



NATIONAL SCRAPIE PLAN

RAM GENOTYPING SCHEME REVIEW

BENEFITS REVIEW

(December 2006)

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1. Introduction

- 1.1 A review of the National Scrapie Plan's Ram Genotyping Scheme (RGS) has been requested by GB Agriculture and Rural Affairs Ministers. It has 3 workstreams:
- A review of the scientific basis for breeding for TSE resistance in sheep and related public and animal health questions.
 - A review of the **benefits** realised from the RGS.
 - The development of future options for the RGS.
- 1.2 The science review will include advice from SEAC and its Sheep Subgroup. The conclusions of the science and benefits reviews together with options for consideration will be reported in submissions to GB Ministers in December 2006.
- 1.3 The primary purpose of *this* report is to describe:
- Benefits realised from the RGS since it was launched in 2001 and to whom
 - Issues of note identified during the benefits review
- 1.4 In line with the commitment given in the survey questionnaire to RGS members it is intended that this report will be published for example on the NSP website.

2. Benefits - Conclusions and Issues

Conclusions

- Having regard to the theoretical risks as understood and described by SEAC in 1999, the RGS will have delivered a benefit to public health by increasing the genetic resistance of the national flock to ovine BSE (through increasing the levels of ARR alleles and reducing the levels of ARQ alleles in ram lambs) (11.14)
- The RGS has benefited animal health by delivering a reducing proportion of TSE susceptible genotypes in the national flock and consequently it will have contributed to a reduced risk of scrapie infections and clinical disease. This cannot be accurately quantified at present as work to assess the speed and extent of this has yet to be undertaken. (12.11)
- The RGS has delivered the capacity to comply with a range of TSE related statutory obligations. (13.9)
- The RGS as the mainstay of the NSP has been integral to meeting the aims and objectives of Government and Devolved Administration strategies concerned with both animal and public health risks from TSEs in sheep and with providing a level of assurance for the sheep industry and dependant businesses and communities against what was the perceived theoretical risk of BSE in sheep. (14.20)
- The NSP through the RGS has been highly successful in demonstrating the benefit of genuine partnership working with industry stakeholders. (15.7)
- The RGS has demonstrated that on the one hand sheep EID can provide a robust audit trail for small to large scale sampling and testing of tissues, but on the other hand the overwhelming majority of (RGS) flock owners have not been ready to employ it for purposes not connected with the RGS. (16.7)
- The RGS has provided flock owners with the means to identify and more selectively breed out a deleterious trait using scientific knowledge of sheep genetics. (17.6)
- The RGS has contributed to the burgeoning awareness amongst sheep breeders of and interest in possibilities for the identification and use of genetic markers to control diseases and to select for commercially important traits. (17.7)
- The RGS would have been able to deliver the capacity to genotype and subsequently identify more TSE resistant rams to use for breeding to provide safe slaughter lamb in the event that the BSE in sheep contingency plan had required it. (18.3)
- The RGS has an effective delivery infrastructure that has also adapted to deliver other important schemes concerned with control and eradication of scrapie. (19.8)
- The RGS has supported important initiatives concerned with the conservation of an important GB farm animal genetic resource (FAnGR). (19.9)

- Although membership of the RGS is not a pre-requisite for exports it has facilitated some exports of breeding sheep with an NSP Type 1 genotype certificate to other EU Member States, as they are exempt from EU scrapie monitoring rules which would restrict the holdings from which they could originate. (20.7)
- The provision of the RGS has been cost-effective. Its economies of scale have kept down the costs of genotyping for other NSP schemes. (21.4)

Issues

2.1 A number of common issues of concern were raised by stakeholders at various points and through various means during this review, these are:-

- Phenotype v Genotype – Notwithstanding experts' current conclusions and research work underway on genotypes and traits there remains a persistent view among flock owners that care to comment on the issue that genotypes more resistant to classical scrapie are of an inferior quality when it comes to commercial traits (4.12, 19.5, 22.22 & 36).
- Continuation – Most members felt that they would benefit if the RGS continued. In addition, an appreciable amount of those that cared to comment felt that they had invested considerable amounts of their own time, effort, and resources (such as culling good quality but susceptible animals) and that there would consequently be issues in justifying that if the scheme were not to continue. (22.23, 22.26)
- Cost-sharing – There are some divergent views on this between societies on the one hand (possibly) and flock owners on the other hand (clearly against). However, it was apparent from comments from both sectors that consideration of this was frequently qualified as being dependant on how 'reasonable cost-sharing' would be defined. (4.12, 6.6, 22.36).
- Sales – RGS has brought confidence to pedigree ram sales in so far as purchasers are assured of the genotype they are purchasing but some RGS members remain concerned that they do not see an express demand for genotypes / certificates from their commercial buyers (16.5, 22.19, 22.36)
- Science – There continues to be a misapprehension amongst some breeders as to the scientific evidence that underpins the rationale of breeding for resistance to control/eradicate scrapie, and this has been exacerbated to some extent by the emergence of the issue of atypical scrapie. (4.12, 6.6, 22.36).

3. Background to the Ram Genotyping Scheme

- 3.1 Historically, scrapie had been considered to be an animal health issue. However, between 1996-99 SEAC had been considering the control and eradication of scrapie in the UK also with public health in mind because of concern over several issues;
- MBM, suspected to be the source of the BSE in cattle outbreak in the late 1990's had also been fed to sheep and goats
 - BSE had been transmitted to sheep following experimental oral exposure;
 - TSE Infection was widespread through the carcasses of the sheep, unlike cattle infection.
 - Scrapie in sheep was underreported and it might be masking BSE – were it present in sheep;
 - SRM measures may not be adequate to control human exposure
- 3.2 It had been known for many years that sheep of a certain genetic make-up were more susceptible to scrapie than others. The difference being in the make-up of the gene responsible for the production of the prion protein PrP (the rogue form of which is associated with the development of scrapie). In general, sheep which carry one VRQ allele seemed to be more susceptible to classical scrapie and sheep which carried two VRQ alleles (VRQ/VRQ sheep) were the most susceptible to the disease. Consequently, and prior to 1999 a number of breed societies had been operating their own scrapie genotyping schemes.
- 3.3 SEAC considered this approach in their 1999 sheep subgroup report on research and surveillance on TSEs in Sheep¹. They noted that the eradication of scrapie would require improved understanding of the mechanism of transmission and of the **genetic** factors that influence susceptibility of sheep to TSEs as well as the availability of suitable diagnostic tests. They recommended that a programme for the **long-term** control and eventual eradication of scrapie should be drawn up in consultation with sheep industry representatives
- 3.4 A genotyping based breeding programme was envisaged whereby the number of rams resistant to scrapie could be increased and they would cascade their genes throughout the breeding pyramid. Ultimately it was anticipated that this could lead to the reduction and eradication of scrapie from the national sheep flock. SEAC's recommendation was endorsed by the EU Scientific Steering Committee, and the FSA.
- 3.5 Proposals for a National Scrapie Plan were developed by the GB Agriculture and Rural Affairs Departments and a public consultation on a Ram Genotyping Scheme (RGS) was launched in July 2000². This followed an extensive prior consultation with industry stakeholders.

- 3.6 As discussed in that original consultation document it was envisaged that the NSP was to be carried out in 3 phases:

<u>Phase 1</u>	Breeding for resistance through ram genotyping (RGS)
<u>Phase 2</u>	Checks for scrapie - on <i>scheme</i> farms
<u>Phase 3</u>	Programmes to help <i>scrapie-affected</i> farms

- 3.7 This (same) phased approach was subsequently envisaged in the EU SSC's opinion of April 2002.

- 3.8 The consultation document also stated that:

We propose that Phase 1 of the plan will initially operate as a voluntary scheme. However, we anticipate that in due course statutory control will follow for all Phases so that eventually, probably some years from now, the National Scrapie Plan will operate on a compulsory basis.

- 3.9 12 months later the NSP-RGS was launched. The following table is a chronology of key events in the lifetime of the scheme since then

July 2001	RGS for Purebred Registered Flocks launched.
January 2002	RGS for Purebred Non-Registered flocks launched.
Spring-Autumn	Rare Breeds genotype Survey.
November 2002	Relaxation of breeding / sale restrictions on Type 3 rams.
December 2002	One-off ewe genotyping scheme (Dec '02-March '03)
January 2003	RGS in Northern Ireland launched (part of NISP).
April 2003	NSP Ram Register launched.
July 2003	Welsh Ewe Genotyping Scheme II launched.
April 2004	Voluntary Scrapie Flocks Scheme launched.
April 2004	Extension of the requirement to slaughter NSP Type 4 & 5
June 2004	Millionth sheep sampled under the RGS
July 2004	Compulsory Scrapie Flocks Scheme (CSFS) launched
July 2004	NSP/NISP Semen Archive launched.
July 2004	NSP strategic review – public consultation.
November	CSFS launched in Wales
January 2005	Decision for a compulsory scheme to replace RGS.
January 2005	End of restrictions on breeding / sale of Type 3 rams.
June 2005	NSP Flock Register launched.
July 2006	Suspension of CRGS plans pending a review of the RGS

4. The EU dimension

- 4.1 The requirements for ram genotyping as they exist at the time of this review emanate from harmonised EU-wide controls to address TSEs in sheep which are proposed by the European Commission and agreed at European level.
- 4.2 Until May 2003 the Commission received scientific advice on consumer health and food safety from its Scientific Steering Committee (SSC). It had regard to SSC opinions and statements in formulating its proposals for the control and eradication of TSEs. Since then this advice is now provided by the European Food Safety Authority (EFSA).
- 4.3 Key SSC communications concerned with breeding for scrapie resistance are its:
- Opinion on the risk of infection of sheep and goats with BSE agent. (September 1998).
 - Statement on the SEAC Subgroup report on research and surveillance for TSEs in sheep (April 1999).
 - Opinion on Surveillance of TSEs in sheep and goat in relation to the risk of infection with BSE agent and related actions to be taken at EU level (on the basis of the above opinion and statement).
 - Opinion on the policy of breeding and genotyping of sheep, i.e. whether sheep should be bred to be resistant to scrapie (July 1999)
 - Opinion on safe sourcing of small ruminant materials (April 2002).
- 4.4 The July 1999 SSC opinion advised that Member States should:
- Reduce the levels of scrapie susceptibility in the EU sheep flock;
 - Evaluate Member States breeding programmes (including the GB-NSP);
 - Genotype sheep and acquire a view on the distribution of the various genotypes in the national flocks.
 - Thereafter give strong consideration to the use of appropriate resistant strains of sheep.
 - Have regard to phenotypic characteristics.
- 4.5 The April 2002 SSC opinion contained various recommendations for breeding programmes for TSE resistance including (but not limited to):
- Acceptable methods of identifying individual sheep (e.g. electronic boluses);
 - Knowledge of genotype prevalence (to assess the speed towards ARR predominance);
 - Monitoring of breed characteristics in resistant genotypes.

- 4.6 The April 2002 SSC opinion led directly to the adoption of Commission Decision 2003/100 of 13 February 2003 which laid down minimum requirements for the establishment of breeding programmes for resistance to TSE in sheep (see also para [13.7](#) below)
- 4.7 The Decision required that Member States breeding programmes for TSE resistance were to
- Be focused on flocks of high genetic merit (to be defined by each Member State);
 - Have a database of individual animals tested;
 - Use specifically designated personnel for sampling;
 - Use identification/processes, animals/samples, in a way which minimised possible human error;
 - Genotype samples in specifically approved laboratories
 - Assist breed societies, on a discretionary basis, to establish banks of germplasm from susceptible sheep genotypes.
 - Have regard to breed allele frequencies
 - Have regard to breed rarity
 - Avoid inbreeding or genetic drift.
 - Increase the frequency of the ARR allele within the sheep flock
 - Reduce the prevalence of TSE susceptible alleles
- 4.8 The minimum rules for participating flocks were to be that:
- All animals in flocks being genotyped should be individually securely identified;
 - All rams intended for breeding within the flock would be genotyped before being used for breeding
 - VRQ males must be slaughtered or castrated within six months of being genotyped
 - Such males would only leave the holding for slaughter;
 - Females known to carry the VRQ allele would only leave the holding for slaughter;
 - Only male animals certified under the programme for breeding within the flock could be used for semen donation for artificial insemination
- 4.9 In order to protect rare breeds and production traits Member States would be able to grant certain derogations for breeds with a low level of ARR alleles, or which are in danger of being lost to farming.
- 4.10 Allied to the breeding programme Member States were also required to introduce a programme to recognise the TSE-resistant status of certain sheep flocks – i.e. a “Flock Register”. The aim was to encourage farmers to breed for scrapie resistance and to provide a known source of resistant animals.

