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## Joint Working Party on Agriculture and the Environment

# FARMER BEHAVIOUR AND MANAGEMENT PRACTICES IN RELATION TO MITIGATION AND ADAPTATION TO CLIMATE CHANGE

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## NOTE BY THE SECRETARIAT

This study is mandated under the Programme of Work 2009-10 (Strategic Objective 3: Contribute to Shaping Globalization for the Benefit of All through the Expansion of Trade and Investment, Output Area 3.23: Agriculture and Fisheries Sustainability, Output Result 3: Responding to Climate Change). This analytical exercise is intended to provide information to the OECD countries to contribute to policy design that can influence farmers' behaviour and also be a part of a suite of studies of "agriculture and climate change".

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## EXECUTIVE SUMMARY

This study examines the broad range of factors driving farm management decisions that can improve the environment, including drawing on the experiences of OECD countries. It identifies policy options that would contribute to a sustainable and resilient agricultural sector in the context of climate change.

Farmers have a long record in adapting to changes in rainfall and temperature over time. Future changes in the climate could have significant impacts on agriculture that will challenge farmers to adapt to changes in land use, commodity production, and its location. Moreover, agriculture is a major source of global greenhouse emissions, representing 10-12% of total global anthropogenic emissions of greenhouse gases (GHGs). Agriculture will be expected to reduce its own greenhouse gas emissions, and offset emissions from other sectors through carbon storages. All of these actions are closely related to farmers' management practices. It is therefore important to understand the cultural and social (education, information, traditional local practices) factors and the incentives in place that can facilitate or hinder the implementation of adaptation and mitigation actions.

Understanding farmers' decision-making processes and behaviour is critical. Many potential win-win options are not currently being adopted. Various studies (focusing on marginal abatement curves) show that some farmers' management are both profitable to them and to the environment by reducing greenhouse gas emissions (such as fertilizer managements and animal breeding), but are not implemented by farmers. Identifying the reasons for this, and how behaviour could be influenced to encourage greater uptake of adaptation and mitigation options, is needed in order to inform and clarify potentially cost-effective measures.

Policy measures addressing climate change (mitigation and adaptation) alter the set of incentives and disincentives faced by farmers – which will affect the actual mitigation and adaptation actions that will be taken. Factoring in farmer behaviour has the potential to improve the effectiveness of mitigation and adaptation policy.

Although a considerable amount of research has focused on financial incentives (such as appropriate pricing and monetary compensation for additional efforts for mitigating GHG emissions) and disincentives (regulations, and carbon pricing schemes), those financial incentives and disincentives can be more or less effective depending on farmers' behaviour. In other words, behavioural factors can complement or constrain the effects of financial incentives. Other studies have shown that the realistically achievable level of GHG mitigation is much lower than the biophysical potential, due to non-price-determined limitations to implementation, including institutional, educational, social and political constraints. Financial and regulatory incentives and disincentives, education and information, and consistency with traditional local practices, all play a role in determining actual outcomes. Understanding farmers' behaviour and the removal of barriers to behavioural change is essential, as well as carbon pricing and technology policy.

Four main policy implications emerge from the analysis:

**1. A holistic approach is needed**

- Understanding how transformational or technological change in farming occurs requires an understanding of a wide range of factors. Financial incentives are clearly important, because new farming practices will not be adopted if they are not profitable to do so. But financial incentives alone cannot explain all the change.
- An agricultural sector that can contribute to GHG mitigation and adaption to climate change is likely to require a combination of market-based instruments and other tools (affect to habits, cognition and norms) which could influence farmer behaviour.

**2. Behavioural change should be understood at the local level**

- Many elements could affect farmers' behaviour in relation to agriculture and the environment. Although farm level mitigation and adaptation management actions in general overlap – bearing in mind that farmers manage an overall set of interrelated resources – each farm and farmer has specific characteristics. Thus, in order to deal with heterogeneity, understanding behaviours requires that policy needs to be developed with the recognition that different policy tools work differently for different farmers. For example, modern, large-scale, commercially-oriented farm businesses are likely to display behavioural characteristics that differ from small-scale, family run farm businesses.

**3. "Nudging" could be a useful approach to guide policy**

- Market-based policy instruments have been designed on the assumption that farmers act rationally. However, it is problematic to assume rational behaviour, especially where markets for environmental goods and services do not exist (lack of market arbitrage does not encourage rational choice). Behavioural economists have started to think about the implications of their findings for public policy, including in the context of climate change, and policy makers can use the findings in behavioural economics to inform the design of institutions and policy.
- Identifying "behavioural failure" recognizes that people may systematically make mistakes in decision-making. "Behavioural failure" that relies on assumptions of unbounded rationality will not deliver optimal results. This raises challenging questions about the role of government policy – whereby government intervention is justified when people know what the right decision is but for various reasons do not make these decisions. Thus, policy makers might have to think about correcting for both market failure and behavioural anomalies, simultaneously.
- Consequently, governments can set an appropriate default rule or set (or limit) choices for farmers with a clear recognition that behaviour tends to be affected by those default settings. These interventions should 'nudge' individuals – without restricting their choices – towards what they would have chosen had they not been subject to specific limitations of behaving rationally. A "nudge" implies a small change in the social context that alters behaviour without forcing anyone to do anything.
- An example of a nudge approach is "visualization" policies such as labelling (carbon foot print). This approach encourages farmers to establish what they need to do, while their efforts can be conveyed to consumers through labelling. Consequently, identifying "ecologically cooperative" farmers is a visible way by means of labelling that could complement incentive measures to address climate change.

### 4. Forming networks of farmers or working collectively can play an important role

- Policy instruments may have indirect effects on behaviour through their impacts on motivation. Public policy affects behaviour not only through its direct impact on relative prices and budgets or via regulatory constraints, but also through the impacts on individuals' perception of morally ideal actions. Advisory systems, extension, diffusion of innovation and training have a crucial role in shaping attitudes and motivations. It has been argued that monetary incentives can "crowd out" civic motives[1], but also they can "crowd in" motivations when they are used to acknowledge the social worth of individual's contributions.
- These social norms – or social capital – could potentially influence the collective action (various forms of group activity) of farmers. Collective options should be given serious consideration as an alternative to the market or to regulation in addressing many agricultural and natural resource problems. As both adaptation and mitigation are closely linked to the public benefit (shared value), strategies to encourage farmer cooperation have been a feature of government policy. Efforts to reduce GHG emissions and adapt to climate change are a classic collective action problem that is best addressed at multiple scales and levels. Schemes such as network building mean communities pledge to "collectively plan" for a large reduction in their carbon emissions.
- Collective action is also closely related to external and internal factors. If information about other people's behaviour is not available, people tend not to cooperate. For example, farmers need to receive information not only about their own behavioural choices (management practices or emissions) but also whether those choices are below or above the standard (benchmarking). Consequently, how to share such information and where to set adequate benchmarks is also crucial for policy design.

Behavioural economics has important implications in relation to environmental economics and policy. If individual choices do not maximise utility, then there is a role for government intervention. Traditional market based tools including taxes, subsidies and regulations work well as external factors. However, these traditional tools are sometimes insufficient. Government policy could potentially deal with more than market failure, justifying actions by governments in relation to behavioural failure. Although the extent of behavioural failure has not been empirically tested enough in respect of its impact on agricultural management and policy instruments, more attention needs to be paid to a wider range of drivers of farmers' actions concerning the environment than is explained by concentrating purely on financial incentives. In addition, research on measures that realize both mitigation and adaptation goals need to be encouraged to identify synergies between two strategies. This knowledge should then be transferred to farmers.

From the review of the literature, and given the fact that behavioural economics is a relatively recent branch of economics, more research and empirical evidence is required in order that the insights can be of further use in policy making, in particular to illuminate how incentive and disincentive measures can best be implemented to help farmers adapt to climate change and mitigate GHG emissions.

1. "Crowding out" civic motives mean that the intrinsic motivation is partially destroyed when price incentives are introduced. In short, the price mechanism becomes less effective (Frey and Oberholtzer-Gee, 1997).

# FARMER BEHAVIOUR AND MANAGEMENT PRACTICES IN RELATION TO MITIGATION AND ADAPTATION TO CLIMATE CHANGE

## 1. Introduction

1. The purpose of this study is to enrich the analysis of the factors influencing farm management practices in relation to mitigation and adaptation to climate change mainly in OECD countries. It focuses on the many inter-related factors that influence farmers' decision-making. It also identifies policies that can influence farmers' behaviour.

2. This study examines the broad range of factors driving farm management decisions that can improve the environment and draws on the experiences of OECD member countries – and selected non-OECD countries – to identify the policy implications in different situations that would contribute to a sustainable and resilient agricultural sector. Understanding the factors that motivate farmer behaviour is complex and the impacts will not only affect mitigation of greenhouse gases and adaptation to climate change, but a range of other economic and environmental outcomes as well.

3. The outline of the study is as follows. Section 2 provides the background. Section 3 reviews the literature that has examined the determinants of farmers' behavioural change and key findings are synthesized. The results of these findings are then extended to the management of mitigation of GHG emissions, followed by a review of adaptation studies. Section 4 considers the drivers of and barriers to behavioural change in more depth, applying theory and recent findings from "behavioural economics". Section 4 also provides examples of recent activity in OECD countries to tackle farmer behaviour issues. Finally, the roles of government and policy implications are provided in section 5.

## 2. Background

4. Farmers have a long record in adapting to changes in rainfall and temperature over time. Future changes in the climate could have significant impacts on agriculture that will challenge farmers to adapt to changes in land use, commodity production, and its location. Moreover, agriculture is a major source of global greenhouse emissions, representing 10-12% of total global anthropogenic emissions of greenhouse gases (GHGs) (Wreford, Moran, and Adger, OECD, 2010). Agriculture will be expected to reduce its own greenhouse gas emissions, and offset emissions from other sectors through carbon storage. All of these actions are closely related to farmers' management practices. It is therefore important to understand the cultural and social (education, information, traditional local practices) factors and the incentives in place that can facilitate or hinder the implementation of adaptation and mitigation actions.

5. Climate change could have significant effects on farm management practices as well as land use, commodity production, and its location. The UNFCCC (2008) pointed out that most of the current mitigation measures in agriculture are closely related to farmers' management practices and the main barriers to their implementation are cultural and social (education and information gaps, incompatibility with traditional local practices) and lack of appropriate incentives.

6. Understanding farmers' decision-making processes and behaviour is critical. Although some farmers' management would be both profitable to them and to the environment by reducing greenhouse gas emissions (such as fertilizer managements and animal breeding), they are not being implemented by

farmers (Wreford, Moran and Adger, OECD, 2010). Identifying the reasons for this, and how behaviour could be influenced to encourage greater uptake of options, is needed in order to achieve reductions in GHG emissions. In addition, farmers' decision making processes are more complex than in other sectors. This is not only because of different scales of economic activity, but also because agricultural activities depend on and have a very large impact on natural resources, which will also affect farmers' behaviour. For example, when farmers are aware of their own contribution to natural resource management and their role within the local community (i.e. altruism and inequality aversion), the effect of financial incentives and disincentives will be more complicated than with a behaviour purely driven by profit maximization.

7. Thus, an exploration of the role of behavioural factors in analysing linkages between policies (external drivers), farm management decisions, farm practices and GHG emissions and carbon sequestration as the environmental outcome will help to clarify the role of policy. The Joint Working Party on Agriculture and the Environment has in the past – in another context – expressed much interest in more in-depth analysis of the role of farmer behaviour and management practices (Shadbolt, OECD, 2008).

8. It is important to recognize that policy measures addressing climate change (mitigation and adaptation) alter the set of incentives and disincentives faced by farmers – which will affect the actual mitigation and adaptation actions that will be taken. Factoring in farmer behaviour has the potential to improve the effectiveness of mitigation and adaptation policy.

9. Although a considerable amount of research focuses on financial incentives (such as better pricing and monetary compensation for additional efforts for mitigating GHG emissions), drivers and barriers to actual farmers' behavioural change complement or constrain the effects of their incentives. In fact, previous studies have shown that the realistically achievable level of GHG mitigation is much lower than the biophysical potential, due to non-price-determined limitations to implementation, including institutional, educational, social and political constrains. Financial and regulatory incentives and disincentives, education and information, and consistency with traditional local practices, all play a role in determining actual outcomes. Understanding behaviour and the removal of barriers to behavioural change is essential, in addition to economic instruments and technology developments.

10. Regarding adaptation, possible instruments include market mechanisms, insurance measures, microfinance and R&D incentives. Behavioural studies in relation to climate change adaptation do exist, but few focus specifically on the agricultural sector (Wreford, Moran and Adger, OECD, 2010). Risks to agriculture, forestry and other economic activities can be greatly reduced by farmers' appropriate adaptive action. For example, Mendelsohn and Neumann (1999) estimated damages to agriculture from climate change using a cross-sectional empirical analysis of Midwestern counties in the US to measure the sensitivity of yields and profits to climate compared to agronomic models which did not include adaptation. The damages to agriculture were estimated to be 50% less as a result of farmer adaptation.

11. In addition to conventional field surveys which try to find possible universal socio-economic variables that explain farm management behaviour, drivers of and barriers to behavioural change could be considered in more depth by applying theory and recent findings of behavioural economics (i.e. enriching economic theory by applying findings from the psychology literature).[2] Recently, several studies incorporated the findings of behavioural economics into climate change policies, because it is widely considered that actual (not hypothesized) human behaviour needs to be taken into consideration to tackle

2. Behavioural Economics combines the insight of psychology and economics to better understand human decision making. But the definition used in this study is wide. This study introduces key findings from recent developments in behavioural economics, and tries to apply them in the context of climate change and agriculture. Not all of issues in behavioural economics are considered in this study.

climate change, and incentives should be thus adapted as appropriate. However, there are few such studies of agriculture and agricultural policy at this stage.

12. Findings from behavioural studies and behavioural economics could also play an important role on the links between current actions and the long-term goal at the forefront of policy. After the Stern review (Stern, 2007), economists have been tackling the problems of expected utility theory which is widely used for economic analysis on climate change (e.g. Weitzman, 1998; Quiggin, 2008). For example, individuals often apply a high discount rate to trade-offs between the present and the near future, but a low discount rate for trade-offs between the near and far future (termed hyperbolic discounting). At the same time, governments need to provide long-term policy signals that could help farmers find the incentives to change behaviour and investment. Humans are – according to some researchers – myopic decision-makers and underestimate cumulative probabilities. Gowdy and Erickson (2005) argue that these new theoretical and empirical findings on actual behaviour are largely ignored in applied work and policy applications.

