30p (£57-145/tonne), therefore, the total cost of wrapping each bale is 132-150p.

Contamination of used wrap (e.g. water, soil and waste silage) can account for at least 50% of the total weight. Reducing the levels of contamination found on big bale silage wrap can significantly reduce your costs of disposal by between 5 -12p per bale (i.e. up to 9% of total costs). Recommendations to minimise contamination levels on silage plastic (bale wrap and sheet) are as follows:

- Ensile grass at a high dry matter where possible to minimise effluent.
- Store silage bales on a clean, well drained (preferably concreted) surface. Where stored in a field, consider using a silage sheet to stack bales on in order to minimise soil contamination.
- If rodents are a problem, place suitable rodenticides around (not within) the stack.
- Store the bales undercover wherever possible. Consider covering the bale stack with a simple roofing system, e.g. corrugated sheets. If stored outside, ensure the stack is netted to minimise damage from birds and wind.
- Avoid siting the bale stack under trees.
- Where possible, carry wrapped bales using a front spike, avoid using a back spike or adjust the back spike to prevent the bale from dragging along the ground.
- Do not allow the waste plastic to be dragged over mud or get caught under tractor wheels.
- Open the bale from underneath, allowing any collected effluent to drain off (in safe manner) before removing the wrap.
- Where possible, remove plastic from bales under cover over a clean dry surface.
- Ensure string and waste silage is not adhered to the wrap.
- Do not allow other materials such as tyres, bricks, stones, metal objects etc to be mixed with the waste plastic.
- Segregate silage wrap from silage sheet and ensure that all other types of plastic (e.g. bales netting) are stored separately.
- Prevent waste plastic from being blown around.
- Store waste plastic undercover in a dry, airy environment within a sealable holder made of the same material, i.e. low density polyethylene.
- If the plastic must be stored outside, roll it up tightly.
- Keep store of waste plastic away from animals and machinery.

9.0 FURTHER WORK REQUIREMENTS

These include:

- Examining the levels of contamination to be found on horticultural plastic
- Working with alternative reprocessors to establish new reprocessing options
- Carry out a more in depth analysis on recommended storage techniques

10.0 ACKNOWLEDGEMENTS

In producing this report, ADAS acknowledges the assistance of the following:

- The Welsh, Cumbrian and Scottish farmers who participated
- Lance Hamer of bpi.recycled products
- Marilyn and Peter Birch of Second Life Plastic Wales
- Carol Douglas of Cumbria Farm Plastic Recycling Scheme
- Roy Hiddleston and Chris Hartshorne of Solway Recycling

All the organisations above and others contacted had a great willingness to co-operate, showing the extent of the goodwill and commitment to get the recycling of agricultural plastic off the ground.

11.0 REFERENCES

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Starr N (1997) It ain't hay: Recycling Agricultural Film. *Resource Recycling*, June 1997.

APPENDIX 1 – Scheme Pro Forma

Name of Scheme:	Interviewee:
Date:	Interviewer:
BACKGROUND	
Date scheme started:	Reason for Scheme:
Stand alone as a business: *Seasonality* *Associated business*	
Scheme's overall objective(s):	
STRUCTURE	
Overview of Scheme: General Description Flow charts/diagrams	
Standards in Place: *Any requirements set by scheme* *Inspection procedures, failure to comply means...what?* *Packaging requirements (liners, pallets, bins)*	

LOGISTICS	
Drop-Off Points	
Methodology No of farms using each centre Frequency of collection centres Min/Max quantities taken Average weight collected from each farm Use of 'holding centre' Weight/bulk density carried by lorry	
Handling	
Methodology Time loading at site Mechanical v manual Tipped then picked?	
Geographic Spread of Farmers	
Spread of farmers using scheme Distances travelled by users of the scheme	
Transport	
Make & model of vehicle used Containment Capacity Frequency of drop-off to reprocessors Overnight stops	
COLLECTION	
Methodology Size & nature of collection point Rented/owned Covered Security	
Equipment on Site Balers Compactors Weighbridge Washing facilities	
Operating Staff Tonnage throughput Residue/contaminant treatment Separation of plastics	

