The implications of Irish legislation and regulations for the land spreading of manures from intensive agricultural enterprises

Implications de la législation Irlandaise et des réglementations pour l'épandage des déjections en exploitation d'élevage intensif.

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Abstract

Improving manure management on farms is essential to sustainability. In Ireland, considerable progress in this context has been made in the last decade. However, newly introduced legislative requirements are now demanding even greater change for larger pig, poultry and mushroom enterprises. Achieving both a better balance between the applied manure nutrient loads, particularly nitrogen and phosphorus and the crop requirements are now a requirement. The implications are that larger land spreading areas are required than have been traditionally used by these enterprises. However, compliance with the Environmental Protection Agency's Batneec regulations; the national Code of Good Agricultural Practice to Protect Groundwater from Pollution by Nitrates; the general exclusion of land associated with the national Rural Environment Protection Scheme; the localised concentration of the enterprises in parts of the country and their general separation from tillage areas all impact seriously on the availability of suitable spread lands for the manure. In the absence of improvements in the national water quality it is inevitable that other agricultural enterprises will be regulated. Therefore, current legislative controls must be carefully monitored and any future control considered in context so that the viability of the manure land spreading option remains, particularly for the intensive agricultural enterprises. Sustainable alternatives do not currently exist.

Résumé

L'amélioration de la gestion des déjections à la ferme est indispensable au maintien de leur durabilité. En Irlande, des progrès considérables ont été réalisés au cours des dix dernières années. Cependant les nouvelles réglementations en vigueur exigent de plus grandes modifications des pratiques notamment pour les exploitations porcines, avicoles et champignonnières de taille importante. Il est en effet exigé un équilibre entre la charge en éléments minéraux épandus particulièrement N et P et les besoins des cultures. Cela implique que davantage

de surfaces d'épandage sont à présent nécessaires. Cependant, le respect des différents codes et réglementations en vigueur (Réglementations Batneec de l'Agence pour la protection de l'Environnement ; Le code national de bonnes pratiques agricoles pour la protection de la pollution de l'eau par les nitrates...) affecte considérablement la disponibilité des surfaces aptes à l'épandage.

En l'absence d'amélioration au niveau national de la qualité de l'eau, il est inévitable que d'autres activités agricoles seront également soumises à ces nouvelles réglementations. Il est toutefois important de conserver l'option épandage, notamment pour les exploitations intensives. Les alternatives pour une gestion durable ne sont pas encore disponibles.

1. Introduction

It has been estimated that 153 m t of manure are produced annually in Ireland by farmed livestock (Carton and Magette, 1996). Cattle and sheep manure account for almost 43 m t which require management annually. Pig and poultry enterprises produce an estimated 2.8 and 0.6 m t of manure, respectively, every year. There is in excess of 0.25 m t of spent mushroom compost (SMC) to be managed each year. Land spreading is the preferred management option for all manures.

Public attention has focused on intensive agricultural enterprises (IAE), *i.e.* pig, poultry or mushroom farms, in terms of their impact on water quality in spite of the fact they account for less than 10% of total quantity of manure requiring management. A factor in this is that their development has largely been confined to a limited areas of the country. For example, about 40% of the national sow herd is located in two of the 26 counties. In one county, poultry and mushroom production account for 47% and 12%, respectively, of the gross agricultural output (GOA) compared with the national figures of 4% and 2%, respectively (Teagasc, 1994). There is further concentration of IAE within counties. Poultry and mushroom enterprises account for over 60% of the GAO in one of seven river catchments within one county (MAWMS, 1994) .

In some of these areas with IAEs, particularly, the North West of the country, water quality is inferior compared with other regions (MAWMS, 1994). The first major Irish case of euthrophication in an Irish lake was in this region, Lough Sheelin, and was linked to the expansion of agriculture, including pig enterprises, in the catchment. It has left a lasting legacy in the public perception about the impact of 7IAE on water quality. This is reflected in legislation through the Environmental Protection Agency's (EPA) Integrated Pollution Control (IPC) licensing requirements for pig and poultry enterprises above a specified size (EPA,1997).