13. Farmer behaviour and how it can be changed or influenced, is a challenge for policy makers (Wreford, Moran and Adger, OECD, 2010). Low-carbon agriculture relies on the contribution of farmers. Policy to induce action requires an understanding not just of science or economics, but also of political and behavioural/psychological factors to identify how to enhance the acceptability of policy (Ho, 2008).

14. Given this background and motivation, this study mainly focuses on the inter-related factors that influence farmer decision-making for mitigation and adaptation, with the aim of identifying:

- The extent to which individual farmers make decisions in ways that may systematically deviate from traditional assumptions of profit maximization; and thus
- Given such deviation, how policies can help or hinder mitigation and adaptation efforts in the agricultural sectors in OECD countries; and thus
- Whether governments should intervene to facilitate farmer mitigation actions and their adaptation to climate change and, if so, the appropriate policy measures to adopt, taking into consideration farmer behaviour.

## 3. Review and synthesis of previous research

15. There is a very large body of literature which has tried to understand the primary determinants of farmers' behavioural change. Among these studies, there is a literature regarding the determinants of adoption of environmental management practices in agriculture. However, compared to the uptake of conservation management (i.e. of water and soil), there is quite limited empirical research on the determinants and motivational influences specially focusing on mitigation and adaptation behaviour. Accordingly, first, the relationship between determinants and general farmer's behavioural change is reviewed in Section 3.1. Next, the extension of these findings for mitigation management is made in Section 3.2. Then, adaptation behaviour is reviewed in Section 3.3.

### *3.1 Farmer behaviour for conservation management*[3]

*Introduction*

16. As a pioneering study, Gasson (1973) analysed the driving forces inducing farmers to participate in conservation schemes, suggesting that a better understanding of motivation could lead to a more

3. "Conservation management" represents as several forms of conservation management practices in agriculture which could contribute to reduce negative externality and enhance positive externality.

adequate explanation and prediction of farmers' economic behaviour. In her study, empirical research on how farmers' behaviour is linked to their attitudes, values and goals was conducted. The main contribution of the many post-Gasson studies is the now established recognition that farmers' goals and values are complex, and that dividing them into behavioural types on the assumption of simple profit maximising behaviour is increasingly difficult to sustain (Defra, 2006). For example, in addition to the single objective (maximising income), McGregor *et al*. (1996) identify that farmers' decisions are influenced by: objectives and goals in farming, attitude towards the traditional/ethical approach to farming, stress and the ability to cope with stress, satisfaction with and optimism about farming, attitudes to legislation, risk taking, autonomy, management attitudes, conservation attitudes, quality and quantity of information, who is involved in the decision making process, the individual's ability to solve problems, and aspects of their personality.

17. Most of the previous studies used self-reporting questionnaires for the elicitation of farmers' data in the particular study area. With respect to the methods of elicitation and the techniques for subsequent analysis on research to understand the behaviour and motivations of farmers, Defra (2006) summarised their methods and the important differences among the most commonly used techniques. In a typical research project, analysts select a number of potential independent variables for inclusion in the analysis.

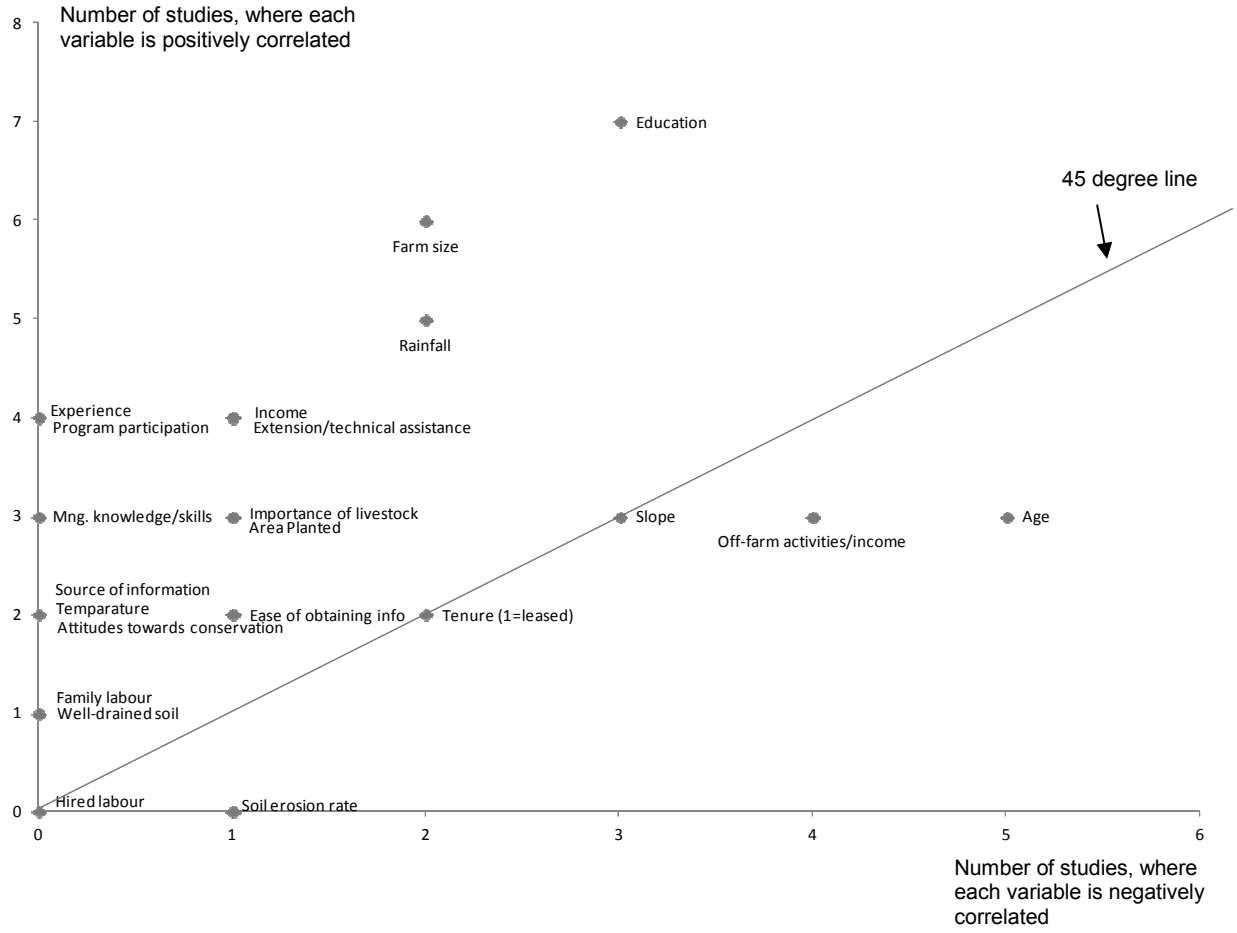
*General View*

18. Some recent studies have reviewed the previous findings on farmers' motivation for conservation agriculture. Knowler and Bradshaw (2007) synthesised recent research on farmers' adaption of conservation agriculture to identify independent variables that regularly explain adoption behaviour based on the results of 31 recent empirical analyses. Most of these analyses are case studies of North American and African countries. Figure 1 shows the results of frequency analysis for independent variables from conservation agriculture adoption analyses adopted from Knowler and Bradshaw's (2007) database. In the Figure, the vertical and horizontal axes represent respectively positive and negative correlative sign with conservation agriculture adoption, and data are plotted as the number of indices where the coefficient of conservation agriculture adoption was positive or negative. Not all of their data are cited here, but selected data were used to construct this Figure in the cases where more than five samples (independent variables in 31 of recent empirical analyses) are available. It should also be noted that *all* of the variables also contain insignificant results (but they are not recorded in the Figure).

19. This frequency analysis is useful for policy makers seeking to find universal relationships across the several studies. Household characteristics will be important in influencing the adoption decision for conservation agricultural managements. As shown in Figure 1, "Farm size" correlated positively with the adoption of conservation agricultural practices in six previous studies, but two negative correlations were also observed. Regarding the "education" level of the farmer, several studies showed a positive correlation with the adoption of conservation practices, however, some analysis also found a negative correlation and insignificance. Similarly, the age of the farmer does not demonstrate a clear relationship. In addition, differences between owned land and leased land are not clear. Regarding the geographical differences between North America and Africa, Knowler and Bradshaw (2007) found that studies from North America tend to show a more positive significant effect of "education", "land tenure" and "farm size" on adoption than do studies in African regions.

20. Consequently, the main finding is that there are few variables that universally explain the adoption of conservation agriculture across past analyses. Knowler and Bradshaw (2007) conclude that efforts to promote conservation agriculture will have to be tailored to reflect the particular conditions of individual locations. There is no simple formula to explain which factors may be the most important in a given case, suggesting that understanding local conditions are key.

**Figure 1. Factors influencing the adoption of conservation agriculture in recent studies**




*Source*: OECD, based on Knowler and Bradshaw (2007).

21. Similarly, Prokopy *et al.* (2008) reviewed literature that focused on the adoption of agricultural best management practices in the United States to examine general trends in the categories of capacity, awareness, attitudes and farm characteristics, using a vote count methodology and counted every instance of positive, negative and insignificant relationships in 55 studies. In brief, it is suggested that the results are clearly inconclusive on which factors consistently determine the adoption of best managing practices.

*Financial Incentives*

22. Financial incentives are used in one of the programmes in the studies cited above, to encourage the adoption of conservation agriculture. In economic terms, addressing externalities through the adoption by farmers of agri-environmental management practices is essentially the "private provision of public goods". However, where farmers are not likely to receive compensation for production of public goods, (including because some public goods are provided by the collective actions of many farmers in a given area or watershed) they may not be motivated to produce them (Hellerstein *et al*., 2002). A farmer will adopt conservation agriculture, if the expected net return from participation is at least as high as it would have been if he or she chooses not to participate.

23. As explained in the Annex, the supply of public goods tends to be socially sub-optimal. This problem can be overcome by a simple financial incentive scheme in theoretically (e.g. Falkinger, 1996) and in experimentally (e.g. Falkinger *et al*., 2000). Falkinger has shown that a tax-subsidy scheme in which governments reward and penalize deviations from the mean contribution would produce an efficient level of public good provision. Bracht *et al*. (2008) empirically compared the performance of two incentive mechanisms in public goods experiments. One mechanism is the "Falkinger mechanism", and the other one is the compensation mechanism, which allows agents to subsidize other agents' contributions (compensation mechanism) in laboratory experiments. As a result, they found that although both mechanisms lead to an increase in the level of contributions to public goods provision, the "Falkinger mechanism" predicts the average level of contributions more reliably than the compensation mechanism.

24. On the demand side, in order to estimate the appropriate amount of financial incentive, demand for agricultural public goods has been evaluated by standard methodologies such as CVM (Contingent Valuation Method), conjoint analysis (choice experiment), replacement cost methods and travel cost method and, where appropriate, also uses benefit transfer (OECD, 2003).

25. However, the relationship between financial compensation and participation in a programme is not expressed by a simple formula *in practice*. As plotted in Figure 1, a positive correlation was found in some studies (e.g. Napier and Camboni 1993, Swinton, 2000). On the other hand, an insignificant relationship was also found (e.g. Traore *et al*., 1998, Soule *et al.*, 2000, Nomura and Yabe, 2007). As featured in Wynn *et al*. (2001), compensation alone may not ensure success of a conservation program. Recently, Blandford (2010) reviewed three types of incentives that influence participation in voluntary programmes in his Presidential Address to the Agricultural Economics Society (AES): (1) personal satisfaction from environmental stewardship; (2) market-based incentives through such factors as consumer preference for green products; and (3) government-created positive and negative incentives.

26. Poe *et al*. (2001) studied the attitudes of farmers: in one study of farmers in New York State in the US, even if they were fully compensated for the cost of participation, only 78% would agree to participate, and when only nominal compliance costs are involved the likelihood of participation falls dramatically. Vanslembrouck *et al*. (2002) found that economic factors were only given by 20-30% of farmers as the primary reason for not taking part in country side stewardship measures by using survey information in Belgium. Dunlap and Van Liere (1984) showed that improving the environment is a significant motivation for appropriate environmental behaviour only when basic economic and survival needs are met. Wandel and Smithers (2000) found that despite getting information and financial incentives to motivate the adoption of conservation tillage, many farmers rejected adoption due to the many constraints they encounter. Without change in the attitude of the farm community there is unlikely to be a significant change in the effectiveness of voluntary programmes.

27. One more important insight concerning financial incentives is the motivation to "crowd out". A growing body of experimental evidence indicates that financial incentives can be a deterrent to cooperative behaviour (Gowdy, 2008). Kverndokk and Rose (2008) reviewed recent literature on how price incentives interact with moral motivation and considerations. Price incentives may crowd out moral motivations to contribute to a public good, such as a good environment, as it may change the responsibility of the problem from the individual to the regulating authority (Frey and Oberholzer-Gee 1997, Brekke *et al*., 2003), with the result that the net effect may be low. A number of experimental studies show that monetary incentives can be deterrent to a co-operative behaviour. For example, Frey and Oberholzer-Gee (1997) shows theoretically and empirically that intrinsic motivation is partially destroyed when price incentives are introduced. In short, the price mechanism becomes less effective. The consistent implication was introduced in Brekke *et al*. (2003), which tried to provide a framework for formal analysis of the relationship between moral motivation, economic incentives, public policy and actual consumer choice. They said that moral motivation is not incompatible with utility maximisation and public policy may have

indirect effects on behaviour through its effects on moral motivation. Consequently, financial incentives and motivation are not characterised by a linear relationship. However, since the reverse situation can also be also found, depending on the form (process/design) of policies, generalization is difficult.

28. In order to understand the reasons for non-adoption, despite financial incentives, the existence of dual motivation could be one economic explanation. Seminal works of Lynne (i.e. Lynne 1995, 1999, 2006, Sheeder and Lynne, 2009) show that farmers' decision-making reflects a compromise between private and collective utility. The divergences from the economically rational choice could also be made understandable by applying behavioural economics (overview is provided in Kahneman, 2003). Further insights on the application of behavioural economics are given in Section 4.

29. As reviewed in this section, farmers don't only consider direct monetary incentives. There is a consensus in the literature cited that a financial incentive is not enough to consider as the behavioural driver, while acknowledging that the overall picture is not entirely clear. In the next section, research on motivation (psychological factors, such as attitudes) is reported.