FINANCIAL MECHANISMS	
Income	
Membership Fee	
Funding EU LA National Assemblies Organisations Landfill Tax In-kind	
Subsequent Tonnage Fee	
Other Income Equipment Quality control, XS charges Labour time	
Costs	
Admin	
Overheads	
Insurance	
Recruitment/training	
Haulage	
Office Equipment	
Publicity	
Staff	
Gate Fee	
Promotion	

APPENDIX 2 – Storage Protocols

Research into Sustainable Options for the Recycling of Agricultural Plastics

A – Storage Outside

Set out below is a step by step guide on how ADAS requires you to store your waste silage wraps. It would be much appreciated if you would follow the guide in order to give accurate results, which may then be used to establish a protocol for farmers.

1. Spike or grab the bale(s).
2. Take bale(s) to a clean, outdoor concrete area.
3. Remove wrap from bale in the usual manner.
4. Tightly roll the wrap (similar to wrapping a fleece)
    - Flatten out the wrap
    - Tuck in any stray edges
    - Roll the wrap tightly into a sausage shape
5. Stack the rolled wraps on top of one and other.
6. Any string or netting should be collected separately.
7. Resume feeding the silage bale.

Thank you for your help.

B – Storage Inside

Set out below is a step by step guide on how ADAS requires you to store your waste silage wraps. It would be much appreciated if you would follow the guide in order to give accurate results, which may then be used to establish a protocol for farmers.

8. Spike or grab the bale(s).

9. Take bale(s) to a dry, clean indoor area.

10. Remove wrap from bale in the usual manner.

11. Form a pile of the wraps in an area of the building that is out of the way of machinery and animals. It should be an area that is clean and dry.

12. Please do not roll the wraps, they should be kept as loose as possible.

13. Any string or netting should be collected separately.

14. Resume feeding the silage bale.

Thank you for your help.

C – Storage Inside, Bagged

Set out below is a step by step guide on how ADAS requires you to store your waste silage wraps. It would be much appreciated if you would follow the guide in order to give accurate results, which may then be used to establish a protocol for farmers.

15. Spike or grab the bale(s).
16. Take bale(s) to a clean, dry, indoor area.
17. Remove wrap from bale in the usual manner.
18. Tightly roll the wrap (similar to wrapping a fleece)
    - Flatten out the wrap
    - Tuck in any stray edges
    - Roll the wrap tightly into a sausage shape
19. Place the rolled wraps in the sack provided.
20. Any string or netting should be collected separately.
21. Resume feeding the silage bale.

Thank you for your help.

APPENDIX 3 – On-farm Information

Farmer Name		Farm Ref.	
Address			
Farm Type		Visit Date	
Plastic Used			
Storage Conditions			
Waste Plastic Storage			
Bales Wrapped			
Bales Cut			
Use of Recycling Scheme			
General Notes			

APPENDIX 4 – Analysis of Contamination Methodology

Method 1 – Overall Weight Analysis

If the plastic was being assessed for overall contamination, the following procedure was followed:

- Place each sample into an individually labelled crate.
- Transfer the sample to the washing point. The washing point should be a concreted, free draining area with access to a power washer.

Washing procedure

Wraps

- Flatten out individual wraps.
- Power wash the wrap until all visible signs of contamination are removed.
- Turn the wrap over and repeat the process.
- Separate the layers of the wrap, checking for contamination.
- Place the layers back into the crate.

Silage sheet

- Flatten out the piece of sheet.
- Power wash the sheet until all visible signs of contamination are removed.
- Turn the sheet over and repeat the process.
- Place the sheet back into the crate.