2. IAE nutrient balances

Generally, there is no link between crop and animal production on IAE. Most nutrients are imported in the form of cereal based animal feeds or composts on

mushroom farms. The sale of meat, eggs or mushrooms results in the export of a fraction of the imported nutrients. Therefore, an annual farm nutrient surplus is generated in the manure or SMC. Logically, the nutrients in the manure should be recycled to the land that provided the inputs.

However, the spatial separation of the two enterprises militates against the practice. Crop production is primarily confined to the southern and eastern regions while IAE's are somewhat concentrated in the north east and a number of other smaller areas within the country thus giving rise to high manure transport costs. Consequently, the traditional approach has been for IAE manure to be applied to limited areas of grassland in the vicinity of the enterprise. The nutrient supply in the applied IAE manure generally exceeded the crop requirements as the nutrient deficit on grassland farms is relatively small (Tunney *et al* 1996 and Culleton *et al* 1996). In some cases the situation was exacerbated by making no adjustment, on the recipient land, in the inorganic fertiliser applications to take account of the nutrients already supplied by the IAE manure. The result has been soil test phosphorus (STP) levels of the IAE manure spread lands that are in excess of those required for crop production (*e.g.* Figure 1).

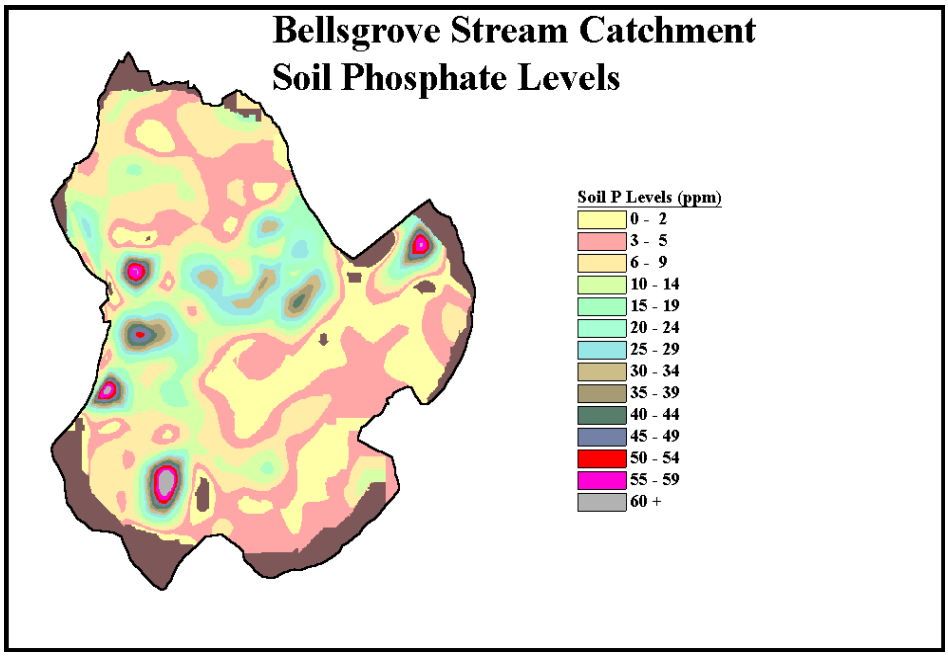

Figure 1
The distribution of STP within the Belsgrove catchment Co. Cavan. Areas with elevated STP are generally associated with IAE (Humphries et al, 1996).

More than 30% of mushroom farms, 50% of poultry farms and 60% of pig farms had spread land soils with P levels greater than 15 mg/l (MAWMS, 1994). This compared with less than 10% on farms with grass based enterprises only.