- 4.11 More recently, in July 2006, at the request of the Commission the EFSA Biohazards Panel published an opinion³ on the EU-wide breeding programme for TSE resistance in sheep. This had regard to issues such as resistance against other disease, risks of inbreeding, the emergence of atypical scrapie, the prevalence of different TSEs, and the eradication programmes for BSE and for classical scrapie.
- 4.12 The Panel concluded that:
- No general adverse affects were apparent from breeding for resistance
 - There was no evidence for the counter-selection of other TSE strains (including atypical scrapie)
 - Thus far no negative effects on production traits or susceptibility to other diseases had been proven
 - The current breeding programme could be expected to reduce the occurrence of TSEs – but over the long term
 - There is a low risk of disease in ARR/ARR animals in flocks with atypical scrapie
 - The current breeding programme should thus continue, with rapid eradication of the most susceptible alleles.
- 4.13 Questions concerned with public and animal health and this opinion from EFSA will be considered by SEAC and will feed into the reviews science work stream (paragraph 1.1). It is however understood that SEAC does not concur fully with all of the above-mentioned key points of EFSA's opinion.
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5. The RGS Reviewed (2004)

- 5.1 The RGS has been a voluntary scheme since its launch in 2001. It has already been the subject of a previous strategic review in 2004-5⁴.
- 5.2 There were three key drivers back then for that review. Firstly, against the backdrop of significant public expenditure on the RGS it was appropriate to review and evaluate whether the NSP's aims and objectives were being met, whether there remained a scientific justification for breeding for resistance and, if so, whether it related to public health, animal health, contingency planning for BSE in sheep, or indeed all three. The views of SEAC were sought as part of that consultation.
- 5.3 Secondly, recently published EU legislation (paragraphs 4.6 and 13.7) would eventually require genotype based breeding programmes on a compulsory basis in all flocks of 'high genetic' merit and decisions needed to be taken on whether in Great Britain Departments should apply the minimum requirements of that legislation, the RGS as it was then, or some measure in between.
- 5.4 Thirdly, the operation of the NSP was to be guided by the Animal Health and Welfare Strategy for Great Britain published in June 2004 and the principles for Government decision making and for Government intervention contained in it.

- 5.5 The conclusion of that review, announced in January 2005⁵ was that the approach to dealing with TSEs in sheep underpinned by the NSP-RGS was still valid, and, that the RGS would transit to a *compulsory* ram genotyping scheme (CRGS) scheme.
- 5.6 The CRGS was to be focused on the removal of VRQ genotypes and would apply in flocks of high genetic merit (as per the above-mentioned EU [Legislation](#)), and with additional genotyping of rams/shearlings/ram-lambs intended for sale and further breeding elsewhere. It was envisaged that there would eventually also be a voluntary ewe testing scheme conditional on the eventual removal of ARQ/ARQ breeding rams in participating flocks. Work was underway to develop the infrastructure to launch that scheme before the end of 2006.
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6. This RGS Review (2006)

- 6.1 Since the above-mentioned review a number of developments delayed the launch of the planned CRGS scheme and resulted in the current review of the RGS.
- 6.2 Firstly, the above-mentioned EU legislation which mandated the CRGS scheme was a 'transitional' EU Commission 'Decision'. Consequently, the Commission was required to prepare a proposal to provide a permanent legal basis for compulsory genotyping - within the main EU TSE Regulation. That proposal was subject to the EU's co-decision procedure⁶ and thus had to be presented to and approved by the EU Council of Ministers *and* the EU Parliament (EP).
- 6.3 Subsequently in its deliberations on the Commission's proposal the EU Parliament's Committee on the Environment, Public Health and Food Safety expressed doubts about the scientific basis of such programmes and their potential to impact adversely on genetic diversity and on rare and locally adapted breeds. Accordingly they proposed an amendment⁷ to the Commission's proposal so that breeding programmes for scrapie resistance must have regard to such issues and significantly that they would however be voluntary and discretionary for each Member State. Those Member States which decide to continue or introduce such programmes will be required to so on the basis of EU harmonised rules.
- 6.4 The Commission accepted the EP amendments to their proposal. These were adopted by the Council of Ministers in December 2006.
- 6.5 Secondly, following the introduction of more rigorous surveillance and using new, sensitive, diagnostic tests, there have been reports across Europe, including in Great Britain of what appears to be a previously undetected form of scrapie, termed 'Atypical scrapie'⁸. There are some clear differences between the newly identified atypical scrapie and the classical strains of scrapie that are well documented in the UK.
- 6.6 What is also notable about these atypical cases are the genotypes in which they occur. Whereas for classical scrapie the VRQ allele appears to confer most susceptibility with the ARR allele conferring the most resistance, the atypical cases tend to occur in sheep carrying the alleles considered to be more resistant to classical scrapie, including the ARR allele.
- 6.7 Thirdly the European Food Safety Authority has recently published an [opinion](#) on breeding for scrapie resistance, and they are due to produce a quantitative risk assessment on BSE in sheep, possibly by the end of 2006.

- 6.8 Other considerations include the availability now of diagnostic tests that can distinguish scrapie from experimental BSE in sheep, which are in use within the national sheep TSE surveillance programme surveys, and which have also been used to test historical tissue samples, without thus far detecting BSE. Latest modeling work on the likely prevalence or otherwise of BSE in sheep will be considered by SEAC as part of the work mentioned at 1.1 above.
- 6.9 Because of the various developments outlined above GB Ministers decided that it was appropriate for the existing voluntary Ram Genotyping Scheme (and the NSP's Flock Register) to be reviewed prior to a public consultation early in 2007 on options for their future.
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7. Aims of the NSP and RGS

- 7.1 The overall aims of the NSP have been to protect both
- animal health by reducing and eventually eradicating scrapie and;
 - public health from the theoretical risk of BSE (if it is there and being masked by scrapie)
- by increasing the levels of genetic resistance to TSEs in the national flock.
- 7.2 The RGS was established as the key part of the NSP strategy to meet these aims.
- 7.3 The RGS aims were thus to increase the proportion of scrapie –resistant rams in the national flock and hence, over time, levels of resistance in the flock as the progeny of those rams are used for future breeding whilst at the same time selecting out the susceptible alleles.
- 7.4 The underlying principle behind the RGS is that use of resistant rams to breed resistant rams and ewes of the same breed would lead to more resistant purebred stock at the top of the breeding pyramid. This, in time, would lead to increased resistance over the national flock as rams from the purebred sector were passed onto the commercial sector.
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8. RGS Facts and Figures

- 8.1 Membership of the RGS has progressed at an encouraging rate since its launch. The current membership stands at over 12,397 (NSPAC data October 2006).
- 8.2 This probably accounts for the vast majority of purebred tup producing flocks nationwide although it is very difficult to put a figure on the exact number of flocks as no authoritative census data exists on the number of ram and ewe breeders in GB.

- 8.3 The 2003 British Sheep Breed Survey⁹ estimated that there were around 13,559 tup producers in GB. However this survey did not include the Shetland or Western Isles and so needs to be increased by a further 1,000 or so (data from SEERAD). How this translates in terms of RGS membership is impossible to gauge because whilst most terminal sire and long wool flocks will actively trade in both rams and ewes, a large percentage of purebred hill flocks will only sell ewes but not rams:
- 8.4 Some 88 breeds have participated in the RGS to date with the proportion of purebred tup producing flocks reflecting the role each breed has in the stratification of the industry.
- 8.5 For the 41 breed societies that responded to a questionnaire survey for this RGS benefits review (Section 23 below) the following table shows their estimates of both their total registered membership and how many of these are primarily tup producers. This illustrates that significant percentages of breed society memberships participate in the RGS.

Breed membership data from: NSPAC & Breed Society responses the benefits review questionnaire (Section 22.)

	(A)	(B)	(C)	(D)	(E)	(F)	(G)
Breeds responding	NSP Membership (Registered)	NSP Membership (Non-Registered)	NSP Membership Total	Breed Society (Reported membership)	Breed society - members in NSP (Reg'd) (A as % of D)	Breed Society (Reported number of tup breeders)	% of Breed Society's members as tup producers (F as % of D)
Badger Face Welsh Mountain	145	34	179	285	51%	100	35%
Beltex	201	47	248	408	49%	100	25%
Berrichon du cher	46	7	53	60	77%	25	42%
Blackface	349	229	578	1300	27%	300	23%
Black Welsh Mountain	131	25	156	240	55%	not reported	not reported
Bleu du maine	33	4	37	200	17%	20	10%
Blue Faced Leicester	820	182	1002	1200	68%	1200	100%
British Milk Sheep	1	0	1	3	33%	3	100%
Cambridge	6	2	8	12	50%	4	33%
Castlemilk moorit	3	1	4	75	4%	0	0%
Charrollais	380	127	507	780	49%	700	90%
Cheviot	64	85	149	123	52%	50	41%
NCC	240	106	346	380	63%	100	26%
Shetland Cheviot ¹				70		not reported	not reported
Cheviot total	304	191	495	573	53%		-
Clun	36	2	38	60	60%	15	25%
Dalesbred	49	3	52	110	45%	50	45%
Easy care	0	30	30	80	0%	20	25%
Friesland	4	6	10	45	9%	not reported	-
Greyfaced Dartmoor	71	4	75	250	28%	15	6%

¹ Shetland Cheviot is a cross breed. They sent in a questionnaire but participate in the NSP as separate breeds (i.e. NCC tups put on to Shetland ewes).

	(A)	(B)	(C)	(D)	(E)	(F)	(G)
Breeds responding	NSP Membership (Registered)	NSP Membership (Non-Registered)	NSP Membership Total	Breed Society (Reported membership)	Breed society - members in NSP (Reg'd) (A as % of D)	Breed Society (Reported number of tup breeders)	% of Breed Society's members as tup producers (F as % of D)
Hampshire Down	92	11	103	250	37%	50	20%
Herdwick	78	37	115	150	52%	60	40%
Kerry Hill	102	21	123	200	51%	40	20%
Llanwenog	82	7	89	160	51%	100	63%
Lonk	25	8	33	70	36%	20	29%
Manx	19	4	23	70	27%	10	14%
Meatline	6	0	6	7	86%	7	100%
North Ronaldsay	1	2	3	70	1%	not reported	-
Oxford Down	42	6	48	62	68%	40	65%
Rouge	23	1	24	150	15%	50	33%
Rough Fell	55	5	60	206	27%	50	24%
Shetland (mainland)	189	146	335	388		0	0%
Shetland (Island flock book)				108		52	48%
Shropshire	56	5	61	150	37%	5	3%
Southdown	136	13	149	299	45%	10	3%
Suffolk	842	440	1282	946	89%	900	95%
Swaledale	570	72	642	1280	45%	not reported	-
Texel	1348	557	1905	2700	50%	2032	75%
Welsh Mountain (reg'd)	204	450	654	60	43%	15	25%
Welsh Mountain (Hill section)				420		60	14%
Whitefaced Dartmoor	10	7	17	41	24%	20	49%

9. The review approach to identification and quantification of RGS benefits

- 9.1 For this review a benefit has been taken to be an actual or likely improvement since 2001 to present of an indicator relevant to achieving the aims and objectives of the RGS (or NSP), or a related policy or initiative. The RGS could therefore be expected to produce many if not dozens of benefits during its lifetime (for example in relation to individual breeds).
- 9.2 An assessment of these benefits is presented in Sections 10-21 below.
- 9.3 To help identify the benefits realised questionnaires were devised and were sent to RGS members, Breed Society Secretaries, colleagues in the GB Devolved Administrations, the SVS, the FSA, and to other stakeholders.
- 9.4 A double page postal questionnaire was sent to 10,200 RGS members registered with the NSP Administration Centre (NSPAC) in Worcester. 38% of the forms were returned in time to inform this review (2% were not). Virtually all were usable. The Members and Breed Society survey forms are at [Annex A](#) and [Annex B](#).
- 9.5 RGS members' responses were anonymous and were used for the purpose of producing aggregated survey data. There was no obligation on anyone to respond.
- 9.6 Summaries of the RGS Members and Breed Society surveys results are presented in sections 22 and 23. The complete data sets are available on request.

10. RGS - Benefits

- 10.1 The following list identifies the major areas where benefits that could reasonably be expected to have been realised from the scheme have been examined.

- [Protection of Public Health](#)
- [Protection of Animal Health & Welfare](#)
- [Delivering on Statutory Obligations](#)
- [Delivering Departmental Strategies on TSEs](#)
- [Improving stakeholder relationships](#)
- [Secure \(Electronic\) Sheep/Sample Identification](#)
- [Utilising Genetic advances for Selective breeding](#)
- [Protection against risks to consumer confidence](#)
- [Supporting other NSP Schemes and Initiatives](#)
- [Supporting intra-community trade in breeding sheep](#)

- 10.2 The following sections 11 – 21 describe the benefits that have been realised from the RGS in these areas.

11. Protection of Public Health

- 11.1 Government's past and present have introduced successive precautionary measures to address the risk that BSE might have been transmitted to sheep in the national flock and maintained as an infection. These included the bans on the recycling of animal protein in feed, SRM controls, and the compulsory slaughter of suspect scrapie cases, and more recently active surveillance and more extensive genotyping and culling action on scrapie-affected farms.

- 11.2 As noted in section 3 above, in 1998-99 SEAC's sheep subgroup produced a report on research and surveillance on TSEs in Sheep¹⁰. They reviewed amongst other things: the risk of BSE being present in the national flock, related research, sheep PrP genetics, and the public (and animal) health risks. They recommended that

'A programme for the long-term control and eradication of scrapie should be drawn up in consultation with sheep industry representatives through the Scrapie Information Group.'

