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Abstract

This paper employs Q methodology to investigate farmer opinions of the operation of the EU Nitrates Directive regulations after the first 4 year National Action Programme phase and explores the level of acceptance and refutation of measures from the view of farmers own knowledge and experience of land stewardship. Results indicate 4 main opinion groups. A "Constrained Productionists"group remain unconvinced about the appropriateness of certain measures from a farm management, environmental and water quality perspective. A second group "Concerned Practitioners" share some of these concerned but are generally more positive regarding other farm management and environmental benefits accruing from the regulations. A third group, "Benefit Accepters", indicated quite an environmentalist position and are generally very positive towards regulation implementation and associated environmental and farm management benefits. The final group "Regulation Unaffected" have some concerns but are mostly unaffected by the regulations. Results suggest there is a growing acceptance among some farmers of environmental benefits accruing from the regulation but scepticism remains around the validity of certain measures, especially, in the area of temporal farm practices.

1.0   Introduction

The 1991 Nitrates Directive (ND) is one of the earliest pieces of EU legislation aimed at controlling and improving water quality (Europa, 2010). Agriculture in the EU contributes 40 to 80% of the nitrogen (N) and 20 to 40 % of the phosphorus (P) entering surface waters (OECD, 2001) and the sector has a major challenge to curtail these losses. The ND is a precursor of the Water Framework Directive (OJEC, 2000) and aims to minimise surplus P and N losses from agriculture to the aquatic environment. Nutrients in fertilisers promote plant growth but application in excess

of plant requirement can cause negative environmental externalities such as eutrophication (EPA, 2008). The ND requires each member state to introduce a programme of measures in vulnerable areas. The ND programme of measures was implemented uniformly across the Republic of Ireland, this contrasts with other countries where measures were targeted at identified Nitrogen Vulnerable Zones (NVZ) on a more regional basis. The Irish National Action Programme (NAP) wasn't transposed into national legislation until 2006 through Statutory Instrument 378 of 2006 and was subsequently updated in Statutory Instruments 101 of 2009 and 610 of 2010. Commonly referred to as the Good Agricultural Practice (GAP) regulations, these gave statutory effect to Ireland's national ND NAP. The NAP is subject to a periodic 4 year update and review.

As outlined by Fealy et al. (2010) the GAP regulations address the need for managing both potential point and diffuse sources of nutrient transfers from agricultural land. Grant aided capital investment was made available for yard management, specifically for soiled water separation and slurry storage and handling (Minister for Agriculture and Food, 2006). Minimum slurry storage requirements[1] for the housing of livestock over the winter period mitigate point source losses and also facilitate closed periods for spreading during autumn and winter months[2] to avoid incidental diffuse transfers during heavy rainfall. Limits on livestock intensity are implemented to indirectly constrain organic N use to 170 kg organic N / ha / yr and up to 250 kg organic N/ ha / yr where a derogation has been granted. Closed periods for ploughing[3] and the use of

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[1] 16 to 22 weeks depending on geographic location.
[2] The closed period for the application of slurry begins on October 15th and finish on either January 12th, January 15th or January 31st depending on geographic location.
[3] Ploughing of grassland is prohibited between 1 July and 15 January unless green cover is provided for emergence by 15 November. Ploughing of arable land between 1 July and 15 January must be accompanied by emergence of green cover within six weeks of ploughing from a sown crop.

non-selective herbicides on arable land during the winter months (unless a green cover is established within 6 weeks of the original green cover destruction) is a measure aimed at reducing the potential for nitrate leaching during wet weather. The application limit of inorganic N fertilizer is recommended by crop type at rates defined by demand (Coulter & Lalor, 2008). To minimize diffuse P transfers from agricultural soils, a constraint on the use of fertilizer prevails based on status of a Morgan soil P test (Morgan, 1941).

Farmers in the Republic of Ireland voiced opposition to operational elements of the GAP regulations when first introduced, most notably in relation to stocking rate restrictions, fertiliser application thresholds and closed periods (Brosnan, 2004, IFA, 2004). Farmers apply fertilisers because a benefit is derived through either increased output, income or both, however, plants absorb nutrient contained in fertilisers only up to their requirements. Application of fertilisers in excess of plant requirement and under unsuitable conditions has both economic (loss of nutrient for agricultural production) and environmental consequences (nutrient leaching and/or runoff transfers from land to watercourses) (Sharpley et al., 2003). Excessive and untimely fertiliser applications compared to the optimum has be attributed to such factors as risk aversion to lower yields, information asymmetry or incentive incompatible fertiliser pricing (Scott, 2005; Barnes, 2009a) .