The potential for phosphorus (P) loss to water is positively correlated with STP. Therefore, improved nutrient management strategies to achieve better balances between the nutrient load in the IAE manure and the needs of crop production are being introduced in legislation and regulations. The objective is to minimise the impact of land spreading on the environmental media, particularly surface and ground water.

3. Legislative controls and restraints on the land spreading of manures

The primary legislative control on land spreading of IAE manures is the IPC licensing requirement. IAE applicants for an IPC license must comply with the EPA BATNEEC (Best Available Technology Not Entailing Excessive Costs) STP requirement, which prohibits - IAE manure from being applied to land where the existing STP exceeds 15 mg/l (Morgan=s Test). Other licensing controls include requirements to implement a nutrient management plan, and assessing spread lands in terms of their vulnerability to nutrient loss. Spread lands with high risk are not acceptable. Defined buffer zones between waterways, wells and buildings also are required. There has been considerable criticism of aspects of the IPC licensing requirements by the industry (Tuite, 1996 and Reilly, 1996). However, the process is in place and to date a number of licences have been issued to operators by the EPA.

The national voluntary Code of Good Agricultural Practice to Protect Groundwater from Pollution by Nitrates (COP) (DOE/DAFF, 1996) recommends an upper organic nitrogen (N) load for agricultural land - “In areas supporting high stocking rates, and provided surface and groundwater are in good condition, *i.e.* nitrate concentrations do not exceed 20 mg/l and there is no evidence of eutrophication caused by nitrates, the maximum quantity of manure and other organic materials applied to land, including that deposited by grazing animals, should be such as to ensure that the N contained therein does not exceed 250 kg/ha/annum. In all other areas, the N applied from these organic fertilisers should not exceed 210 kg/ha/annum. Lower application rates than those indicated should be observed in areas where the County Council indicates that this is necessary because nitrate level in ground waters, or because the P content of the slurry or other organic manure is causing or is likely to cause water pollution”. To date the impact of this Code on manure management practices has been minimal. However, one Local Authority with polluted ground water supplies is now actively pursuing the statutory implementation of the COP in water quality black spots under its jurisdiction. It is anticipated that there will be considerable problems for some of the more intensive farmers, including grassland farmers, in these areas. It is very possible that some producers will be required with the possibility of the requirement to reduce stocking rates and remove IAE manure to suitable areas outside the affected catchment. The recently introduced Rural Environment Protection Scheme (REPS) (DAFF, 1996), which implements Council Regulation (EEC) No. 2078/92, practically eliminates the potential of participating farmers to receive IAE manure. REPS farmers cannot exceed an organic N load of 170 kg/ha/yr.

Good nutrient management involves matching nutrient inputs with offtakes. The revised Teagasc P recommendations for grassland (Carton, Ryan and Magette, 1996) challenge the concept of achieving a balance between P inputs in IAE manure and removals by the crop - particularly grass.

4. Implications of legislative controls and restraints on spread land availability for IAE manure

Achieving compliance with the EPA regulations, COP and REPS create a significant challenge to the IAE operator in securing acceptable spread lands.

4.1. Soil test P limits

Soils with P levels greater than EPA's STP limit of 15 mg/l are not acceptable for the application of IAE manure. The limit is based on the previous Teagasc agronomic STP level for silage production above which no P was recommended (Gately, 1994). Discounting the exemption that allowed 30 mg P /l on spread lands with low vulnerability for nutrient losses, the 15 mg/l restriction is similar to the STP limit previously proposed by Teagasc (Teagasc, 1994). The exemption was originally included to accommodate the special circumstances of IAE nutrient surpluses and their concentration in specific areas within the country. The more recent links established between STP and P loss to water and the demands for more sustainable nutrient management resulted in the establishment of the 15 mg/l EPA BATNEEC STP limit. To date, the EPA has acknowledged the special problems of IAE by **not** reducing the BATNEECSTP level to the revised Teagasc agronomic level of 10 mg/l for grassland (Teagasc, 1996). However, it has the powers to do if deemed necessary.

