



SOMERSET FARM PLASTIC RECYCLING SCHEME

Summary of Final Report – Baling Options and Logistics

Prepared for:
AWP Programme Website
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Trial 1 – Somerset FWAG Baling Options and Logistics

Trial Outline Trial 1, run by Somerset Farm Plastic Scheme or ‘Somerset FWAG’, was designed to illustrate economic and quality improvements that could be gained from sorting and baling AWP at source (farm) or at collection hubs, and to provide collection hub data that could inform the development of PR. Anticipated improvements included increased tonnage capacity and efficiency at collection centres, better quality control, and reduced transport costs to reprocessor.

As the trial developed, additional methods of compaction and transportation were introduced, to test compaction and road haulage efficiency between collection hubs and reprocessor.

Feedback from this trial is given in the following sections below:

- Key Findings
 - Achievement of Trial Objectives
 - Trial Methodology
 - Hub Collection Planning
 - Farmer Education and Promotion
 - Hub Attendance
 - Hub Operation
 - AWP Data
 - Economics
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Key Findings

Transport Costs

The costs of transport of AWP remains a significant part of costs

The least cost transport was a flat bed articulated lorry carrying baled AWP. £29/tonne was achieved on the trial, and if load size is optimised with maximum bales this could be £18/tonne. AWP must be baled for this which raises the cost well above other options.

The costs calculated for well compacted Ro-Ro was £31/tonne, ejector trailer £30/tonne, and bulk lorry £32/tonne. The REL dust cart provided a local solution within a restricted distance, and was made available for trial purposes at a cost of £34/tonne.

More local reprocessing capacity would have a very favourable impact on reducing transportation costs.

Baling	<p>Baling is not viable at temporary hub operations</p> <p>There is limited range of mobile balers for AWP that are currently available. The industry uses vertical manual feed type. Average work rate of 500kg/hr is too low to service hubs receiving 20 to 25 tonnes AWP, and cost of £41/tonne (£36 at best work rate) is not economical.</p>
Bagged AWP & Reduced Contamination	<p>AWP delivered in bags facilitates hub operations</p> <p>Plastic appeared to be cleaner and drier than loose plastic accepted in previous collections. Feedback from one reprocessor indicated contamination levels of 38% (average generally received at the plant is 60%). Bagging helps handling and weighing (part load) provided that bags are fit for purpose and securely tied. 77% of farmers support use of dumpy/fertiliser bags.</p>
Segregation Acceptable to Farmers	<p>Farmers will separate plastic at source</p> <p>Farmers are prepared to separate AWP on farm, and gradually farmers have become more aware of this requirement. Farmers would like hubs to take all AWP types.</p>
Farmer Friendly	<p>Hubs were received favourably by farmers</p> <p>89% of participating farmers interviewed supported collection hubs rather than on-farm collection. Farmers see this as a way of keeping their own costs down, albeit hidden in their own transport costs.</p>
Average Tonnage per Farmer	<p>Quantity per farm varies, but averages at approximately half a tonne.</p> <p>The average was 505kg per farmer at main hubs and 400kg at mini hubs of mixed AWP (packaging and non-packaging, excluding rigid containers). This is lower than previous collections in the area and is perhaps due to</p> <ul style="list-style-type: none"> • Reduced levels of contamination • The timing of the trial including only a part of the silage use season • Hub collections held ahead of spraying and fertiliser season • Non-inclusion of rigid AWP containers
Farmer Deliveries per Day	<p>The average number of farmers attending hubs per day was 34</p> <p>Attendance over all the Somerset main hubs peaked at 77 at one of the two-day hubs. The maximum number of farmers received in a day was 41; peaks of ten farmers per hour was a comfortable maximum during the trial. It should be noted that the weighing of the received AWP slowed down hub operations and limited the number of farmers that could participate.</p>
Hub Size	<p>A range of hub size appropriate to circumstance are feasible</p>

(by Farmer Number)	Mini-hubs (~ ten farmers) and small scale hubs (~20 farmers) could be operated with low overhead costs, but require self organisation. Full size hubs (~50 plus farmers) can be operated efficiently using an experienced organising body.
Seasonality of Hubs	<p>Farmer preference is a Spring collection in April/May</p> <p>Timing of hubs has an influence on participation rate; the early hubs in December were less favoured, and the hubs in April and May were very well attended.</p>
Weighing AWP	<p>If charging for AWP, there is merit in weighing at hubs</p> <p>Weighing AWP allows a fair price to be charged for the material received, and the principal was well received by farmers compared to previous 'per load' charges. This also appeared to encourage farmers to keep AWP drier and cleaner. Weighing does add to the time and costs of running collection hubs; sites with existing weigh facilities for complete load weighing are an advantage.</p>
Trial Hub Costs	<p>The trials run for collecting AWP from hubs incurred high costs</p> <p>The operating costs of the trial hubs were not economically viable. The operational cost of the trial hubs were:</p> <ul style="list-style-type: none"> • £204/t for loose collection and baling at hub • £163/t for bagged collection at hub • £947/t bagged collection and baling at mini-hubs (on-farm) <p>Costs for the trial were high due to consultancy day rates of staff, the requirement to weigh plastic, the lack of any economies of scale and limited farmer participation.</p>
Potential Commercial Hub Costs	<p>It is potentially economically viable to run commercial hubs</p> <p>Excluding costs specific to the trial situation, Somerset FWAG forecast the operational cost of commercial hubs to be £130/tonne for main hubs and £158/tonne for mini-hubs (on-farm). Administration costs would be additional to the operational costs.</p>
Reprocessor Gate Fees	<p>Reprocessor gate fees can be a significant cost of collection</p> <p>The closure of the reprocessing plant in South Wales significantly increased the overall costs of the trial. The benchmark was a nil gate fee, and the trial paid between £40 and £60/tonne.</p>
Recycling of	Knowledge of the recycling of AWP is important to farmers

AWP Farmers appear to have a genuine interest in knowing what happens to AWP, particularly how and where it is reprocessed, and what it is then used for.

Achievement of Trial Objectives

Trial Objectives Trial 1 had eight key objectives that it set out to achieve. These are listed in the table below, where the level of achievement of each is also outlined.