- 11.3 The high level aims of the NSP-GB as agreed between Government and Devolved Administration stakeholders, and subsequently published in its programme brief¹¹, were/are to protect:

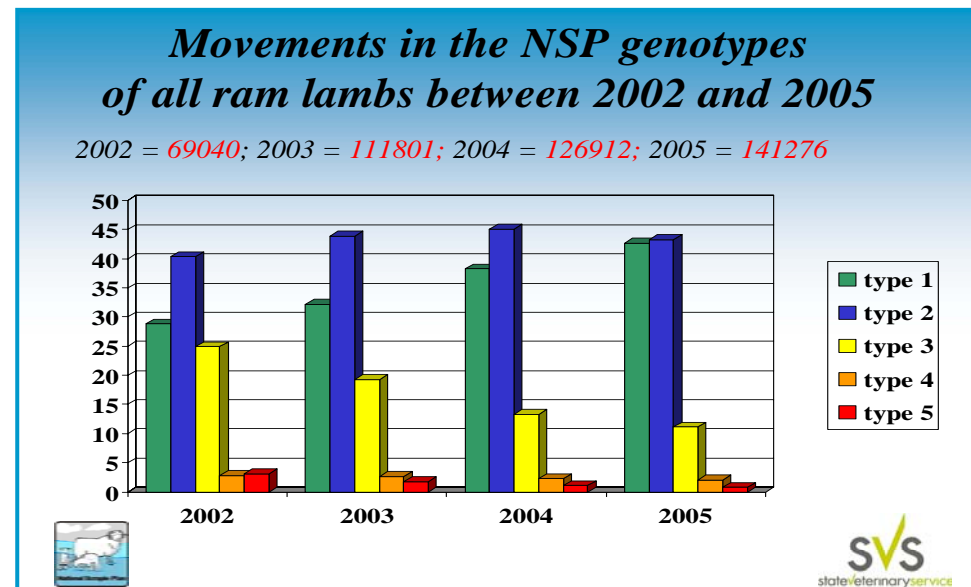
- **animal health** by reducing and eventually eradicating scrapie and;
- **public health** from the theoretical risk of BSE (if it is there and being masked by scrapie)

by increasing the levels of genetic resistance to TSEs in the national flock.

- 11.4 The subgroup report and recommendation were subsequently considered and endorsed by SEAC¹², and by the European Union's Scientific Steering Committee (SSC)¹³ and the FSA.
- 11.5 In 2001 the RGS was therefore launched against a background of increasing concern about the risk of sheep TSEs.
- 11.6 At the time officials were also considering prioritising the use of genotyping capacity should evidence emerge from the TSE research and surveillance programme indicating that BSE was present in sheep. Thus an important supplementary role for the NSP was not just identifying a way to build up a more TSE-resistant national flock for the future, but also finding a way of allowing some sheep to pass into the human food chain in the short term should BSE be found in sheep ([14.16-19](#)).
- 11.7 The genotyping approach has more recently been endorsed by EFSA ([4.12](#)).

Progress delivered

- 11.8 Periodic analyses of progeny genotype data from NSP flocks, which constitute a significant proportion of suppliers of breeding males, show that the RGS **is delivering** increased genetic resistance. This is illustrated in the following tables of NSP data of ram lamb genotypes between 2002-2005.



- 11.9 The RGS has genotyped rams/ram lambs in the vast majority of tup producing flocks in GB. The genotype/allele frequencies have moved significantly towards reduction of disease risk. In participating flocks the % frequency of VRQ has reduced by 50%, ARQ by 30%, and the % frequency of ARR in ram lambs has increased by 30%. Consequently this will lead to a reduction of disease risk in progeny.

Changes in allele percentage frequencies of ram lambs 2002-2005

	ARR	AHQ	ARH	ARQ	VRQ
2002	50.4	7.4	9.9	29.2	3.0
2003	55.6	7.5	7.7	26.9	2.3
2004	62.0	6.5	6.9	22.9	1.7
2005	65.4	5.9	6.3	20.9	1.5

svs
stateveterinaryservice

- 11.10 In addition the work of Warner et al 2006¹⁴ shows that in the ram lambs of 11 prominent breeds tested between 2002 and 2004 there was a progressive decrease in the proportion of lambs carrying the susceptible VRQ allele and an increase in the proportion carrying the resistant ARR allele. He recognises that change in the overall PrP genotype profile of a breed's ram lambs from one year to the next is a useful indicator of RGS progress and also that it can disguise the wide range of progress achieved in individual flocks, for example between flocks that have joined in the same year, and between those that have newly joined and have less well developed (improved) genotype profiles and who will therefore 'dilute' the effect of flocks that have presented ram lambs for genotyping in one or more previous years. The results from Warner et al show that for the majority of breeds examined the genotype profiles were most highly developed/improved in flocks that had been testing longest.
- 11.11 Warner states that it would be interesting to compare the measurable changes in the RGS members genotype profiles with those that were predicted by Arnold and others (2002) and by Roden (2002). However, due to operational changes that were put in place to the NSP RGS largely as a consequence of EU requirements none of the strategies described will provide a satisfactory benchmark against which to monitor the actual changes in the NSP flocks.
- 11.12 The RGS targets the pure-bred sheep sector that sits at the top of the breeding pyramid and the rams from these flocks are subsequently used in other flocks further down the pyramid. This means that the genotypes present in the rams from the pure-bred sector will filter down to the rest of the sheep population. Thus Warner suggests that one possible method is to determine the change in PrP genotype profile of the slaughter lamb population.
- 11.13 Roden (2002)¹⁵ estimated that in 2001 the frequency of slaughter lambs in the population having at least one ARR allele and no VRQ allele would be about 69%. It was predicted that if uptake of the RGS were 100% among pure-bred flocks (pedigree and commercial) it would increase this to 76% in 2007 and 85% in 2012. With (current) uptake rates, weighted by breed and number of rams sold, the level will be 73% in 2007 and 80% in 2012. It is understood that more recent but unpublished modeling work by Roden and Gubbins which will have been informed by available RGS data estimates the *current* level of slaughter lambs in the population having at least one ARR allele and no VRQ allele at 79%.
- 11.14 This was a predictive model and needs to be validated by looking at what the actual PrP genotypes look like within the slaughter lambs population. Although this sounds like a simple task, it is not as straightforward as it would appear as lambs from different sectors and from different breeds enter the food chain at different times of the year. So to ensure that the true genotype profile of the lamb population is measured with the minimum of bias, Defra has initiated a research project to design an abattoir survey to determine the genotype profile of the slaughter profile of lamb population (SE0244). A decision on whether or not it is possible to undertake will not be made until 2007.

Conclusion

- 11.15 Having regard to the theoretical risks as understood and described by SEAC in 1999, the RGS will have delivered a benefit to public health by increasing the genetic resistance of the national flock to ovine BSE (through increasing the levels of ARR alleles and reducing the levels of ARQ alleles in ram lambs).

12. Protection of Animal Health and Welfare

- 12.1 The NSP objective of protection of animal health and welfare was implicitly recognised by SEAC and other stakeholders and is explicitly stated in the original 2001 consultation document and NSP aims as published in the Programme Brief and elsewhere (see above).
- 12.2 More recently, in 2004, this has been reiterated and emphasised in the GB Animal Health and Welfare Strategy whose overarching aim is to
- ‘...make a lasting and continuous improvement in the health and welfare of kept animals’
- 12.3 The RGS has been cited as a significant example of meeting this aim ([14.14-15](#)).

Longer term

- 12.4 Having regard to the data referred to in the preceding section, it can be surmised that the RGS will have led to a cascade of resistant genotypes down through the stratified structure of the national flock (more particularly the last 2-3 years). Targeting the top end of the breeding pyramid, i.e. the purebred sector, was always envisaged as being the most effective way of delivering RGS aim of increased resistance over time¹⁶. The longer-term benefit will accrue from continued cascading of resistant genes from any ongoing initiatives to breed for scrapie resistance. Some members (7.5% of the benefits survey respondents submitting written observations) commented that commercial buyers do not proactively purchase tups on the basis of known genotypes (but seemingly rely on the vendors membership of the RGS for assurance). This perception has been reiterated by the Meat and Livestock Commission (MLC). This may mean that the ‘draw down effect’ may, thus far, not be as strong as it might otherwise have been.

Short to medium term

- 12.5 In terms of more immediate benefits to animal health and welfare the infrastructure developed to deliver RGS genotyping supports the more active approaches taken on farms that have been confirmed as sources of infection ([13.4](#) & [19.1](#)). Certainly the risks from these holdings, due to the more active selection of resistant genotypes, has been very much reduced by these schemes, but the extent to which that has been successful in contributing to the long term reduction in scrapie is at present difficult to measure.
- 12.6 Scrapie has been endemic in the national flock for hundreds of years. It has always been significantly under-reported despite being a notifiable disease since 1993. Consequently, ongoing ‘active’ surveillance with tracing of disease to affected premises and the removal from them of susceptible genotypes, and genotyping and selective breeding for resistance in non-affected premises are effective ongoing means of achieving a (real) reduction of infections and clinical disease, and eventual eradication of the disease.
- 12.7 Although scrapie is under-reported we can see from the RGS members survey that 49.6% of respondents have said the control and prevention of scrapie was one of the top reasons they joined the Scheme ([22.8](#)).

- 12.8 One of the most obvious ways to assess the progress of the RGS would be to monitor the prevalence of TSEs in the national sheep flock. However scrapie has a relatively low incidence in the sheep population, which makes it difficult to measure and to monitor small changes in the prevalence. Although active TSE surveillance is carried out on sheep at the abattoir and as fallen stock as part of an EU wide programme of surveillance, the numbers are not sufficient to allow the prevalence of the disease to be accurately monitored.
- 12.9 Defra have been aware that this was an issue and to help address this problem initiated a research project to design scrapie surveillance strategies in Great Britain. The outcomes of this project will help provide estimates of the frequency of scrapie in the national flock and to suggest modifications to the existing surveillance strategies to allow more accurate estimates of the prevalence of scrapie to be obtained.
- 12.10 As this project is not due to report until 2008 it has not been possible to properly assess the progress the RGS may have had on scrapie prevalence.

Conclusion

- 12.11 The RGS has benefited animal health by delivering a reducing proportion of TSE susceptible genotypes in the national flock and consequently it will have contributed to a reduced risk of scrapie infections and clinical disease. This cannot be accurately quantified at present as work to assess the speed and extent of this has yet to be undertaken ([14.7](#)).

13. Delivering on Statutory Obligations

- 13.1 The UK including GB has had the following legal obligations concerned with the surveillance and control of sheep TSEs.

A survey of scrapie genotypes.

- 13.2 In late 2002 in response to a recommendation from the EU's Scientific Steering Committee (SSC) an EU Decision¹⁷ required Member States to estimate the frequency of ARR carrying sheep for their important breeds. The Commission needed this to consider the application of future scrapie controls concerned with genotypes and breeding for resistance.
- 13.3 This source of this data for the UK was the large number of NSP-RGS results that had been generated by late 2003.

Taking disease control action on affected holdings

- 13.4 Since late 2004 the (EU-wide) requirement¹⁸ to either slaughter all small ruminants on a scrapie-affected holding, or genotype of the entire sheep flock with selective culling has been enforced in Great Britain through the Compulsory Scrapie Flocks Scheme (CSFS). This can involve the resource intensive genotyping of large numbers of animals on single premises.
- 13.5 In addition the NSP also genotypes animals on other holdings in an effort to identify Type 1 rams that may then be used as replacement animals on affected holdings.

- 13.6 The infrastructure put in place to deliver the RGS enabled the testing required for this scheme.

(Voluntary) breeding programmes for scrapie resistance in flocks of high genetic merit

- 13.7 EU legislation¹⁹ required Member States to operate voluntary breeding programmes for scrapie resistance by January 2004, to be compulsory in flocks of high genetic merit by 2005. These requirements have recently been dropped and the Commission is instead proposing harmonised rules to be applied by those Member States who decide they wish to operate such programmes.

Recognition of flocks TSE-resistant status

- 13.8 The same EU legislation also required Member States to establish a framework for the recognition of the TSE-resistant status of sheep flocks. Participation is voluntary with flocks categorised (A to E) according to their prevalence of NSP Type 1, 2, and 3 genotypes. Flock owners do *not* have to be NSP-RGS members. However, all rams in FR flocks (and ewes in category A which requires all rams and ewes to be Type 1) have to be NSP certified i.e. if the flock is not in the RGS they will have previously been tested through the RGS. Member States will now also have the discretion to operate such a flock register. The NSP Flock Register in GB is also subject to a separate review at this time.

Conclusion

- 13.9 The RGS has delivered the capacity to comply with a range of TSE related statutory obligations.

14. Delivering Departmental Strategies on Sheep and TSEs

- 14.1 The RGS is the core vehicle for delivery of the NSP's aims and objectives as referred to previously. It therefore enables GB Agriculture and Rural Affairs Departments to deliver a number of past and present national strategies concerned with sheep and TSEs. These are currently as described below. They may of course evolve over time.

UK Action Plan for Farming (2000)

- 14.2 The Action Plan for Farming was announced by the Prime Minister on 30 March, 2000. It was intended to help chart a way out of the financial crisis seen to be affecting agriculture, and 'help farmers to find new and better ways to make their businesses more resilient, more efficient and more responsive'. It said:

'The Government will work for the reduction of scrapie in sheep with the Objective of making a start this year (2000) with a voluntary scheme for breeding based on ram genotyping.'

Strategy for Sustainable Farming and Food

- 14.3 The Policy Commission on the Future of Farming and Food was set up by the Prime Minister in August 2001. Its remit covered England. Its report²⁰ to Government of 29 January 2002 commented on the NSP-RGS as follows:

Late last year, the Government launched the National Scrapie Plan, whose object is to breed resistance to scrapie (and possibly BSE) in the national sheep flock. This is an important initiative. We encourage sheep farmers to participate in the voluntary National Scrapie Plan. We regard it as vital that Government, the sheep industry and other stakeholders work closely together to ensure its success. This should be given the very highest priority by Defra.

