**Using Principal-Agent Theory
to Deal with Output Slippage in
the European Union Set-Aside Policy***

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Using Principal-Agent Theory

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the European Union Set-Aside Policy*

by

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ABSTRACT

This paper proposes modifications to the existing EU set-aside policy which are designed to alleviate the problem of output slippage associated with heterogeneous land quality by using "incentive-compatible" mechanisms drawn from principal-agent theory. Specifically, it is suggested that there should be differential reference yields based on land quality to discourage the "adverse selection" of lower quality land for set-aside, and that the scope of set-aside monitoring should be expanded to include both the quantity and the quality of land set-aside so as to discourage "moral hazard" problems. The potential of these modifications is illustrated using a numerical analysis, which is also used to evaluate the role of a range of factors which determine the set-aside decision. Finally, an estimate of the "benefits" from reducing slippage required to justify the costs of including these modifications is provided.

INTRODUCTION

"Slippage" in a set-aside programme is defined as a situation where the percentage reduction in output is less than the percentage reduction in the area of land in production (Gardner, 1987). As demonstrated by Rygnestad and Fraser (1996) land heterogeneity plays a major role in determining slippage in the European Union's (EU) set-aside policy, with growers choosing to set-aside the less productive land on their farms so as to keep better land in production.[1] Moreover, this problem of "adverse selection" provides the basis for the argument of Bourgeon, Jayet and Picard (1995) in favour of a voluntary set-aside policy in the EU as opposed to the existing mandatory policy. In particular, they demonstrate that a voluntary scheme designed to be "incentive compatible" in the tradition of principal-agent theory (see Laffont and Tirole, 1993) will see the aggregate area of land set-aside concentrated among the "less-efficient farms" but may still result in more effective output-reduction than a mandatory scheme which features a uniform set-aside area and payment for each farm.

The broad aim of this paper is to develop the contribution of Bourgeon et al (1995) to debate over the EU's mandatory set-aside policy. However, whereas their approach was to use principal-agent theory to develop a voluntary alternative to the existing mandatory scheme, the approach taken here is to integrate incentive-compatible mechanisms into the mandatory scheme in a way which tackles the slippage problem.[2] It should be emphasised that in this situation the objective of the principal is not to maximise a social welfare function which takes account of the various interests of producers, consumers and taxpayers. Rather the objective is to achieve output control from the use of a given rate of compulsory set-aside in the most cost-effective way.

In this sense, the paper is focussed in a “second best” area of government policy, that of trying to expend a given budget most effectively.

More specifically, this paper suggests modifications to the existing set-aside scheme which have the effect of encouraging growers to choose to set-aside their more productive land. But in this case dealing with the problem of "adverse selection" creates the associated problem of "moral hazard", with the mechanism designed to give growers the incentive to set-aside their more productive land creating a new incentive to "cheat" and declare this the land which has been set-aside when in fact it is still in production.[3] Consequently, the suggested modifications to the existing set-aside scheme must include a broadening of the monitoring system to allow validation not only of the proportion, but also the quality of set-aside land.

The structure of the paper is as follows. Drawing on the model of the grower's set-aside decision developed in Rygnestad and Fraser (1996), Section 1 incorporates incentive-compatible features into the structure of the set-aside policy which deal with the joint problems of adverse selection and moral hazard. With these features, a grower with heterogeneous land quality is both encouraged to set-aside their more productive land, and discouraged from claiming to have done this while in fact doing the opposite. In order to illustrate the potential for these modifications to the existing set-aside policy to reduce the problem of slippage associated with heterogeneous land quality, Section 2 contains a numerical analysis of the theoretical formulation in Section 1. This analysis shows how the success of the suggested modifications is dependent on a range of factors, some of which are related to the specification of the modified set-aside policy, but others of which are out of the control of the policy-maker and relate to conditions both on and off-farm. In particular, the overall cost-effectiveness of the changes is shown to depend on the level of world prices relative to EU prices.[4] The paper ends with a brief conclusion relating the existing EU set-aside policy to the theory of policy mechanism design.

SECTION 1: Modifying the Set-Aside Policy

Based on Rygnestad and Fraser (1996), a specialist cereal grower in the EU receives income from three main sources: production income, compensatory payments and set-aside payments. However, both compensatory and set-aside payments are determined with respect to the relevant reference yield for the grower's region, and so these payments are uniform for a particular grower, regardless of the heterogeneity of their land. Consequently, for this grower it is only production income which varies according to the quality of land in production. It follows that when this grower chooses which land to set-aside, it will be that land which generates the lowest production income.[5] It is this choice which represents "adverse selection" within the context of the existing set-aside policy, and is responsible for the "slippage" associated with the policy in situations of heterogeneous land quality.