Research around the theory of regulation highlight the importance of the legitimacy ascribed to a regulation in determining the effectiveness with which it can be implemented (Davies and Hodge, 2006; Barns et al., 2009). Individuals are perceived to be more likely to adhere to regulation when it is believed to be appropriate, fair,

equitably implemented, process efficient and/or effective, proportionate, necessary and relevant. The introduction of regulation in the absence of these factors may lead to widespread transgressions, entailing high monitoring and enforcement costs (Winter and May, 1999; 2001). Policymakers are generally eager to ensure farmer consultation and co-operation in policy design to limit compliance problems (Davies and Hodge, 2006).

The efficacy of the GAP measures is being evaluated holistically by an Agricultural Catchments Programme through intensive bio-physical and socio-economic monitoring in six small scale river catchments dominated by moderate to high intensity grassland and arable enterprises across Ireland. To represent a range of farming types and intensities, and physiographic differences in the country, as advised under EU guidelines, a GIS multi-criteria decision analysis (MCDA) was employed to select candidate catchments. The MCDA process is described in detail by Fealy et al. (2010). In summary, the criteria used for 4 km^2 to 12 km^2 catchment selection were to maximise agricultural intensity (as livestock units per ha or percent arable landuse) minimise non-agricultural landuses (as peat soil percentage, forestry, building density, and major roadworks) and select for a range of high N or P transport risky landscapes (Anon., 2003; Anon., 2004). This paper investigates attitudes towards GAP regulation implementation from the subjective perspective of the farmer stakeholders in these catchments using Q methodology.

Q methodology was first pioneered by William Stephenson (1935) and encompasses a distinctive set of psychometric and operational principles that when combined with the statistical application of factor analysis provides the researcher with a systematic

and robust means of examining human subjectivity (McKeown and Thomas, 1988). Q methodology is expressly aimed at identifying different patterns or shared ways of thinking on a topic that is relatively independent of the researcher. The experimental design of the Q methodology reduces any potential researcher bias and pre-specification of concepts by the researcher (Ellis et al, 2007). Brown (1980) describes it as the 'science of subjectivity' where the goal is to extract patterns of similarity between the responses of a small respondent sample which represent the spectrum of views among the targeted population. The technique is not designed to have results scaled up to draw conclusions about the relevant whole population.

Originally associated with the fields of psychology and health studies the technique has been more recently applied to a range of agricultural and land use issues many revolving around land stewardship (Wilson 1998; Brodt et al., 2006; Davies and Hodge, 2007; Visser et al., 2007; Fairweather & Klonsky, 2009), adoption of genetically modified crops (Hall, 2008), organic farming (Zagata 2010), forestry management (Steelman and Maguire, 1999; Swedeen, 2006; Urquhart, 2008) and prevention of animal disease (Kristensen and Jakobsen, 2011).

A number of studies across developed countries have investigated farmer attitude to compulsory water quality management regulations. Predominant themes to emerge include acceptance of water pollution problems associated with agriculture (Morton 2007, Popp and Rodriguez 2007); knowledge gaps around regulations (Dwyer et al. 2002, Nimmo-Smith et al. 2007, Sang, 2008); resistance to regulations imposition (Uri 1999, Shoreman and Haenn 2009) and burden of compliance in terms of time and costs (Bratt 2002, McDermaid 2005). A growing body of literature has started to look

at farmer attitudes to ND implementation. Widdison et al. (2004) in a study of the LEET NVZ catchment in the UK found that there were gaps in farmers' knowledge of ND regulations. Additionally, farmers wanted more concise and clear information on guidelines and were sceptical of management changes required by the regulations. Macgregor and Warren (2006) investigated qualitatively the motivations and management practices of a small sample of farmers located within the Strathmore and Fife Nitrate Vulnerable Zone in Scotland. They found that farmers rarely consider environmental issues beyond the boundaries of their farms unless it affects the productive capacity and economic viability of their farms. Farmers in this study did not believe that they were responsible for any water quality problems, nor was the intrinsic linkage between catchment and coastal zone management established in their minds. Most farmers regarded the terrestrial environment as being more important than the river or marine environment. They did however exhibit a clear sense of what nutrient management practices were most likely to cause significant problems, such as excessive applications of fertilisers and manure, poor timing of applications, inadequate or poorly maintained manure, as well as slurry and silage storage. Additionally, most farmers in this study exhibited strong antipathy towards government associated initiatives, whether these were regulations associated with various forms of legislation or funding opportunities. Notably Macgregor and Warren (2006) found that farmers claimed that lack of physical evidence led to a reluctance to positively participate within regulatory schemes and that national regulations ignore regional resource requirements in agricultural production. Barnes et al., (2007) (citing Ecotec, 2005) also highlighted this issue and suggested it could be a decade or more before changes in farm practices could be assessed in terms of impact on water quality. This report also highlighted the lack of transparency in NVZ designation and

the slow impact of any agricultural practice change on groundwater nitrate levels undermined the credibility of the zones and the low willingness of many farmers to seek advice or make many changes (Nimmo Smith et al., 2007). Barnes et al., (2007) drawing on research by Lowe et al. (1997) and Burton (2004) suggest that farmers foremost see themselves as food producers and not managers of animal waste. Where maximising resources and output was associated with being a good farmer (Burton, 2004).