Figure 1 Trial Objectives

Objective	Achieved?
1. Reduce transport costs to reprocessor by at least 50% (To £39 per tonne or less)	Achieved
2. Increase average throughput per day at collection centres (Increase average by 27% to 30 tonnes per hub day)	Not achieved (Averaged 17 t per hub day)
3. Increase average number of farmer deliveries per day (Increase average by 30% to 30 farmers per hub day)	Achieved (Averaged 34 per hub day)
4. Evaluate & field test mobile baling equipment for AWP film	Achieved
5. Evaluate & field test mobile weighing equipment for AWP	Achieved
6. Assess economic benefits of weighing and baling	Achieved
7. Assess & compare economic benefit of baling plastic films (At source/farm, at collection centres, or not at all)	Achieved
8. Evaluate effectiveness & economic benefits of various types of compaction/transport methods, other than baling (REL 'dustcart', RoRo lorry, compactor lorry body, bulk lorry)	Achieved

Producer Responsibility Data The data collected in this trial have been used as input and comparison data in the development of an economic model to inform the development of producer responsibility for non-packaging AWP.

Trial Methodology

Introduction The Trial was run in three distinct phases as outlined below.

Hub Planning (Phase 1) The project started in September 06. The first phase prepared the foundations of the field trials. Specification and suppliers for the hubs, and for baling and weighing equipment, were developed, and a benchmarking activity of existing collection was carried out. Waste Regulation compliance, including exemptions and Duty of Care obligations were established, and the advertising and promotion campaign planned and started.

Operation of Collection Hubs (Phase 2)

Part 1

Initial hub trials were run in December 06. Two collection centres were run with the numbers of farmers limited to 15 to allow a focus on establishing sound operational procedures for the main trial hubs. The report prepared the way forward for the next two phases.

Part 2

Nine main hubs were established and run between mid April and early June 2007, with an increased target of 30 farmers per hub. The hubs were planned to fit the time scale of the program and as far as possible fit the seasonal factors affecting farms in the area. The original plan to use a mobile baler at the hubs was revised following experience gained in Part 1, to allow testing of four transport methods which included an 'REL dustcart', 'roll on roll off' bins with two methods of compaction, a compactor trailer, and hi-ab loaded bulk lorry. The collected material was transferred to two separate local collection companies for onward transport to reprocessor.

Operation of Mini-Hubs (Phase 3)

Phase three trials ran with baling and weighing equipment on five farms, drawing in five neighbouring farms to form a 'mini-hub' to test the feasibility of baling AWP at source. These hubs were carried out in the first half of April, and the bales were collected for transport to reprocessor.

Data analysis and reporting Following the hub collection days the data from the trials was analysed and presented in a final report to the AWP Programme in June 2007.

Phase 1 Collection Hub Planning

Benchmark The first activity of Phase 1 was to carry out benchmarking, whereby specific costs of the collection hub scheme to date were identified for comparison at a later stage. Three rounds of collection hubs had been previously operated in Somerset; key elements of cost from these collection hubs are summarised in Figure 2 and Figure 3 below.

Figure 2 Costs of three FWAG collections during 2005-06

	Spring 2005	Winter 2006	Spring 2006
Number of hubs operated	13	14	15
Number of farmers delivering	288	220	479 (32/hub)
Weight of plastic collected (tonnes)	317	203	410
Average tonnes per load	1.10	0.92	0.85
Expenditure items	Actual cost	Actual costs	Actual costs
FWAG staff costs	40000	23450	17000
Staff costs per tonne	126.18	115.52	41.46
Collection site costs (total)	4864	5100	6000
Collection sites costs per tonne	15.34	25.12	14.63
Haulage costs (total)	10618	14450	32000
Haulage costs per tonne	33.50	71.18	78.05
Gate fee at reprocessor	12578	8867	9000
Gate fee per tonne	39.68	43.68	21.95
Promotion of scheme	3500	3500	2000
Promotion costs per tonne	11.04	17.24	4.86
Travel (total)	1400	2600	2600
IT	1000	1000	0
Sundries	250	250	250
Total costs	74210	59017	68850
Total cost per tonne	234.10	290.72	167.93

Figure 3 Benchmark data for the Somerset collection hubs

No of farmers per hub	Tonnes per hub	Fixed costs/hub	Admin staff per hub	Operational staff per hub	Loading costs per hub	Haulage costs per hub	Gate fees	Approx cost per tonne
10	9	£900	£125 (0.5 days)	£250 (one person)	£150 (6 hrs)	£625 (£70/t) (2 bins)	Nil	£280
20	18	£900	£125 (0.5 days)	£500 (2 people)	£180 (7 hrs)	£625 (£35/t) (2 bins)	Nil	£130
25	22	£900	£175 (0.7 days)	£500 (2 people)	£180 (7 hrs)	£1350 (£61.36/t) (3 bins)	Nil	£140
30	27	£900	£175 (0.7 days)	£500 (2 people)	£180 (7 hrs)	£1350 (£50/t) (3-4 bins)	Nil	£115
40	36	£900	£250 (1.0 days)	£500 (2 people)	£200 (8hrs)	£1350 (£37.50/t) (4 bins)	Nil	£90
50	45	£900	£250 (1.0 days)	£750 (3 people)	£225 (9hrs)	£1975 (£43.88/t) (5 bins)	Nil	£90
60	54	£1200 (2 days)	£325 (1.3 days)	£1000 (2 people, 2 days)	£360 (2 days)	£1975 (£36.57/t) (6 bins)	Nil	£90
80	72	£1200 (2 days)	£500 (2 days)	£1000 (2 people, 2 days)	£360 (2 days)	£2700 (£37.50/t) (8 bins)	Nil	£80

Note: The cost of bulk hauling loose plastic in bins can be between £35/tonne (18 tonnes in two bins, one trip) and £80/tonne (8 tonnes in two bins, one trip).

Selecting baler and weighing equipment

A specification for baler and weighing equipment was developed in phase 1. Following an analysis of the categories of commercial balers, Figure 4, it was found that the high capacity balers were not available for hire, and capital cost was prohibitive. The vertical manual feed baler was found to be popular and used by a number of collector operators, and a contractor with a suitable machine was employed for the initial hubs.

Weighing equipment suitable for use at collection hubs can be separated into four distinct groups, as set out in Figure 5. A suitable weigher could not be purchased or hired for Phase 2.1, but a platform scale was later purchased for use on Phases 2.2 and 3, and was modified to fit transport to move it between hubs.