- 14.4 In response the Strategy for Sustainable Farming and Food launched by the Government on 12 December 2002 said:

*The Government was very pleased to launch the NSP and congratulates the State Veterinary Service and others involved in this **major** achievement. ... We also note the close co-operation of key stakeholders throughout the ongoing development of the plan, which has led to adaptation of some of the NSP rules to recognise the differing circumstances of individual breeds. The Animal Health Act, which received Royal Assent in November 2002, provides the Government with enabling powers to make participation in the NSP compulsory at an appropriate future date. We urge all eligible farmers to join the NSP to help secure its **animal** and **public** health objectives of developing a **scrapie** and **BSE** resistant national flock.*

- 14.5 In February 2006 Sir Don Curry was appointed by the Defra Secretary of State to lead the governance of the Strategy for three years.

Defra's PSA9 target.

- 14.6 Defra currently has a public Service Agreement²¹ with the Treasury; essentially a contract between Defra and the Treasury to deliver a number of performance targets and increase the productivity of operations in return for the resources allocated to the Department. PSA 9 is:

To improve the health and welfare of kept animals, and protect society from the impact of animal diseases, through sharing the management of risk with industry, including:

- *a reduction of 40% in the prevalence of scrapie infection (from 0.33% to 0.20%) by 2010.*

- 14.7 This target for a reduction in scrapie prevalence is based on work undertaken by the VLA and WIRS. Research is underway to provide best estimates of the annual prevalence of infection. This will allow the detection of significant changes in prevalence. When these methods have been developed the results will be published in the scientific literature together with the resulting prevalence estimates. In the meantime, the prevalence will be monitored through the results of testing fallen stock and those from the abattoir survey and statistical analysis of the trend over time will be possible with the accumulation of additional annual estimates.

Scotland – ‘A Forward Strategy for Scottish Agriculture (June 2001)’

- 14.8 Following a review of priorities and directions for Scottish agriculture this strategy initiative²² emphasised the importance of concerted action to protect and enhance the health status of Scottish farmed livestock. One of its aims is that the Executive will work with other UK Agriculture Departments to speed up the eradication of scrapie from sheep. Similarly for the GB Animal Health and Welfare Strategy the Executive’s target is to press forward to speed up the eradication of TSEs including Scrapie in sheep.
- 14.9 In Scotland the RGS has been important in supporting this aim.

Wales - ‘Farming for the Future Strategy’ (November 2001)

- 14.10 In its Strategy document²³ the National Assembly for Wales noted its work with DEFRA and SEERAD to implement the NSP/RGS, and that it is funding additional work through the Welsh Sheep Strategy.
- 14.11 It states that in conjunction with Defra and SEERAD it will work with the farming unions and the industry in Wales to eradicate scrapie from the sheep flock. It describes this as a ‘critical priority’.
- 14.12 The Welsh Assembly Government (WAG) also operates the Welsh Ewe Genotyping Scheme (WEGS II) for Welsh flock owners - who must also be members of the RGS. The first Welsh Ewe Genotyping scheme was developed by WAG at the same time as the RGS.
- 14.13 In Wales the RGS has helped to support these National Assembly aims. These two complimentary schemes have practical benefits for Welsh flock owners who can gather their sheep for 1 visit rather than separate ones. Furthermore, the economies of scale derived from the different NSP genotyping schemes including RGS and WEGS drives down the unit costs of the tests, to the benefit of the taxpayer.

GB Animal Health and Welfare Strategy (June 2004)

- 14.14 The Animal Health and Welfare Strategy²⁴ for Great Britain is the route map for work to improve the health and welfare of kept animals in England, Scotland and Wales. It is a Strategy for all who have a role to play – Government, the food and farming industry, vets, consumer groups and many others. Its aim is to:
- “develop a new partnership in which we can make a lasting and continuous improvement in the health and welfare of kept animals while protecting society, the economy, and the environment from the effect of animal disease”.*
- 14.15 The Strategy England Implementation Plan (2004) noted that the NSP/RGS strongly supported three of the Strategy’s strategic outcomes/themes of:
- working in partnership;
 - promoting the benefits of animal health and welfare: prevention is better than cure; and
 - delivering and enforcing animal health and welfare standards effectively.

FSA Strategic Plan (2005 – 2010)

- 14.16 Animals that are known disease suspects or that are clinically affected cannot go for slaughter for the food chain. Such animals will be disposed of under the NSP CSFS so that they do not present a risk to consumers. The Food Standards Agency's strategic plan 2005-2010²⁵ includes a commitment to protect consumers from the risk of TSEs by implementing and enforcing proportionate and effective controls in relation to UK-produced sheep meat.
- 14.17 A critical element of this is therefore the control of the risk occurring at source, by action to reduce the prevalence of TSE disease in sheep being bred for the food chain. Thus, the RGS, by increasing genetic resistance in participating GB breeding flocks contributes, directly to this FSA aim.
- 14.18 In addition, scientific risk assessment work commissioned by the FSA has shown that, of the measures potentially available to protect consumers from the possible risk of BSE in sheep, genetically-based measures² provide the highest level of risk reduction. Such measures would require lambs for slaughter to be produced using breeding stock known to be of an appropriate genotype. Consequently, should BSE ever be found in UK sheep, restrictions on the genotypes of sheep allowed to enter the food supply might, depending on a risk assessment, be considered necessary to manage the resulting consumer risk.
- 14.19 In those circumstances, the systems put in place under the RGS for the production of animals for breeding of certified more-resistant genotypes could provide a basis on which proportionate and effective consumer protection measures could be introduced, in line with the Agency's objectives.

Conclusion

- 14.20 The RGS as the mainstay of the NSP has been integral to meeting the aims and objectives of Government and Devolved Administration strategies concerned with both animal and public health risks from TSEs in sheep and with providing a level of assurance for the sheep industry and dependant businesses and communities against what was the perceived theoretical risk of BSE in sheep.

15. Improving stakeholder relationships.

- 15.1 In order to develop proposals for the RGS, a wholly new and novel initiative, Defra, SEERAD, and WAG conducted extensive and intensive meetings during 2000-01 with a large number of breed societies, and with NGOs (NSA, NFUs, RBST, Sheep Trust, etc). This happened before and during the public consultation on the RGS. The public consultation paper was subsequently published and widely disseminated, and discussed with stakeholders including at sheep industry shows (e.g. Sheep 2000) and at dedicated events (e.g. an NSP forum hosted by the NSA and attended by some 60 breed societies). Defra received compliments on that effort at Ministerial level.
- 15.2 This joint effort in launching and delivering the RGS has yielded positive and ongoing results in that Defra, the Devolved Administrations, and the SVS enjoy excellent relationship with industry stakeholders both on a business and a personal level.

² i.e. only allowing into the food chain sheep that are fully-resistant or semi-resistant below a certain age

- 15.3 The ongoing benefit from this has been that in developing subsequent NSP initiatives, including some that have been unwelcome or difficult, Defra and the Devolved Administrations have been able to have frank and productive dialogues with industry stakeholders. This has happened through ad-hoc issue/project meetings and at formal bi-annual stakeholder meetings. This excellent partnership has been recognised in the context of the Animal Health and Welfare Strategy partnership theme by industry leaders, Ministers, and the UK Chief Veterinary Officer.
- 15.4 Furthermore, the SVS-NSPAC as the RGS delivery partner has an excellent reputation with RGS members ([22.24](#)).
- 15.5 This was recognised at the genotyping of the millionth sheep in June 2004²⁶ when the UK's Chief Veterinary Officer stated that the NSP was an excellent example of the farming community, sheep industry and vets working in partnership with Defra, SEERAD and the Welsh Assembly to improve the health of the GB flock.
- 15.6 It was further recognised through the SVS NSP Administration Centre winning the first ever Defra Team award in 2005 – for their exceptional efforts in working with RGS stakeholders.

Conclusion

- 15.7 The NSP through the RGS has been highly successful in demonstrating the benefit of genuine partnership working with industry stakeholders.

16. Secure (Electronic) Sheep/Sample Identification

- 16.1 In the development phase of the NSP/RGS Defra recognised that (i) potentially very large numbers of tissue (blood) samples were likely to be collected and tested with significant/adverse results for some sheep – e.g. culling for the most scrapie susceptible genotypes, (ii) that some of these animals may turn out to be already valuable breeding animals (based on breed traits etc), and that (iii) a potential therefore existed for fraud.
- 16.2 It was concluded that the solution to ensuring accuracy and confidence in RGS genotype tests was the electronic identification of sheep being blood sampled, and bar-coding of the samples being genotyped.
- 16.3 Also, having regard to the above, and to industry concerns expressed during the 2001 RGS consultation that additional (EID) ear-tags could lead to welfare issues it was agreed that the EID used should be the ruminal bolus form.
- 16.4 The benefit of this solution has been a secure audit trail between the sheep, their sample, the lab test, and the result and associated result certification.
- 16.5 In the early days of the RGS there were a number of queries from flock owners on RGS genotype results that were different from commercial genotype results already supplied for some animals that had since been tested under the RGS. The RGS results were able to be checked and confirmed because of the EID/audit regime. This has enabled a confidence in the security and accuracy of RGS/NSP results. Indeed, some 75% of respondents to RGS survey of society secretaries stated that the assurance afforded by the EID was either beneficial or very beneficial ([23.14](#)) for RGS members the response was just over 63% ([22.19](#))

- 16.6 However, more generally, it can be concluded that at present EID may have limited alternative uses in RGS flocks as over 85% of respondents to the survey of RGS members stated that they did not use the EID boluses for purposes other than the RGS ([22.29](#)). This information will be of interest to those responsible for policy on sheep identification.

Conclusion

- 16.7 The RGS has demonstrated that on the one hand sheep EID can provide a robust audit trail for small to large scale sampling and testing of tissues, but on the other hand the overwhelming majority of (RGS) flock owners have not been ready to employ it for purposes not connected with the RGS.

17. Utilising Genetic Advances for Selective Breeding

- 17.1 The testing of individual animals for specific genetic information associated with disease susceptibility and its use as a tool for selective breeding within a national animal disease control programme was novel when the RGS was developed and launched in 2001.
- 17.2 The RGS has been the largest programme of its kind anywhere in the world and has successfully and usefully shown the efficacy of this approach.
- 17.3 It has resulted in the gathering of a *substantial* amount of data on the PrP genotype profile of the GB national flock, and, of different breeds within it. This data enabled the epidemiological modeling of and analysis of policy options for the further development of the RGS - e.g. the breed specific relaxation, and eventual removal of the breeding restrictions on Type 3 ram genotypes in RGS flocks. It has also enabled Defra to agree and negotiate for particular positions with UK interests in mind during the development of proposed EU scrapie controls on affected holdings – e.g. by having regard to treatment of breeds with low percentages of resistant genotypes, and with regard to breeding for resistance.
- 17.4 It is apparent from contacts with industry representatives that they are now finding that, since the advent of the RGS and its more direct involvement of flock owners with issue of genetics and genetic selection, that more and more breeders are becoming aware of or receptive to the possibilities for using genetic markers for the control of animal health problems (e.g. foot rot and worm resistance) and selection of commercially important traits (e.g. carcass muscle and fat depth) as the way ahead for breeding programmes. Some 65% of respondents to RGS survey of sheep breed society secretaries stated that *awareness* of genetics to control disease was one of the main benefits accrued from the RGS since its launch ([23.10](#)).
- 17.5 Ancillary beneficiaries include GB based NSP service providers whose delivery of laboratory infrastructures and testing technologies has enabled them to develop biochemical and software technologies, file a number of patent applications, and helped them to bid for and win other business including from customers abroad.

Conclusion

- 17.6 The RGS has provided flock owners with the means to identify and more selectively breed out a deleterious trait using scientific knowledge of sheep genetics.
- 17.7 The RGS has contributed to the burgeoning awareness amongst sheep breeders of and interest in possibilities for the identification and use of genetic markers to control diseases and to select for commercially important traits.

18. Protection against risks to consumer confidence in sheepmeat and contingency planning for BSE in sheep.

- 18.1 The benefits from the RGS as perceived by the FSA are mentioned above ([14.16-19](#)). Consumers' knowledge of or perception of a public health risk from BSE in sheep meat are generally low, and any related concerns tend to have come to the fore on ad-hoc occasions when reports of specific research projects or surveillance activities have been placed in the public domain.
- 18.2 On such occasions the FSA and/or the Departments concerned who may have received enquiries have been able to allay concern by referring to the precautionary controls in place, including the NSP and RGS and, had they ever needed to implement it, the BSE Contingency Plan which would have been underpinned by the RGS sampling and genotyping infrastructure.

Conclusion

- 18.3 The RGS would have been able to deliver the capacity to genotype and subsequently identify more TSE resistant rams to use for breeding to provide safe slaughter lamb in the event that the BSE in sheep contingency plan had required it.

19. Supporting other NSP Schemes and Initiatives

Scrapie Flocks Schemes

- 19.1 The infrastructure put in place for the RGS has as mentioned above subsequently enabled the delivery of other genotyping based disease prevention and control schemes including the Compulsory Scrapie Flocks Scheme (CSFS) (13.4), and its pre-cursor the Voluntary Scrapie Flocks Scheme (VSFS) for historically affected flocks. This includes the testing in other flocks for replacement animals of required genotypes for use in these affected flocks.