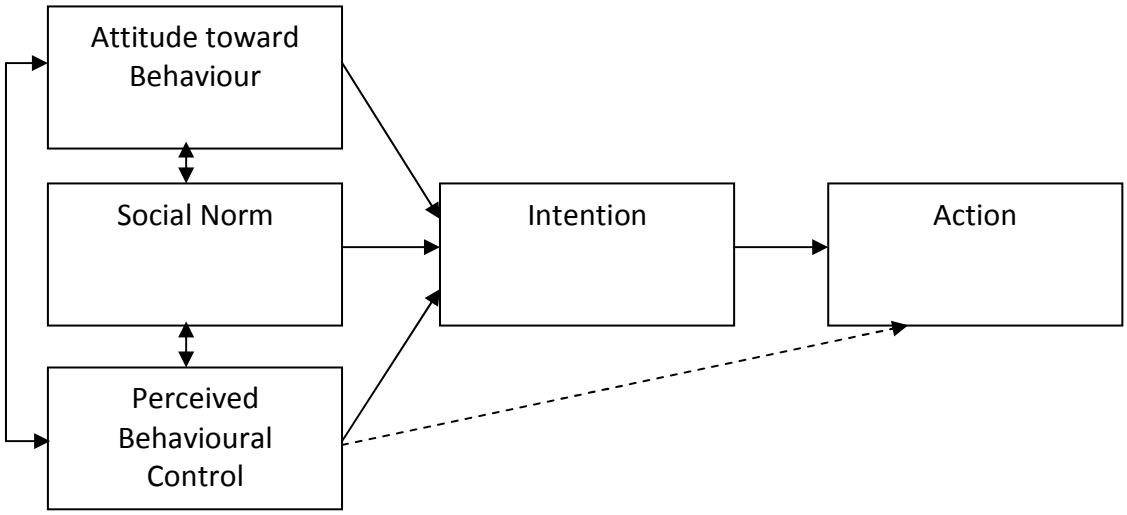
*Non-financial Incentives*

30. Recently, research on farmers' behaviour has drawn on the principles of social psychology (Beedell and Rehman, 2000). Regarding environmental attitudes, Morris and Potter (1995) argued that farmers' conservation-oriented attitudes in marginal environmentally sensitive areas (ESAs) may tip the balance toward participation. In order to increase participation, it is suggested that policy makers (and those administering policy) specifically target non-participants. The importance of farmer's environmental attitudes for participation was also pointed out by Wilson (1996) from a case study on environmentally sensitive areas in the UK. It highlights that environmental attitudes are important variables explaining farmers' dispositions toward conservation and participation behaviour in the ESA scheme, in addition to age, education, length of residency, farming philosophy and the existence of semi-natural habitats on farms.

31. Among several theories that try to explain behaviour, the most commonly used is "The Theory of Reasoned Action" (TORA) (Ajzen and Fishbein, 1980) and its extension to "The Theory of Planned Behaviour" (TPB) (Ajzen 1988, 2005) for exploring farmers' attitudes and intentions. TPB consist of behavioural intentions, attitudes, subjective norms, and perceived behavioural control.

32. TPB can be used to predict behaviour and explore the underlying motivations for adopting that particular behaviour. TPB assumes that an individual's behaviour is influenced by three determinants: 1) beliefs about the likely outcomes of behaviour (Attitude toward Behaviour), 2) beliefs about societal norms (Subjective Norms) and 3) beliefs about an individual's control over the outcomes of a behaviour (perceived behavioural control). In the aggregate, these beliefs influence an individual's intention to adopt that behaviour. Figure 2 illustrates how TPB considers behavioural intentions to be formed, and remain as useful conceptual idea to analyse farmer behaviour (e.g. Sherrington *et al*., 2008, Armagen and Ozden, 2009).

**Figure 2. Theory of planned behaviour**




*Source*: OECD, Adapted from Ajzen (1991).

33. According to Artikof *et al.* (2006) and Hu *et al*. (2006), who adopt TPB to analyse influence factors of climate forecasts on farmer decisions, TBP can be elucidated as follows:

$$A \approx I = f(Attitude, Social\_norms, Perceived\_control) \quad (1)$$

where $A$ is action, $I$ is intention, and $f$ is a function of the causal factors on intention and action.

- ***Attitude***: Farmers who believe that the use of climate information has a high probability of helping them increase their profits, and who value increased profits, would be more likely to use that climate information.
- ***Social norm***: Social norms can be considered as a person's perception of the social pressure to the behaviour in a particular way.
- ***Perceived behavioural control***: Perceived behavioural control reflects an individual's various beliefs about personal access to or control over various resources and factors and the extent to which various factors will constrain or facilitate his/her ability to perform the action.

34. Their results quantify the relative importance of attitude, social norm, perceived behavioural control, and financial capability in explaining the influence of climate information, and short-term and long-term forecasts on agronomic, crop insurance, and crop marketing decisions. The decision analysis in their paper addresses this challenge by combining economics, public policy, and the insights from other social sciences.

35. Not only the TPB framework, but also other research shows the importance of attitudes. Based on the literature review on the motivations and determinants, Kabii and Horowitz (2006) presented a conceptual model to show hypothesized relationships between motivational factors and five constructs: nature conservation equity; economic dependence on property; confidence in permanent covenant mechanisms; nature conservation ethics; and private property rights.

36. According to these studies, in addition to socioeconomic and structural factors, it is acknowledged in the literature that participation depends on farmers' attitudes. However, how and to what extent is not uniform. An Italian study (Defrancesco, 2008) shows that besides income factors, the farm's future in the business, and the relationship with neighbouring farmers and their opinions on environmentally friendly practices all have significant effects on the adoption of agri-environmental measures. This paper concludes by suggesting that farmers' attitudes and beliefs, as well as local behavioural influences, have to be taken into account when designing and communicating agri-environmental measures.

37. Recently, behavioural science and cognitive psychology have involved the participation of economists. One example of the importance of behavioural science in the adoption of conservation management is the effect of co-operative behaviour. Many experimental results and field evidence suggest that people are willing to choose cooperative behaviour only if others do so. They are also willing to contribute more to a good social causes if they think other people are contributing, and teams seems to act more altruistically than individuals (Brekke and Johansson-Stenman, 2008). Regarding the problem of designing institutions, cooperative action needs to also be considered in policy design (explained in section 4 and 5). On this point, advisory systems, extension, diffusion of innovation and training have a crucial role in shaping attitudes and motivations. According to Defra (2006), farmers tend to trust their own experience more than other social references.

*Incorporating behavioural findings for economic modelling approach*

38. Recently, findings on farmers' behaviour are being incorporated into policy analysis models (see Defra, 2006 for a review). To assess the treatment of behavioural issues in agricultural policy models, which are essentially economic models, is a challenging task as economics is a behavioural science. Economic theory is based on a number of fundamental behavioural assumptions: consumers' utility maximization, producers' profit maximization and perfect information. When economic agents engage in the act of exchange, in perfectly competitive markets without any distortions, it leads to the maximization of overall social welfare (Defra, 2006).

39. Lynn (1995) has already tried to combine social psychology theories (Theory of Reasoned Action, or its extension, TPB) with traditional economic analysis, with respect to farmer's technology adoption. Burton (2004) addressed the importance of motives, values and attitudes that determine the decision-making processes of individual farmers through discussing the 'behavioural approach' in the context of advances in socio-psychological theory.

40. With respect to the public goods provision model, Andreoni (1989, 1990) proposed a "warm-glow model". The utility function is modified by including "own contribution to public goods directly", where individuals maximise $u^i(c_i, g_i, G)$ instead of $u^i(c_i, G)$ (see the Annex for traditional public provision models). Andreoni shows that public goods provision depends on the amount of "impure" altruism. This formulation is more consistent with empirical findings (Bernheim and Rangel, 2007).

### *3.2 Mitigation management*

41. Agriculture contributes to climate change through actions which produce GHGs, but it can contribute to the solutions (e.g. carbon sequestration; energy crops that displace fossil fuels; changes in livestock diets). The effectiveness of GHG mitigation methods depends to a large extent on the farmer or land user's response to any potential economic benefits or penalties and motivation including attitudes towards global climate change issues.

*3.2.1 Application of key findings from the literature to the mitigation management*

42. As stated in the Stern review (Stern, 2007), policy to reduce emissions needs to be based on the removal of barriers to behavioural change as well as carbon pricing and technology policies. However, few researchers specially focus on farmers' behaviour, in relation to mitigation management. Although such studies are limited, farm level mitigation management similar and overlaps with the conservation management discussion reviewed in section 3.1. Best practices for reducing greenhouse gas emissions are widely known and previous findings from the literature review can be extended to this context. Representative management for GHG mitigation in crop farming is summarized in Table 1.

**Table 1. Measures for mitigation GHG emission from crop farming**

| Measure | Example |
|---|---|
| Cropland management | Agronomy |
| | Nutrient management |
| | Tillage/residue management |
| | Water management (irrigation, drainage) |
| | Rice management |
| | Agroforestry |
| | Set-aside, Land-use change |
| Management of organic soils | Avoid drainage of wetlands |
| Restoration of degraded lands | Erosion control, Organic amendments, Nutrient amendments |
| Manure/Biosolid management | Improved storage and handling |
| | Anaerobic digestion |
| | More efficient use as nutrient source |
| Bioenergy | Energy crops, solid, liquid, biogas, residues |

*Source*: OECD, Adapted from Smith *et al*. (2008).

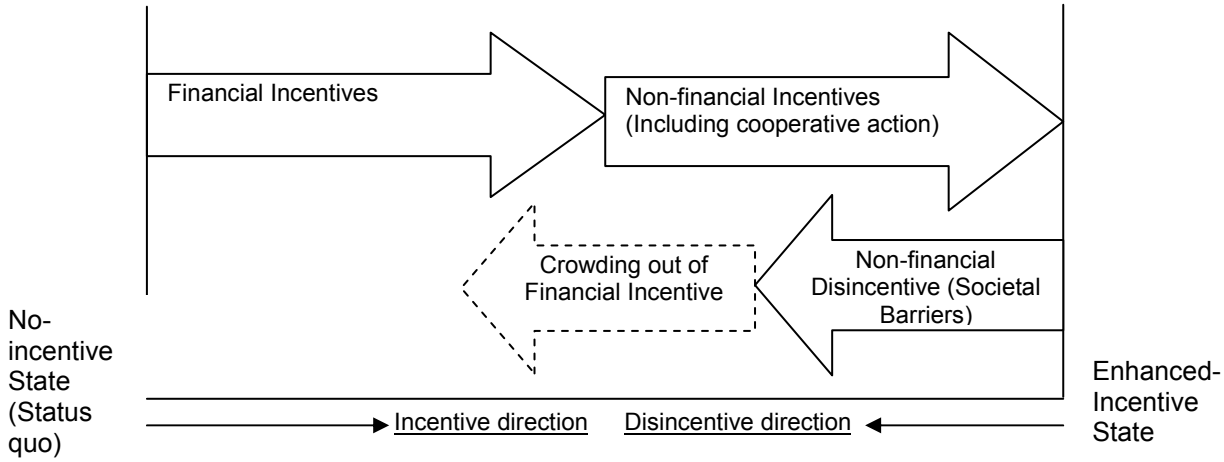
43. Concerning the attitudinal and behavioural issues, for example, Blackstock *et al*. (2009) reviews the literature relating to the provision of information and advice as a mechanism to encourage farmers to mitigate diffuse pollution. The paper presents findings from a literature review on influencing farmer behaviour and synthesises three main areas of research: psychological and institutional theories of behaviour; shifts in the approach to delivery of advice (from knowledge transfer to knowledge exchange); and the increased interest in heterogeneous farming cultures. In addition, Ovchinnikova *et al*. (2009) elucidate the attitudes and behaviour of carbon offset providers, who have not yet entered the market, using experimental economics techniques. While trading of credits allows farmers to obtain credits for reducing their GHG emission reductions, the authors found that environmental considerations are powerful motivators and subjects are willing to forgo pecuniary profits for the sake of "doing-the-right-thing". The World Bank (2009) expressed concerns in its World Development Report 2010 featuring climate change that often individual behaviour tends to be neglected and an emerging body of social-psychology research needs to examine the barriers and drivers of individual behaviour in relation to both adaptation and mitigation.

44. There is not sufficient empirical evidence to conclude as to which behavioural determinants are universally significant across countries. However, the main findings in the literature on influencing farmers' behaviour are relevant in the climate change context. As shown Figure 3, financial and non-financial incentives could enhance behavioural change, and disincentive such as societal barriers and crowding out effects of financial incentives may affect behaviour at the same time. However, the

generalization of the "crowding out" effect needs to be treated with caution, because it depends on each situation. The key findings from the literature can be summarised as follows:

- Principal factors which influence the adoption of mitigation management vary with types of techniques. Regarding household characteristics and biophysical characteristics, there is no simple explanation as to which factors may be most important in a given case, suggesting that understanding local conditions is a key.
- Financial and non-financial incentives both affect farmers' behaviour. At the same time, these could also be a barrier due to the crowding out effect of financial incentives.
- Regarding motivation, the relationship with neighbouring farmers has also significant effects on adoption of mitigation management. Not only farmers' response to self-interest but also shared interest is relevant.
- Farmers' attitudes and beliefs, as well as local behavioural influences, have to be taken into account when designing appropriate incentives.

**Figure 3[4]. Incentives and disincentives**




*Source*: OECD Secretariat.

### *3.2.2 Characteristics of climate change*

45. Regarding behavioural change in relation to mitigation, by comparison with other environmental issues (especially regional and local environmental issues), there are several specific issues concerning climate change: effect of carbon prices (financial incentive or disincentive), consideration of co-benefits (financial incentive), and priorities compared with other environmental issues (motivation and attitude).