Figure 4 Mobile baling equipment for farm plastics

Feature	Mobile vertical baler	Static horizontal baler	Mobile round baler
Mobility	Trailer mounted	Static i.e. based at depot	Self-contained trailer
Power	Single phase	Three phase	Tractor PTO (>120 hp)
Feed	Manual	Hopper or conveyor	Conveyor
Pre-treatment	Not required	Not required	Partial shredding
Bale weight	250-400 kg	500-600 kg	800-1000 kg
Through-put	< 1 tonne/hour	1-3 tonnes/hour	Not tested for farm plastic, but up to 40 tonnes/hour for other shredded material
Capital costs	£5-7k approx	£25k approx.	£130k approx
Advantages	Low capital outlay Can be self-contained	Semi-automatic feed	Self-contained High potential through-put
Disadvantages	Low through-put Manual feed	Not mobile Three phase power needed	High capital cost

Figure 5 Mobile weighing equipment for farm plastics

Feature	Weighbridge	Axle pads/beams	Platform scales	Weigh-link device
Mobility	Non-mobile or very expensive to set-up	Mobile	Mobile	Mobile
Power requirements		Self-contained	Self-contained	Self-contained
Dependants	Fixed location	Level, even surface Similar axle sizes	Plastic is contained in bag or platform	HIAB type crane arm or similar
Capital costs	Very high	Medium	Low	£700-1500
Advantages	Accurate Ease of operation		Low cost	Low cost
Disadvantages	Capital cost	Difficult to operate when axles vary in size and load	Material needs to be contained	Needs HIAB type crane or similar

Site specification.

The hub collection sites and operating procedures for the trial were planned based on previous experience of Somerset FWAG. The specification for hubs for the trial was drawn up in phase 1 to include the main features:

- **Size.** 30m x 40m minimum (excluding access and turning area).
- **Access.** Safe access for both agricultural vehicles and for articulated lorries. A wide range of transport type was found to be used by farmers delivering.
- **Surface.** Hard surface, preferably concrete.
- **Drainage.** The main environmental risk is from liquid runoff, and the site must take consideration of safe containment of runoff from the hub area.

- **Licensing and planning.** Sites generally registered as being exempt from the Waste Management Regulations for the purposes of storing wastes intended for recycling or recovery (Exemption 17).
- **Power supply.** Minimal need, and can be independent of power supply.
- **Weighing facilities.** For the trial a mobile weigh platform was employed to weigh incoming plastic. Selecting sites with weigh facilities on site would have been an advantage.

Hub Selection

The sites were selected to fit the pre-defined criteria, and be representative of the region under trial. All hubs were planned to run for one day; to satisfy demand, five hubs in phase 2.2 were open for two days, with allowance for up to 40 spaces on day one and up to 20 spaces on day 2. Farmers were booked into one hour slots, with six to eight slots being available each hour of hub opening times. Details of main hubs (Phase 2.2), including transportation and collection method and hub description are given in Figure 6 below.

Figure 6 A summary of the nine collection hubs in Phase 2.2

Date	Address	Transport method	Hub description
19.04.07	Coates Farm, Greinton	REL dust cart (by Southern Agri)	Hub is in a silage clamp, on a farm in Somerset Levels where beef and dairy farming is predominant.
24.04.07	London Lodge Farm, Cricket St Thomas, Chard	REL dust cart (by Southern Agri)	Hub is in a silage clamp, on a farm in the Blackdown Hills where mixed farming is predominant.
26.04.07	Tillhouse Farm, Broadclyst	REL dust cart (by Southern Agri)	Hub is in a silage clamp, on a farm in East Devon where mixed farming is predominant.
1/2.05.07	Dimmer Composting Site, Castle Cary	Ro-Ro bins plus 360 excavator (by Viridor)	Hub is on a concrete pad used for composting green waste, part of the Dimmer landfill site. Dairy is the dominant farming type of the area. A commercial weigh-bridge is available.
3/4.05.07	Walpole Composting Site, Pawlett	Ro-Ro bins plus tele-handler (by Viridor)	Hub is on a concrete pad used for composting green waste, part of the Walpole landfill site. Dairy and beef is the dominant farming type found in the surrounding area. A commercial weigh-bridge is available.
08.05.07	Higher Woodlands, Isle Abbots	Ejector trailers (by Veolia)	Hub is in a silage clamp, on a farm on the fringes of the Somerset Levels in an area where dairy farming is predominant.
10/11.05.07	Preston Farm, Preston Bowyer, Milverton	Ejector trailers (by Veolia)	Hub is in a silage clamp, on a farm in the Taunton Vale where mixed farming is predominant. A weigh-bridge is available.
14/15.05.07	Cutcombe Market, Wheddon Cross	Lorry & trailer (by BG Pearce)	Hub is on the stoned surface of an open air market site near Wheddon Cross on Exmoor, where beef and sheep are farmed.
4/5.06.07	Dunkeswell Airfield, Honiton	Lorry & trailer (by BG Pearce)	Hub is on the concrete perimeter road of an airfield on the Blackdown Hills where beef and sheep are farmed.

Service development

The description of the service offer was important. Many farmers were familiar with previous Somerset FWAG collections. The changes required for source separation and bagging of plastic by farmers was explained at the point of registration to the service on the telephone, and described in the scheme fliers that were sent to farmers. (Appendix 5)

Exemptions & compliance

Somerset FWAG investigated the requirements for planning consents, and Waste Management License for the purpose of the hubs, and organised as necessary:

- **Planning consents:** There were no planning changes required for the hubs used on the trials.
 - **Licensing:** Registration for each of the trial hubs was completed via the Exemptions Registration Packs for the paragraph 17 exemption of the Agricultural Waste Regulations.
 - **Duty of Care:** Somerset FWAG provided the Duty of Care transfer note for the waste plastic, which also served as an invoice reference to farmers.
 - **Waste carrier licence:** Waste carriage for the trial was undertaken by a number of contractors. In each case the carriers license was checked and confirmed appropriate for purpose.
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Farmer Education and Promotion

Phase 1

No general advertisement. Invitations were sent direct to 15 farmers who had brought farm plastic to each of the hubs during a previous collection round. Bookings were then taken over the telephone, with the farmers being invited to come in the morning or afternoon of the collection day.

Phase 2

There were spaces for a maximum of 450 farmers to bring plastic to the nine collection hubs. Approximately 1,200 flyers were posted out to those farmers who had used the collection service in previous years or who had previously expressed an interest in the scheme, and this included 700 FWAG members in Somerset. The NFU with 2,000 members had direct mailing using Farmer Fax. Press coverage included the Western Gazette, the Fosseway and Blackmoor Vale magazines. Hubs had to be pre-booked by farmers

registering onto the scheme, and farmers were booked into preferred time slots on the day and place of choice until target numbers were achieved.