A major constraint identified in this literature is the lack of belief in the scientific evidence by the farmer due to the complexity of N and P transport and its relatively slow impact on water quality. Heretofore, little physical evidence was available for farmers to fully accept regulatory standards. Elnagheeb et al. (1995) found that the willingness to alter farm practices was positively related to how a land manager perceived the seriousness of the pollution problem.

Barnes et al (2007) employed Q methodology to investigate farmer attitude to Nitrogen Vulnerable Zone regulation in Scotland. In this research three opinion groups emerged, the first 'freedom farmers' felt most strongly about the details of the restrictions placed on them and the impacts the regulations were having on their farm business. The second group 'benefit sceptics' indicated a lack of belief that any environmental benefit was accruing from the regulation. The final group 'information seekers' felt there were inadequacies around the information available to farmers in NVZs. Barnes et al (2007) did however note that there was not much that distinguishes between the groups and all generally have the similar overall concerns

about the NVZ regulations, with each group placing a greater emphasis on different aspects of concern.

Barnes et al. (2011) also investigated attitudes and values of farmers within designated Nitrate Vulnerable Zones (NVZs) in Scotland using factor and cluster analysis techniques. This analysis identified three farmer types; 'resistors', 'apathists' and 'multifunctionalists'.   The 'multifunctionalists' and the 'resistors' had similar approaches to land use management, but then diverged in terms of their perceptions towards the environment, water management and the NVZ regulations in particular. Notably the 'resistors' disagreed that there was a link between water quality and the health status of the farm and placed a greater emphasis on the importance of resource maximisation. The apathists (one-third of the sample) indicated indifference towards the aims of the regulation and to water quality management in general indicating a policy conundrum from policy makers. The authors suggest the need for greater targeting of information to this group emphasising favourable perceptions which encourage water quality management behaviours. Barnes et al. (2009b) in a related study found that farmer attitudes indicate a mostly negative view towards the perceived environmental benefits, water management and compliance of NVZ regulations in Scotland. The study also indicated that farmers viewed the restrictions placed on farming practices within NVZs as too inflexible. They suggested the need for policymakers to provide clearer information over the science and purpose of the designations and also to invest in the transfer of technologies with the ultimate goal of embedding N pollution impacts within the farmer's cultural framework of decision-making.

Sonneveld and Bouma (2003) also proposed a number of initiatives to address this disconnect in the context of ND implementation in the Netherlands. These included research aimed at improving and maintaining nutrient use efficiency at farm level; promotion of joint learning experiences between farmers and researchers; greater emphasis on site and time specific management (precision agriculture) and provision of site-specific advice via modern information and communication technologies.

Although legally obliged to comply with GAP regulations, this paper aims to investigate farmers' subjective view of the regulations after the first 4 year implementation phase and identify areas where there is farmer acceptance and refutation of ND measures based on their knowledge and experience of land stewardship. The remainder of the paper is organised as follows; firstly the methodology is outlined. This is followed by results and finally some conclusions and discussion are offered.

2.0   Methodology

Implementing a Q methodological study typically involves 6 main stages (Addams and Proops, 2000). The first step is to identify the discourse of interest and relevant population. In this instance farmer attitude towards the GAP regulations in the Republic of Ireland.

Stage 2 involves collection of a full concourse of statements on the discourse by the relevant population. Statements should be representative of the opinion domain at issue (Watts and Stenner 2005). The statements set can be either naturalistic or

readymade (McKeown and Thomas 1988). Naturalistic statements are those emerging from the respondents, either in written or oral form. Alternatively, ready-made statements can be compiled from existing sources, such as other academic studies, related literature or newspaper articles. Naturalistic statements tend to be more familiar and better understood by respondents as they derive from the respondents themselves. The naturalistic approach was adopted here where a questionnaire was developed with a number of open ended questions designed to educe statements on the implementation of the EU ND in the Republic of Ireland through the GAP regulations. This scoping questionnaire was delivered to 6 farmer discussion groups[4] during the summer of 2009. A total of 51 farmers across a range of farming systems (dairy, tillage and livestock) completed the questionnaire and 556 statements emerged. However, there was a large degree of repetition among statements generated such that the final concourse of statements totaled 120 statements. The statements were either positive, negative or neutral across a number of thematic areas including farm management, environment, farm profitability, information provision and equity of implementation. Each of the statements was assigned to a relevant box in a matrix depending on the thematic area and orientation.