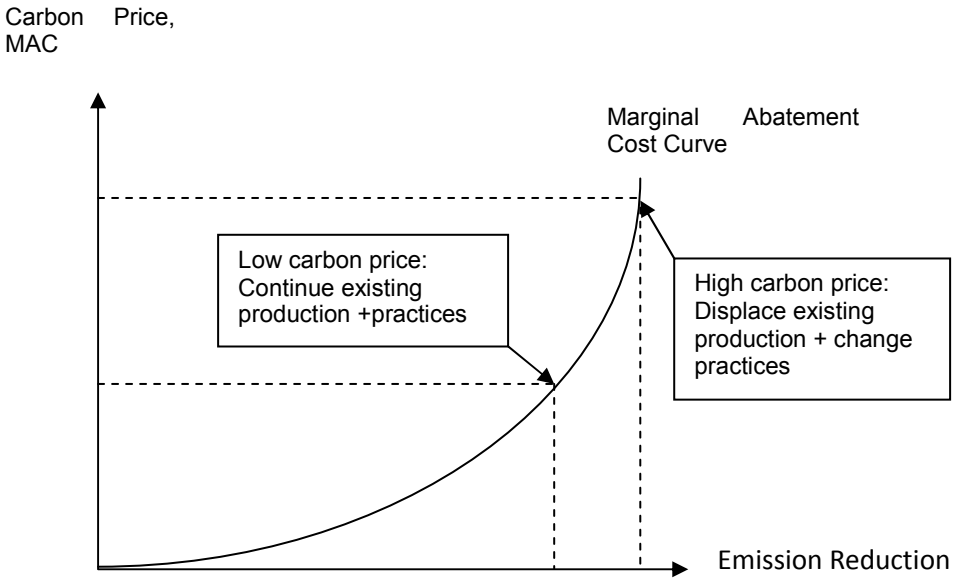
4. This figure is symbolic and the magnitude of each incentives indicated in the figure is hypothetical. There is no consensus on this in the literature.

*Carbon prices and behavioural change*

46. Depends on the farm practices, mitigation options entail additional costs to farmers.[5] Sending clear signals on the costs and benefits of mitigating activities and also providing a real or implicit price of carbon to create incentives is an important part of policy implementation. According to economic theory, it is socially profitable to reduce GHG emissions up to the point where the marginal abatement cost is equal to the carbon price, if the carbon market is well developed. As the basis for a cost effectiveness criterion, in addition to the shadow price of carbon (SPC) which is derived from the estimation of the present value of damages associated with GHG emission, an alternative benchmark can be given by, for example, the European Union Emission Trading Scheme (EU ETS) which provides an opportunity cost approach to assessing whether a mitigation measure is worthwhile (Wreford, Moran, and Adger, OECD, 2010).

47. As shown Figure 4, at low prices, the dominant strategies are those consistent with existing production such as change in tillage practice, fertilizer application, diet formulation and manure management, while at higher prices land use change that displaces existing production, such as biofuels (and afforestation), and allow the use of more costly animal feed-based mitigation options, are privately and socially beneficial. (Smith *et al.*, 2008). Unless the price of carbon is raised sufficiently high, such schemes are likely to be of limited economic interest to farmers.

**Figure. 4. Carbon price and marginal abatement cost**




*Source*: OECD Secretariat.

*The role of co-benefits in decision making*

48. Incentives and disincentives cannot be assessed solely on their effects of climate change. Recently, Le Foll (2010) stated that compensatory aid is necessary to cover the extra costs arising from meeting some environmental objectives and payments for services rendered to society through the supply of "public goods" in the EU. In this context, in order to strengthen the financial incentive for mitigation

5. Note that MAC (marginal abatement cost curves) show there can be win-win action, but not taken up by farmers.

management, understanding the co-benefits and trade-offs of farm management for GHG mitigation is necessary.

49. The co-benefits and trade-offs of a practice will vary from place to place because of the differences in climate, soil, or the way the practice is adopted (Smith *et al*., 2007). For instance, the potential positive externalities (co-benefits) and trade offs are:

- Reduced tillage: to alter soil organic matter, increasing soil water-holding capacity and lead to the need for less irrigation water (but can also be negative because pesticide application will be increased).
- Expanded conversion of agricultural lands to grasslands or forests: to stimulate wildlife populations (but this is also negative for food production).
- Diminished use of fertilizer: to alter the chemical content of runoff from agricultural lands affecting water pollution, water quality, and ecology of streams, rivers, lakes and aquifers. Such alterations might improve the characteristics of the waters in these regions for use by non-agricultural water consumers (but could influence food production).
- Diversion of agricultural lands into energy production: to reduce $CO_2$ emissions that might induce technological improvement in agricultural crops, and permit expanded electricity generation at lower cost (but this is also negative for food production and possible non inducement of innovation).

50. Smith *et al*. (2007) have surveyed co-benefits and trade-offs. However, quantitative valuation of co-benefits and negative effects are both complicated physically and economically. From the economic view point, although CVM, Choice Experiment, Replacement Cost Method and Experimental Economic Approaches have been used for decades[6], universal consensus for the valuation techniques has not been developed among academia, or the OECD. Each method has both advantages and disadvantages.

51. DeFries *et al.* (2004) also pointed out that very few land management practices for mitigation of GHG yield purely win-win outcomes, and most involve some trade-offs. In a win-win situation, an immediate goal (e.g. water purification) may increase in value if the longer-term goal is to maintain ecosystem functions (land preserved).

52. Such co-benefits and trade-offs would play an important role in the decision-making process regarding the selection of appropriate policies and measures at the national or regional level (UNFCCC 2008). McCarl *et al*. (2003) showed the conceptual equation for the cost of mitigation including the cost of co-benefits, and pointed out that governments may have to play an active role in the assembly, measurement, producer education or market delivering as well as in providing payments for some mitigation (sequestration) related actions.

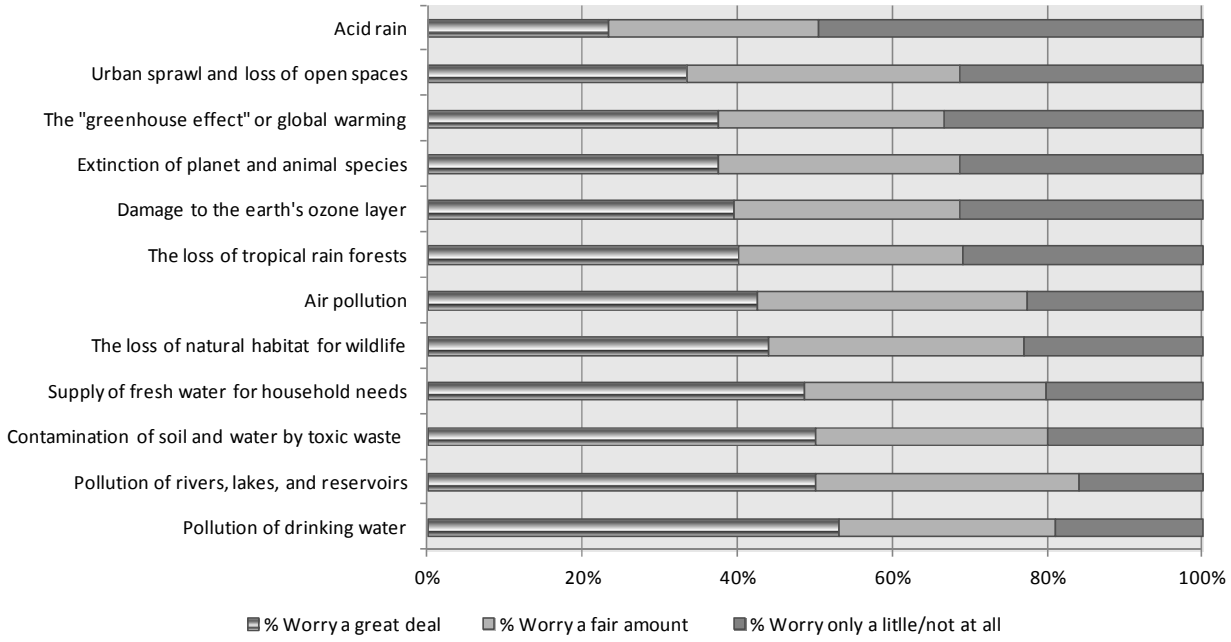
53. Is it also necessary to mention that the co-benefits related to land use management for GHG mitigation are not only ecosystem functions but also societal benefits. For example, regional development may be encouraged by creating a new employment (e.g. afforestation/reforestation) (Yedla and Park, 2009). All of these co-benefits and trade-offs could both affect farmer behaviour and be determined by farmer behaviour.

6. Stated preference methods such as CVM and the choice experiment are the means of valuing non-market benefits. CVM has been the most commonly used non-market valuation method, while the choice experiments are relatively new valuation techniques. On the other hand, the replacement cost method is a revealed preference method, and involves the estimation of how much it would cost to replace the externality benefit by a substitute. (see e.g. Hanley *et al*., 1997 for further explanation).

*Priority of climate change*

54. As reviewed in relation to TPB, environmental knowledge and attitudes play a role in behavioural change. At present, some surveys (e.g. Gallup Poll in USA, Figure 5) show that individuals rank climate change lower than other environmental issues (loss of rain forest, water pollution and soil quality, although some of these are linked to climate change). Individuals tend to rank climate change lower than other environmental issues perceived as "closer to home" and visual (World Bank, 2009). It should be also noted that responses and attitudes for the survey on climate change could also be affected by the question design (Krosnick, 2010), and will vary across countries and groups in society.

**Figure 5. Climate change priority among environmental problems in the USA (2008)**




*Source*: Gallup Poll (April 21, 2008), http://www.gallup.com/poll/106660/Little-Increase-Americans-Global-Warming-Worries.aspx

### *3.3. Adaptation management*

55. Damage of climate change on agriculture can be greatly reduced if economic agents adapt efficiently. In this section, key elements needed to understand behavioural change for adaptation decision are synthesized, based on the literature.

*Drivers for Farm Level Adaptation*

56. Adger *et al*. (2007) has stated that adaptive capacity is defined as the ability to respond successfully to change, and includes adjustments in both behaviour and technology. For example, Mendelshon and Neumann (1999) estimated damage to agriculture using a cross-sectional empirical analysis of US Midwestern counties to measure the sensitivity of yields and profits to climate compared to agronomic models which did not include adaptation. The damage to agriculture was estimated to be 50% less as a result of farmer adaptation.

57. A wide variety of agricultural adaptation actions to climate change is reported in Smit and Skinner (2002) (see also Wreford *et al*., 2010). They noted that decision-making with respect to adaptation

to climate change is not likely to be considered as separate from other agricultural decisions and most adaptation options are modifications to on-going farm practices. In this sense, the main findings from the previous section of this report should be borne in mind. Consequently, for progress on implementing adaptation to climate change in agriculture to occur there is a need to better understand the relationship between potential adaptation options and existing farm-level and government decision-making processes and risk management frameworks. Wall and Smit (2005) identify several climate and weather risk adaptation strategies currently in use with close links to sustainable agriculture practices, based on the data from Canadian farmers. They concluded that the mutually supportive relationship between sustainable agriculture and climate change adaptation could be used by farmers to justify more government support for sustainable agriculture policies and programs.

58. Farm production practices for adaptation include diversification of activities and intensification of crop and livestock production (including crop substitution), changing land use and topography, irrigation, and timing of operations. For example, crop diversification has been a focus of government attention and promotion in Canada, not only in light of anticipated climate change but also because recent agricultural policy reforms have significantly altered the production and risk environments of prairie producers. However, individual farmers have generally become more specialized in their cropping patterns since 1994 because of start-up costs and achieving economies of scale, and other risk-reducing strategies (crop insurance or securing of off-farm income) may be preferred by producers (Bradshaw *et al*., 2004)

59. At both the farm and government levels, adaptation decisions are continuous (Table 2). Individual decisions for adaption are influenced by internal stimuli to the farm household such as risk of income loss and environmental perception, and the external stimuli that affect the agricultural system at large such as macro-economic policy and institutional frameworks (Chiotti and Johnston, 1995). In addition, farm level adaptation strategies can be categorized as on-farm production practice management and farm financial management (insurance and risk management).

**Table 2. Farm level and public level adaptation strategies**

| Farm level | Public level |
|---|---|
| Crop and farm income insurance | Invest in research and development (e.g. develop heat resistant) |
| Diversification of production | Promote adoption of new technologies and practices |
| Adjust the timing of operations | Provide institutional support to diffuse information on climate change and adaptation possibilities (e.g. extension services, early warning systems) |
| Migration (move to cities or other rural regions) | Promote efficient use of resources (e.g. ensure market efficiency) |
| Adjust intensity of input use (e.g. fertilizer, irrigation) | Review policies to create an environment which is conductive for efficient and sustainable adaptation (e.g. water rights, environmental policies, trade policies, domestic support) |
| Adopt new production tillage (e.g. conservation tillage) | |
| | Enhance agricultural trade to spread the impact of regional supply shortage over the international market |

*Source*: OECD (2008).

60. As reviewed in section 3.1, an extensive literature exists on adoption of new technology, agricultural innovation and extension. Farmer perceptions of risk and uncertainty, institutional and government intervention can all affect innovation (Sunding and Zilberman, 2000), as can social learning and farmer-to-farmer interactions (Pretty, 1995). Connectedness, integration and diversity help the adoption of agricultural conservation technology (Warriner and Moul, 1992), but there is no simple formula to explain what factors may be most important in a given case, suggesting that understanding local conditions is key.

61. Recently, Tarnoczi and Berkes (2010) pointed out that information from government and producer organizations can be important for the co-production of knowledge that can lead to successful adaptation, based on 28 semi-structured interviews of producers in Alberta and Manitoba, Canada. They emphasized the importance of providing specific technical/regional information to specialty farmers. Accordingly, producer organizations could undertake bridge building by linking policymakers to farmers with local knowledge and experiences thorough implementing extension strategies at the farmer-level.

*Real Farmer Assumption*

62. In the context of measuring climate change impacts on agriculture, discussion of the "smart farmer-dumb farmer" assumptions have been made since the early 1990s. Previous studies in which no adaptation is assumed ("dumb farmer", Easterling *et al*., 1992a) versus farmer-agents blessed with perfect foresight ("smart farmer" Easterling *et al*., 1992b or "clairvoyant farmer", Reilly and Schimmelpfennig, 2000) could be compared. Schneider *et al*. (2000) suggested that these could be compared to "realistic farmers". Which kinds of decision rules such realistic farmer-agents would adopt to deal with climate change involve a range of issues.

63. Farm financial management also involves decision-making by producers and includes the use of crop insurance, investment in crop shares and futures, participation in income stabilization programs, and diversification of household income. Adaption strategies are also closely related to the risk management strategy of farming as underlined by the fact that climate change may have some impact on agricultural risk (OECD, 2009). With respect to risk management, several studies (e.g. Turvey, 2001) have identified sources and types of farm-level risk due to climate change. In addition, Easterling (1996) and Chiotti *et al*. (1997) considered how these risks might be managed through adaptation. This study provides valuable insights into agricultural decision-making with respect to adaptation in light of the uncertainties associated with climate change, especially those associated with variability and extremes. While there are such several such options that can improve the economic performance of the farm, appropriate actions depends on regional and local biophysical conditions.