Phase 3

No general advertisement. Individual invitations were sent to five farmers in the very close vicinity of the five mini-hubs offering them the opportunity to bring their waste to the hubs, and asked to deliver their AWP between 10 am and 12 noon on the day of the mini-hub.

Hub Attendance & Farmer Questionnaire

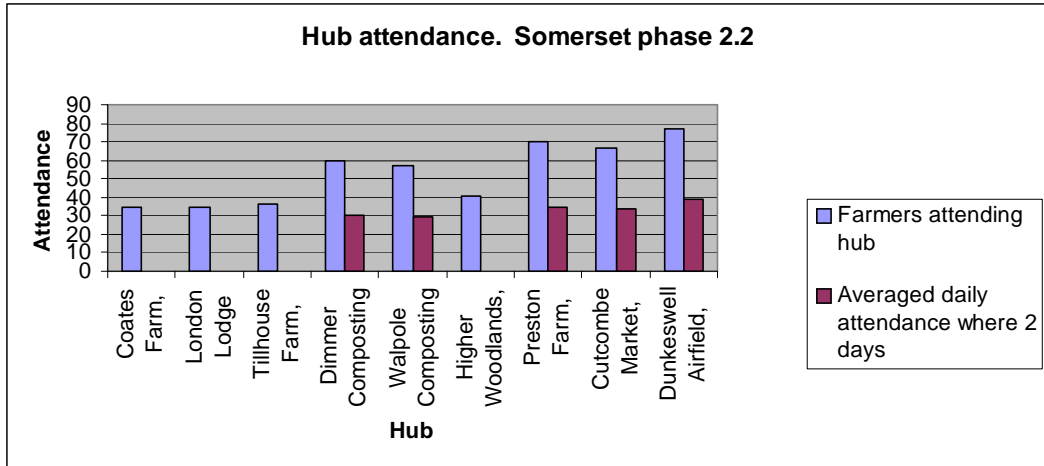
Total

The objective of increasing average number of farmer deliveries per day by 30%, to 30 farmers per hub day, was exceeded at the Phase 2,2 collection hubs, with an average of 34 farmer deliveries per day. Attendance peaked at the Dunkeswell hub, with 77 farmers attending over two days. The maximum number of farmer deliveries in any one day was 41. Participation at Phase 2 hubs is shown in Figures 7 and 8.

Figure 7 Attendance at Phase 2 Collection Hubs

Phase	Date	Hub	Farmers attending	Daily Average
2.1	5.12.06	Preston Bowyer, Milverton	14	
2.1	12.12.06	Dunkeswell Airfield, Honiton	14	
2.2	19.04.07	Greinton, Coates Farm	35	
2.2	24.04.07	Cricket St Thomas	35	
2.2	26.04.07	Broadclyst, Tillhouse Farm	36	
2.2	1/2.05.07	Dimmer, Castle Cary	60	30
2.2	3/4.05.07	Walpole, Pawlett	57	29
2.2	08.05.07	Isle Abbots, Higher Woodlands	41	
2.2	10/11.05.07	Preston Bowyer, Milverton	70	35
2.2	14/15.05.07	Cutcombe, Wheddon Cross	67	34
2.2	4/5.06.07	Dunkeswell, Honiton	77	39
		Total	478	

Figure 8 Hub Attendance



By farm type and size

The Phase 2.2 hub survey revealed that the average farm size using the hubs was 100ha, ranging between 70 and 170ha. Most farms were mixed, with beef being the most dominant (74%), followed by sheep (37%), and dairy (34%).

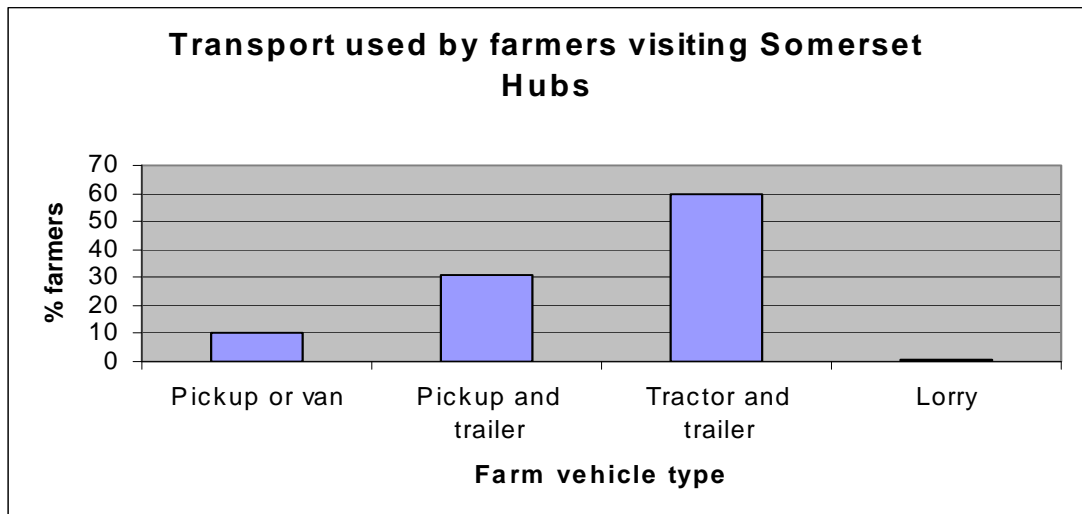
Distance Travelled

The average distance travelled by farmers attending the Phase 2.2 hubs was 7.3 miles. However, it revealed that farmers were prepared to travel up to 15 miles.

Vehicle used

The type of vehicle used by farmers was monitored through the trial; 60% of farmers used a tractor and trailer. The pick up category included 4X4 and vans and were also very popular.

Figure 9 Vehicle types used by participating farms visiting Somerset hubs



Support for Hubs From the farmer questionnaire, there was overwhelming support for hubs; 86% of farmers responding preferred hub to farm collection. There is a preference for collection once per year, in spring following winter turn out of animals, and completion of application of pesticide and fertiliser.

Support for other wastes From the farmer questionnaire, farmers were asked if they had substantial quantities of other waste categories on the farm. From the answers, 29% of farmers said that they had waste tyres, 22% had batteries, and 16% had waste oil. These items have potential for recycling and hubs could offer an additional service to farmers to take these wastes.

Hub Operation

Preparation and Operation of Collection Hubs

Pre-registration Registration is an essential preliminary activity to hubs to help with the planning process. Pre-registration was important to the production of Duty of Care Transfer Notes prior to each day.

Site Inspection The Somerset hubs were mostly known sites from previous years. There was adequate knowledge on site facilities. The owner/operator was contacted as appropriate to the site to revise knowledge and make arrangements as appropriate.