The third stage of Q methodology implementation involves reducing the concourse of statements down to a representative manageable number, or a Q set. A Q set typically ranges between 30 and 50 statements. Brown (1993) suggests that, in line with sampling procedures, the main goal in selecting a Q set is to provide a miniature that is representative of the larger population. The statements should be broadly reflective of the issue complexity while still allowing room for individual experience

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[4] These were discussion group run by Teagasc (The Agriculture and Food Development Authority in Ireland) and were located in close proximity to the 6 catchment areas.

to be represented (Previte et al. 2007). The concourse is usually approximately three times the size of the Q set (Rogers 1995, pg. 185). In this application of the Q methodology a total of 30 statements were chosen to be representative of the full concourse and structured along a factorial design as set out in Table 1 as recommended by McKeown and Thomas (1988). The frequency with which thematic elements appeared in the final Q set was determined by the original concourse structure. The statements were pre-tested on a number of volunteer farmers as well as research staff and some minor alterations were initiated to improve, clarify, and remove any potential ambiguity.

Table 1: Factorial design of Q-sort

	Positive	Negative	Neutral
Farm Management	4	4	2
Environment	3	3	1
Profitability	3	3	1
Information	2	2	0
Equity	1	1	0

The fourth stage of implementation involves selecting participants and instructing them to rank or 'sort' the selected statements from most agree to most disagree normally following a forced quasi-normal distribution structure. Although not a methodological imperative (Cottle and McKeown, 1981) the quasi normal distribution is recommended as a device for encouraging subjects to consider the items more systematically (McKeown and Thomas. (1988). The Q sort was administered to a sample of farmers across the agricultural catchments programme (N=71) by a team of

trained farm advisors. Respondent were selected to represent the range and intensity of agricultural production across the 6 case study catchments. Respondents were instructed to sort the statements on a 7 point scale from -3 (most disagree) to +3 (most agree) as outlined in Figure 1 below.

Figure 1: Q sort scheme design

Most Disagree   Most Agree

-3	-2	-1	0	1	2	3
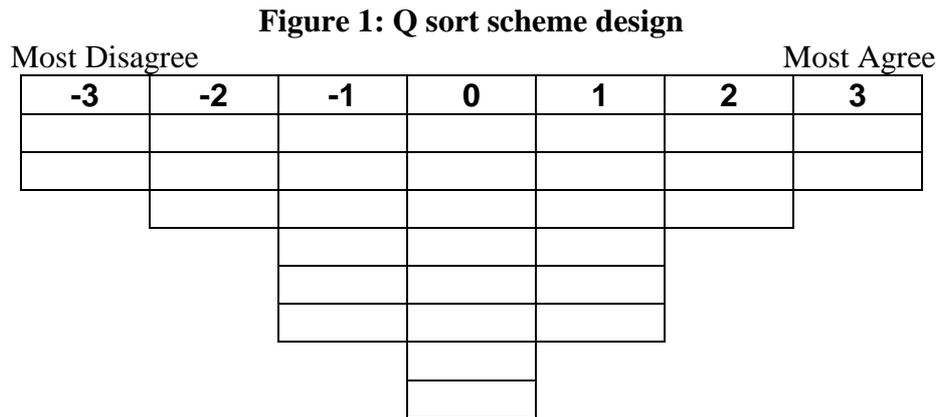
During the process of Q sort administration, respondents were requested at the outset to read all the statements and then to initially sort into 3 piles namely agree, disagree, indifferent or not sure. Subsequently they were then requested to fill the sort following the quasi-normal distribution. During this process respondents compared statements and traded-off on the relative strength on how they view one statement versus another. Respondents were at liberty to alter the placement of statements at any stage until they felt the final distribution best represented their subjective opinion. As highlighted by Rogers, (1995, p.180) 'ranking is a holistic or gestalt procedure in which all elements are interpedently involved' where the sorting process reveals the participants subjectivity and the structure of the quasi-normal distribution facilitates comparison through correlation and factor analysis.

The fifth stage involves statistical analysis and the extraction of a few 'typical' sorts which are representative of distinct attitude or understanding of an issue or policy.

This involves Q sort correlation, factor analysis and rotation to reduce the data to a limited number of defining factors which define different views on the discourse. Correlation is useful for indicating which pairs of Q sorts bear a resemblance, and factor analysis searches for family resemblances more generally which indicate a group of type which go together (Brown, 1980). This penultimate stage was undertaken using PQMethod (Schmolck, 2002). In Q methodology the individual respondents are the defacto variables, hence there could be 71 different discourses if each farmer ranked the 30 statements in a statistically different manner. Factor analysis determines if there are a smaller number of families of Q sorts that represent a discourse pattern among the participants (Swedeen, 2006).

A principal components analysis was conducted to identify a small number of heavily loaded factors (groupings of farmers). Principal Components Analysis (PCA) uses a correlation matrix to determine how many factors or groups exist. Q sorts that are highly correlated with one another and uncorrelated with the sorts in other groups could be said to have a 'family' resemblance (Brown, 1993). PCA derives a set of factor loadings which indicate the degree to which each Q sort is associated with each factor. Varimax rotation was then used to rotate factors to find the simplest structure in the data that can explain the greatest amount of variability (Brown, 1980).