As already noted above traditional IAE spread lands tend to have STP levels in excess of the BATNEEC limit. Over 20% of all grassland and 27% of tillage land soil samples received at the National Soil Testing Laboratories at Johnstown Castle had STP levels above the BATNEEC limit (Coulter and Tunney, 1996). Assuming that these soil samples are an unbiased representation of Ireland's agricultural soil resource, at least one fifth of the country's agricultural land is excluded from receiving IAE manure. Intensive compared with extensive grass land will tend to have higher STP levels. This is confirmed by results from a recent Teagasc pilot nutrient management planning scheme, supported by the EU LIFE programme, to promote uptake of nutrient management planning on farms (Carton 1996). The average stocking rate and STP in two of the catchments with predominately dairy farms participating was 2.2 LU/ha and 10mg/l, respectively. However, the mean STP was 6 mg/l in a third catchment with a lower average stocking rate of 1.6 LU/ha and a greater mix of dairy and dry stock farms. It is inevitable, therefore, that compliance with the BATNEEC STP limit will require the transport manure to areas outside those normally used. It will also force IAE operators to seek spreading agreements with more extensive farms, which have lower nutrient requirements. Greater public environmental awareness and the odour associated with the land spreading of IAE manures may create further difficulties when attempting to secure new spread lands in areas with no previous history of the practice.

4.2. Code of Good Agricultural Practice

As noted above the COP sets a voluntary organic N load limit of 250 kg/ha in areas with no water quality problems. The limit can be reduced to 210 or 170 kg/ha in areas with known water quality problems. These N restrictions will limit the stocking rates that can be accommodated on grassland used for IAE manure applications. The maximum allowable stocking rate will depend on the organic N load applied in the manure and the COP limit (Table 1).

Applica-tion rate (t/ha)	Code of Good Agricultural Practice Organic N limit (kg/ha)											
	250				210				170			
	Pig	Poultry		SMC	Pig	Poultry		SMC	Pig	Poultry		SMC
		Slurry	Litter			Slurry	Litter			Slurry	Litter	
0	2.9	2.9	2.9	2.9	2.5	2.5	2.5	2.5	2.0	2.0	2.0	2.0
5	2.7	2.1	1.4	2.4	2.2	1.6	0.9	2.0	1.7	1.2	0.5	1.5
10	2.4	1.3	-	1.9	2.0	0.8	-	1.4	1.5	0.4	-	1.0
15	2.2	0.5	-	1.4	1.7	-	-	0.9	1.2	-	-	0.4
20	1.9	-	-	0.9	1.5	-	-	0.4	1.0	-	-	-
25	1.7	-	-	0.4	1.2	-	-	-	0.7	-	-	-
30	1.4	-	-	-	1.0	-	-	-	0.5	-	-	-
35	1.2	-	-	-	0.7	-	-	-	0.2	-	-	-
40	0.9	-	-	-	0.4	-	-	-	-	-	-	-
45	0.7	-	-	-	0.2	-	-	-	-	-	-	-
50	0.4	-	-	-	-	-	-	-	-	-	-	-
55	0.2	-	-	-	-	-	-	-	-	-	-	-

- Organic N load in IAE manure exceeds COP limit.
- The organic N content of manures used in the calculations were 4.3, 14, 26 and 8.8 kg/t for pig slurry, poultry slurry, poultry litter and SMC, respectively (DOE/DAFF, 1996). An annual organic N output of 85 kg for a livestock unit (LU) (equivalent to 1 dairy cow) was also used (DOE/DAFF, 1996).

Table 1.
The stocking rate limits on grassland receiving IAE manure at a range of application rates in order to remain in compliance with COP organic N limits.