Set-up On the day of each event, FWAG staff arrived on site an hour before opening. The hub manager held a short team briefing to cover the days' operation, individual responsibilities and any Health and Safety aspects. PPE was issued as appropriate. Staff set out signage and equipment prior to the event, including road signs, direction arrows and warning signs for the general road traffic.

Hub staffing The hub event was designed to run independently of any other operations on site. FWAG managed each event, utilising four key roles (mini hubs operated with less FWAG staff input utilising the goodwill of the host and visiting farmers):

- Traffic and Registrations Manager
- AWP weighing and recording, plus Quality Control

- Farmer documentation and questionnaire
 - AWP handling and reloading vehicle operator
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AWP weighing

The weighing equipment for the trials was a weigh cell which was ground mounted with a flat platform. In each instance it was positioned on hard area, and checked for clearances, response and zeroing.

Management of participants

As farmers arrived, they offloaded one at a time and the contents were weighed by 'the bag'. There were peak times when a queue developed; this did not cause undue time delays, and the time slot allocation was crucial to smoothing flow in the hub. Traffic flow was managed to be one way where site facilities allowed.

After weighing the AWP was cleared and loaded either to the baler where a baler was contracted (Phase 2.1 and 3), or to a stockpile on the ground or direct to onward transport.

Data was recorded manually. The participant was interviewed and the Duty of Care documentation was signed and released.

Baling at hub

Introduction

Baling was carried out at the two initial hubs in December (Phase 2.1) and the five mini-hubs (Phase 3).

Baler Work Rate

The baler work rate was around 610kg/hr at the initial hubs, and 468kg/hr at the mini hubs, as indicated in Figure 10. Interestingly the work rate was higher at the early hubs, possibly due to the higher contamination that was reported, but also possibly due to the pressure of higher overall quantities to bale on the day. The farmers delivered plastic in bags to the mini hubs, which made handling the plastic easier, and whole bags could be baled.

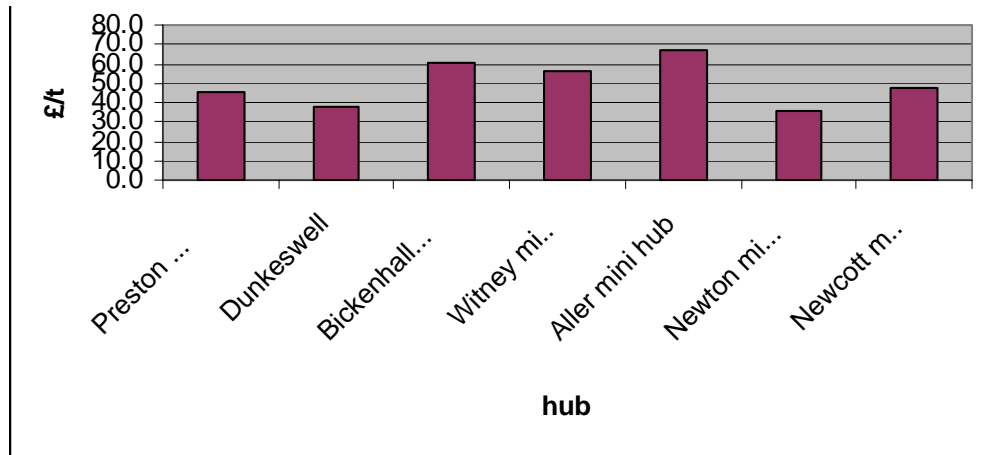
Figure 10 Bale weights and baler work rate from phase 3 trials

Collection hub	LDPE bales	PP bales	Total bales	Average workrate
Bickenhall Farm, Taunton 2 April	3 full bales <i>Ave 453kg/bale</i> Total 1,358 kg	1 full bales <i>Ave 284kg/bale</i> Total 284 kg	4 bales Total 1,642kg	410 kg/hr
Witney Farm, Ilminster 3 April	6 full bales <i>Ave 447 kg/bale</i> Total 2,684 kg	2 full bales <i>Ave 224 kg/bale</i> Total 448 kg	8 bales Total 3,132 kg	447 kg/hr
Aller Farm, Stockland 4 April	3 full bales <i>Ave 378 kg/bale</i> Total 1,135 kg	3 full bales <i>Ave 240kg/bale</i> Total 722 kg	6 bales Total 1,857 kg	371 kg/hr
Newtown Farm, Chard 10 April	4 full bales <i>Ave 456kg/bale</i> Total 1,826 kg	1 full bales <i>Ave 289 kg/bale</i> Total 289 kg	5 bales Total 2,115 kg	705 kg/hr
Newcott Farm, Yarcombe 11 April	2 full 1 part bale <i>Ave 311 kg/bale</i> Total 932 kg	2 full 1 part bale <i>Ave 209 kg/bale</i> Total 628 kg	6 bales Total 1,560 kg	520 kg/hr
Totals	18 full 1 part bales <i>Ave: 417 kg/bale</i> Total 7,935 kg	9 full 1 part bale <i>Ave: 237kg/bale</i> Total 2,371 kg	27 full 2 part bales 10,306 kg baled	468 kg/hr

Baler cost

The cost of baling at best was £36/tonne, and generally much higher up to £67/tonne as illustrated in Figure 11. The high cost of baling with this type of vertical manual feed baler is mainly a function of the low work rate, which incurs a high labour cost. At these costs baling at hubs is not economical.

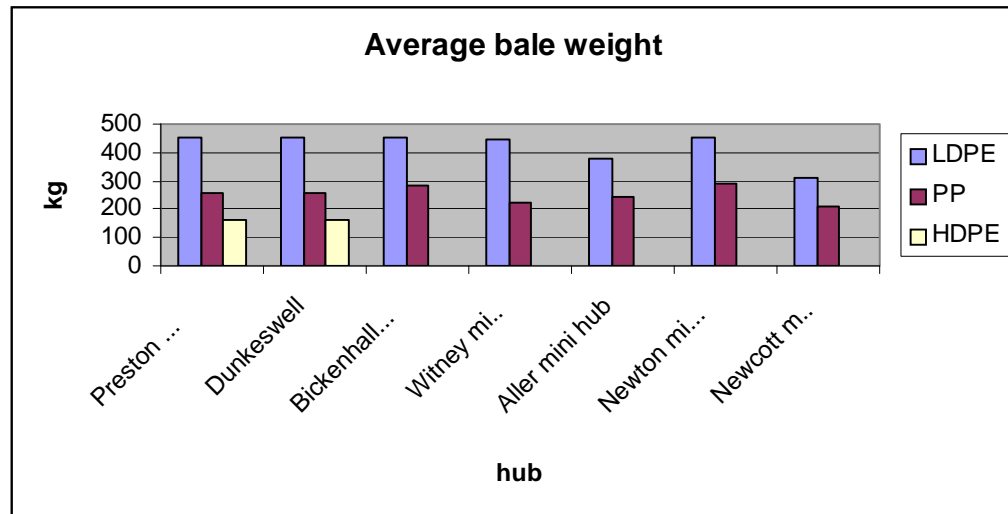
Figure 11 Average cost of baling at seven hubs (£25/hour bale hire cost)