As outlined by Sweden (2008) when statistically significant factors are identified the original statements are given a factor score. A factor score is calculated based on the average score given to that statement by all of the Q sorts associated with a given factor. Q sorts that are significantly associated with a factor are then weighted to account for the degree of association with that factor. The weight for each Q sort

within a factor is used to generate a normalized z score for each statement. The normalized z scores are related back to the original response scale (-3 to +3) where a predicted sort is generated for each factor. Hence for a given factor the two statements with the highest z scores are assigned a score of +3 from the original scale in the predicated sort for that factor. Finally, these "idealized" sorts are described and interpreted in terms of shared attitudes or discourses. Each factor is considered to represent a distinct view to the topic under investigation.

3.0   Results

After considering several different iterations, a four factor solution was deemed to represent the most coherent explanation of the farmer opinion on the discourse. Eigen values and percentage variance explained by each factor are as shown in Table 2 below. The four factor solution accounted for nearly 64 per cent of the variation in the data. In all 61 of the Q-sorts significantly loaded on one of these 4 factor groups, 8 respondents loaded significantly on more than one factor while 2 farmers failed to load significantly on any factor.

Table 2: Four factor solution - eigenvalues and explained variance

	Factor 1	Factor 2	Factor 3	Factor 4
Eigen values	30.4	7.2	4.2	3.2
% Variance explained	42.8	10.2	6.0	4.5

The eigen values represent the sum of squared loadings of cases on a factor, and its' relative size is consequently dependent on both the number of cases within a factor group and the total number of cases in the sample. In larger sample (N=71 is

significantly larger than the average application of the Q method) this can prove problematic as the sum of numerous very small loadings can contribute to a large number of factors with eigen values over one, none of which are significantly correlated with an individual. Given the relatively large number in this sample the criterion employed (similar to Davies and Hodge, 2007) was to retain a factor if 3 or more cases loaded on the factor.

The four factors extracted here represent four distinct views on the GAP regulation in the Republic of Ireland. In keeping with Q methodology convention each factor was given a label in line with associated characteristics. The four factor groups are called "Constrained Productionists", "Concerned Practitioners", "Benefit Accepters" and "Regulation Unaffected" respectively. The statements on which each factor loaded upon are outlined in Table 3 and are discussed in greater detail in the following sections, specific statements are referred to in brackets.

Table 3: Statement scores for each of the 4 groups

Statement	Factor 1	Factor 2	Factor 3	Factor 4
2. The GAP regulations have resulted in farming to calendar dates and not to weather/ground conditions and have lead to farmers undertaking farm management practices at inappropriate times.	3**	3**	-3**	2**
29. The GAP regulations have had no effect on farm management or workload.	-3**	-1*	-1	-1
3. The GAP regulations have had no effect on my farm business.	-3*	-2	-2	1**
14. Due to the GAP regulations work such as manure/fertiliser spreading and ploughing are concentrated into the time immediately after closed periods thus increasing the risk of pollution.	3	3	-3**	1**
5. The GAP regulations have not helped to	0**	-3	-2	-1*

improve water quality or the environment.				
1. The GAP regulations have made farmers more aware of the nutrient requirements of grassland / crops and encourage the better use of organic and chemical fertilisers.	1	3**	1	0
16. A GAP cross compliance inspection is a serious concern and a significant threat to farm income.	2	-2**	3	3
4. The GAP regulations have helped to reduce nitrogen and phosphorus leaching and run-off and have assisted in improving water quality.	-1**	2	2**	0
20. The GAP regulations promote good farming practice standards and encourage safety and neatness on farms.	-1**	1	3**	0
23. There is not enough information available on how to comply with the GAP regulations.	-1	-3	-1	-1
25. The GAP regulations have lead to a significant increase in red tape and bureaucracy and have increased pressure and workload.	2	0**	1**	3
27. The GAP regulations have restricted the use of chemical fertilisers and have had a detrimental effect on farm yield and output.	0	-1*	0	-3**
30. GAP regulations have restricted the potential to expand my farm business.	0	-1**	0	-3**
7. GAP regulations involve significant compliance cost and have placed an additional financial burden on farmers.	1**	0	0	-2**
19. The GAP regulations put undue focus on the potential for agricultural pollution.	1**	-1	-1	-1*
10. The GAP regulations have made farmers plan fertiliser usage to a greater extent.	1**	2	2	1*
21. GAP regulations have lead to an improvement in farm facilities.	1**	2	2	1
13. The GAP regulations have made farmers more aware of environmental and pollution related issues associated with agriculture.	0**	1	1	2
26. I am not sure whether the GAP regulations were warranted or are having a positive impact on the environment.	0**	-1	-1	-1
22. The GAP regulations are helping to protect the environment for future generations.	-1**	1	1	0
9. GAP regulations are fairly applied as all farmers in each zone have to abide by the same regulations.	-1*	1	1	0
11. The GAP regulations have restricted the freedom to farm in accordance with a farmers own experience and knowledge.	2	0**	0*	2
18. The information provided on GAP regulations is clear on the rules.	-1	2**	-1	-1