Grassland farmers are practically excluded from receiving poultry litter or slurry if they are to remain in compliance with even the highest COP organic N limit of 250 kg/ha (Table 1). At this limit, stocking rates of 0.9 LU/ha or less are necessary where poultry litter is applied at 5 t/ha. Therefore, it is probable that poultry litter will be directed towards the most extensive farms considering that the national average stocking rate is 1.47 LU/ha. A similar, though not as severe scenario, applies to poultry slurry. Generally, only tillage farms will be in a position to receive poultry manure without exceeding the COP limit. This is a limited option as tillage crops account for 8% of agricultural land use in Ireland and there is little history of poultry manure use in these production systems. The use of improved slurry/manure spreading systems which can reliably achieve lower spreading rates and a greater integration of the poultry and tillage enterprises are required to ensure the viability of the land spreading option for poultry manure.
The lower organic N content of pig slurry and SMC eases the impact of COP on spread land availability for these manures (Table 1). In general, grassland with stocking rates in excess of 1.9 LU/ha will not be available to receive these manures under a COP restriction of 250 kg N/ha/yr. Where the lower COP limits are applied the availability of spread lands will be even more curtailed and could disappear altogether.

The introduction of REPS will exclude significant areas of the national land bank for use as a receiver for IAE manure. As presently specified there is a 170 kg organic N limit for participating farmers. Therefore, only the more extensive REPS farmers with organic N loads of less than 110 kg/ha, equivalent to a stocking rate of 1.3

LU/ha, can accept pig manure at the lower end of the application rate achievable (15 t/ha) with the commonly used vacuum tanker. SMC applied at the 10 t/ha using a rear discharge spreader will supply almost 80 kg organic N/ha. Consequently, only REPS farmers with organic N loads of less than 90 kg/ha, equivalent to a stocking rate of less than 1 LU/ha, can accept SMC and remain in compliance with the REPS limit. Generally, the use of poultry litter or slurry on REPS farms is practically excluded because of its high N content.

REPS is a financially attractive scheme for many farmers as it provides annual payments of up to £5000. The COP limit on organic N will push IAE manure towards land farmed at intensities permissible in REPS. The Government have set a national target for a 30% uptake of REPS by farmers by the end of 1999 in its recently published Sustainable Development Strategy. Failure of farmers participating in REPS to comply with the organic N limit specified will jeopardize annual payments as well as other government financial supports. There is an understandable unwillingness for them to accept IAE manure. Therefore, the combined effect of REPS and COP will move the manure towards the most extensive grassland farmers *i.e.* with stocking rates < 1.3 LU/ha. It is interesting to note only one third of farmers with stocking rates less than 1.25 LU/ha indicated that they were willing to accept IAE manure for application to their land even if it was free (Teagasc, 1994).

Nutrient requirements on the more intensive farms are being met with inorganic fertilisers even though the potential exists to utilise the nutrients in IAE manure. Instead these manures are being diverted to farms with minimal nutrient demands. The impact of COP and REPS on land spreading of IAE manure deserves further consideration in the context of achieving improvements in water quality and an integrated and diversified agriculture. However, IAE operators must adopt and implement manure management practices such as those outlined by Carton and Magette, (1998) to provide the public assurance that the option will not impact negatively on the environment.

It is unlikely that the combined impact of REPS and COP on IAE manure management options was planned national policy considering that the continued expansion of the pig industry remains Government policy.

4.3. Revised P recommendations for grassland.

Teagasc have recently revised their P recommendations for grassland (Teagasc, 1996). These set lower agronomic STP levels for grazing and silage ground above which no P is recommended for full crop yields. The quantities of P recommended, were also lowered. The revised recommendations have reduced the P requirements for silage and grazing by approximately 50 and 40%, respectively.

Applying nutrients at rates which meet crop requirements, including in some cases building up soil fertility, is the basis of Teagasc's nutrient management strategy. The reduced P recommendations for grassland make achieving this balance when IAE manures are applied very difficult to achieve in practice. The quantity of P applied with IAE manure at the lowest practical application rates is summarized in

Table 2.

Pig slurry (15 t/ha)	Poultry Slurry (15 t/ha)	Poultry litter (10t/ha)	Spent Mushroom Compost (10t/ha)
21	75	90	42

Table 2.
The average P (kg/ha) supplied by pig and poultry slurry, poultry litter and spent mushroom compost applied at the lowest practically achievable spreading rates.