The Semen Archive

- 19.2 This UK-wide initiative launched in 2004 is storing semen from rams with scrapie susceptible genes that may be reduced in number or bred out of the national flock through the NSP and the NISP. It will then be possible to re-establish breeding populations of these ram genotypes if such a need was identified in the future, for example were it found that breeding for scrapie resistance compromised important health and production traits. The RGS has provided genotyping for non-RGS animals nominated for the NSP/NISP Semen Archive and most of the rams nominated so far have previously been genotyped through the RGS²⁷.
- 19.3 It is true to say that this archive is being established primarily as a consequence of the NSP RGS. However, notwithstanding its selection of donor rams based primarily on their PrP genotype it is also consistent with the UK's international treaty commitments to protect its biodiversity. To that extent, the delivery of this project has been strongly welcomed in the UK Farm Animal Action Plan on Farm Animal Genetic Resources (FAnGR) published on 6th November 2006²⁸.
- 19.4 Furthermore, through cooperative arrangements put in place by Defra this project has also benefited the Rare Breeds Survival Trust (RBST) by enabling it to source donor rams for its national conservation archive²⁹ of semen (embryos and other genetic) samples from native species including sheep - to protect them against the danger of catastrophes such the 2001 FMD outbreak. Currently there are some 26 breeds of sheep on the Trust's watch list, 25 of which have almost 30,000 semen straws in the NSP/NISP Archive (November 2006) which is very creditable progress when contrasted against some 20,000 straws in the Trusts archive.

Breed traits research

- 19.5 The infrastructure has also enabled the genotyping of many thousands of sheep for an important research project SE0236³⁰ to assess the links between breeding for scrapie resistance and economically important production and health traits.
- 19.6 As with the archive project it is recognised that this work is being undertaken primarily as a consequence of the NSP/RGS and also it is consistent with biodiversity protection. The desirability of such research has also been highlighted in successive EU SSC/EFSA opinions on breeding for resistance.

The Flock Register

- 19.7 See paragraph 13.8.

Conclusion

- 19.8 The RGS has an effective delivery infrastructure that has also adapted to deliver other important schemes concerned with control and eradication of scrapie.
- 19.9 The RGS has supported important initiatives concerned with the conservation of an important GB farm animal genetic resource (FAnGR).
-

20. Intra-Community Trade in breeding sheep

- 20.1 Sheep (and goats) for export to other EU Member States, for breeding, must originate from holdings which comply with scrapie monitoring requirements. Essentially, these are that:-
- the holding is subject to official veterinary checks;
 - the animals are marked;
 - no case of scrapie has been confirmed on the holding for at least 3 years;
 - checking by brain sampling has taken place on a proportion of cull ewes;
 - female animals are only introduced onto the holding from similarly monitored holdings.
- 20.2 Certification of compliance is provided by the owner's local Vet.
- 20.3 Defra and the SVS operate a *voluntary* certification scheme – the Scrapie Monitoring Scheme (SMS)³¹ whereby farmers can demonstrate, on an annual basis, compliance with these requirements. This facilitates the certification described above which is of benefit to exporters of breeding sheep. A review of the scheme is underway and will report to Ministers at the end of 2006.
- 20.4 Following changes to the Community TSE Regulation it is now permitted for breeding sheep of the ARR/ARR genotype (NSP Type 1) to be traded without restrictions – i.e. they need not come from holdings that demonstrate compliance with all of the above-mentioned requirements (e.g. SMS farms). Indeed they may even come from holdings that have had scrapie in recent years.
- 20.5 The RGS therefore provides an additional route whereby farmers can export to other member states Type 1 breeding sheep certified as such under the NSP.
- 20.6 About 38% of respondents to the breed society survey reported that the potential for the RGS to assist with exports had been a consideration in their promoting it to their membership ([23.9](#)). About 25% had thought that that had happened in practice ([23.11](#)). The value/volume of the (overall) trade in breeding sheep is hard to quantify and therefore relatively speaking probably small. There is however anecdotal evidence that the above-mentioned flexibility accorded to Type 1 genotypes when it comes to Intra-Community exports has been helpful for some breeds (Texel, Cambridge, Clun, Charollais, Rouge and a few others).

Conclusion

- 20.7 Although membership of the RGS is not a pre-requisite for exports it has facilitated some exports of breeding sheep with an NSP Type 1 genotype certificate to other EU Member States, as they are exempt from EU scrapie monitoring rules which would restrict the holdings from which they could originate.

21. RGS Expenditure

- 21.1 NSP programme expenditure data is not generated and recorded by specific NSP scheme. The financial report at [Annex C](#) estimates and describes the costs of the RGS. The costs are for discrete areas of 'programme' expenditure as such they do not include SVS delivery costs (NSPAC or field staff) as the Agency is responsible for these costs from their global budget allocated from Defra and which are not available by scheme for analysis.
- 21.2 Key elements of the costs are the service supply contracts (genotyping tests and EIDs) which are procured for the programme as a whole. Thus, the genotyping labs do not know anything about the provenance of the samples they receive to test (scheme, farm, breed etc) other than their EID numbers against which they report the result. This aggregation procures significant economies of scale – higher volumes produce lower invoiced charges.
- 21.3 These scheme costs have been estimated have been carried out across all schemes from the start of the NSP in 2001 to the end of the 2005-6 financial year. They show that the RGS services are cost effective and that for key elements such as genotyping tests they represent value for money.

Conclusion

- 21.4 The provision of the RGS has been cost-effective. Its economies of scale have kept down the costs of genotyping for other NSP schemes.

22. Findings of the Benefits survey of RGS Members

- 22.1 A questionnaire survey was carried out to determine what benefits RGS members felt had been delivered by this voluntary Scheme and to identify any areas or issues that are of particular interest that have arisen over its period of operation.
- 22.2 Members' responses were anonymous and were used to produce aggregated survey data. There was no obligation on anyone to respond.
- 22.3 As part of the analysis the review team looked not only at the total response but also by country (England, Scotland and Wales) and where possible by the number of years someone has been in the scheme (5, 4, 3, 2, 1 years). The complete data set is available on request.

Response rate

- 22.4 A single page postal questionnaire was designed ([Annex A](#)) and was sent to 10,200 RGS members registered with NSPAC. It was predominantly a tick-box design to minimise the burden on respondents, and to assist in generating a high response rate. This aim was successful.

- 22.5 Some 3,948 forms were returned (nearly 39%) and virtually all responses were usable. Unfortunately, almost 90 forms were received after the data input deadline set to enable analysis to begin. Some respondents did not complete every question on the form (which explains why some percentage totals will not be 100). A few will have ticked more than one box when they should not have. When analysing the data, the total number of people who completed the form was used to generate the percentage results shown below and not the number who actually completed that particular question. This means for questions where it would be expected that the total results would reach 100%, they may not always (e.g. for questions 11, 12, 13 and 14).

Q.1 Region

- 22.6 Not every respondent told us in which country their RGS flocks were located and in some cases more than one box was ticked e.g. some respondents ticked the boxes for both England and Wales. The % response rate by region is given below.

Country	Response %
England	53.5
Scotland	22.4
Wales	22.6

Q.2 Length of membership

- 22.7 The largest proportion of respondents (38%) had been in the scheme for 5 years. This is not different by Country, other than a slightly higher percentage of Scottish respondents (42%) that have been in for 5 years, with a lower percentage for 1 year or less (6%).

Length of time in RGS (total survey response)	Response (%)
5	38.5
4	24.9
3	14.6
2	11.2
≤1	7.7

Country	In 5 years (%)	In ≤ 1 year (%)
England	39	8.7
Scotland	42.4	6.0
Wales	34	7.2

Q3. Influences on members deciding to join the RGS

- 22.8 Over 60% of all respondents indicated that the greatest influence on them joining the RGS had been their breed society, followed by the possibility of better ram prices (50.3%), and their desire to prevent or control scrapie (49.6%). The belief that the RGS would become compulsory was cited by 40% of respondents.

- 22.9 This influence of breed societies was slightly higher in England with Scotland and Wales showing a more equal response between these 4 factors

Country	Breed society support (%)	Possibility of better ram prices (%)	Thought RGS would become compulsory (%)	Thought RGS would help prevent or control scrapie (%)
England	68.1	50.9	39.6	51.1
Scotland	52	48.4	44.6	42.3
Wales	52.6	51.1	37.6	53.2

- 22.10 For members that had been in for 5 years the trend was similar although for relatively new members improving the quality of their flock was also seen as an important influence.

Years in RGS	Breed society support (%)	Possibility of better ram prices (%)	Thought RGS would become compulsory (%)	Thought RGS would help prevent or control scrapie (%)	Improve quality of flock (%)
5	66.4	53.2	40.3	48.6	31.9
≤1	55.2	42.5	35.1	52.8	47.2

Q4. Benefits seen by Members in their business since joining the RGS

- 22.11 Almost 40% of all respondents thought that no additional benefit was seen by their businesses from joining the RGS however some (34%) felt there had been better prices for breeding rams.
- 22.12 It was noticeable that over 49% of Scottish respondents felt there was no additional benefit to their business from joining the RGS.

Country	Better prices for breeding rams (%)	No additional benefit (%)
All	34.2	39.1
England	34.8	36.8
Scotland	29.7	49.3
Wales	37	34.8

- 22.13 Members who have been in the scheme for less than 1 year unsurprisingly feel no additional benefit has yet been seen, or commented that it was too soon to say.

Years in RGS	Better prices for breeding rams (%)	No additional benefit (%)
5	40.8	39.3
≤1	13.4	41.5

Q5. At sales has the RGS influenced prices?

- 22.14 Overall the greatest effect on prices at sales has been increases for type 1 rams. In Scotland and Wales this was particularly high (for 80% of Scottish and Welsh respondents)

Country	Type 1 sales up (%)	Type 1 sales down (%)	Type 1 sales no change (%)
All	74.6	0.4	18.3
England	70.1	0.4	21.
Scotland	80.5	0.2	14.6
Wales	79.7	0.6	15.2

- 22.15 Consequently prices of rams of uncertified genotypes were seen to have decreased, with the effect again greatest in Scotland.

Country	Uncertified rams sales up (%)	Uncertified sales down (%)	Uncertified sales no change (%)
All	0.7	58	22.9
England	0.9	53.5	24
Scotland	0.7	66.5	20.4
Wales	0.1	61.2	22.9

- 22.16 A larger proportion of Members who have been in the scheme longest (5 years) have seen price increases in type 1 and decreases in prices of uncertified/other genotypes. Not surprisingly fewer members that have been in one year or less see these price movements.

Years in RGS	Type 1 rams sales up (%)	Type 1 sales down (%)	Uncertified rams sales up (%)	Uncertified sales down (%)
5	77.7	0.7	0.7	63.6
≤1	59.5	0	1.3	39.1

- 22.17 This affect on prices of Type 1 rams was confirmed in a report prepared by MLC's Signet Breeding Services³². It examined available data on rams of some breeds (Charollais, Suffolk, Texel, Dorset and Lleyn, North Country Cheviot, and Swaledale) coming forward at some major sales. It looked at their genotypes if stated and the prices realised to see if the genotype is reflected in the ram price. A constraint on when this work could be commissioned by Defra meant that not all breeds / major sales could be covered e.g. it was not possible to use Welsh hill breed data from the major ram sale at Builth Wells in September 2006.

- 22.18 The report noted that scrapie genotype is one of a dozen or so key factors that influence ram sale prices. It was clear from the data that could be gathered that for many breeds Type 1 rams have earned higher prices in recent years. Also, in the terminal sire breeds the *vast majority* of rams used for pure breeding are Type1, which over time, should have a big impact on the genotype status of the finished lamb coming from commercial flocks that are using terminal breeds as the crossing sire. Within Lowland Maternal breeds (Lleyn and Dorset) the *majority* of rams used for pure breeding and commercial ewe production are Type 1, again having an impact on the genotype status of the finished lamb crop from the Commercial flocks using these breeds. Within the Hill sector (North Country Cheviot and Blackface) there is evidence that a Type 1 genotype is no longer a primary factor for purchasing breeding rams, either for Pedigree flocks or Commercial flocks (purebred or cross bred production).

Q6. Benefits to RGS members from official audit and certification of genotypes

- 22.19 Considerable effort was put into the RGS operation to make sure there was a secure audit trail between the ram, the blood taken and the genotype result certificate issued (Section 16 above). The value of this is borne out by the survey with over 63% of all respondents recognising that there is a benefit from the official auditing and certification of rams. This response is slightly different in Scotland with not such a strong difference in members seeing the benefit. Also, about 8% of those submitting comments were disappointed that their *commercial* buyers were not interested in genotype results and certificates. It seems they were simply assured that the ram owner was in the NSP RGS (a view echoed by industry representatives).

Country	Very beneficial (%)	Beneficial (%)	Of no benefit (%)
All	21.3	42.1	15.5
England	22	42.2	14.7
Scotland	16.5	38	22.9
Wales	24.4	45.6	10.4

- 22.20 There was little difference in the recognition of benefit between those who have been in the scheme longest (5 years) and those in it less than 1 year.

Years in RGS	Very beneficial (%)	Beneficial (%)	Of no benefit (%)
5	23.7	39.8	16.1
≤1	21.1	42.5	10.7

Q7. Ram quality

- 22.21 When asked if the overall quality of rams had improved since joining the RGS the majority of respondents felt that there had been no discernable improvement since joining. This was particularly evident in Scotland. This was also independent of how long they had been in the scheme.

Country	Improved (%)	Not improved (%)	No discernable change (%)
All	24	33	40
England	25	30	41
Scotland	20	41	37
Wales	26	33	38

Years in RGS	Improved (%)	Not improved (%)	No discernable change (%)
5	23	41	36
≤1	17	15	44

- 22.22 Amongst the (c.1.500) written comments received it was noticeable that quality was one of the more identifiable themes in that just over 10% commented that they believed that Type 1 rams were of a poorer quality than other genotypes. (This was not measured over time or geography).