Given this feature of the existing set-aside policy, consider now the issue of how it could be modified to eliminate the "adverse selection". It is suggested here that in order to deal with slippage in situations of heterogeneous land quality, the payment for set-aside land needs to reflect the quality of that land, and needs to do so to an extent which counters the associated differential in production income. Specifically, for two types of land (g = good; b = bad):[6]

$$py_b + sr_g \geq py_g + sr_b \qquad (1)$$

where:
- p = price per unit of output
- y_i = yield from land of type i (i = g,b)
- s = set-aside premium per unit of reference yield
- r_i = reference yield for land of type i.

Allowing for the situation of uncertain production income gives:

$$E(py_b) + sr_g \geq E(py_g) + sr_b \qquad (2)$$

where: $E(py_i)$ = expected production income from land of type i.

Note that if (2) is satisfied, then even a risk averse grower will choose to set-aside "good" land:

$$E(U(py_b + sr_g)) > E(U(py_g + sr_b) \qquad (3)$$

because:

$$Var(py_g) > Var(py_b) \qquad (4)$$

where: $E(U(I))$ = expected utility of total income (I) ($U`(I) > O, U''(I) < O$)

$Var(py_i)$ = variance of production income from land of type i.

That is, the typically higher yield from "good" land means that the overall level of variability of production income will also be higher (given similar levels of seasonal variability), and so a risk averse grower will find both the expected level and variability of total income from setting-aside good land more attractive.[7]

However, although achieving this incentive-compatibility corrects the problem of "adverse selection" by encouraging growers to set-aside better quality land, in so doing it creates the problem of "moral hazard" whereby a grower states that "good" land is being set-aside whereas in fact it is the "bad" land that is set-aside:

$$E(py_g) + sr_g > E(py_b) + sr_g \qquad (5)$$

Consequently, the monitoring of set-aside needs to be extended so that it is not just the quantity, but also the quality of set-aside land that is monitored. Given that monitoring typically involves only partial coverage of the grower population, but that if detected as "cheating" then the grower suffers a penalty, (5) needs to be adjusted so that "truth-telling" is worthwhile:[8]

$$E(py_g) + sr_g \quad - \quad qsr_g x \quad < \quad E(py_b) + sr_g \tag{6}$$

where: q = probability of being monitored $(O \leq q \leq l)$

x = penalty proportion, $(O \leq x)$.

Or in the case of a risk averse grower:

$$E(U(py_g + sr_g - qsr_g x)) < E(U(py_b + sr_g)) \tag{7}$$

Note that (6) may not hold, but (7) still hold for a risk averse grower because the greater variance of total income associated with attempting to "cheat" has a dominant impact on expected utility. This point is developed formally in the Appendix for the example of three land types for use in the numerical analysis of the next section.

Finally in this section, it should be recognised that the cost-effectiveness of these changes in terms of the EU budget relies on the benefits associated with reduced slippage exceeding the costs of higher set-aside payments and more detailed monitoring. For example, where these benefits take the form of reduced export restitution payments:

$$(\bar{p} - \bar{p}_W)(y_g - y_b) \quad > \quad s(r_g - r_a) + Z \tag{8}$$

where: $\bar{p}$ = expected grower price

$\bar{p}_W$ = expected world price

r_a = existing reference yield

Z = extra monitoring cost.

Equation (8) highlights the important role of expected world prices relative to EU prices in determining the cost-effectiveness of the proposed modifications to the existing set-aside policy. Moreover, in considering equations (2), (7) and (8) collectively, it can be seen that there are a range of policy-related, on-farm and off-farm factors which have a role in determining the effectiveness of the proposed modifications. Evaluating the role of these factors is the aim of the numerical analysis of the next section.

SECTION 2: The Numerical Analysis

The principal purpose of this section is to illustrate using a numerical analysis the potential for the proposed "incentive-compatible" modifications to the existing EU set-aside policy to alleviate the slippage problem of this policy. In addition, the numerical analysis will be used to evaluate the role of the range of on-farm, off-farm and policy-related factors identified in equations (2), (7) and (8) as influencing a grower's set-aside decision.

Such an analysis requires a complete specification of the circumstances in which the grower is to make the decision of which land to set aside. In what follows use is made of the off-farm and policy parameter values specified in Fraser and Rygnestad (1999). In addition, use is made of the details contained in Fraser and Rygnestad (1999) regarding the on-farm specification of the yield response functions for three qualities of land. Finally, the analysis is simplified by assuming the farm in question has equal proportions of the three land qualities (where average land is denoted by the subscript “a”), and that the compulsory set-aside proportion is one-third of all land. This elimination of the complications of differing proportions serves only to enhance the clarity of the analysis.