Note: Nutrient values for slurries, litter and spent mushroom compost from COP. These are guide values only and will vary from IAE to IAE. Application of 10 t/ha of poultry litter just exceeds the COP limit of 250 kg organic N/ha.

The P recommendations for a range of crops at soil index 3 (6.1 to 10.0 mg P/l) are given in Table 3.

Grazing (2 to 2.5 LU/ha)	Silage (2 cuts)	Cereals	Potatoes	Sugar beet
12	0	20	60	30

Table 3.
The phosphorous recommendations (kg/ha) for a range of crops at soil Index 3

It nearly all cases the annual application of the manure, at the rates indicated in Table 2, will result in an over supply of P compared with crop requirements. The extent of the surplus is greatest for poultry slurry and litter (Figure 2). The P recommendations are greater at the lower soil P indices therefore the surplus P applied in the IAE manure will be proportionately smaller at these lower indices. Annual balancing of nutrient inputs with outputs is difficult to achieve in practice when IAE manure is land spread, particularly to grassland.

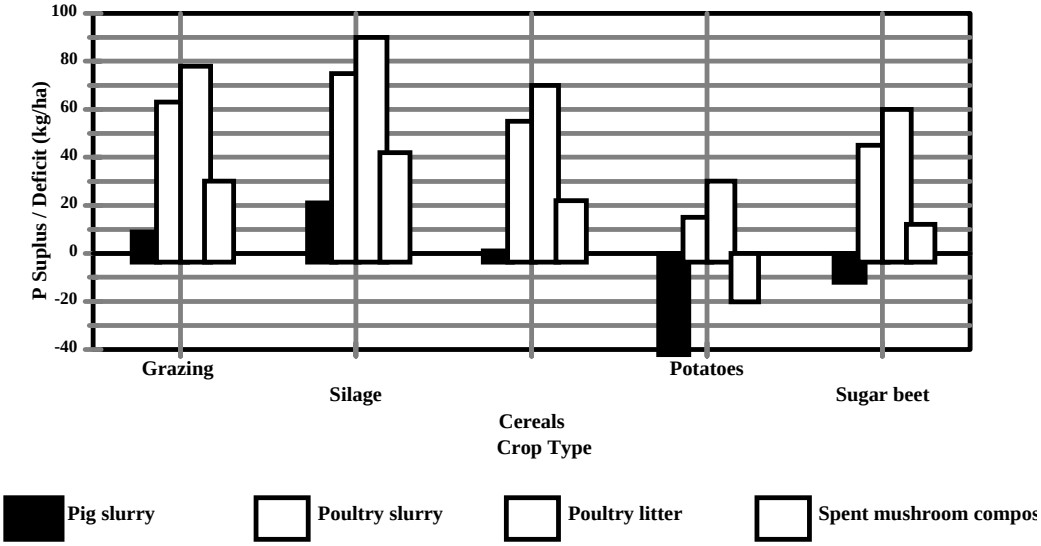

Figure 2.
The P surplus/deficit (kg/ha) following manure applications at lowest practical achievable spreading rates to a range of crops on soils with STP levels between 6.1 and 10 mg/l.

Phosphorus applied in excess of crop requirements will result in a build up in STP. In effect the soil "stores" the surplus P, and while the capacity to do so is not unlimited, it is significant for many soils. Recognition that soils do have a measurable capacity to store P is essential for the viability of the land spreading option for IAE manure. Nevertheless, a sustainable balance must be achieved between the extent of soil P storage and the resulting increase in environmental risk. By regulation (*i.e.*, BATNEEC) the soil P "storage" capacity is fixed at a maximum STP of 15 mg P/l. In other words, P applications above levels required for agronomic requirements are allowed for IAEs until STP reaches 15 mg P/l. Once the STP reaches this limit new spread lands with lower STP must be located. A reduction in this limit could have serious consequences for the IAE manure land spreading option.