Drying

- Samples should be taken to the drying point. The drying point for this project was an industrial greenhouse, aided by a diesel-generated heater.
- Samples should be hung out on the drying lines in the greenhouse and labelled with their individual reference number.
- Samples should be checked daily and turned where required.
- As the samples dry, bag up the plastic and seal.

Weighing

- Weigh the bagged, dry samples using the digital scales as soon as the complete sample is collected.
- Repeat the above weighing procedure again after 24 hours.

Method 2 – Identifying Different Contaminants

On samples where weight was attributed to different types of contamination, the following procedure was used:

- All samples to be hung to dry in greenhouse before being washed.
- Lay a clean polythene sheet below the area where the samples are hung in order to catch any fallen contaminants (to include inorganics).
- Leave samples for ten days to allow to dry out without disturbing the layers.
- Bag the samples and weigh individually.
- Collect any fallen contaminants and weigh.

- Continue to process the samples as set out in Method 1.

Method 3 – Wet Weights

Wrap samples that had been through Method 1 and therefore were clean and dry, were saturated with water. Once wet through, the plastic was collected up, allowing the majority of the surplus to drain, before being weighed. This gave a figure for the amount of water that a typical silage wrap could carry

Method 4 – Using Protocols

The results from the above analyses, allowed preliminary conclusion to be drawn as to which was the best way to store waste silage plastic in order to minimise the weight of the waste wrap, reflecting lower levels of contaminants.

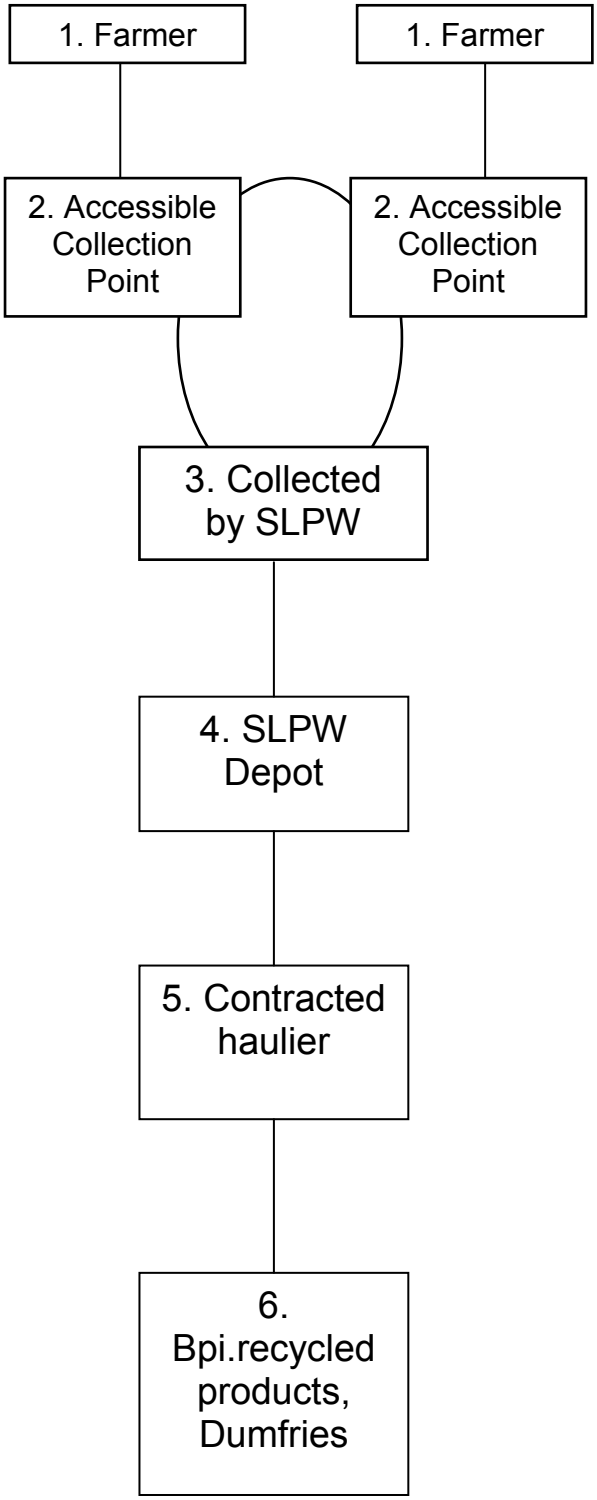
Three methods giving the lowest percentage weight loss due to contamination were identified. Protocols were then drawn up (see Appendix 2) reflecting these methods. Three farmers were then approached and asked to store their waste silage plastic for 12 days according to the set protocol.