This approach provides the following parameter values as they relate to the existing set-aside policy.[9]

$$y_g = 10.00; \quad y_a = 8.01; \quad y_b = 5.03; \quad \bar{p} = 110; \quad s = 70; \quad r_a = 8$$

and the coefficient of variation of price (CVp) = 0.35.

Add to this the following cost data based again on Fraser and Rygnestad (1999):

cost/tonne on good land = 36

cost/tonne on average land	=	38
cost/tonne on bad land	=	42
fixed costs	=	688

Finally, assume the attitude to risk of the grower can be represented by the mean-variance formulation and the constant relative risk aversion function form:[10]

$$E(U(\pi)) = U(E(\pi)) + \frac{1}{2} U''(E(\pi)) \cdot Var(\pi) \tag{9}$$

where: $E(\pi)$ = expected profit

$Var(\pi)$ = variance of profit

and

$$U(\pi) = \frac{\pi^{1-R}}{1-R} \tag{10}$$

where: R = constant coefficient of relative risk aversion

$$= {-U''(\pi).\pi}\big/{U'(\pi)}$$

Note this coefficient is set at 0.5 for the numerical analysis, although unreported analysis shows its value does not affect the general pattern of results.

On this basis, Table 1 contains details of the numerical results relating to the expected profit, variance of profit and expected utility of profit from setting aside good, average and bad land respectively given the existing features of the EU set-aside policy. Table 1 shows the expected finding that, given the existing formulation of the EU set-aside policy, the best decision for the grower is to set-aside the poor land, but that this "adverse selection" results in the largest total output from the farm.

Next consider the modification of the existing set-aside policy to a form proposed in Section 1 as being "incentive-compatible". In particular, introduce the following differential reference yields for good, average and poor set-aside land:

$r_g = 10$

$r_a = 7.6$

$r_b = 4.3.$

In addition, let the features of the monitoring system be as follows:

$q = 0.5$

$x = 1$

These values imply that setting aside good land is associated with full compensation, but that setting aside other types gives less than full compensation, while a "cheating" grower has a 50% chance of being detected, and suffers the penalty of full withdrawal of set-aside payments if caught.[11] Using these "Base Case" parameter values for the modified set-aside policy gives the results contained in Table 2. This table shows that the introduction of differential reference yields as specified results in the "truth-telling" grower finding it beneficial to set-aside good land ahead of the other types, and that this "truth-telling" is more beneficial than "cheating" by claiming to have set-aside the good land, but instead to have set-aside the bad land. Note also that although the expected profit from "cheating" exceeds that for all cases of "truth-telling", the greater variance of profit in the case of "cheating" means that overall the risk averse grower prefers not to "cheat". However, this excess of expected profit from "cheating" over "truth-telling" means that a less risk averse grower may find the increased risk from "cheating" worthwhile. In particular, for $R \leq 0.25$:

$$E(U_T(\pi)) < E(U_C(\pi))$$

Finally in relation to the Base Case, the cost-effectiveness of the modifications as specified by equation (8) can be evaluated by setting a cost of enhanced monitoring (to check land quality as well as quantity) and then determining the level of expected world price required for (8) to hold. For example, if the extra cost of monitoring is approximately 1% of the expected profit of each farm (ie 9.3), then (8) holds if:

$$\bar{p}_w \leq 80.$$

Alternatively, if the extra cost of monitoring is twice this level, then (8) holds if:

$$\bar{p}_w \leq 78.$$

Consider next the role of off-farm factors relating to the grower's price distribution in determining the success of the proposed modifications to the existing set-aside policy. The top panel of Table 3 shows that if the expected grower price ($\bar{p}$) falls from 110 to 100, then not only does this accentuate the desirability of setting-aside good land, but also it reduces the expected profit from "cheating" to a level where, regardless of the attitude to risk of the grower, "truth-telling" is always preferable. Note, however, that in this case the modifications are only cost-effective (for Z = 1% of $E_T(\pi)$) if:[12]

$$\bar{p}_w \leq 70.$$

In contrast, if the variability of grower prices is reduced (to CV_p = 0.2), then the associated reduction in the riskiness of production income means that the expected utility of "cheating" exceeds that from "truth-telling" for R = 0.5. Consequently, for this level of price variability only growers with attitudes to risk in excess of R = 0.5 would find "truth-telling" worthwhile. It follows that decreases in the expected level and variability of grower prices have opposite impacts on the effectiveness of the

Comment [s1]:

proposed modifications, with lower expected prices enhancing this effectiveness by discouraging "adverse selection", and lower variability of prices diminishing it by encouraging "moral hazard".