Bale weight

Average weight for different polymers baled (Figure 12) shows that LDPE bales range between 311kg and 450kg, and were heavier than PP bales ranging from 160kg to 260kg. (one bale of HDPE was produced). The bales produced at the later mini hubs were less heavy, probably due to less contamination.

Figure 12 Average bale weight of different polymers from seven hubs



AWP weight reduction

The contamination levels were different at the two hub types. At the initial hubs, up to 14% weight loss was recorded with baling, and at the mini hubs the average weight loss was 4%. Whilst this weight reduction is a factor in reducing overall hub running cost, through the trials an improvement in

contamination levels has been observed as farmers become more aware and better practiced at reducing contamination

Conclusion The combination of low work rate and high running cost means that mobile vertical balers are not appropriate for use at collection hubs. A baler could have a place at mini-hubs, if farmer numbers and plastic tonnage can be matched to the daily capacity of the machine. I.e. operating a seven to eight hour day, baling four tonnes, servicing up to ten farmers.

Transport from Hub to Reprocessor

Baled AWP Phase 2.1 and Phase 3 of the trial used a flat bed articulated lorry to transport bales from the hubs and mini hubs. The bale width was 1.2m and the trailer width 2.4m, to allow 20 bales per layer.

In Phase 2.1, 33 bales with total weight 13.76 tonnes were transported at a day rate of £400 per day, with a single trip to the reprocessor in S Wales. This equates to £29 per tonne. At optimum load capacity of 50 bales (two layers of 20, and one layer of ten) and 450kg bale weight the load capacity calculates to be 22.50t, and the cost just under £18 per tonne.

In Phase 3, a total of 29 bales were made, 27 full, and two part bales, with a total weight of 10.30 tonnes. This was transported to the transfer station in Exeter using an articulated flat bed lorry, at a standard rate of £400 per day. The cost was £38.84 per tonne. The averaged bale weight of both LDPE bales and PP bales was 355kg, and if the load could be optimised with 50 bales, the cost would have been £22.50 per tonne.

Bagged AWP Transport costs for AWP are made up of four factors:

- Density of a load, primarily determined by the plastic type rather the vehicle used or the loading method.
- Loading time, which can be reduced by collecting AWP in bags.
- Distance travelled, which is a function of distribution of re-processors and is out of the control of hubs.
- Optimising load capacity, avoiding part loads.

The cost of using the transport operated by the transfer station during the trials was lower than using a third party, and helped simplify hub management. Self compacting transport proved very attractive in the trials.

The load weight achieved with bagged AWP is provided in Figure 13 below. The table shows the average weights measured on the trial, taken from a number of loads. When comparing the transport it should be remembered

that the Ro-Ro will normally travel as a pair on lorry and trailer to keep the cost low. The bulk lorry refers to a six wheel lorry with bin towing a twin axle trailer and bin combination (Birch Plastic).

Figure 13 Weights of loads of a range of transport in Phase 2.2

Transport vehicle	LDPE	LDPE	PP	PP	Average weight of all loads (Kg)
	Number of loads	Average weight (Kg)	Number of loads	Average weight (Kg)	
REL Dustcart	8	7753	2	3920	6040
RoRo with 360 exc.	4	6025	2	3660	5237
RoRo with Telehandler	3	4760	1	3400	4420
Ejector trailer	4	11955	1	7200	11004
Bulk lorry	7	8642	3	5213	7614

The single trip capacity of 11 tonnes is similar for the ejector trailer and the RoRo bin when a heavy excavator is used to compact into the RoRo load. Using this method of compacting into RoRo bins increased capacity by an average 18%. The bulk lorry has a lower capacity, and the REL Dust cart the lowest at six tonnes. There was considerable difference between loads, particularly between polymer, and the figures illustrated are average load weight.

Cost Comparison

To provide a comparison of costs between transport types, the trial cost is illustrated in Figure 14. The day rate has been charged as an opportunity rate; for a commercial hub local rates would apply and take account of local competition, distance travelled, road connection, and availability.

Figure 14 Comparison of transport costs using measured load weights in phase 2.2.

Transport Method	Typical weight (rounded kg) Transported	Day cost (£) inc. driver & fuel	One trip/day transport Cost/tonne (**£)	Two trip/day (45 miles limit) transport Cost/tonne (**£)
* Artic lorry (bales only)	22500	400	18	9
REL Dustcart	6000	400	67	34
RoRo bins (x2) + 360	10600	650	62	31
RoRo bins (x2) + telehandler	8800	650	74	36
Ejector trailer	11000	650	59	30
Bulk lorry	7600	475	63	32

* Taken from Phase 2.1 with a maximum load of 50 bales.

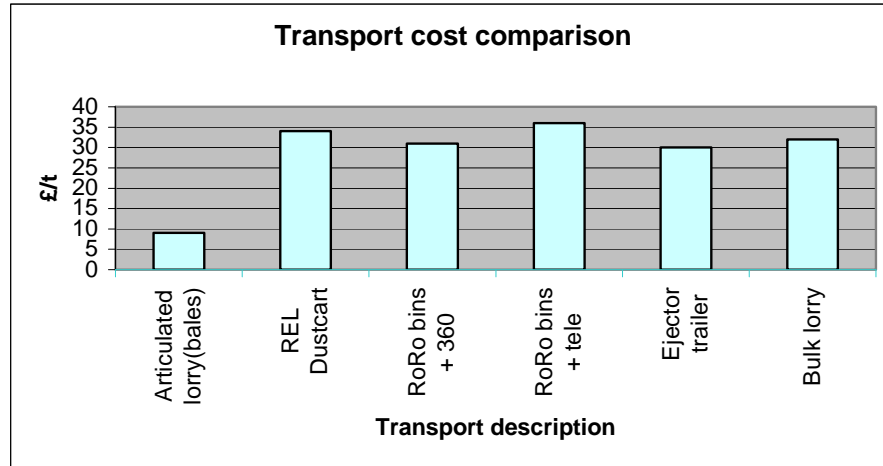
** figures rounded up to £

The table illustrates clearly the advantage of using a flatbed articulated lorry with optimised load carrying baled AWP, and less than 45 mile travel. However, there is a cost of baling to add to this which then makes the overall cost high.