Plastic was then collected and processed in the same way as Method 1.

APPENDIX 5 – Published Material

APPENDIX 6 – Material Flow

Material Flow Chart - Second Life Plastic Wales



1. Farmers are not specifically asked to keep the plastic clean but a suggested storage method is to store plastic on a pallet, out of the way of machinery and animals.
Potential to pick up contamination in the form of water and solids.

2. Farmers are asked to leave the plastic in an accessible area for the pick-up lorry which generally is outside, near to the entrance to the farm.
Potential to pick up contamination in the form of water and solids.

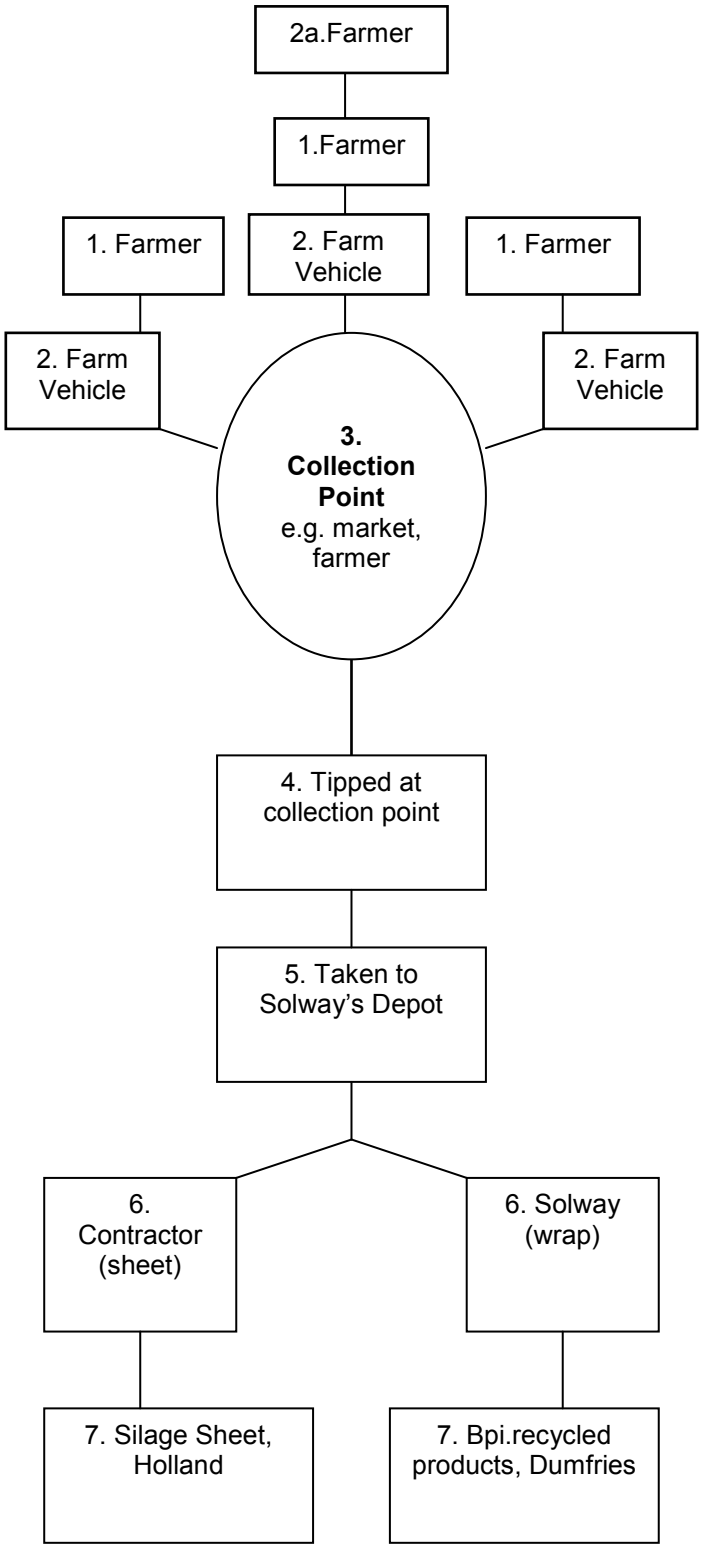
3. The SLPW lorry picks up the plastic using a grab and weigh-link. Excess water is allowed to drain from the plastic, then transported to depot.
Potential to pick up contamination in the form of water during transit.