64. Previous studies commonly assume that farmers are risk-averse. However, behavioural change under uncertainly is not simple. Repetto (2008) illustrates the characteristics with decision making under uncertainly in relation to climate change:[7]

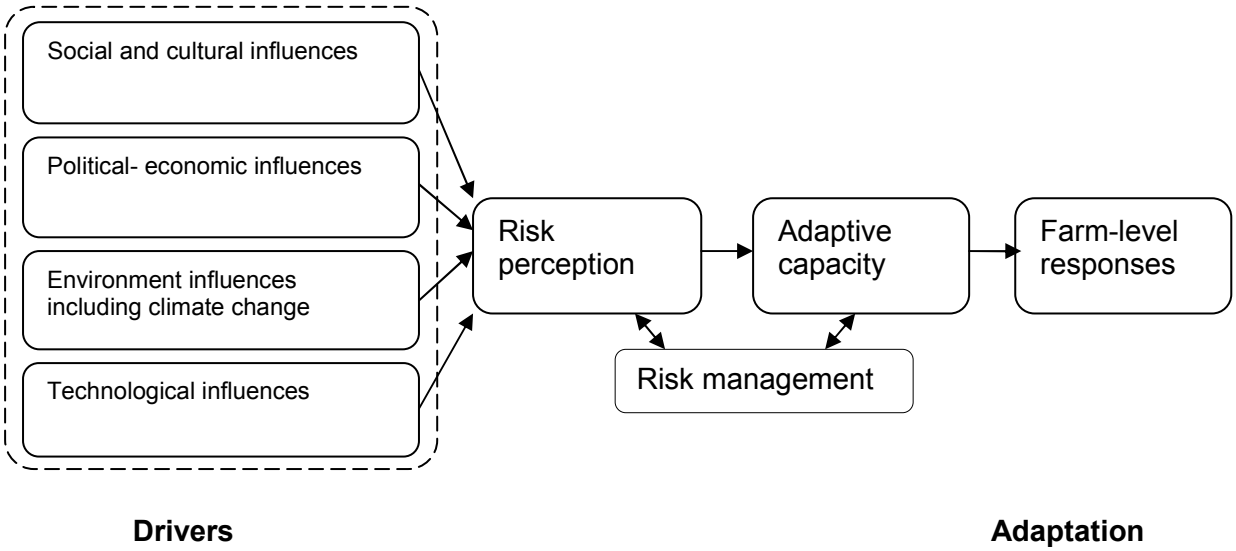
- Because of myopic[8] decision making of humans, people assign a relatively low priority to climate change because its effects are perceived to occur in the future, not the present.
- Decision makers tend to make small adjustment from the status quo (termed *anchoring*).
- People tend to resist and deny information that contradicts their value or ideological beliefs. It may relate to the fact that individuals rank climate change lower than other environmental issues.

7. Further explanations of Behavioural Economics are given in the Chapter 4.

8. Myopic decision means that a decision making at a time ignoring information that is both relevant and available for important decisions.

65. Tarleton and Ramsey (2008) tried to assess what farmers think of climate change and how it fits into their risk management strategies using farm survey in Manitoba, Canada. Figure 6 depicts the conceptual framework which is provided in their study. Given that climate change risks are perceived in the context of a wide range of other influences or conditions, adaptation is specified as a response to perceptions of risk brought about by external stimuli as evidenced by farm-level responses.

**Figure 6. Framework of farm-level adaptation**




*Source*: OECD Secretariat, based on Tarleton and Ramsey (2008).

66. Previous studies have shown that psychological and socio-economic factors simultaneously influence adaptation decision of farmers, and understanding how farmers actually weigh the qualitative and quantitative aspects when making decisions may assist policy makers to better understand interrelationships amongst these factors, which could aid policy design.

**4. Behavioural economics- Mitigation and adaptation**

67. As noted in section 3, it remains difficult to find universal socio-economic variables that explain farmer behaviour across the various studies reviewed because of heterogeneity. Psychological and socio-economic factors simultaneously influence farmers' decisions. In fact, although traditional market based tools including taxes, subsidies and regulations work well as external factors, these traditional tools are sometimes insufficient.

68. In this section, drivers and barriers of behavioural change are considered in more depth, applying theory and recent findings of Behavioural Economics. Behavioural economics could offer many insights, particularly in regard to internal influences on behaviour. In addition, this section also provides a systematic framework, which integrates external factors and internal and social factors in order to consider holistic policy design.

### *4.1. Introduction to behavioural economics*

69. The behavioural economics approach is empirical science and not based on systematic economic modelling, and applies appropriate theory and evidence to each situation.[9] It is an approach that combines the insights of psychology and economics to better understand and predict human decision making. Recent experiments reveal many behavioural "anomalies" that are seemingly irrational, as well as unpredicted behavioural responses to policies. Based on psychological analysis, behavioural economics can help illuminate other characteristics of human-decision-making under uncertainty. This does not mean abandoning the standard economic approach, only that economic models could be enriched by applying the results of research in psychology, where new insights will need to cohabit with traditional economic analysis.[10] In fact, some studies tried to incorporate behavioural issues to reflect more realistic farmer behaviour into modelling (e.g. Rothman and Robinson, 1997, Laitner *et al*., 2000, DeCanio, 2003). In their studies, social and psychological factors are taken into account, going beyond the traditional economics conceptual framework.

70. Although the behavioural economics approach for policy analysis is relatively new, there are a large number of studies on consumer behaviour. OECD (2010a) concludes that "work done in the field of behavioural economics identify a number of important ways that consumer behaviour may deviate from the assumptions underlying the traditional neoclassical market model. The work enriches understanding of consumer behaviour in key areas, providing an important complement to the neoclassical model. In certain areas, such as designing information disclosures or evaluating situations involving default-setting, behavioural economics may provide important insights that could improve policy formulation. As behavioural economics continues to mature, there may be further implications for consumer policy; it is, therefore, an area that merits continued attention".

71. In addition, although the accumulated empirical and experimental evidence are largely from the US and Europe, there is little comparable work from developing or transition countries (Anderson and Stamoulis, 2006), the behavioural responses to incentives for farmers in OECD countries may be different from those for farmers in non-OECD countries (Box 1).

72. Several of the findings from behavioural economics could be extended to agricultural policy in the context of climate change. Previous studies (e.g. Gintis, 2000), for example, indicate the existence of: endowment effects (people place higher values on things they already possess); hyperbolic discounting (people discount the near future at a higher rate than the distant future); and loss aversion (people are significantly more averse to taking a loss than failing to receive an equal gain). In addition, several studies try to incorporate the findings of behavioural economics into climate change policy (e.g. Brekke and Johansson-Stenman, 2008, Gowdy, 2008, Shogren and Taylor, 2008, Ho, 2008, Hepburn, 2010, Hepburn *et al*., 2010, Allcott1and Mullainathan, 2010), because it is widely considered that actual (not hypothesized) human behaviour needs to be taken into consideration in tackling climate change, and incentives should be stimulated in an appropriate way. With respect to agricultural policy, it has also been proposed that a more

9. Behavioural economics and experimental economics apply the experimental methods to study economic questions (human behaviour/economic theory). Experimental Economics Laboratory in Montpellier (LEEM) put together the information of 120 experimental labs all over the world, Asia, Europe, North America, and Oceania countries. All of information is available in their web site; http://leem.lameta.univ-montp1.fr/index.php?page=liste_labos&lang=eng

10 The role of experimental economics in the science of economics is well explained in Croson and Gächter (2010). They said relationship between theoretical and experimental work could contribute to understanding economic phenomena, decision making and policy analysis.

realistic behavioural model needs to be employed than is typically used in economic analysis, because of the issue of unbounded rationality (Blandford, 2010).[11]

**Box 1. Behavioural studies in developing countries**

**Economic experiments for farmer behaviour analysis**

Duflo *et al.* (2008 and 2009) provide one of the examples of using behavioural economics to inform policy. In rural Western Kenya, the Ministry of Agriculture recommends the use of hybrid seeds and fertilizer to increase maize yields. In 2004, however, according to a survey conducted in a random sample of farmers, only 37% of farmers had ever used fertilizer, and only 37.5% had used fertilizer in the year before. A series of randomized experiment was conducted to try to understand the determinants of fertilizer adoption. Other than the issues on profitability by using fertilizer in earlier work (Duflo *et al.*, 2008), they also suggests behavioural factors (e.g. present-biased) likely play an important role, and as a policy tool, small, time-limited subsidies are likely to yield higher welfare than either heavy subsidies or laissez faire(Duflo *et al.*, 2009),

The IFPRI Mobile Experimental Economics Laboratory (IMEEL) was established in 2007 by the Markets, Trade, and Institutions Division (MTID) of the International Food Policy Research Institute (IFPRI). Its primary objective is to implement economics experiments in the field to better understand the behaviour of smallholders and the poor in rural areas, especially in Africa, Central America and the Caribbean, Latin America, and Southeast Asia. Because IMEEL is portable, researchers can conduct behavioural studies of individuals and groups in remote areas (IFPRI, 2009). This system analyzes farmer behaviour in the field, as opposed to the laboratory experiments that are often used in universities in developed countries. IMEEL is unique in that it is the first mobile laboratory developed by an international organization that exclusively studies the world's poor, using hands-on decision making experiments. IMEEL is currently being used in several projects:

- The contract farming project
- The rural producers organizations project
- Financial rural–urban linkages
- Social protection and insurance
- Social interactions, preferences and norms

Experimental economics methods are becoming commonplace in the design of economic policy. Experiments complement traditional field studies such as surveys. Apart from IMEEL, field experiments (not in labs) have been explored in recent years. Cardenas and Carpenter (2008) summarize field experiments done in developing countries. Field experiments could also be useful for further understanding farmer's decision making in relation to climate change context.

**Evidences in the climate change context**

According to the Accenture survey with 10 733 individuals in 22 developed and developing countries, the results clearly point to a polarization of concern and confidence, showing that individuals in emerging economies appear to be more optimistic, more confident in a solution of climate change and are taking more actions than those in more developed economies (Accenture, 2010). To that end, the World Development Report 2010 (Word Bank, 2009) tried to offer an explanation of optimism in developing country, where information on climate change is not readily available compared with developed countries. As a key message of Word Bank (2009), in order to tackle climate change, going beyond the international mobilization of finance and technology, it addresses the psychological, organizational, and political barriers to climate action. In relation to this issue, Stage (2010) pointed out, from his broader literature on the

11. Not only the proposition of Blandford (2010), Slangen *et al*. (2008) have already argued that behavioural economics is one of the element to integrate institutional economics and organization theory for the policy design, with the clear recognition that the market is not the only transaction mechanism.

economics of climate change adaptation in developing countries, that development that only analyzes economic aspects is not enough for adaptation to climate change, and climate science, behavioural science, and legal and moral aspects also need to be taken into account.

**Future research needs**

In addition to individual behavioural anomalies in developing countries, one of the most important characteristics is that the market mechanism (arbitrage) does not function well in those countries. For example, Schneider and Klinglmair (2004) estimate the average size of the "grey" economy as a percentage of official GDP to be 18% for OECD countries, 38% for transition countries, and 41% for developing countries. More individuals in developing countries trade in small and informal markets where anomalous behaviours are less likely to be eliminated by competition and arbitrage (Anderson and Stamoulis, 2006). Experimental and behavioural economics evidence is largely related to developed countries, but the relation between several factors and famers' behavioural change in developing countries is likely more complex due to less developed markets and difficulty to access information. Given this, tackling climate change policies require careful design of incentives mechanisms, based on precise field research.

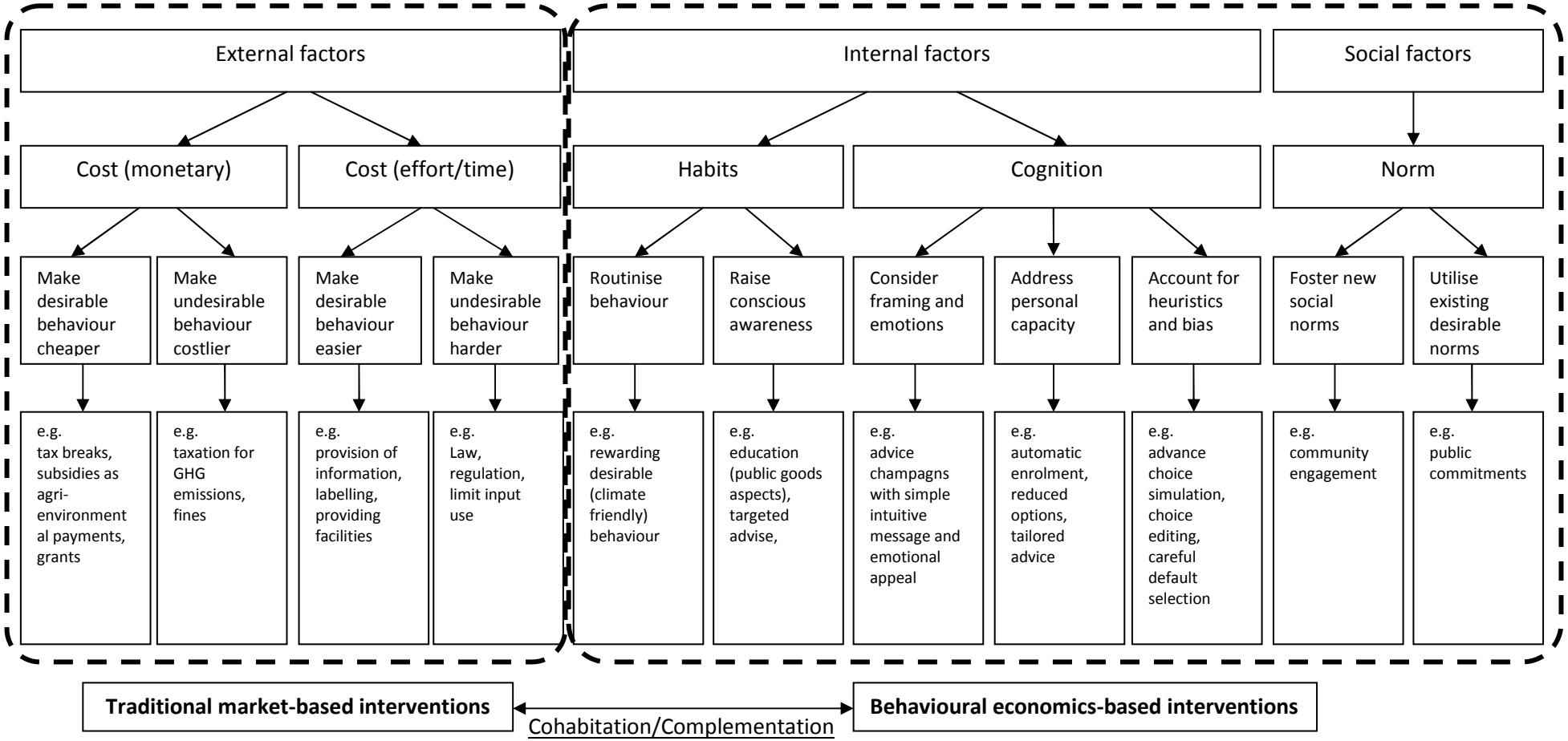
### *4.2. Application of behavioural economics*

73. No consensus for the appropriate standards and criteria of policy application of behavioural economics has emerged yet. In this section, a simplified but practical "framework" of drivers and options is provided, which can be used by policymakers to help identify the key influences on behaviour by applying the findings from behavioural economics. This framework was developed by the Social Market Foundation (SMF, 2008). It is also important that practicing behavioural economics requires a modification, not abandonment, of the key methodological principles of modern "traditional" economics (Bernheim and Rangel, 2007).