It must be emphasised that acquisition of spread lands cannot be accomplished capriciously. Assessment of spread land suitability for IAE manure, particularly where soil P storage is required, is essential because of the accepted potential of elevated STP as a contributory factor for increased P loss and transport to water.

4.4. Site assessment for land spreading

There is evidence that there are differences between areas within catchments in the extent to which they contribute to nutrient loss to water (Magette, 1998). Consequently, areas within catchments can be classified in terms of the risk that nutrients used there will be lost and transported to receiving waters.. While the process of ranking fields or catchments in Ireland is at early stage of development it does provide a mechanism to assist in assessing the suitability of spread lands for IAE manure applications. Only sites ranked as low risk (for their potential to lose P and for it to be transported to receiving waters) should be used to "store" the surplus P from applied IAE manure. High risk sites should not be used for IAE manure applications.

National acceptance of the combination of site assessment and the use of soil P "storage" is critical for the viability of land spreading of IAE manure. Without this, the practicality and economics of the land spreading option for IAE manure is questionable. As already noted, the COP and REPS constraints on organic N loads and the BATNEEC STP limit of 15 mg/l are creating significant difficulties in terms of available land base. Even as they are currently structured, achieving compliance for some poultry enterprises is almost impossible. Therefore, any downward revision of the current BATNEEC STP limit will require careful consideration.

4.5. Buffer zones

The inclusion of buffer zones, prescribed in the COP around water sources and houses will further diminish the quantity of available land for manure application. For example, 12 to 15% of land will be excluded in areas with a high land to water ratio while in areas with low land to water ratios this may be up to 35%.

4.6. Other factors influencing their availability to receive IAE manure

The EPA IPC license has a requirement for supplementary spread lands over and above those required to assimilate the nutrient load in the manure. This is set at 50% of the area acquired by agreement (*i.e*., not under the ownership of the IAE operator) for new enterprises.

5. Costs

There are costs associated with securing and maintaining an Integrated Pollution Control license for pig enterprises from the EPA. The costs (excluding those necessitating by structural changes at units to comply with licensing) are of three main types : application preparation, annual administrative cost, and annual monitoring fee. For intensive pig producers, these costs are estimated to be as follows:

1. Preparation of an IPC licence or planning application, including preparation of an Environmental Impact Statement ~ £25-£40 per sow
2. Annual EPA charge (based on a 1000 sow unit) ~ £1,800

3. Annual monitoring charged incurred as a result of licensing (based on a 1000 sow unit) ~ £ 1,600 including soil and water analysis but excluding any consultancy or sampling charges.

6. Conclusions

The requirements for improved manure management on farms to reduce environmental impact are nationally accepted. The growing national concern to maintain the high quality of the nation's water resources has resulted in the introduction of legislative controls on IAE manure management practices. The restrictions, noted above, on spread land availability have significant implications for the land spreading of IAE manure for both new and existing units. Newer IAE have the option to locate in areas of the Country where the implications of the constraints on spread land availability are not as great. Ideally, these should be in the tillage areas where the crops are produced that are used to feed the pigs and poultry. Such a strategy facilitates the recycling of the manure nutrients back to the areas from which the nutrients originated. However, achieving this will require clear national policy about the future development of IAE so that the local fears of their impact, particularly as many of these areas have no history of IAE, will not result in unnecessary and costly delays in the planning/licensing process.

There is a more difficult problem for existing enterprises. Locating new spread lands, in areas with already high IAE concentrations, will require greater travel distances as STP levels in the immediate vicinity of the operations exceed the BATNEEC STP limit. An adequate time scale for the full implementation of the manure management plan will therefore be necessary from the Licensing Authorities for existing enterprises.

Caution is required with the introduction of any further legislation to ensure that any new restrictions proposed combined with those already in existence do not preclude the land spreading option for IAE manure. Alternative management options for IAE manure are scarce.

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