Q8. Stakeholder engagement

- 22.23 Members were asked if their opinion of the individual GB Agriculture and Rural Affairs Departments or the SVS had improved as a result of the RGS. It is disappointing to report that a modest proportion thought that it had.

- 22.24 It is however worth noting that this contrasts with one of the stronger themes of the written comments received, at just under 6%, which were very complimentary indeed about the customer service provided by both the SVS NSP Administration Centre and veterinary field staff who came on to farms to bolus and blood sample in RGS flocks.

	Improved opinion of:				
Country	DEFRA (%)	WAG (%)	SEERAD (%)	SVS (%)	NONE OF THEM (%)
All	20.1	4.3	4.3	19.5	44
England	23.6	0.5	0.7	24.6	42.2
Scotland	9.8	0.1	16.7	11.9	52.5
Wales	22.1	17.4	0.6	14.9	40.1

- 22.25 There were no consistent differences due to the length of membership.

	Improved opinion of:				
Years in RGS	DEFRA (%)	WAG (%)	SEERAD (%)	SVS (%)	NONE OF THEM (%)
5	17	4.8	5.3	19.6	47
≤1	24.4	2.7	2	20.1	35.1

Q9. In Wales – Joined or not to access WEGS II

- 22.26 Members in Wales were asked specifically if they had joined the RGS so that they could access WEGS II (as RGS membership is a condition of that Scheme). Surprisingly more members responded that they hadn't joined RGS to access WEGS.

	Yes (%)	No (%)
All Wales	32.8	56.5

Q10. Genotype results and tupping management

- 22.27 Members were asked how they had used the RGS results in the management of their tupping.
- 22.28 The majority of respondents said they had used type 1 rams only. Many had avoided using Type 3 rams. In addition, an appreciable amount who had some females genotyped had culled those ewes/ewe lambs with Type 4 and 5 genotypes even though the voluntary RGS culling requirements related only to Type 4 and 5 males (these genotypes are the most susceptible to classical scrapie). This pattern of response was also seen in the length of time someone had been in the scheme.

Country	Used only Type 1 rams (%)	Avoided Type 3 rams (%)	Not used genotype results (%)	Mated rams with single group of ewes (%)	Culled Type 4&5 ewes/ewe lambs (%)
All	51.4	45.1	6.3	9.2	33.4
England	55	41	6.0	9.2	29
Scotland	43.7	50.4	8.7	8.4	31.5
Wales	51.8	49.54	4.8	10.1	46.3

Years in RGS	Used only Type 1 rams (%)	Avoided Type 3 rams (%)	Not used genotype results (%)	Mated rams with single group of ewes (%)	Culled Type 4&5 ewes/ewe lambs (%)
5	51.7	47.5	5.4	10.8	37.7
≤1	48.5	33.8	9.7	4.0	19.7

Q11. Use of the EID for purposes other than the RGS

- 22.29 Although some two-thirds of respondents thought that the secure audit trail afforded by the bolus Electronic Identification Device (EID) had been beneficial or very beneficial when it came to genotype assurance (see sections [16](#) and [22.19](#) above), the overwhelming majority of respondents did not use the EID for any other purpose i.e. not related to the genotyping of their sheep or for movement recording.

Country	Yes (%)	No (%)
All	11.1	85.4
England	10.9	85.7
Scotland	9.5	86.6
Wales	13.3	83.6

- 22.30 This was not dependent on the length of time in the scheme.

Years in RGS	Yes (%)	No (%)
5	15.2	82
≤1	7.7	80.3

Q12. EID and sales

- 22.31 Similarly the majority of members considered that the NSP EID bolus had not helped them to sell their breeding sheep. This weight of response was likewise not dependent on the length of time in the scheme or region.

Country	Yes (%)	No (%)
All	26.1	64
England	28.1	61.5
Scotland	23.5	67.9
Wales	24.1	66.2

Years in RGS	Yes (%)	No (%)
5	28.9	64.1
≤1	15.7	56.5

Q13. Cost sharing

- 22.32 When asked if they would have joined the RGS (i.e. in 2001 and since) if they had been required to make a 'reasonable' contribution towards its costs the majority of members said no. Some respondents who submitted text comments said that that they would like to see "reasonable" quantified.

Country	Yes (%)	No (%)
All	30	63
England	32	60
Scotland	25	69
Wales	28	65

Years in RGS	Yes (%)	No (%)
5	30	63
≤1	32	55

Q14. Benefit of continuing with the RGS

- 22.33 When asked did members see a benefit to their business in continuing with the RGS the majority said yes. Also, in written comments it was strongly pointed out that this was closely aligned to the fact that (notwithstanding that this is a voluntary scheme funded by Government) members felt considerable investment had been made *by the industry* (in time, effort, culling of otherwise valuable animals etc) and there would be issues in justifying why if the scheme was to be pulled in the face of that.
- 22.34 This view was strongly held by English and Welsh members but there was more of a dichotomy of views between them and Scottish members. In the survey the most vociferous written comments on this issue were from self-identified Scottish Black face breeders who held the view that there would be no benefit to them in continuing in the scheme.
- 22.35 Unsurprisingly the length of time in the scheme influenced responses with members who had been in the scheme less than 1 year feeling their business would benefit more if the RGS continued which is understandable seeing as not all of them may have had their test results and been able to use them for selective breeding.

Country	Yes (%)	No (%)
All	59	30
England	61	28
Scotland	49	42
Wales	68	22

Years in RGS	Yes (%)	No (%)
5	57	33
≤1	66	18

- 22.36 1,486 respondents submitted text comments on a wide variety of themes. Key themes were: concerns about the effect of PrP genotype on breed quality, that the RGS should continue, and the high quality of the service delivery.

Theme	%
Believe Type 1s are of a poorer quality	10.70
No commercial interest in genotypes, certificates etc	7.60
RGS should 'continue' and/or be made compulsory	6.9
Believe Type 2s-5s are of a better quality	5.8
Very complimentary about NSPAC & SVS staff	5.7
Cost sharing / paying - acceptable to a 'reasonable' degree - Or - neutral	4.1
May/have culled best / better quality animals / bloodlines	3.9
Cost sharing / paying - not acceptable / difficult to justify.	3.8
Mistrust / misunderstand the science / the genetics	3.6
Should not waste the time and effort invested so far	3.3
Uncertainty due to atypical scrapie	2.6
NSP should provide / continue ewe testing	2.2
NSP/NISP semen archive (positive/negative/neutral)	1.1
Have culled Type 3s losing some better animals	1
Query why GB approach differs from New Zealand & Australia	0.8

23. Findings of the Benefits survey of Breed Society Secretaries

- 23.1 A single page postal questionnaire ([Annex B](#)) survey was carried out to describe how and what benefits the Breed Societies with participants in the RGS felt had been delivered by the RGS and to identify any areas or issues that are of particular interest that have arisen over the period of the voluntary RGS.
- 23.2 The responses were identifiable by breed and were used for the purpose of producing aggregated survey data. There was no obligation on anyone to respond.

Response rate:

- 23.3 41 forms were returned (nearly 44%) and all responses were usable. It is apparent that there are issues with the quality of the data that is held by some societies (whose responses on numbers were sometimes estimates or qualified in some way). It is interesting to note that some breeds have types that are represented by several societies reflecting the regional significance of the breed or their function.

Number of members and proportion of tup producers.

- 23.4 Not every respondent told us the proportion of tup producers to membership. Using the information provided it is possible to estimate the number of RGS “registered” members and compare this to the estimated number of “registered” members by breed society. This information is summarised in the [table](#) at section 8.5 above.

Knowledge of scrapie incidence within breeds

- 23.5 The largest proportion of respondents (60%) believed that scrapie was a minor problem in their breed with 30% stating it had never been identified in their breed.

Knowledge of scrapie in breed	Response (%)
Minor problem	65
Endemic	5
Never identified in breed	30
Uncertain of status	7.5

- 23.6 The following table summarises the Societies view of how scrapie may have historically affected, or not, their breed.

Society's knowledge of scrapie	Breeds responding
It is a minor problem	Beltex, Bleu du Maine, Berrichon du Cher*, Cambridge, Castlemilk Moorit, Charollais, Cheviot, Dalesbred, Easycare, Greyface Dartmoor, Hampshire Down, Herdwick, Kerry Hill, Llanwenog, Meatlinc, North Country Cheviot, Shetland (Island), Shetland-cheviot, Shropshire, Suffolk, Swaledale, Texel, Welsh Mountain (registered section), Whiteface Dartmoor.
It is endemic	Friesland, Manx Loghtan
Never been identified in the breed	Bluefaced Leicester, Berrichon du Cher*, Clun, Icelandic, Lonk, British Milksheep, Oxford Down, Rouge de l'Ouest, Rough Fell, Scottish Blackface, Southdown, Shetland (mainland)
Uncertain of status of the breed	Badgerface Welsh Mountain, Black Welsh Mountain, North Ronaldsay

*ticked both boxes

- 23.7 In future it may be of interest to compare this list with confirmed cases by breed as this recollection may not be correct in all instances. However, breed identification of individual scrapie notifications has historically not always been reliable. Some breeds are perhaps recording a minor problem after several years of recording/culling/genotyping e.g. Suffolk, Swaledale, Shetland (Island), and Charollais.

Support for the RGS

- 23.8 Only 7.5% of all respondents indicated that their society did not support the RGS.

Support for RGS	Response (%)
Support/promotes RGS	77.5
Neutral	20
Doesn't support or promote RGS	7.5

Reasons for promoting the RGS if supported by the Society

- 23.9 Almost 55% of all respondents indicated that they supported the RGS with the expectation that it would bolster genotyped sales. Other key reasons included to market their flocks health status, possible better ram prices, and because they thought the RGS would become compulsory.

Reason for promoting it	(%)
To bolster genotype sales	57.5
To market flocks health status	52.5
Thought RGS would be compulsory	50
For possible better breeding ram prices	45
To assist exports	37.5
To eradicate scrapie in the breed	35
As other societies did	30
To prevent scrapie affecting breed	30
To control scrapie in the breed	22.5
As other member states genotyped	20
Other members joined	10

Perceived benefits to GB Sheep industry since 2001

- 23.10 When asked what their breed society had seen as the main benefit of the RGS to the GB sheep industry 65% of respondents considered that it was the awareness of the use of genetics in disease control in sheep (see also section [17](#) above). Proactive action on scrapie and a reduction of the risk of BSE in sheep was considered to be a benefit by half of the respondents.

Main benefit to GB sheep industry	(%)
Awareness of genetics in disease control	65
Proactive action on scrapie	52.5
Reduce risk of BSE in sheep	52.5
Better prices	30
EID	27.5
Engagement with SVS	25
Engagement between flock owners	17.5
Engagement with the Society	17.5
No benefit	12.5
Other problems identified on the NSP visit	7.5

Perceived benefits to the breed society

- 23.11 There were fairly widespread responses to the question “Has your breed or society seen any of a list of potential benefits (see table below) since 2001?” With the greatest benefit seen as being better prices for genotyped rams followed by better prices for genotyped ewes. However just under a third of responding societies saw no additional benefits to them or their members.

Benefit seen	(%)
Better prices for genotyped rams	55
Better prices for genotyped ewes	35
No additional benefit	27.5
Assisted exports	25
Better record keeping	17.5
Scrapie controlled	15
Scrapie eradicated	15
Scrapie prevented	12.5
Better prices for finished lambs from genotyped flocks	0

RGS influence on breed sales prices

- 23.12 There has been a lot of anecdotal evidence that the prices of type 1 rams have been very high as a result of the RGS (section [22.14](#)). This is difficult to accurately quantify across the industry but some limited work done for this review suggest that this has happened ([22.17](#)). The likely scenario is that prices in type 1 animals in many breeds did increase to an artificially high price but that this will decrease in time as more type 1 animals become available. We have also received some anecdotal comments to that effect.
- 23.13 When asked how the RGS has influenced breed sale prices almost 78% of responding societies said that type 1 sales prices were up. This is probably very breed dependant but again no extensive quantifiable data is available.

Effect on ram prices (%)	Up	Down	No Change	Don't know
Type 1	77.5	0	17.5	2.5
Type 2	22.5	17.5	50	5
Type 3	5	65	20	0
Uncertified	0	50	10	5

Assurance of a secure audit trail

- 23.14 Almost three quarters of responding societies recognised that the secure audit trail between the rams, samples, and their genotype certificate enabled by the use of EIDs was a benefit to their breed.

Benefit	(%)
very beneficial	30
Beneficial	45
Of little benefit	12.5
Of no benefit	2.5

Recording EIDs

- 23.15 Conversely however, 75% of responding societies said they did not record rams' NSP EID numbers for purposes other than genotyping.

Priority of Type 1-3s when registering males

- 23.16 When asked when registering breeding males what priority the society gave to having a genotype that confers resistance to classical scrapie (NSP Types 1-3) there was a dichotomy of views with 35% of societies giving registration of type 1-3 a high priority but some 40% not considering registering of males a priority

Priority	(%)
High	35
Medium	12.5
Low	5
Not considered	42.5

Requiring NSP certification at sales

- 23.17 Over 80 % of the breed societies that responded require their members to present certificates at ram sales. This contrasts with comments from members on the lack of demand for certificates at *commercial* sales.