The cost of the dust cart for the trial is a local service offer, and may not

reflect the true cost of transport of this type of lorry. The RoRo bins, ejector trailer, and bulk lorry had similar cost when material is pressed into the transport container.

Figure 15 Comparison of Phase 2 Transport Costs



Storage and separation on farm

The quality of plastic received was very good. Simplicity and common sense was the focus for separation and storage on farm and farmers delivered in separated bundles with very few exceptions. Farmers were asked to package plastic by type use, which effectively separated the plastic by polymer. Farmer response from the questionnaire showed very high support for use of large bags for storage and collection, with preference for the larger dumpy / fertiliser bag outer.

Figure 16 Preferences regarding separation and storage of AWP

Collection hub	No.	Method of storage/collection			
		Loose (%)	Fertiliser outers (%)	Dumpy bags (%)	Bins & bags (%)
Greinton	29	31%	41%	48%	7%
Cricket St Th	29	24%	28%	38%	17%
Broadclyst	29	3%	90%	79%	0%
Dimmer	36	31%	8%	64%	0%
Walpole	44	23%	0%	61%	20%
Isle Abbots	24	25%	54%	71%	0%
Preston Bowyer	34	32%	41%	21%	0%
Cutcombe	46	24%	50%	59%	7%
Dunkeswell	20	10%	5%	90%	6%
Overall	291	23%	35%	59%	6%

Number of Bags

Over 6,100 bags were delivered to the nine main hubs in Somerset. Farmers brought an average 13 bags, with a 9:4 ratio LDPE: PP. There was considerable range in weight of bags, with some bags up to 400kg; the averages were:

- Soiled film (silage LDPE/LLDPE) - 43kg
- Feed and fertiliser bags, string and net (PP) - 29kg

The data collected from the mini hubs are not reported here but mirror the figures found at the main hubs in Phase 2.2.

AWP Data

Total Quantities

The total plastic collected at all the hubs was 273 tonnes. The majority of 241kg was collected in the main hubs of Phase 2.2. The highest hub collection, which also had a record attendance of 77 farmers, was 40 tonnes at Dunkeswell.

The recovery of plastic was less than 800kg per farmer predicted at the start of the trial. In the main hubs, the 505kg per farmer achieved is considered to be lower than would be expected in future, as the early hubs were run before the end of the silage feed season; also indicated by a slight rise in the figure as hubs progressed. The hubs did not collect agrochemical containers, which will increase slightly now that the ban on burning of agrochemical containers is in force (May 07). The lower figure of 400kg per farmer achieved in the mini hubs has no clear reason for being lower.

Total by plastic product/type**Silage film (LDPE and LLDPE)**

- Phase 2.2: Silage film collected was 192 tonnes (79% of total)
- Phase 3: 8 tonnes (78% of total)

This includes bale film LLDPE, and clamp film LDPE. As expected, this is the highest proportion of AWP collected, due to the nature of the farming area.

String, net and fertiliser bags (PP)

The quantities of string, net-wrap and fertiliser bag outers were collected together. 50 tonnes (21%) in Phase 2.2 and 2 tonnes (22%) in Phase 3. The PP materials were not separated out for this collection, and the net wrap may have included some HDPE polymer (net wrap is made with PP and HDPE)

Figures 17 and 18 below illustrate the quantities and split of plastics collected

at Phase 2.2 and Phase 3 hubs respectively.

Figure 17 Quantity of plastic by polymer type delivered to Phases 2.2 Hubs

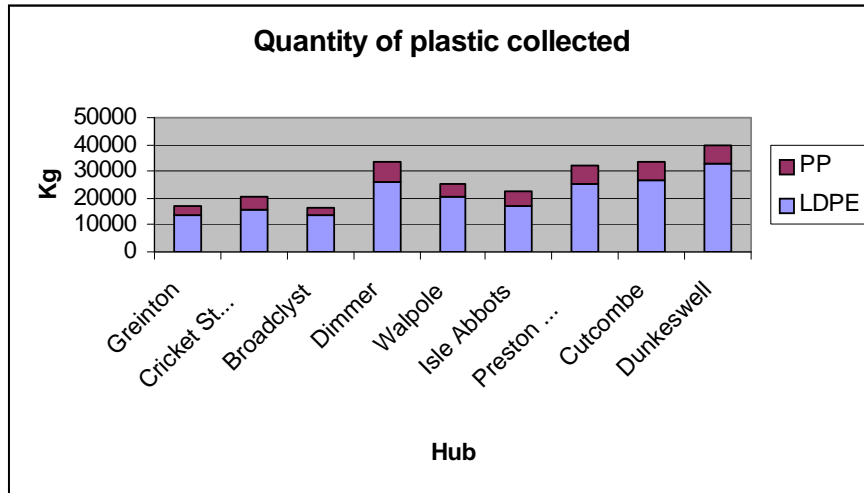
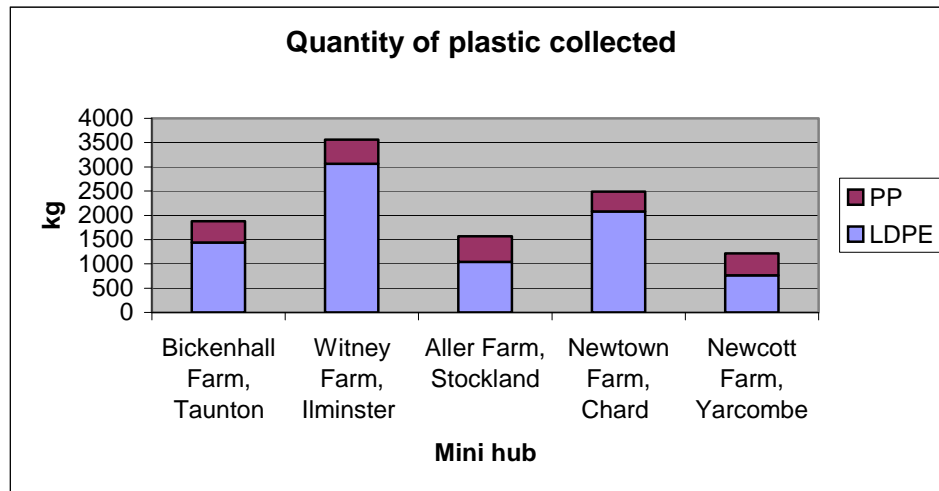


Figure 18 Quantity of plastic by polymer type delivered to Phases 3 Hubs



Economics

Introduction

The Somerset FWAG hubs were run as a trial designed to capture and collate data, incurring additional costs and expenses over and above what

would have been required under a commercial operation. It is acknowledged that in reality, there are strong elements affecting pricing which is markedly affected by local resource availability, proximity to market and level of competition.