4. The plastic is sorted and baled at the SLPW depot, using their own baler. Bales are stacked and stored until there are enough to make up a load.
Potential to pick up contamination in the form of water during storage.

5. A contractor is hired to take the plastic up to Dumfries for reprocessing. The contractor may or may not be doing a return trip to/from Scotland.

6. The baled plastic is taken to bpi.recycled products in Dumfries. It is taken over a weighbridge and the gate fee charged accordingly. It is then stacked in the storage yard prior to processing.
Potential to pick up contamination in the form of water during storage. Not essential as this will not effect the recycling process.

Material Flow Chart – Cumbria Farm plastic recycling Scheme



1. Farmers are asked to keep the plastic clean on an area of hardstanding and separated from string and netting. Liner system recommended.
Potential to pick up contamination in the form of water and solids during storage on farm, unless using liner/containment system.

2 & 2a. Farmers load plastic into vehicle. Two neighbouring farms may come together to collect waste.
Potential to pick up contamination in the form of water and solids during loading.

3. Waste plastic is taken to collection point in farm vehicle which could be an open trailer, landrover, tractor etc.
Potential to pick up contamination in the form of water during transit.

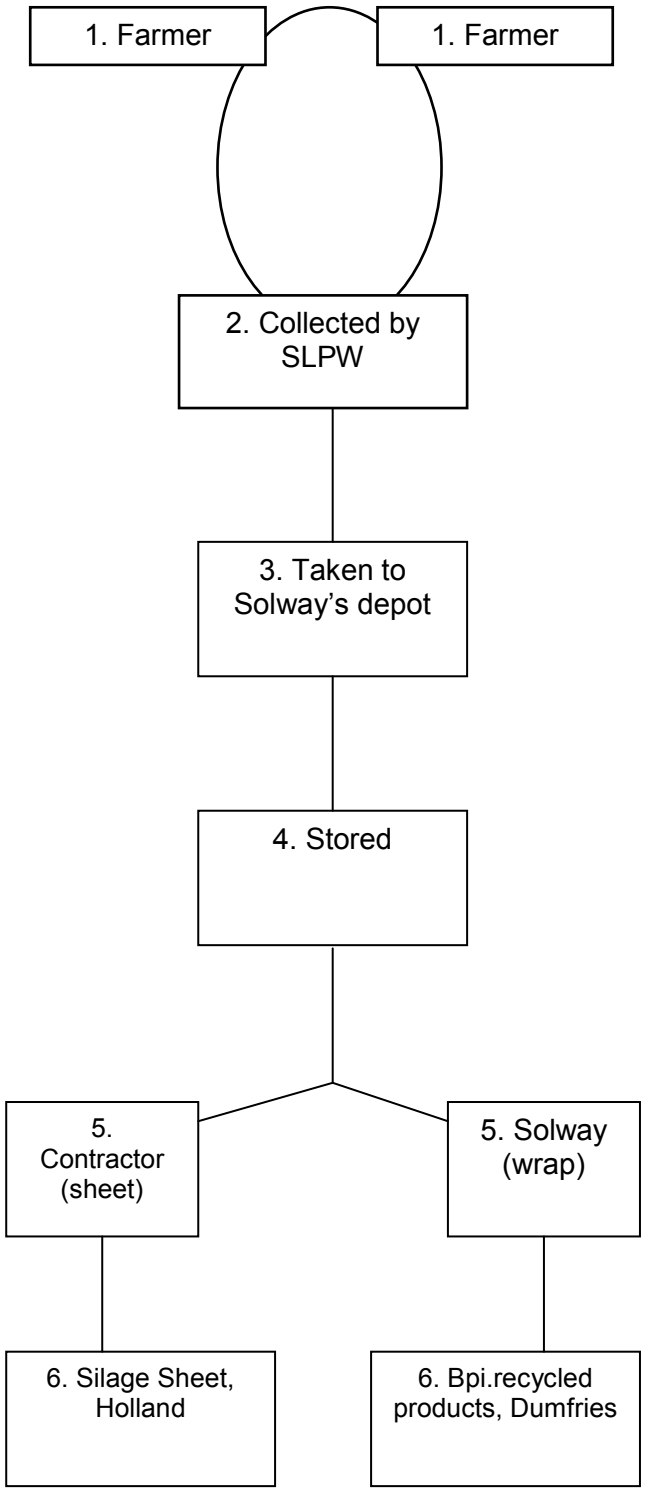
4. The plastic is tipped at the collection point and may be left overnight if a two day collection is arranged.
Potential to pick up contamination in the form of water overnight.

5. Solway Recycling collects the plastic from the collection points to be taken back to their depot and sorted and baled and stored prior to the next stage.
Potential to pick up water contamination during storage.

6. Silage sheet is taken to a reprocessors in Holland using a contractor and wrap is taken to bpi, Dumfries by Solway.
Potential to pick up contamination in the form of water in transit.

7. Plastic going to bpi.recycled products in Dumfries is taken over a weighbridge and the gate fee charged accordingly. It is then stacked in the storage yard prior to processing.
Plastic going to Holland has a value as the company pays Solway.
Potential to pick up contamination in the form of water during storage. Not essential as this will not effect the recycling process.

Material Flow Chart Solway Recycling (Dumfries & Galloway)



1. Farmers are told to keep their plastic in a liner.
Potential to pick up contamination only if the liner is stored outside.

2. Solway Recycling collect the waste plastic from their farmers.
Liner will be sealed, therefore no further contamination will be collected.