Stakeholder engagement

- 23.18 Societies were asked if their opinion of the individual GB Agriculture and Rural Affairs Departments that sponsored the RGS or its delivery agent (the SVS) had improved as a result of the RGS. Over a third of respondents felt that their opinion of both Defra and SVS had improved. This was higher than in the members survey ([22.23](#))

Department	(%)
DEFRA	35
SVS	35
WAG	13
SEERAD	12.5
None of them	27.5

Continuation of the RGS

- 23.19 When asked would the breed/society benefit, long-term, if the RGS continued, over half of respondents said yes.

Continue with RGS	(%)
Yes	52.5
No	25
Don't know	20

Cost sharing

- 23.20 When asked if they would support a successor scheme to the RGS if their members would have to make a 'reasonable' contribution towards the costs the majority of societies responding said yes. A small number of respondents commented on this and said that they were either unsure or would like to see "reasonable" quantified.

Cost sharing	(%)
Yes	50
No	27.5

Annex A Members' Questionnaire

RGS Members Questionnaire

1. Are your RGS flock/s in:
 England ☐ Scotland ☐ Wales ☐
2. How long have you been in the RGS?
 5 years ☐ 4 years ☐ 3 years ☐
 2 years ☐ 1 year or less ☐
3. What influenced you to join the RGS?
 NSA / NPU / FUW supported it ☐
 Breed Society supported it ☐
 Other flock owners were joining ☐
 Thought RGS would become compulsory ☐
 Possible better breeding ram prices ☐
 Possible better finished lamb prices ☐
 To help prevent or control scrapie ☐
 Marketing advantage of a higher health status flock ☐
 Improve the quality of my flock ☐
 To assist with exports ☐
4. Since joining the RGS has your business seen any of the following benefits?
 Better prices for breeding rams ☐
 Better prices for breeding ewes ☐
 Better prices for finished lambs ☐
 Scrapie controlled or prevented ☐
 Improved the quality of my flock ☐
 Better record keeping ☐
 Assisted exports ☐
 No additional benefit ☐
5. At sales, do you believe that RGS has influenced the prices of...
 Type 1 rams:
 Up ☐ Down ☐ No change ☐
 Type 2 rams:
 Up ☐ Down ☐ No change ☐
 Other genotypes or uncertified:
 Up ☐ Down ☐ No change ☐
6. How beneficial to your business is it that your RGS rams' genotypes are officially audited and certified?
 Very beneficial ☐ Beneficial ☐
 Of little benefit ☐ Of no benefit at all ☐
7. Has the overall quality of your rams improved since you joined the RGS?
 (To include breed characteristics, performance & carcass traits, health status and scrapie genotype)
 Yes ☐ No ☐ No discernable change ☐
8. Has the RGS improved your opinion of its sponsors and their delivery partners?
 Delta ☐ WAG ☐ SEERAD ☐
 SVS ☐ None of them ☐
9. If in Wales - did you join RGS to access WEGS II? Yes ☐ No ☐
10. How have you used RGS genotype results in your tupping management?
 Used Type 1 rams only ☐
 Avoided the use of Type 3 rams ☐
 I have not used them to manage my tupping ☐
 Mated rams of different genotypes with a single group of ewes ☐
 Culled Type 4 & 5 ewes/ewe lambs ☐
11. Have you used the NSP EID bolus for purposes other than genotyping? Yes ☐ No ☐
12. Has the NSP EID bolus helped sell your breeding sheep? Yes ☐ No ☐
13. Would you have joined RGS if you had to make a reasonable contribution towards its costs? Yes ☐ No ☐
14. Would your business benefit long term, if the RGS continued? Yes ☐ No ☐
15. Any comments on the RGS?
 (If so, please indicate if relevant to one of the above questions)

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Annex B Breed Society Secretaries Questionnaire

NSP RGS - Breed Society Secretaries Questionnaire

For questions 7, 8, 9, 10, and 14 you may tick multiple answers.

For questions 7 and 8 please rank your answers as 1, 2, 3 etc with 1 being the highest ranking

1. What breed do you represent?
2. How many members are in your breed society?
3. How many members do you have that you regard as primarily tup producers?
4. What is your knowledge of scrapie in your breed?
Scrapie has been a minor problem in the breed ☐ Believe that scrapie has never been identified in the breed ☐
Scrapie is an endemic problem in the breed ☐ Uncertain of scrapie status of the breed ☐
5. Does your society support and promote the NSP RGS? Yes ☐ No ☐ Neutral ☐
6. If no or neutral (to 5) please summarise your reasons

7. If yes (to 5) why have you promoted the RGS to your members?
- | | Tick | Rank | | Tick | Rank |
|--|--------------------------|--------------------------|--|--------------------------|--------------------------|
| Other European member states genotype | <input type="checkbox"/> | <input type="checkbox"/> | Possible better breeding ram prices | <input type="checkbox"/> | <input type="checkbox"/> |
| Other Breed Societies promote it | <input type="checkbox"/> | <input type="checkbox"/> | To prevent scrapie from affecting the breed | <input type="checkbox"/> | <input type="checkbox"/> |
| Other members are joining | <input type="checkbox"/> | <input type="checkbox"/> | To control scrapie within the breed | <input type="checkbox"/> | <input type="checkbox"/> |
| To bring confidence to sales of genotyped breeding animals | <input type="checkbox"/> | <input type="checkbox"/> | To eradicate scrapie within the breed | <input type="checkbox"/> | <input type="checkbox"/> |
| Thought RGS would become compulsory | <input type="checkbox"/> | <input type="checkbox"/> | Marketing advantage of higher health status flocks | <input type="checkbox"/> | <input type="checkbox"/> |
| | | | To assist with exports | <input type="checkbox"/> | <input type="checkbox"/> |
8. What have you seen as the main benefit(s) of the RGS to the GB sheep industry since 2001?
- | | Tick | Rank | | Tick | Rank |
|---|--------------------------|--------------------------|---|--------------------------|--------------------------|
| More engagement between flock owners | <input type="checkbox"/> | <input type="checkbox"/> | Reduction of theoretical risk of BSE in sheep | <input type="checkbox"/> | <input type="checkbox"/> |
| More/better engagement with breed society | <input type="checkbox"/> | <input type="checkbox"/> | Electronic Identification | <input type="checkbox"/> | <input type="checkbox"/> |
| More/better engagement with SVS | <input type="checkbox"/> | <input type="checkbox"/> | Better prices for breeding stock | <input type="checkbox"/> | <input type="checkbox"/> |
| Visible/proactive action on scrapie | <input type="checkbox"/> | <input type="checkbox"/> | No benefit | <input type="checkbox"/> | <input type="checkbox"/> |
| Awareness of genetics to control diseases | <input type="checkbox"/> | <input type="checkbox"/> | Other diseases/health problems identified on NSP visits | <input type="checkbox"/> | <input type="checkbox"/> |
9. For your breed/society - have you seen any of the following since the RGS started in 2001?
- | | | | |
|--|--------------------------|------------------------|--------------------------|
| Better prices for genotyped breeding rams | <input type="checkbox"/> | Scrapie eradicated | <input type="checkbox"/> |
| Better prices for genotyped breeding ewes | <input type="checkbox"/> | Better record keeping | <input type="checkbox"/> |
| Better prices for finished lambs from genotyped flocks | <input type="checkbox"/> | Assisted exports | <input type="checkbox"/> |
| Scrapie controlled | <input type="checkbox"/> | No additional benefits | <input type="checkbox"/> |
| Scrapie prevented | <input type="checkbox"/> | | |

NSP 105 (b)

Please turn over

10. At sales of your breed, has the RGS influenced the prices of :
- | | | | | |
|-------------------|-----------------------------|-------------------------------|------------------------------------|-------------------------------------|
| Type 1 rams: | Up <input type="checkbox"/> | Down <input type="checkbox"/> | No change <input type="checkbox"/> | Don't know <input type="checkbox"/> |
| Type 2 rams: | Up <input type="checkbox"/> | Down <input type="checkbox"/> | No change <input type="checkbox"/> | Don't know <input type="checkbox"/> |
| Type 3 rams: | Up <input type="checkbox"/> | Down <input type="checkbox"/> | No change <input type="checkbox"/> | Don't know <input type="checkbox"/> |
| Uncertified rams: | Up <input type="checkbox"/> | Down <input type="checkbox"/> | No change <input type="checkbox"/> | Don't know <input type="checkbox"/> |
11. The NSP provides a high level of security between each ram's EID, its blood, and its assured genotype result/certificate. How beneficial is this assurance to your breed?
Very beneficial ☐ Beneficial ☐ Of little benefit ☐ Of no benefit at all ☐
12. When registering breeding males what priority does your society give to having a genotype that confers resistance to classical scrapie (NSP Types 1-3)?
High ☐ Medium ☐ Low ☐ We don't consider it ☐
13. Do you require RGS Genotype Certificates to be presented at society sales? Yes ☐ No ☐
14. Has the RGS improved your opinion of or engagement with its sponsors and their delivery partners?
Defra ☐ WAG ☐ SEERAD ☐ SVS ☐ None of them ☐
15. Does your society record rams' NSP EID numbers for purposes other than genotyping?
Yes ☐ No ☐
16. Would your breed/society benefit long-term, if the RGS continued?
Yes ☐ No ☐ Don't know ☐
17. Would your society (continue to) support membership of a successor to the NSP RGS if it involved a reasonable financial contribution towards its costs from individual participants?
Yes ☐ No ☐
18. Any comments on RGS benefits? (if so, please indicate if relevant to one of the above questions)

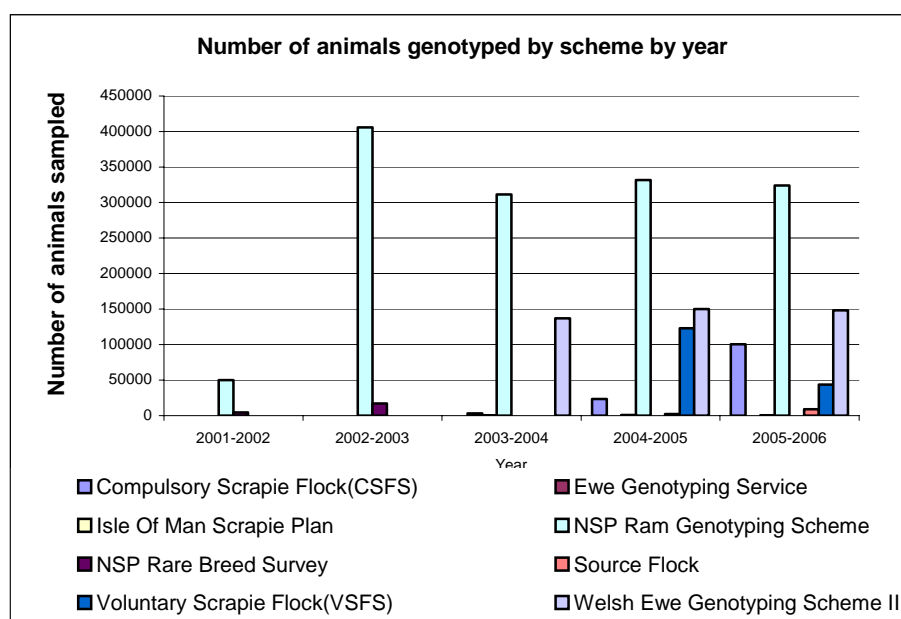
Annex C Financial report

Number of samples genotyped

Table 1: Number of samples genotyped by scheme July 2001 – March 2006

Scheme	2001-02	2002-03	2003-04	2004-05	2005-06	Total
CSFS				23,373	100,564	123,937
EGS			3,180			3,180
Isle of Man			647	854	644	2,145
RGS	50,058	405,772	311,333	331,694	323,678	1,422,535
RBS	4,493	17,172				21,665
Source Flock				2,118	9043	11,161
VSFS				122,897	43,629	166,526
WEGS II			136,730	150,107	148,100	434,937
Total	54,551	422,944	451,890	631,043	625,658	2,186,086

- C1. Table 1 shows the number of samples taken by scheme by year. The RGS peaked in 2002-03 with over 400,000 samples taken and has averaged at over 300,000 samples per year since.
- C2. The second highest scheme by volume of samples is the Welsh Ewe Genotyping Scheme (WEGS II), which tests approximately 150,000 ewes per year. WAG funds this scheme with the costs of EIDs and genotype tests reclaimed by Defra.
- C3. EGS was a one off exercise in 2003-04 as was the Rare Breeds Survey in 2002-03.
- C4. Graph 1 below shows the distribution of samples taken by scheme by year.



Activity by Scheme (%)

- C5. Table 2 shows the percentage activity by scheme. This is calculated by comparing the number of samples collected by each scheme in table 1 against the total number of samples taken for the year.

Table 2: % activity by scheme

SCHEME	2001-02	2002-03	2003-04	2004-05	2005-06
CSFS				3.70%	16.07%
EGS			0.70%		
Isle of Man			0.14%	0.14%	0.10%
RGS	91.76%	95.94%	68.90%	52.56%	51.73%
RBS	8.24%	4.06%			
Source Flock				0.34%	1.45%
VSFS				19.48%	6.97%
WEGS2			30.26%	23.79%	23.67%
Total	100.00%	100.00%	100.00%	100.00%	100.00%

- C6. In the initial years of the NSP most samples were collected for the RGS. As new schemes have been introduced this % has reduced and stabilised at just over 50%.
- C7. Almost ¾ of all samples taken throughout the NSP have been for RGS.

Expenditure

- C8. Table 3 demonstrates the distribution of spend for each major area of expenditure within the NSP.