8. Information on the GAP regulations needs to be simplified and made more practical.	1	0**	1	1
15 GAP regulations have increased the emphasis on grassland / crop management and have improved profit margins.	-2	-1	0*	-2
24. The GAP regulations have had no effect on the use of organic and chemical fertilisers on my farm.	-2	-2	-2	0**
6. GAP regulations have put an increased focus on nutrient management and resulted in cost savings on chemical fertilisers.	0	1	0	1
12. There is sufficient agricultural advice available on how to comply with the GAP regulations.	0	1	0	0
17. The GAP regulations have created no problems for the environment.	-2	-1	-1	-2
28. The GAP regulations have highlighted the importance of keeping records for farm management purposes.	0	0	0	0

Distinguishing statements, * p< 0.05 , ** p< 0.01

3.1 Factor 1 – Constrained Productionists

This group represents a position that is generally negative towards the regulations both from a farm management and an environmental benefit perspective. They are clearly of the view that the regulations have had a significant impact on how they manage their farm operations (29 & 3, -3)[5] and have restricted the freedom to farm in accordance with their own experience and knowledge (11, +2). They indicate that compliance with the regulation has increased bureaucratic load (25, +2; 16, +2) and placed additional cost on farmers (7, +1). This group also strongly objects to the restriction of certain farm practices such as organic manure spreading and ploughing based on calendar dates (2, +3; 14, +3) and intimate that this could actually increase the risk of pollution. Consequently they were indifferent on whether the regulation

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[5] The first number(s) that appears refers to the statement number as in Table 3, the last number in the sequence refers to the stylized score.

are helping to promote good farming practice generally (20, -1) or have increased farmers awareness of environmental issues associated with agriculture (13, 0). They are unconvinced that the regulations are helping to improve water quality (5, 0; 4, -1) or are provoking positive environmental outcomes (26, 0; 22, -1). They also take the position that the regulations have put undue focus on the potential for pollution from agriculture (19, +1) and are not convinced that the regulations are being implemented on an equitable basis (9, -1). They do acknowledge that the regulations have made farmers more aware of the nutrient requirement of their crops and encourage the better planning and use of fertilisers (1, +1; 10, +1) and have lead to an improvement in farm facilities (21, +1).

3.2   Factor 2 – Concerned Practitioners

This group shares some of the same concerns of the "Constrained Productionsts" but is generally positive regarding other farm management and environmental benefits accruing from the regulations. This group also objects to calendar date restriction on organic manure spreading and ploughing (2, +3; 14, +3) as well as general impacts on management of farm operations (29, -1; 3, -2). From de-briefing post Q-sort administration this group and the "Constrained Productionists" suggested that calendar date measures can be counter productive and could actually increase the risk of pollution. They tended to argued that that the regulations are too inflexible, don't account for local conditions and discount their expertise and knowledge on how to manage their land.

However, this cohort acknowledges environmental benefits arising from the regulations (4, +2). For example they firmly reject the statement "The GAP regulations have not helped to improve water quality or the environment" (5, -3). This group also stipulate to some farm management benefit associated with the regulations and agreed with the assertion that the regulations have made farmers more aware of the nutrient requirement of their crops and encourage the better planning and use of fertilisers (1, +3; 10, +2). This group is unconcerned about cross compliance[6] or bureaucratic requirements associated with the regulations (16, -2; 25, 0) and believe there is enough information available on how to comply and implement the regulations (23, -3; 18, +2; 8, 0). These farmers indicate that the regulations have not restricted their potential to expand (30, -1) or unduly influenced their freedom to farm (11, 0).

3.3 Factor 3 – Benefit Accepters

This group is labelled "Benefit Accepters" as they are quite positive towards regulation implementation and associated environmental and farm management benefits. They agree that the GAP regulations promote good farming practice standards (20, +3) and help to reduce N and P leaching and run-off and have assisted in improving water quality (4, +2; 5, -2). The also stipulate to positive farm management benefits and agree that the regulations have made farmers more aware of the nutrient requirement of their crops and encourage the better planning and use of fertilisers (1, +1; 10, +2) and have helped to improve farm facilities (21, +2). They

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[6] To receive a payment under the Common Agricultural Policy based Single Payment Scheme a farmer must follow a variety of regulations on the environment, public health, animal health, plant health, animal welfare and land maintenance. This system is known as Cross Compliance.

take an opposing view to the "Constrained Productionists" and the "Concerned Practioners" on the closed periods for ploughing and organic manure applications (2 & 14, -3) but are in agreement that the regulations have had some farm level impacts (29, -1; 3, -2). They have some concerns about cross compliance inspections (16, +3) and the bureaucratic load associated with the regulations (25, +1).