Initial Hubs (Phase 2.1)

The operational costs of the two initial hubs are given in the table below; the total cost was £204 per tonne. The hubs were designed to operate for one day. However as shown in the table, the hubs ran for two days and three days because of the low work rate of the baler, and also machinery break down during the hub operation. As a result the cost of labour and machinery was higher for the additional days used. Taking out the third day on the second hub and reducing the labour on the second day of each hub would bring the hub costs down by £46 to £158 per tonne. This cost is higher than benchmark, and would not be viable.

Figure 19 Costs of running two collection hubs in Phase 2.1

Cost item	Date	Date	Date	Date	Date	Totals
	05/12/06	06/12/06	12/12/06	14/12/06	15/12/06	
	£	£	£	£	£	£
Hub rental	300		300			600
Baler + operator	175	175	175	175	100	800
Wheeled loader + operator	140	140	140	140	100	660
Site staff 1	250	250	250	250	150	1150
Site staff 2	150		150			300
Pallets	60					60
Weighbridge	120					120
Total cost of running two hubs						3690
Weight of AWP collected (tonnes)		8.26			(12.87)	21.13
<i>Weight of baled AWP (tonnes)</i>		<i>7.140</i>			<i>11.290</i>	<i>18.430</i>
Overall hub costs/tonne AWP collected (per tonne baled)						175 (200)
(nil gate fee for this trial)						
Transport to re-processor					400	400
<i>Weight of plastic transported (t)</i>						<i>13.76</i>
Transport cost/tonne						29
Overall collection costs/tonne AWP collected						204

Main Hubs (Phase 2.2)

The operational costs of running the 9 main hubs on the trial are summarised. The cost varies between hubs, as some hubs ran for one day and some for two days; however the two day hubs collected more plastic. The average cost of running the nine hubs was £163.21 per tonne.

Figure 20 Costs of running the nine on-farm hubs in Phase 2.2

Cost item	Averaged cost over nine hubs	Totals nine hubs
	£	£
Hub rental (average 4 single and 5 double days)	383.33	3450
Wheel loader + operator (average 4 single and 5 double days)	255.56	2300
Site staff – Registration and manager @ £250/day (14 days)		3500
Site staff – Weighing and QC. @ £150/day (14 days)		2100
Site staff – questionnaire @ £150/day (14 days)		2100
Site staff – materials management @ £150/day(14 days)		2100
Weighing equipment, van hire (£400 per day)		3600
Total cost of running five hubs		19600
Weight of baled plastic at nine hubs (tonnes)		241.341
Overall hub costs/tonne		81.21
Gate fee @ average £50/tonne		50
Transport cost/tonne @ nominal £32/tonne		32
Overall collection costs/tonne		163.21

This could be related to benchmark hub collecting, however direct comparison is difficult as the tonnage per farmer is lower, and five of the nine hubs were run over a two day period; 1.5 days operation. The cost of the trial however is higher than benchmark of £115/tonne for 27 tonnes collected (average collected per trial hub) or £130/tonne for 18 tonnes collected (27 tonnes divide by 1.5 days).

As this was a trial additional costs were incorporated:

- One additional staff member to run the questionnaire (£2100)
- One additional staff member to operate the trial weigh scales (£2100)
- The cost of transport for the trial weigh scales (£3600)
- The nominal £50 average gate fee is included. Gate fee is nil in the benchmark

Removing the additional running cost of the hub above, the cost calculates to £130 per tonne (with £50 gate fee still included). With nil gate fee cost is £80 per tonne, which is comparable with benchmark.

Mini-Hubs (Phase 3)

The cost of running the five mini hubs in Phase 3 was £947 per tonne (Figure 21 below). This is clearly uneconomical at this cost. However opportunities for cost saving include:

- The labour accounts for 60% of the costs, as the hubs were run as a trial to collect data. By operating more as a self-organised hub, the labour cost would be minimised
- The cost of the weighing equipment accounted for 22% of the cost, which in reality may not be included as the delivered weight could be used

- The gate fee of £60/tonne was paid to a local operator to transfer to the re-processor, which is higher than would be expected
- The tonnage collected was just two tonnes per mini hub, and nearer four tonnes would be expected
- Transport cost of £40 was close to the benchmark figure

Thus it can be seen that considerable saving could be made with £172 per tonne, comparable with the benchmark. This does however make an assumption that the hub would be self run by farmers taking no income for their time.

Figure 21 Costs of running the five on-farm mini-hubs in Phase 3

Cost item	Date	Date	Date	Date	Date	Totals
	02/04/07	03/04/07	04/04/07	10/04/07	11/04/07	
	£	£	£	£	£	£
Baler + operator	220	275	220	165	165	1045
Wheeled loader + operator	110	155	110	70	70	515
Site staff (+ set up, admin etc)	1100	1100	1100	1100	1100	5500
Weighing equipment, van hire etc	400	400	400	400	400	2000
Total cost of running five hubs						9060
Weight of collected AWP (tonnes)						10.72
Weight of baled AWP (tonnes)						10.3
Overall hub costs/tonne collected (per tonne baled)						847 (880)
Gate fee @ £60/tonne						60
Transport to re-processor						400
Transport cost/tonne						40
Overall collection costs/tonne AWP collected						947 (980)

Figure 22 Example self organised mini hub

Cost item	1	2	3	4	5	Totals
	£	£	£	£	£	£
Baler + operator	200	200	200	200	200	1000
Wheeled loader + operator	110	110	110	110	110	550
Site staff (+ set up, admin etc)	100	100	100	100	100	500
Weighing equipment, van hire etc	0	0	0	0	0	0
Total cost of running five hubs						2050
Weight of collected AWP estimated (tonnes)						20.0
Overall hub costs / tonne						102.5
Gate fee @ £50/tonne						50
Transport to re-processor						400
Transport cost / tonne						20
Overall collection costs/tonne AWP collected						172.5