74. Based on findings from the literature review, several drivers for behavioural change can be categorized following three areas as defined by the SMF (2008) namely: external factors (the financial and effort costs); internal factors (habits and cognitive processes); and social factors (societal norms and cultural attitudes). External factors are well known as financial incentives and disincentives. On the other hand, internal and social factors are less well understood and considered by policymakers. Consequently, policy instruments which target the latter two have not been well developed in a systematic way.

75. This section is based on comprehensive summaries of behavioural economics (e.g. Kahneman (2003), Thaler and Sunstein (2008)) and the SMF (2008) for policy issues. Figure 7 presents these three dimensional (external, internal and social factors) incentives and corresponding intervention options. An integrated framework clearly shows that market based intervention is targeted only on the external factors. Simultaneously it needs to recognise the wide role of internal and social influences on behaviour. Each of three factors is explained below.

**Figure 7. Market based interventions and behavioural economics based interventions**




*Source*: Modified from Defra (2008) and Social Market Foundation (2008).

*4.2.1. External factors: monetary cost and effort cost*

76. External factors could be defined as monetary and effort factors which are stimulated by traditional market-based policy interventions. Several kinds of policies aim to alter behaviour by lowering the financial cost of desirable behaviour or discourage undesirable behaviour. Traditionally, these kinds of policy instruments (subsidies, taxes, tax relief) are the main policy instruments to incentivise or disincentivise behavioural change.

77. Designing tax or subsidies is crucial in relation to behavioural issues. Input-based instruments depend only on individual decisions, but, there is strategic interaction (collusion) in ambient-based (i.e. the aggregate impacts of farm-level contributions to externalities) instruments. Although ambient-based instruments are not used at the present time, laboratory experiments have been carried out for empirical evaluation. Experiments in Cochard *et al*. (2005) which examined nonpoint source water pollution show that input tax and ambient tax improve welfare with respect to the *status quo*, on the other hand ambient tax/subsidy decreases social welfare with respect to the *status quo*. The reason is collusion. This point has not been considered enough in the theoretical literature. The same conclusion is available in Vossler *et al*. (2006), that ambient based policy is second best in achieving the level of social welfare. Consequently, not only the individual decision but also communication/interaction with others do affect the outcomes depending on the tax policy design. They stressed that communication needs to be incorporated into theoretical work and the policy design of ambient-based policy. In addition to the efficiency of each instruments, the importance of social acceptability needs to be highlighted. If tax works theoretically and experimentally, it poses a problem of social acceptability. Based on laboratory experiments, it is not necessarily the case that an ambient tax is totally unacceptable (Boun My *et al*., 2007). The debate on ambient-based instruments is on-going (for more explanation, see also, OECD, 2010b).

78. Furthermore there are other types of instruments such as auctions. Agri-environmental programmes have generally been promoted through the provision of fixed payments for certain environment-friendly farming or management practices. However, the location and quality of farming land, and the production systems used by farmers, vary enormously, especially for small farming households in hilly and mountainous regions. Consequently, fixed payments that are uniformly distributed across the entire nation cannot correspond to individual heterogeneity, and then conservation auctions could be a noteworthy alternative. Latacz-Lohmann and Hamsvoort (1997) present the advantages of auctioning conservation management contracts. Uniform price auctions require winning bidders to pay a price that may be based on either the highest accepted or the lowest rejected bid, while discriminately price auction winners pay a price based on their own bid (for auction vocabulary, see Ferraro [2008]; for a longer review, see Latacz-Lohmann and Schillizi [2005]). Although some previous studies have compared fixed payments, uniform price auctions, and discriminatory price auctions (see e.g., Cason *et al*., 2003; Cason and Gangadharan 2005, Sasaki *et al*., 2010), the superiority or inferiority of these strategies depends on the settings of the experiment. Agri-environmental contracts have been auctioned to enhance the cost-effectiveness of public expenses in general practice, as well as in various pilot projects in some countries (see also, OECD 2010b). Recent studies have reviewed major findings in the field and investigated the experimental economics approach as it applied to auctions (see e.g., Ferraro, 2008 ; Rousseau and Moons, 2008 ; Romstad, 2009). As Ferraro (2008) concludes, more theoretical work and field and laboratory experimentation is needed before definitive conclusions about the superiority of one or more of these approaches can be drawn.[12]

12. On the issue of policy design on emissions trading, experiences such as the experience of California's RECLAIM (Regional Clean Air Incentives Market, e.g. Lejano and Hirose, 2005) in U.S, and EU ETS could be a good example for future market design.

79. Just as with the non-point source water pollution problem, new forms of incentive and payment schemes are needed to test for GHG mitigation. Several governments have been exploring the potential for introducing market-based approaches. For example, New Zealand has planned the introduction of emissions trading including for agriculture by 2015. In this respect, the agricultural sector includes GHGs from pastoral agriculture, horticulture and arable production (Wreford, Moran, and Adger, OECD, 2010).

80. On the other hand, some policies are targeted to reduce or increase effort costs. Information provision can facilitate conditions which enable producers to have access to desirable choices. Information provision with easier accessibility could be a significant policy tool for both mitigation and adaptation. Generally, high quality information provision on the risks, vulnerability and threats posed by climate change (Wreford, Moran, and Adger, OECD, 2010) is important in this respect. Information such as given by scenarios of climate change could be incorporated into land-use planning by farmers. In addition, through the on-farm GHG emission calculator, the cost of seeking information about individual GHG emission declines significantly. However, as Pannell (2010a, 2010b) has noted, the characteristics of climate change (slow: there will be time to adapt later; highly uncertain: small changes in climate relative to annual variations in weather; farmers respond to weather, not climate and the spatially heterogeneous) should be taken into account. Pannell argues that while information about climate itself may be of value, information about the optimal farming strategy is of limited value because of following reasons:

- Farmers will adapt appropriately to climate change even in the absence of a government program providing advice;
- Such advice would often prompt little if any further change in behaviour;
- The benefits to farmers of providing this sort of information will be minimal.

81. Consequently, it seems that farmers decisions heavily rely on how and which information is offered by the government. In addition, although decision-making with respect to mitigation and adaptation to climate change are modifications to on-going farm practices, policy makers need to take into account these characteristics of climate change compared with other agri-environmental issues. Regulatory options for cropland management (e.g. nutrient, tillage and residue managements) or livestock management (e.g. grazing intensity, feeding) also could be categorized as policy tools tackling external factors as well as information provision which draw on desirable behavioural change. These tools are all highly related to the "internal factors" and "social norms" dimensions.

*4.2.2. Internal factors: habits and cognitive process*

82. Usually, policies targeted to external factors reflect the common understanding that people are economically rational. However, as mentioned above, that hypothesis needs to be qualified as people do not always respond to policy instruments as they might be expected to. Policies must tackle other than external factors, the so-called internal factors: habits and cognitions (emotions, personal capacity, and biases). In this section several representative behavioural "anomalies" which closely relate to the farmers' response toward climate change (and climate change policies) are introduced (e.g. McFadden, 1999, for a detailed review of anomalies), and then appropriate policies are considered.

83. According to the discussion from the SMF (2008), habits are "routinised behaviour which involve minimal deliberation and limit conscious awareness behaviour choice". Consequently, policy makers need to manage it to break or re-establish it, although it is not easy because precise analysis for habitual behaviour requires the consideration of conscious thought. However, several forms of policy could affect conscious awareness of habitual behaviours. For example, financial incentives for environmentally (climate) friendly farming and well designed information provision could both affect habitual behaviours. In addition to these, in order to consider more detail of cognitions, the application of behavioural

economics could be very useful. Simply providing financial incentives or information is sometimes not enough to change behaviours, but these theories and empirical findings could suggest that the way in which information is presented and framed will have an influence.

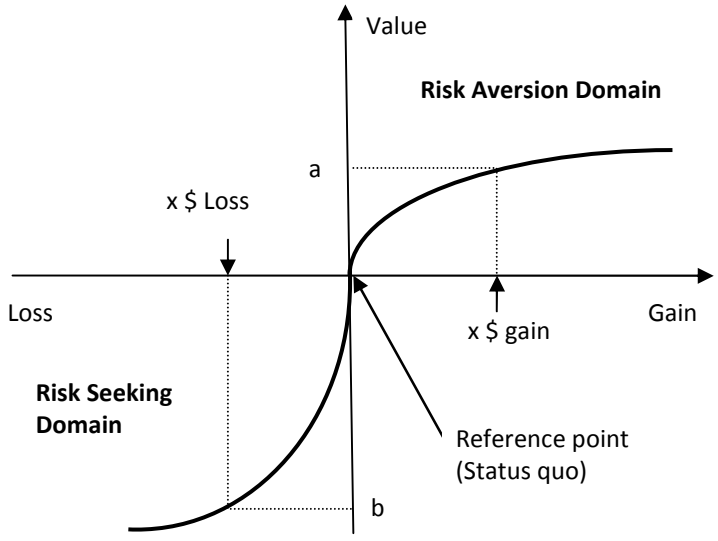
84. "Anomalies", which are circumstances in which individuals exhibit surprising departures from rationality, occur due to these internal factors. From the wide body of research (e.g. The Royal Swedish Academy of Science, 2002) this suggests that individual behaviour *systematically* deviates from economic rational behaviour in several cases, so implementing measures under the assumption of this anomalous behaviour due to habits and cognitions have the potential to alter people's behaviour. So far, consideration of this kind of approach to encourage climate friendly cropland management is limited except for a few examples: for example, the UK is taking a few positive steps with the clear recognition that behavioural economics is a very promising tool to explain behaviour (see section 4.3).

85. As a first step, the role of the "reference point" is noted. Insights into the impact of cognition are offered by the seminal work of Daniel Kahnemen and Amos Tversky. Kahneman and Tversky (1979) and Tversky and Kahneman (1992) developed an operationally applicable alternative to rational choice theory in the form of "prospect theory". They assume that individuals maximise the expected value of the value-function *v(x)* for $\alpha \in (0,1)$ is and $\lambda > 1$ is where

$$v(x) = \begin{cases} x^{\alpha} & \text{for } x \geq 0 \\ -\lambda(-x)^{\alpha} & x < 0. \end{cases} \quad (2)$$

86. Equation (2) introduces a kink in the value function around the "reference point" (status quo) and individuals are risk averse in the domain of gain and risk seeking in the domain of losses.

**Figure 8. Hypothetical value function**




*Source*: OECD, modified from Kahneman and Tversky (1979).

87. An important implication from prospect theory is that there is risk aversion in the domain of gains, and risk seeking in the domain of losses, and a greater sensitivity to losses than to gains. This phenomenon systematically distorts individuals' abilities to make what might be perceived as rational

judgements based on simple profit maximization (cost minimization) assumptions. As shown in Figure 8, peoples' choices are defined relative to a reference point (status quo). For example, people do not only derive utility from their *absolute* income, but also from their income *relative* to others. Consequently, determining the reference point of an individual's behavioural change is important. For the sake of simply showing the importance of a reference point, a classical but typical example is introduced in Box 2.

88. In addition, people are more displeased with losses than they are pleased with equivalent gains. Approximately, it is known that value "b" is twice as big as value "a" (Figure 8).[13] It implies that initial allocated entitlement holders are likely to value it more than those without such entitlements. Based on the fact that people behave as being risk averse or risk seeking depends on their position in relation to the reference points, policy could thus shift the reference point.

**Box 2. The role of the "reference point"**

In one of the experiments in Quattrone and Tversky (1988), respondents In the USA were asked to choose "Policy A" or "Policy B" depending on the expected own profit and other farmer's profit. Group 1 respondents were asked to answer Problem 1 and Group 2 was asked to answer problem 2. This question here is hypothetical and slightly modified form of their published paper. As to the results, the number of the respondents dramatically changed between problem 1 and 2; in problem 1, 28% of respondents preferred policy A and 78%. For policy B, on the other hand, in problem 2, the shares were the same.

**Problem 1 for Hypothetical climate policy**

| Expected profit | | |
|---|---|---|
| Other farmers' profit | Your Profit | |
| | Under Policy A (28%) | Under Policy B (78%) |
| USD 43 000 | USD 65 000 | USD 51 000 |
| USD 45 000 | USD 43 000 | USD 53 000 |

*Source*: OECD Secretariat, based on Quattrone and Tversky (1988).

**Problem 2 for Hypothetical climate policy**

| Expected profit | | |
|---|---|---|
| Other farmers' profit | Your Profit | |
| | Under Policy A (50%) | Under Policy B (50%) |
| USD 63 000 | USD 65 000 | USD 51 000 |
| USD 65 000 | USD 43 000 | USD 53 000 |

*Source*: OECD Secretariat, based on Quattrone and Tversky (1988).

Comparing each problem, the choice between policy A and B was influenced by other farmers' profits. In this problem, other farms' profits are the reference point, USD 44 000 in problem 1 and USD 64 000 in problem 2 as the expected value. Consequently, both policies are treated as gains in the first problem and losses in the second. As explained, the value function entails more risk aversion in problem 1 than in problem 2.