3.4   Factor 4 – Regulation Unaffected

This group seem to be mostly unaffected by the regulation except for record keeping requirements and concern around a cross compliance inspection and have hence been labelled "Regulation Unaffected". Their main objection relates to the bureaucratic load associated with the regulation (25, +3), the threat of being inspected under cross compliance (16, +3) and restrictions on freedom to farm (11, +2). They have similar but not as strongly held views to the first two groups on the closed periods for ploughing and organic manure applications (2, +2; 14, +1). However, the regulations have not influenced their farm operations (3, +1; 7, -2), the potential to expand their farm business (30, -3) or chemical fertiliser practises (27, -3; 24, 0). They do not believe that the regulations have put undue focus on the potential for agricultural pollution (19, -1) and stipulate to some environmental benefit from the regulation in terms of water quality (5, -1) and making farmers more aware of environmental issues associated with agriculture (13, +2).

3.5   Consensus statements

Although the 4 factors clearly represent different positions, there is consensus on some issues. All groups reject the assertion that the regulations have created no problems for the environment (17, -1 & -2). All groups seem to be neutral on whether there is sufficient agricultural advice available on how to comply with the regulations (12, 0 & +1), the benefit of keeping record due to the regulations (28, 0) and whether the regulations have highlighted the role and benefits of nutrient management (6, 0 & +1).

3.6   Group Demographic and farm profile

Over 50 per cent of the sample loaded on the "Constrained Productionists" factor. This group tended to be younger with a median age of between 35-50 years and had the largest average farm size at 90 hectares. Average Kgs N Ha[-1] was 109 suggesting considerable expansion potential in livestock based enterprises. They also had a significant arable element as nearly one-third of area was under arable crops. Gross margin per hectare was estimated[7] at €790 Ha[-1]. The "Concerned Practitioners" were similar in age but their average farm size was a lot smaller (40 hectares) although they were more intensively stocked at 119 Kgs N Ha[-1]. This group has the largest estimated gross margin at €868 Ha[-1]. The "Benefit Accepters" had the second largest farm size at 75 hectares and nearly half this area was devoted to arable crops, they had the lowest total organic N at 59 Kgs Ha[-1] suggesting that compliance with livestock based measures is less of an issue for this group. Gross margin Ha[-1] was considerably lower then the aforementioned groups at €577. This group and the "Regulation Unaffected" tended to be older with a median age in the 51-60 years bracket. The

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[7] This is proxy variable imputed from farm profile data and average gross margin per ha^{-1} for similar farming systems as derived from a national survey based on EU FADN methodology (Teagasc, 2009).

"Regulation Unaffected" had the second smallest average farm size at 46 hectares and tended to be predominantly livestock based. They indicated the lowest estimated gross margin at €477 Ha^{-1}.

Table 4: Demographic characteristics of factor groups

	Constrained Productionists	Concerned Practitioners	Benefit Libertarians	Regulation Unaffected
Sample No.	38	9	5	9
Farm size (mean Ha^{-1})*	91 (66)	40 (19)	75 (73)	46 (25)
Arable area (mean Ha^{-1})*	28 (50)	7 (20)	37 (42)	4 (6)
Total Organic Nitrogen Kgs Ha^{-1} (mean)*	109 (61)	119 (70)	59 (41)	106 (52)
Gross Margin € Ha^{-1}	€790 (€640)	€868 (€825)	€577 (€552)	€477 (€596)
Age (median)	35-50 yrs	35-50 yrs	51-60 yrs	51-60 yrs

* Standard deviations in parenthesis

4.0   Discussion

Results from this research indicate that there are a large cohort of farmers, the "Constrained Productionists" pre-dominantly, who remain unconvinced about the appropriateness of the GAP regulations measures under the ND from both a farm management and environmental water quality benefit perspective. Findings are in line with a range of studies on Nitrates regulations (MacGregor and Warren, 2006; Barnes et al., 2007; 2009b; 2011; Nimmo Smith, 2007). This group and the "Concerned Practioners" objected strongly to closed period restrictions in the winter which restricts practices based on calendar dates. Both groups gave the highest ranking (+3) to statement disagreeing with implementation of such closed periods.

These groups seem to hold the view that these closed periods are counter productive from an environmental outcome perspective and could actually increase the risk of diffuse pollution. Farmers have requested greater flexibility around winter closed periods based on prevailing weather conditions (McGuinness, 2011).