TABLE 3	2001-2002	2002-2003	2003-2004	2004-2005*	2005-2006*	TOTAL
Genotyping (all schemes)	£1,182,837	£4,244,898	£4,573,300	£5,252,524	£5,126,961	£20,380,520
EID	£1,486,709	£894,774	£1,494,019	£1,934,493	£1,695,349	£7,505,344
Consultancy	£1,732,278	£1,020,235	£696,030	£507,086	£404,163	£4,359,792
VLA	£38,131	£78,441	£118,882	£137,925	£138,739	£512,118
Publicity etc	£45,773	£264,106	£345,235	£556,682	£318,306	£1,530,102
SFS	£0	£0	£0	£11,199,271	£20,006,039	£31,205,310
Year Total	£4,485,728	£6,502,454	£7,227,466	£19,587,981	£27,689,557	£65,493,186
Non SFS	£4,485,728	£6,502,454	£7,227,466	£8,388,710	£7,683,518	£34,287,876
				*excludes semen archive		

- C9. Genotyping costs include payments to the two contracted laboratories to genotype NSP blood samples. Also included in this line are blood sampling kits for use by field staff to collect the bloods and royalty payments to the Institute for Animal Health (IAH) who own a patent relevant to scrapie genotype testing. These costs have stabilised at just over £5m per annum for all schemes.
- C10. The NSP uses EID (Electronic Identification Devices) to uniquely identify each animal sampled for genotyping. EIDs are provided by one contractor. EID costs are between £1.5m - £2m per year. Costs were higher in the first year due to the need to purchase equipment to read boluses by field staff but have now stabilised and are expected to reduce further as a newer (one size fits all) bolus is now procured.
- C11. Other costs included are for consultants, although this has been reducing significantly since the introduction of the NSP. As of September 2006 there are no consultants working on any aspect of the NSP.
- C12. VLA operate the supply and distribution of NSP equipment to SVS field staff and maintain the QA flock (to supply blind samples to the contracted labs) and charge Defra for these services.
- C13. Costs also include publicity and publication work, such as printing new forms, brochures etc for each scheme as well postage costs. Other costs include organising regular stakeholder meetings and paying travel costs for attendees.
- C14. Costs specific to the scrapie flocks schemes (compensation payments, haulage costs, disease monitoring and assistance payments) are excluded from the total costs when calculating scheme expenditure. These costs are applied to the relevant scrapie flock scheme once the generic genotyping/EID etc. costs have been calculated.

Expenditure by Scheme

Scheme	2001-2002	2002-2003	2003-2004	2004-2005	2005-2006	Scheme Total
CSFS				£2,100,350	£15,187,735	£17,288,085
EGS			£50,860			£50,860
IoM			£10,348	£11,352	£7,908	£29,609
RGS	£4,116,104	£6,238,447	£4,979,416	£4,409,342	£3,974,992	£23,718,302
RBS	£369,623	£264,006				£633,630
Source Flock				£28,155	£111,054	£139,209
VSFS				£11,043,347	£6,589,094	£17,632,441
WEGS II			£2,186,840	£1,995,433	£1,818,771	£6,001,045
Year Total	£4,485,728	£6,502,454	£7,227,466	£19,587,981	£27,689,557	£65,493,186

- C15. RGS has cost £23.7m from the start of the NSP in July 2001 to the end of the 2005-06 financial year and has tested 1,422,535 animals over the same period.
- C16. In comparison CSFS has cost £17.3m in the first two years of operation, with VSFS costing a further £17.6m. CSFS has genotyped 123,937 animals and culled 232,589 animals. The majority of CSFS costs are related to disposal and compensation of genotypically susceptible animals on CSFS farms.

- C17. The proportion of RGS costs is reducing as costs of the non-SFS elements of the NSP are increasing. The costs of the RGS have reduced as the genotyping costs have increased.

Value for money

- C18. To calculate a value for money for the RGS the increase in costs of other NSP genotype tests if no RGS tests were undertaken was calculated, and the increase in tests undertaken for CSFS was estimated.
- C19. The actual number of samples sent to each of the two contracted laboratories by scheme for 2005/06 was identified and the costs for each scheme were calculated. The number of CSFS tests was separated out and the percentage of CSFS tests compared to the total number of samples was calculated. This percentage was applied to minimum monthly contract charges and added to the costs of samples tested over the minima to calculate the costs for the scheme.
- C20. The total number of RGS samples taken was then removed and the revised costs recalculated.

Results

- C21. Out of a total of 627,931 samples tested over the period April 2005 to March 2006 100,585 were for CSFS and 325,099 were for RGS.
- C22. The busier of the two contracted laboratories received a total of 448,671 samples across the period and the other 179,260. (Since October 2006 all NSP sample go to one laboratory).
- C23. The estimated costs for CSFS were £872,752. However, once RGS samples were removed from the total it reduced to 303,832 samples and the estimated costs for CSFS increased to £1,191,480.35, **a difference of £318,728.35.**
- C24. The average genotyping cost per animal for CSFS increases from £8.68 (£5.61 at the busiest lab and £14.25 at the other) to £11.85 (£7.36 at the busiest and £20.00 at the other).
- C25. The difference in the average price is **£3.17 per sample.**
- C26. It is also worth noting that, while the actual contract unit prices for NSP genotyping tests in the contracts agreed by Defra with its supplier laboratories are not disclosed here due to commercial confidentiality, they have always been much less than commercial prices, and substantially less than prices (c.£150) charged when scrapie genotyping was first available in the UK³³.

Glossary

BSE	Bovine Spongiform Encephalopathy
CSFS	Compulsory Scrapie Flocks Scheme
CVO	Chief Veterinary Officer
DEFRA	Department of Environment , Food and Rural Affairs
EFSA	European Food Safety Authority
EGS	(NSP) Ewe Genotyping Scheme
EID	Electronic Identification
EP	European Parliament
EU	European Union
FAnGR	Farm Animal Genetic Resources
FSA	(UK) Food Standards Agency
IoM	Isle of Man
MBM	Meat and Bonemeal
NFU	National Farmers Union
MLC	Meat and Livestock Commission
NISP	Northern Ireland Scrapie Plan
NSA	National Sheep Association
NSP	National Scrapie Plan for Great Britain
NSPAC	(SVS) National Scrapie Plan Administration Centre
PrP	Prion Protein
PSA	Public Service Agreement
RBST	Rare Breeds Survival Trust
RGS	Ram Genotyping Scheme
SEAC	Spongiform Encephalopathy Advisory Committee
SEERAD	Scottish Executive Environment and Rural Affairs Department
SMS	Scrapie Monitoring Scheme
SRM	Specified Risk Material
SSC	(EU) Scientific Steering Committee
SVS	State Veterinary Service
TSE	Transmissible Spongiform Encephalopathy
VLA	Veterinary Laboratories Agency
VSFS	Voluntary Scrapie Flocks Scheme
WAG	Welsh Assembly Government
WEGS	Welsh Ewe Genotyping Scheme
WIRS	Welsh Institute of Rural Studies

End Notes

- 1 SEAC Report on Research and Surveillance for TSEs in Sheep (April 1999)
<http://www.seac.gov.uk/publicats/sub-rep.pdf>
- 2 The original RGS Consultation (Covering letter) (July 2001)
<http://www.defra.gov.uk/animalh/bse/othertses/scrapie/nsp/publicatsrpts/conslet1.pdf>
- 3 EFSA - Opinion of the Scientific Panel on Biological Hazards on "the breeding programme for TSE resistance in sheep", The EFSA Journal (2006), 382, 1-46
http://www.efsa.europa.eu/en/science/biohaz/biohaz_opinions/ej382_breeding_sheep_tse.html
- 4 Consultation document (and results summary) on a strategic review of the NSP (July 2004)
(Contact Sheep TSE Division, Defra for a copy)
- 5 National Scrapie Plan – New Schemes to follow Consultation. Defra Press Release 14/05, 12/1/2005.
<http://www.gnn.gov.uk/content/detail.asp?ReleaseID=141488&NewsAreaID=2>
- 6 EU Commission flow-chart of the Co-decision procedure
http://ec.europa.eu/codecision/stepbystep/diagram_en.htm
- 7 EU Parliament's Environment, Public Health and Food Safety Committee report on the Commission's proposal for amendments to Regulation 999/2001 on TSEs (amendment 22, pages 16-17).
<http://www.europarl.europa.eu/omk/sipade3?PUBREF=-//EP//NONSGML+REPORT+A6-2006-0161+0+DOC+PDF+V0//EN&L=EN&LEVEL=0&NAV=S&LSTDOC=Y>
- 8 Information on 'Atypical scrapie' (NSP Website)
<http://www.defra.gov.uk/animalh/bse/othertses/scrapie/nsp/Atypicalcases/index.htm>
- 9 The Breeding Structure of the British Sheep industry 2003
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- 10 SEAC Report on Research and Surveillance for TSEs in Sheep (April 1999)
<http://www.seac.gov.uk/publicats/sub-rep.pdf>
- 11 NSP Programme Brief (Section 2.1)
<http://www.defra.gov.uk/animalh/bse/othertses/scrapie/nsp/publicatsrpts/brief.pdf>
- 12 SEAC statement of March 1999 (paragraph 9) http://www.seac.gov.uk/summaries/summ_0399.htm
- 13 Statement of the EU Scientific Steering Committee (April 1999)
http://ec.europa.eu/food/fs/sc/ssc/out45_en.html
- 14 PrP genotype progression in flocks participating in the National Scrapie Plan for GB
Vet. Record, October 7 2006, 159, 473-479.
Warner RG, Morris D, Dawson M.
<http://veterinaryrecord.bvapublications.com/cgi/reprint/159/15/473?maxtoshow=&HITS=10&hits=10&RESULTFORMAT=&author1=warner&searchid=1&FIRSTINDEX=0&sortspec=relevance&resourcetype=HWCIT>
- 15 Breeding programmes for TSE resistance in British sheep. I. Assessing the impact on prion protein (PrP) genotype frequencies. Prev Vet Med. 2006 Jan 16; 73(1):1-16.
Roden JA, Nieuwhof GJ, Bishop SC, Jones DA, Haresign W, Gubbins S.
Breeding programmes for TSE resistance in British sheep. II. Assessing the impact on the prevalence and incidence of scrapie. Prev Vet Med. 2006 Jan 16; 73(1):17-31.
Gubbins S, Roden JA
- 16 Assessing the efficacy of a ram-genotyping programme to reduce susceptibility to scrapie in GB Prev Vet Med. 2002 Dec 30; 56(3), 227:249
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- 17 Commission Decision 2002/1003/EC of 18th December 2002 laying down minimum requirements for a survey of prion protein genotypes of sheep breeds.
<http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=CELEX:32002D1003:EN:HTML>
- 18 Regulation (EC) No 999/2001 of the European Parliament and of the Council of 22 May 2001 laying down rules for the prevention, control and eradication of certain TSEs. As amended. (Annex 7 - eradication action in the case of confirmation of a sheep TSE).
http://europa.eu.int/eur-lex/en/consleg/main/2001/en_2001R0999_index.html
(May not be the most up-to-date consolidated text)
- 19 Commission Decision 2003/100 of 13 February 2003 Laying Down Minimum Requirements for the Establishment Of Breeding Programmes For Resistance to TSEs In Sheep
http://eur-lex.europa.eu/LexUriServ/site/en/oj/2003/l_041/l_04120030214en00410045.pdf
- 20 Report of the Policy Commission on the Future of Farming and Food January 2002 (Page 50)
<http://archive.cabinetoffice.gov.uk/farming/pdf/PC%20Report2.pdf>
- 21 Defra Public Service Agreement 2005-2008 <http://www.defra.gov.uk/corporate/busplan/psa2004.htm>
Technical note (PSA 9 – paragraphs 9.2 - 9.13) <http://www.defra.gov.uk/corporate/busplan/tn.pdf>
- 22 A Forward Strategy for Scottish Agriculture
<http://www.scotland.gov.uk/library3/agri/fssa.pdf> (Action 11, page 12)
<http://www.scotland.gov.uk/library3/agri/fssa-00.asp>
- 23 Welsh Assembly Government – Farming for the Future (Action point no. 10)
<http://www.countryside.wales.gov.uk/fe/master.asp?n1=4&n2=52>
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<http://www.defra.gov.uk/animalh/ahws/strategy/ahws.pdf>
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<http://www.food.gov.uk/multimedia/pdfs/stratplan0510.pdf>
- 26 Ceremony to Mark the One-Millionth Sheep Sample Under the NSP. (Defra Press Notice 217/04)
<http://www.gnn.gov.uk/content/detail.asp?ReleaseID=119093&NewsAreaID=2>
- 27 NSP/NISP Semen Archive homepage
http://www.defra.gov.uk/animalh/bse/other/tse/scrapien/sp/schemes/initiatives/semen_archive.htm
- 28 UK National Action Plan on Farm Animal Genetics resources (FAnGR)
<http://defraweb/farm/livestock/strategy/genetic-res/pdf/fangr-actionplan.pdf>
- 29 RBST ReGeneration Appeal
<http://www.rbst.org.uk/regeneration/main.php>
- 30 SE0236 breeding traits project
<http://www.gnn.gov.uk/content/detail.asp?ReleaseID=100457&NewsAreaID=2>
- 31 International trade: EU exports - Scrapie Monitoring Scheme (Defra)
<http://www.defra.gov.uk/animalh/int-trde/eu/animals/sms.htm>
- 32 Ram Sale Price Analysis – Report for NSP Benefits Review. MLC Signet Breeding Services (November 2006)
- 33 State Veterinary Journal, Volume 12, number 2 - December 2002 (PB7939) – (page 10)
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