89. With respect to the reference point, people tend to like the status quo, and they demand a great deal to justify changing from the status quo. It is called "status quo bias" where choices are evaluated in

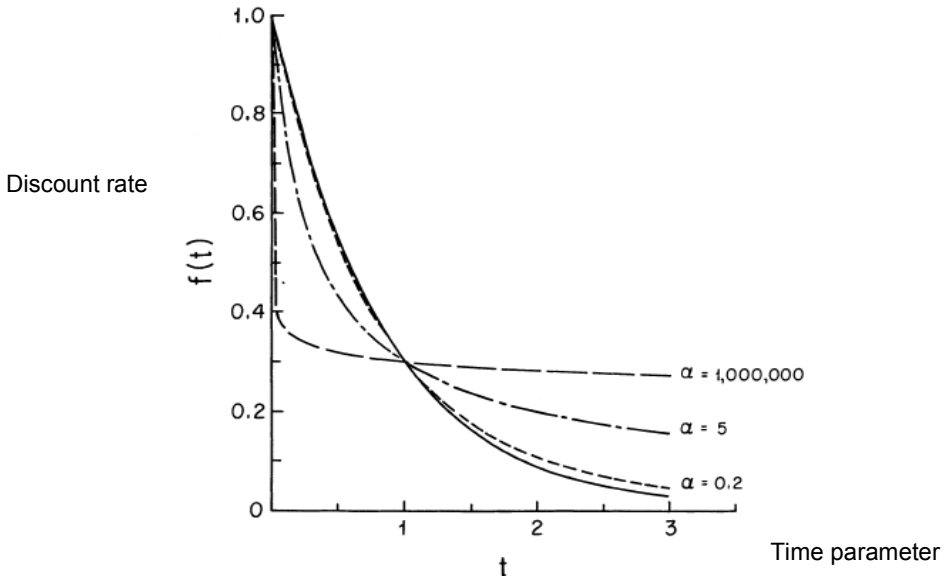
13. The average values of $\alpha$ is approx. 0.8. The so-called "loss-aversion" $\lambda$ is usually set to approx. 2. The parameter values measured by Tversky and Kahneman (1992) are $\alpha = 0.88$ and $\lambda = 2.25$.

terms of changes from an endowment or status quo point. This is also the central finding from prospect theory. In particular, people evaluate situations largely in accordance with their relationship to a certain reference point; consequently people evaluate gains and losses from the reference point. Current status and history are favoured by farmers relative to alternatives not experienced. Thus, how to decide default rules as a policy tool affects farmers' decision making.

90. Secondly, the "discount rate" is the necessary element for inter-temporal decision making. In the context of climate change, how farmers evaluate the future is crucial in considering behavioural change. When farmers are faced with the short-term decision regarding private costs and benefits, the long-term outcome of mitigation and adaptation is discounted at a certain rate. Traditionally, policy evaluation assumes people discount the future at a constant exponential rate, but it can cause inconsistent behaviour. Instead of this, non-constant time discounting, the so-called "hyperbolic discount function," is widely known for its theoretical and empirical explanations. Individuals heavily discount rewards that are available only sometime in the future (Laibson, 1996, 1997). With respect to its robustness, careful reviews of the literature suggest that the evidence for hyperbolic discounting is strong (Hepburn *et al.*, 2010).

91. People often apply a high discount rate to exchange between the present and the near future, but a low discount rate for trade between the near and far future. This is hyperbolic discounting, which has been most frequently used to explain self control (e.g. procrastination and addiction). Three different types of the hyperbolic discounting function applying different parameters are presented in Figure 9, which are hypothetical depictions cited from Loewenstein and Prelec (1992). The solid line curve is conventional exponential discounting. This Figure shows the assumptions in Samuelson's discounted utility model (*constant* discount rate over time) are deviated from real choices.

**Figure 9. Examples of the hyperbolic discount function and the conventional exponential discount function**[14]




*Source*: Lowenstein and Prelec (1992).

14. The hyperbolic discount function $f(t) = (1+\alpha t)^{-\beta/\alpha}$ for three different levels of $\alpha$ . $\alpha$ determines how much the function departs from constant discounting. $\beta s$ are adjusted so that curves cross at $f(1) = 0.3$ (Lowenstein and Prelec, 1992).

92. A substantial body of literature on generalised expected utility theory and behavioural economics attempt to address this discount problem. Recently, Hepburn *et al.* (2010) focus on the linkages between discounting, behavioural economics and environmental policies. They noticed that self-control problems should be explained to people, with policy makers providing them with the option to adopt a commitment device (pre-commitments) if they so wish. And in the particular case of climate change policy, more research on the design of appropriate commitment mechanisms is needed in the future.

93. Finally, an anomaly for the "influence of information" is stressed here. People tend to think that risks are more serious when an incident is readily called to mind. This so-called "availability heuristics" will produce systematic errors, especially for adaptation decisions. In fact, cognitive psychologists consider the availability heuristics to be a key element in individual judgment and perception (Kuran and Sunstein, 2000). It means that undesirable behaviour may be curbed simply by controlling the information available to relevant decision makers. The role of policy intervention is important tackling availability heuristics. Noll and Krier (2000) introduced the theoretical blackboard (including prospect theory) and cognitive theory for regulatory policies designed to control the environment. Considering the presentation and framing of information is the most effective way for behavioural change from the policy maker perspective.

94. All of these phenomena cited here (role of reference point or status quo bias, hyperbolic discount and availability) systematically distort individuals' abilities to make rational judgements based on a strictly mathematical comparison of cost and benefits (SMF, 2008). Given "bounded rationality", careful default selection, automatic enrolment and reduced options, these present key policy challenges. These individual bounded rationalities could be one of the reasons why several win-win mitigation (i.e. benefits, either private or social) options are not currently being adopted. As estimated for the UK, the results indicate that in 2022 around 6.36 MtCO2e could be abated at negative or zero cost (Moran *et al.*, 2009). In order achieve potential physical abatement level, bounded rationality need to be taken into consideration, in addition to technical barriers.

95. Cataloguing potential individual judgement errors should be a decision for policy makers to take in order to identify possible outcomes of policy instruments. As these methods have already succeeded for some policy issues (see Box 3, both of examples are cited from Camerer *et al.*, 2003), it is worthwhile to consider in the context of climate change and agriculture. It can be a powerful policy tool, where enrolment can be automatic for desirable behaviour in addressing climate change. For example, in order to assess an individual's climate change risk based on prospect theory, specifying a reference point is required. Regarding emissions trading scheme design, the initial amount of grandfathered emissions in the ETS could heavily affect the outcome. The Coase Theorem suggests that the initial allocation should not affect outcomes when transaction costs are zero. However, it is highly likely that the allocation of legal entitlements will matter. Substantial research has not been conducted in the agriculture and climate policy contexts, but policy makers would be advised to pay attention to the reference point (status quo) problem for policy design.

**Box 3. Successful examples using behavioural economics: Automatic enrolment**

The first example is in respect of the public insurance system. Pennsylvania State in the US offers insurance with limited rights to sue after an accident. On the other hand, in New Jersey a limited right to sue was the default, and customers had to pay extra to acquire a full right to sue, whereas in Pennsylvania the default was a full right to sue, and customers received a discount if they switched to a limited right to sue. When offered the choice, only about 20% of New Jersey drivers chose to acquire a full right to sue, while approximately 75% of Pennsylvanians retained a full right. The difference in amount spent on insurance in the two states was approximately USD 200 million. As shown in this example, the default position needs to be stated very carefully.

The second example is in respect of pension schemes. Normally employees must decide whether to participate in a retirement plan, Until recently, the default option was non-participation. Employees had to actively choose to participate. In recent years, some companies have changed the default option to participation. Employees are automatically enrolled unless they actively choose not to participate. Recent results show that they have large effects on behaviour—and in particular that participation is significantly higher under automatic enrollment. The similar system of automatic enrollment is being adopted in the UK (Social Market Foundation, 2008).

*Source*: Cited from Camerer *et al*. (2003).

*4.2.3. Social factors: Social norms*

96. The last dimension is the impact of the social context on individual behaviour. It is widely known that free riding will occur in repeated public goods experiments (Ledyard, 1995). However, there are substantial numbers of public goods experiments which have shown that many people would contribute more to the production of public goods than would occur through pure self-interest. "Social norms" or "heuristics" are one of the possible explanations, which induce people to make positive contributions (e.g. Fischbacher and Gachter, 2008). Social factors including networks, norms, and social capital affect individual behaviour and group action (collective action) simultaneously.

97. The collective action is important for many agri-environmental issues such as climate change, where it is the collective (rather than individual) action that matters. It can be characterized as transforming the "tragedy of commons" into the "harmony of the commons" (Defra, 2008) or "the struggle to govern the commons" (Dietz, Ostrom and Stern, 2003).

98. Several studies of collective action suggest when and under what conditions could collective action be determined. Behavioural economics are applied to determine when and under what conditions collective action will occur (e.g. Dowling and Chin-Fang, 2007). Colman (1994) has already pointed out the importance of collective action in agricultural policy design, where he explores the issue of whether market efficiency can be improved when economic agents' behaviour is motivated by ethical objectives such as fairness and altruism. Farmers' collective action has also been identified as a key point in achieving a better environment in rural area (OECD, 1998).

99. According to the latest theory of collective action, it is possible for individuals to act collectively to manage shared natural resources and a large number of variables could increase the likelihood of cooperation. Poteete, Janssen, and Ostrom (2010) synthesize elements that increase the likelihood of cooperation.[15] Cooperation will occur in settings with several broad characteristic (Ostrom, 2009):

15. Ostrom (2006) synthesises the *experimental* results about cooperation in common pool resources.

- *Many of those affected have agreed on the need for changes in behaviour and see themselves as jointly sharing responsibility for future outcomes.*
- *The reliability and frequency of information about the phenomena of concern are relatively high.*
- *Participants know who else has agreed to change behaviour and that their conformance is being monitored.*
- *Communication occurs among at least subsets of participants.*

100. In relation to the cooperation when dealing with other individuals, fairness and justice among the social norms are also important. Individuals tend to choose to follow a fairness strategy and this behaviour is against with pure self interest assumption.[16] Specifically, individuals reject a transaction if they believe it is unfair when predicting the economic incentive to accept it. On the other hand, if punishment (tax/penalty) for those who do not contribute anything is allowed, the amount of cooperation increases dramatically.[17] Altruistic or moral motives, conventional practice and reciprocity could be the reasons for fairness (Alvi, 1998). In climate change, who is responsible for the current and future levels of GHG and who should bear the cost for solutions (Ostrom, 2009) could relate to this fairness problem.

101. These finding may be incorporated into policy instruments. Ostrom (2009) proposed that behavioural theory of human action and recognition of the importance of context in affecting levels of trust and reciprocity be applied to the climate change problem. In fact, the UK is trying to adopt collective action theory to promote collaborative environmental planning, through *community-of-interest based* approaches (with *market based approach*), which can motivate production and consumption (through cooperation and mutual self-restraint) in a more sustainable manner in local situations, particularly where scarce environmental resources are characterised by 'commons' issues. In addition, environmental cooperatives in the Netherlands, the regional landscape initiative in Flanders, the former collective Contrats Territoriaux d'Exploitation (CTEs) in France, the Australian Landcare Programme, and collective nature plans in Denmark are examples of initiatives and practical collective action (Polman *et al.*, 2010).

102. Shifting the concepts of good farming also helps embed longer-term change and a partnership approach, with farming bodies taking a leadership role (and some elements of social pressure) through networks and social norms as a key outcome from a partnership approach towards collective action. In order to enhance altruism and cooperative action of farmers, community engagement and public commitments are useful as policy tools (Defra, 2010).

### *4.3. Recent actions in OECD countries to tackle farmer behaviour issues*

103. In this subsection, examples of efforts in selected OECD countries' to tackle farmer behaviour issues are provided.

*Australia*

104. The National Agriculture and Climate Change Action Plan (2006-09) has been introduced by the Australian government to develop a coordinated framework for climate change policy in agriculture. It provides practical tools to develop effective and efficient policies to deal with climate change challenges.

16. For more evidence of fairness by the ultimatum game and experiments for Rabin (1993), Guth and Tietz (1990), Cameron (1999), Fehr and Schmidt (1999).

17. Regarding free rider problem under the public goods provision, see also Chapter 3.1.

105. The plan aims to raise awareness about climate change among primary producers and rural communities and will provide a strategic framework for primary producers for decision-making and business planning. In addition to Adaptation, Mitigation, Research and Development strategies to respond to climate change, awareness and communication strategies are identified as one of the key areas identified for climate change management. In the Action Plan, strategy is defined as an increase in understanding and integration of scientific knowledge of climate into farm management decisions. OECD (2010c) explained Australia's training opportunity and R&D in order to assist the farmer's adjustment to climate change, in the context of farm households' risk management strategy

106. Research by Mercer and Donnelly (2009), which was submitted to the Department of Agriculture, Fisheries and Forestry, focuses on developing insights on which a communication strategy can be built that will encourage Australian farmers to adapt and mitigate farming practices and adopt new technologies to counter climate change. This report synthesized the reviewing process into the following sections based on Fishbein and Ajzen (1975), and Ajzen and Fishbein (1980):

- Perceptions of climate change
- Attitudes to climate change
- Drivers and barriers to change
- Communication with farmers.

107. In addition to climate change, the Australian government had already undertaken studies focusing on farmer behaviour. According to Byron *et al*. (2006), the government conducted a mail survey to 1000 landholders in the Lachlan Catchment in 2003, which focussed on gathering base-line information regarding the key social and economic factors affecting landholder decision-making on the adoption of practices expected to improve the management of natural resources in the Lachlan Catchment.

*Canada*

108. Conservation tillage has become the dominant annual crops production technology in North American Great Plains agriculture. In Canada, in the case of zero tillage, many years of public and private research were required to develop the machinery, understand the new agronomy and provide credible testing and advice to farmers as they contemplated these new technologies. The shift from conventional to zero-tillage is a good example of how adaptation and change occurs. Recently, Lindwall and Sonntag (2010) synthesized the role of R&D or technology development in the discussion of public policy roles focusing on the no-tillage, as a part of KIS (Knowledge Impact in Society) project (http://www.kis.usask.ca/index.html). This is not a one way process to knowledge diffusion as farmers played a very significant role in the development of the technologies. With GHG mitigation and management R&D can play huge role in providing technologies that make mitigation strategies more profitable.