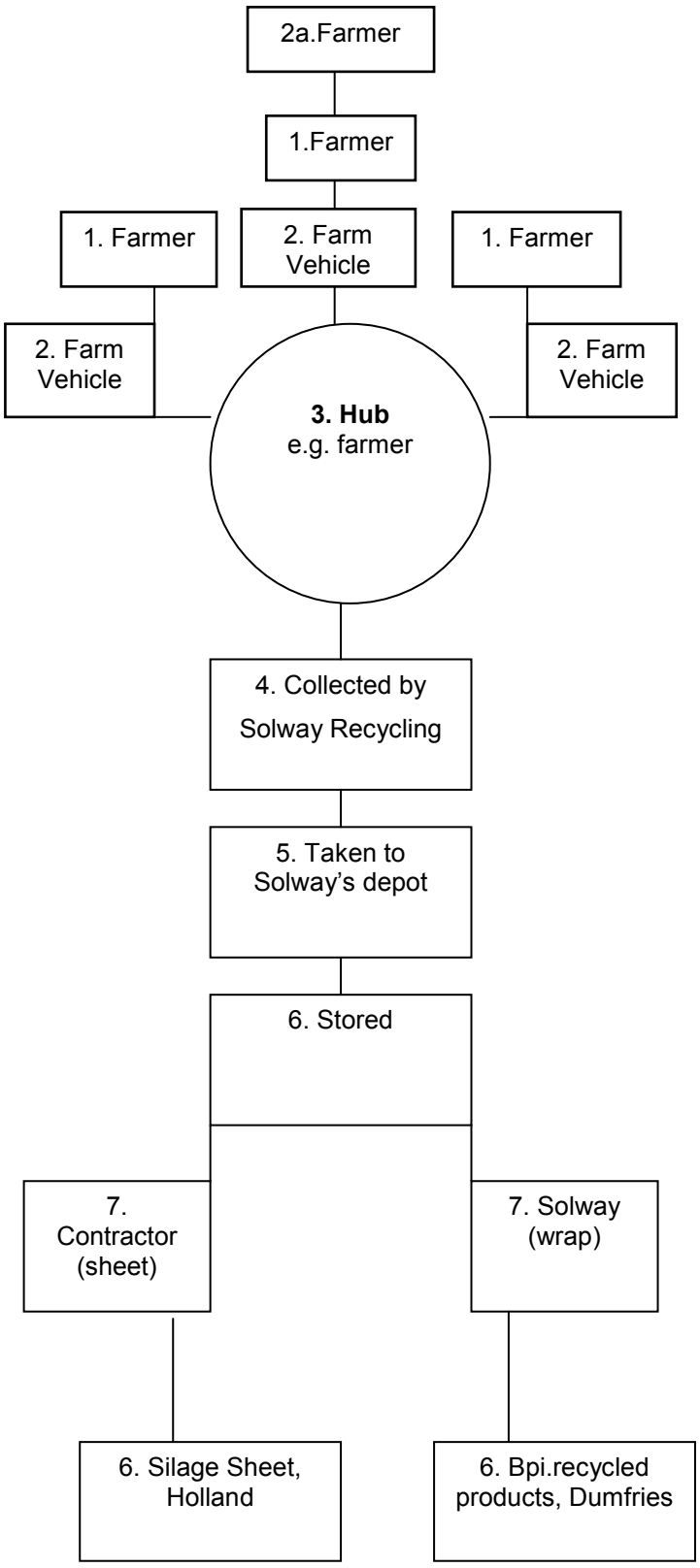
3. Waste plastic is taken Solway's depot to be sorted and baled.
Low potential to pick up contamination in the form of water during processing

4. The plastic is stored until there is a full load to take to the reprocessor.

5. Silage sheet is taken to a reprocessor in Holland using a contractor and wrap is taken to bpi, Dumfries by Solway.

6. Plastic going to bpi.recycled products in Dumfries is taken over a weighbridge and the gate fee charged accordingly. It is then stacked in the storage yard prior to processing.
Plastic going to Holland has a value as the company pays Solway.

Material Flow Chart Solway Recycling (Hub System)



1. Farmers are told to keep their plastic in a liner.
Potential to pick up contamination only if the liner is stored outside.

2 & 2a. Farmers load plastic into vehicle. Two neighbouring farms may come together to collect waste.
Liner will be sealed, therefore no further contamination collected.

3. Waste plastic is taken to collection point in farm vehicle, which could be an open trailer, landrover, tractor etc.

4. Solway Recycling collects the waste plastic from the hub.

5. Waste plastic is taken Solway's depot to be sorted and baled.
Low potential to pick up contamination in the form of water during processing

6. The plastic is stored until there is a full load to take to the reprocessor.

7. Silage sheet is taken to a reprocessors in Holland using a contractor and wrap is taken to bpi, Dumfries by Solway.

6. Plastic going to bpi.recycled products in Dumfries is taken over a weighbridge and the gate fee charged accordingly. It is then stacked in the storage yard prior to processing.
Plastic going to Holland has a value as the company pays Solway.