Research is starting to emerge in this area, for example, recent research by Jordan et al., (2011; 2012) in a study of 4 intensively instrumented Irish agricultural catchments (2 grassland and 2 arable - Fealy et al., 2010; Wall et al., 2011) found that in the context of slurry spreading the closed periods represent approximately 25% of annual rainfall. However, the nutrient losses observed during the closed period in this dataset were all greater than 25% and up to 48% of the annual export of total P and 50% of nitrate. It appears from this analysis that the current closed period remains a time of significant risk of nutrient loss in some catchments. These losses would be accentuated if the closed period was not in place and would increase the environmental risk and economic loss and at farm gate level.

Jordan et al., (2012) did note that current regulatory tools do not account for spatial soil nutrient transport risk factors. They found that a simple spatial nutrient transport metric[8] was a better predictor of the percentage P lost during the closed period compared with any of the source risk metrics (landuse, percentage high P soils, organic P loading). This suggests that the regulatory framework needs to account for local soil and hydrological conditions in environmental risk assessment. This issue has previously been raised in other jurisdictions (Blackstock et al., 2009; Barnes et al., 2011) and now in the Republic of Ireland by Jordan et al (2012).

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[8] Based on stream discharge flashiness from annual hydrometric records

While there are likely to be a cohort of farmers who do not accept the validity of ND measures regardless of the evidence, however, most groups in this study are accepting of some level of positive environmental outcome from the regulation. Results indicate that the "Concerned Practitioners" and "Benefit Accepters" who, while having some issue with regulation implementation, are accepting of the associated environmental benefits in the area of water quality and/or good farming practice. With the exception of Barnes et al. (2011) this has not emerged strongly in previous research on ND implementation heretofore.

The "Benefit Accepters" are significantly positive on nearly all aspects of the regulations except aversion to inspection under cross compliance. This group tend to be more arable based and as such may not have to deal with livestock based compliance measures. This group seems to generally overlap with findings from Davies and Hodge (2008) and Brodt et al. (2006) who found an environmentalist cohort of farmers who prioritise environmental responsibility and were willing to entertain the stick as well as the carrot as a necessary policy tool.

The "Regulation unaffected" group while sharing some of the same ideological objections around freedom to farm and bureaucratic load but were not significantly impacted by the regulation. They do accept the regulations make farmers more aware of environmental issues associated with agriculture and have some environmental benefit in terms of water quality.

Lack of information and advice around the regulation has been previously highlighted as a constraint to regulation implementation (Widdison et al., 2004; Barnes et al.,

2007; Defra 2008). This did not emerge as a significant issue or constraint in the context of this research although concerns around a Nitrates cross compliance inspection[9] did arise. This suggests some farming cohorts may be unclear on all of the details and requirements involved in a ND cross compliance inspection. The farm media have recently highlighted farmer concerns and apprehension around a Nitrates cross compliance inspection (Young, 2010b). Young (2010a) noted that nearly 23 per cent of farmers in the Republic of Ireland who received a inspection under ND cross compliance in 2009 were found to have some level of non compliance.

5.0 Conclusion

Results of this study indicate 4 main opinion groups on ND directive implementation. The "Regulation Unaffected" group was generally indifference to ND measures except for concerns around increased bureaucracy. Two of the groups indentified "Concerned Practioners" and "Benefit Accepters" indicated varying degrees of acceptance of farm level and environmental water quality benefits arising from ND implementation. This has not emerged strongly in previous research may be reflective or slowly changing farmer attitudes and awareness of the costs and benefits of nutrient management both internal and external to the farm gate.

However, two groups "Constrained Practitioners and "Concerned Productionists" in this study remain unconvinced on the validity of certain measures particularly around winter closed periods. A major issue for these groups would seem to be the lack of scientific evidence or belief therein by farmers in the link between temporal farm practices and the impact on watercourses due to the complexity of N and P transport

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[9] To receive CAP based payments under the Single Payment Scheme a farmer must adhere to a variety of regulations on the environment, public health, animal health, plant health, animal welfare and land maintenance.

and its relatively slow impact on water quality in some instances. Information on the scientific and economic rationale behind certain regulatory and best practice measures, where it exists, needs to be disseminated and additional research is required to answer outstanding research questions on the nutrient source-delivery-impact spectrum across a range of farming landscapes and conditions. This may assist in entrenching diffuse pollution and associated nutrient loss economic considerations in the decision making processes of farmers.

One of the potential drawbacks of a strict "one size fits all" regulatory approach is that it doesn't relate standards to prevailing soil and hydrological conditions. In policy design and review terms there is a case for regulations to take account of local conditions such as soil type and hydrology where the scientific evidence exists to reflect the risk (or lack thereof) of N and P loss to the aquatic environment in conjunction with agronomic best practise and economic returns. This has potential implications for policy design at future reviews of the ND NAP.

6.0   Acknowledgements

7.0   References

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