109. One the key lessons learned from the current success in Canada was good cooperation and communication among the various stakeholders in development and application of the technology, fostered by the leadership through farm organizations and effective lobbying of government organizations and support of applied research (Lindwall and Sonntag, 2010).

*France*

110. The "Adaptation to climate change on agriculture and ecosystems" scheme was launched in 2010 by the Institut national de la recherche agronomique (INRA), which aims to study the risks and opportunities of projected regional adaptation costs and benefits. In addition, France is currently

undertaking climate adaptation consultations with all stakeholders, including farmers' organizations so as to involve them in taking ownership of the climate change adaptation issue and drawing together recommendations for best practices. This includes the acquisition of knowledge to be transferred to the actors in the sector, and across territories.

*Japan*

111. Japan is undertaking the development of user-friendly software to estimate the amount of GHG emissions which require the input of the amount of fertilizer application, and fuel and light expenses of famers, and will be ready during the 2010 fiscal year. This software can also estimate the emission of the transportation process of fertilizers. This system is expected not only to help farmers' gauge their efforts, but also to convey those efforts to consumers through labelling, if it becomes widely used.

*Netherlands*

112. In the Netherlands, collective approaches for resource management are widely used, and several studies show that the encouragement of collective action, by enhanced incentives, or lowering the transaction costs, can contribute to addressing agri-environmental problems (see Polman *et al.*, 2010 for a review).

113. The first co-operatives in 1990s were initiated by groups of farmers co-operating with the aim of preserving the agri-environment and combining this activity with farming. There were approximately 130 environmental co-operatives by 2006. Approximately 70% of these co-operatives are associations, about 20% foundations (trust) and about 9% are formal cooperative. In total, environmental co-operatives have 18,000 members. About 20% of all land use type farmers are members of an environmental cooperative (Polman *et al.*, 2010)

*Switzerland*

114. Since 2008, the Competence Center Environment and Sustainability (CCES) of the ETH (Eidgenössische Technische Hochschule Zürich) Domain in Switzerland has been investigating adaptation and mitigation behaviour or the behavioural intention of farmers to reduce green house gases to identify and quantify the relevant factors in the local context, involvement of other stakeholders, and analysis of existing incentives. The relevant factors are:

- ***Psychological***: values, attitudes, risk perceptions regarding climate change (how severe are impacts of climate change on human health) and market conditions (how severe are impacts of climate change on agricultural production), type of information (numerical vs. verbal), social norms, time preferences etc.
- ***Socio-economic***: farm size, production system, incomes etc.

115. The main goal is to elaborate sound solutions to reduce greenhouse gas emission from agriculture as well as to contribute to implementation of risk management and adaptation strategies related to climate change. The final objective is to outline recommendations for policy makers for the design, communication and implementation of successful mitigation and adaptation strategies in agriculture. (CCES home page, http://www.cces.ethz.ch/projects/clench/CLIMPOL/Clusters/C/C1).

*United Kingdom*

116. Defra (The Department for Environment, Food and Rural Affairs) has undertaken a substantial amount of work in this field, and understanding and influencing behaviours is considered crucial for

policy-making in the UK. Defra has assembled an overview of the evidence collected over three years linking it with recent developments in the area of behavioural economics (Defra, 2008). Defra has been undertaking several projects in relation to farmer's and landowners' behaviour. (e.g. Defra 2002, 2006 and 2008). A final report by the University of Reading commissioned by Defra (Defra, 2006) dealt with behaviour and motivations of farmers in responding to policy changes in England. This is not specific to climate change adaptation.

117. A telephone survey of 750 farmers by UK Continental Research led to divide farmers into five categories. The first category is *Custodians* (23%), which are characterised as "farming is way of life" and "pride in farming heritage and environment". The second category is *Lifestyle choice* (6%), which is characterised as "not main source of income" and "tradition and a pleasure". The third category is *Pragmatists* (22%) which is characterised as "balanced approach" and "emotional connection with farming but recognise need to focus on business". The fourth category is *Modern family business* (41%) which is characterised as "family success and income" and "financial planning important". The fifth category is *Challenged enterprises* (7%) which is characterised as "farming is a burden and a struggle" and "isolated and pessimistic for future". The study discusses how different segments respond to different communication methods. As to results, Custodians and Lifestyle choice may respond to emotive issues which are inclusion, partnership working, and mutual benefit. Modern family business and challenged enterprise are more economically rational and pragmatic. It is recommended by the research organisation that the internal characteristics or descriptions contained within the segmentation model are given priority in terms of communication methods, with the policy tools and market conditions being secondary issues.

118. Given the existing evidence, Defra (2008, pp. 21) recognised seven policy implications;

- ***Recognize diversity (no two farmers are identical)***: Use the segmentation model and a framework for understanding the varied influences on behaviours.
- ***Identify internal factors before policy interventions***: Recognise and respond to individual characteristics by putting at the forefront of policy development.
- ***It's not always just about profits***: Profit maximisation, whilst important, is not the single objective, actions (and inaction) are not solely dependent on costs and benefits (both financial and non-financial) but also encompass personal preferences (cognition, habits etc.).
- ***The why's and the why not's***: Explaining past occurrences and future trends needs an understanding of the why and why not as well as the financial and physical information. Rationale for decisions help guide future policy development in addition to just seeing impacts.
- ***No farmer is an island***: The advice and opinions of others is important and how farmers form networks or work collectively (social norms and social capital) can influence behaviours.
- ***Engage***: Engagement and participation can help identify common ground (and values) where self-interest and wider goals of society may not be mutually exclusive.
- ***Monitor and evaluate***: Monitoring and evaluation of policies is important and think about trying to apply theory in valuing effectiveness e.g. why has a policy been success? Was it due to a change in attitudes as well as positive incentives etc.

*United States*

119. Given the awareness that landowner responses to carbon policies are a key factor in establishing the costs of greenhouse gas offsets from agriculture, USA (ERS) research is undertaking research on ways to estimate the likely responses of farmers to carbon storage policies and to assess the likely impacts of

policies on the carbon balance, land and water use, and agricultural markets (ERS home page, http://www.ers.usda.gov).[18]

120. Thus far, Claassen and Morehart (2009) show that farmers who own the land they farm may be in a better position to generate offsets than those who rent their land, based on the farms' segmentation data into four tenure classes such as high-tenure operators, who own at least 80% of the land they farm or ranch, or low-tenure operators, who own less than 20%. Because carbon is sequestered over time, offset agreements would likely require that sequestration practices be maintained for 5-10 years. In addition, Horowitz and Gottlieb (2010) provide the potential farm response to policy incentives for reducing GHG emissions from the analysis by using existing conservation programs in the US such as the Conservation Reserve Program (CRP), the Environmental Quality Incentives Program (EQIP) and the Wetlands Reserve. They note that whether a particular acre would be eligible for these programs and receive GHG offset credits would affect the owner's willingness to participate in the offset market, as well as the size of the payment required from each. As the extent to which farmers adopt carbon offsetting activities and climate-friendly activities would depend on their costs, potential revenues, and other economic incentives created by climate policy, more precise analysis will be undertaken.

## 5. Policy implications

121. The implication of behavioural economics in relation to human behaviour is of great interest for environmental economics and policy (Hepburn and Duncan, 2010). If individual choices do not maximise utility, there is a role for government intervention. As explained in section 4, government policy could potentially go beyond addressing market failure. Simultaneously, behavioural failure in decision making could be justified as a basis for government action.

122. Although behavioural economics has not been empirically tested enough in agricultural management and policy instruments, it is argued that further consideration be given to its findings, rather than rely solely on traditional incentives and disincentives.

123. Four policy implications result from the findings:

### 1. A holistic approach is needed

- Understanding how transformational or technological change in farming occurs about requires an understanding of a wide range of factors. Financial incentives are clearly important, because changing farming practices will not be adopted if they are not profitable to do so. But financial incentives alone cannot explain all of the behavioural change.
- An agricultural sector that will contribute to GHG mitigation and adaption to climate change is likely to require a combination of market-based instruments and other tools (affect to habits, cognition and norms) which could influence farmer behaviour.

### 2. Behavioural change should be understood at the local level

- Many elements could affect farmers' behaviour in relation to agriculture and the environment. Although farm level mitigation and adaptation management actions in general overlap – bearing in mind that farmers manage an overall set of interrelated resources – each farm and farmer has specific characteristics. Thus, in order to deal with heterogeneity, understanding behaviours

18. In the field of food and consumer policy, in April 2010, the ERS held a two-day conference on how behavioural economics can improve Federal policy. The USDA is planning to award USD 2 million in research grants for this field inspired by behavioural economics (Washington post, 9 June 2010).

requires that policy needs to be developed with the recognition that different policy tools work differently for different farmers. For example, modern, large-scale, commercially-oriented farm businesses are likely to display behavioural characteristics that differ from small-scale, family run farm businesses.

**3. "Nudging" could be a useful approach to guide policy**

- Market-based policy instruments have been designed on the assumption that farmers act rationally. However, it is problematic to assume rational behaviour, especially where markets for environmental goods and services do not exist (lack of market arbitrage does not encourage rational choice). Behavioural economists have started to think about the implications of their findings for public policy, including in the context of climate change, and policy makers can use the findings in behavioural economics to inform the design of institutions and policy.
- Identifying "behavioural failure" recognizes that people may systematically make mistakes in decision-making. "Behavioural failure" that relies on assumptions of unbounded rationality will not deliver optimal results. This raises challenging questions about the role of government policy – whereby government intervention is justified when people know what the right decision is but for various reasons do not make these decisions. Thus, policy makers might have to think about correcting for both market failure and behavioural anomalies, simultaneously.
- Consequently, governments can set an appropriate default rule or set (or limit) choices for farmers with a clear recognition that behaviour tends to be affected by those default settings. These interventions should 'nudge' individuals – without restricting their choices – towards what they would have chosen had they not been subject to specific limitations of behaving rationally. A "nudge" implies a small change in the social context that alters behaviour without forcing anyone to do anything.
- An example of a nudge approach is "visualization" policies such as labelling (carbon foot print). This approach encourages farmers to establish what they need to do, while their efforts can be conveyed to consumers through labelling. Consequently, identifying "ecologically cooperative" farmers is a visible way by means of labelling that could complement incentive measures to address climate change.

**4. Forming networks of farmers or working collectively can play an important role**

- Policy instruments may have indirect effects on behaviour through their impacts on motivation. Public policy affects behaviour not only through its direct impact on relative prices and budgets or via regulatory constraints, but also through the impacts on individuals' perception of morally ideal actions. Advisory systems, extension, diffusion of innovation and training have a crucial role in shaping attitudes and motivations. It has been argued that monetary incentives can "crowd out" civic motives, but also they can "crowd in" motivations when they are used to acknowledge the social worth of individual's contributions.
- These social norms – or social capital – could potentially influence the collective action (various forms of group activity) of farmers. Collective options should be given serious consideration as an alternative to the market or to regulation in addressing many agricultural and natural resource problems. As both adaptation and mitigation are closely linked to the public benefit (shared value), strategies to encourage farmer cooperation have been a feature of government policy. Efforts to reduce GHG emissions and adapt to climate change are a classic collective action problem that is best addressed at multiple scales and levels. Schemes such as network building mean communities pledge to "collectively plan" for a large reduction in their carbon emissions.

- Collective action is also closely related to external and internal factors. If information about other people's behaviour is not available, people tend not to cooperate. For example, farmers could receive information not only about their own behavioural choices (management practices or emissions) but also whether those choices are below or above the standard (benchmarking). Consequently, how to share such information and where to set adequate benchmarks is also crucial for policy design.

124. Behavioural economics has important implications in relation to environmental economics and policy. If individual choices do not maximise utility, then there is a role for government intervention. Traditional market based tools including taxes, subsidies and regulations work well as external factors. However, these traditional tools are sometimes insufficient. Government policy could potentially deal with more than market failure, justifying actions by governments in relation to behavioural failure. Although the extent of behavioural failure has not been empirically tested enough in respect of its impact on agricultural management and policy instruments, more attention needs to be paid to a wider range of drivers of farmers' actions concerning the environment than is explained by concentrating purely on financial incentives. In addition, research on measures that realize both mitigation and adaptation goals need to be encouraged to identify synergies between two strategies. This knowledge should then be transferred to farmers.

125. From the review of the literature, and given the fact that behavioural economics is a relatively more recent branch of economics, more research and empirical evidence is required in order that the insights can be of further use in policy making, in particular to illuminate how incentive and disincentive measures can best be implemented to help farmers to adapt climate change and mitigate GHG emissions.

## ANNEX

## TRADITIONAL ECONOMIC MODEL OF PUBLIC GOODS PROVISION

The mechanism of public good provision can be stated as follows, after Falkinger (1996).[19] The standard model of public goods assumes that each member of group of $n$ individuals has true preferences over consumption of private goods and public goods. First of all, assume that an economy of $n$ individual farmers with income $y_i$, $i=1,...,n$. Note that $c_i$ is private goods consumption and $G$ is public goods consumption. Farmer $i$ maximise utility function

$$u^i(c_i, G). \tag{3}$$

The public good $G$ is supplied by voluntary contributions $g_i$,

$$G = \sum_{i=1}^{n} g_i = g_i + G_{-i}, \tag{4}$$

where $G_{-1} = \sum_{j \neq i} g_j$ . Let the price of $c_i$ equal one and price of public good equal $p_G$. The individual budget constraint without policy intervention is given by

$$c_i + p_G g_i = y_i, \quad i = 1,...n. \tag{5}$$

Nash behaviour leads to the first order conditions:

$$MRS^i = p_G, \quad i = 1,...,n \tag{6}$$

with $MRS^i(c_i, G) = \dfrac{\partial u^i(c_i, G)/\partial G}{\partial u^i(c_i, G)/\partial c_i}$. Each individual chooses independently his/her contribution to maximize $u^i(c_i, G)$.

In contrast, the Pareto optimum occurs when the "Samuelson condition (Pareto efficient provision of public goods equates the sum of the marginal rates of substitution to the marginal cost of provision)" (Samuelson, 1954) is met,

$$MRT = \sum_{i=1}^{n} MRS^i = p_G. \tag{7}$$

Comparing (6) and (7), (6) is less than (7), which imply that individual will choose low value of $g_i$, and then public goods are underprovided if only the private equilibrium is considered. As defined in equation (3), standard economics assumes that individuals only care about their consumption of private and public goods.

19. See also, Hellerstein *et al*., (2002) Appendix 1, for further discussion in the rural amenity context.

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