Finally in this section consider the role of a range of policy-related factors in determining the effectiveness of the modifications. Of the four components of the modified set-aside policy (s, r_i, q and x), decreasing the probability of detection (q) and the size of penalty (x) have the predictable consequence of increasing the attraction of "cheating". In particular:

$$E(U_T(\pi)) \quad < \quad E(U_C(\pi))$$

for: $q \leq 0.45$ (Base Case: $q = 0.5$)

and for: $x \leq 0.92$ (Base Case: $x = 1.0$).

In addition, decreasing the set-aside payment has a proportionately greater effect where good land is set-aside as

$$r_g > r_a > r_b$$

For example, for s = 69 (Base Case s = 70):

$E_T(\pi)$ (good land set-aside) = 920.58

while: $E_T(\pi)$ (bad land set-aside) = 925.68

Consequently, lower values of q, x and s all diminish the effectiveness of the proposed modifications, with decreases in q and x encouraging "moral hazard" and decreases in s encouraging "adverse selection".

The remaining feature of the modified set-aside policy is the set of reference yields on which set-aside payments are based. Reductions in all three of these values need not alter the "truth-telling" preference for setting-aside good land. However, the relative importance of production income is increased in this situation and, as a consequence, the expected utility from "cheating" increases relative to "truth-telling". The top and bottom panels of Table 4 illustrate this effect, with the top panel showing that a decrease in the set of reference yields from: $r_g = 10$; $r_a = 7.6$; $r_b = 4.3$

to: $r_g = 9.2$; $r_a = 6.8$; $r_b = 3.4$

is consistent with a continued "truth-telling" preference for setting-aside good land, and for "truth-telling" over "cheating". However, a further decrease to:

$$r_g = 9.1; \quad r_a = 6.7; \quad r_b = 3.4,$$

although still not encouraging "adverse selection" (ie the setting-aside of poor land rather than good land if truth-telling), is sufficient to lead to a preference for "cheating". It follows that lowering the value of the set of reference yields need not encourage "adverse selection", but clearly does encourage "moral hazard". Note also that these lower reference yields encourage the cost-effectiveness of the modified set-aside policy, with the benefits of reduced slippage exceeding the costs for the settings in Table 4 for:[13]

$$\bar{p}_w \leq 91$$

compared with:

$$\bar{p}_w \leq 80$$

for the Base Case.

CONCLUSION

This paper has proposed modifications to the existing EU set-aside policy which are designed to alleviate the problem of output slippage associated with heterogeneous land quality in a way which is cost-effective for the EU budget. Drawing on the core concepts of principal-agent theory, these "incentive-compatible" modifications involve:

(i) establishing differential reference yields to reflect the heterogeneity of land quality

(ii) broadening the scope of monitoring to include not just the quantity but also the quality of set-aside land.

Establishing differential reference yields means that where higher quality land is set-aside, the set-aside payment is also higher. As a consequence, an incentive is created for the grower to choose to set-aside higher quality land. As shown in Section 1, if sufficient this incentive can overcome the tendency for "adverse selection" of lower quality land which is a feature of the existing set-aside policy. However, creating this incentive also creates an incentive to "cheat" and claim to be setting-aside good land while actually keeping it in production. As a consequence, to counter this problem of "moral hazard" the policy's monitoring programme needs to be extended to check both the quantity and the quality of set-aside land.

In Section 2 a numerical analysis of these modifications was undertaken to illustrate their potential to alleviate the slippage problem. In addition, this numerical analysis enabled the evaluation of the role of a range of on-farm, off-farm and policy-related factors in determining the grower's set-aside decision. It was shown that, if the proportion of production income in total income decreases due to a fall in expected grower prices or an increase in set-aside payments, then "adverse selection" is discouraged. However, lower levels of risk aversion among growers and a decrease in the riskiness of either production income or of being detected "cheating" encourage "moral hazard". Finally, it was shown that the cost-effectiveness of these modifications is dependent on the excess of EU grower prices over world prices. Moreover, although the general level of differential reference yields can be lowered to reduce the cost of implementing the modifications (Table 4), these results suggest that the margin between EU and world prices needs to be in excess of 20% for the benefits of alleviating slippage to justify the costs of using "incentive-compatible" mechanisms in the set-aside policy.

APPENDIX: Variance of Income from "Cheating"

It is assumed that the grower has three land quality types, good, average and bad, in equal proportions, and that the compulsory set-aside rate is one-third of total land. It is also assumed that there is price uncertainty, but no yield uncertainty.

On this basis, total income (I) from "cheating" and setting-aside bad land while claiming to set-aside good land is:

$$I = sr_g + p(y_g + y_a) \text{ if not detected} \quad (A1)$$

$$I = sr_g + p(y_g + y_a) - sr_g x \text{ if detected} \quad (A2)$$

where: y_a = yield from average land.

With a probability of detection of q, expected income from cheating ($E_C(I)$) is given by:

$$E_C(I) = (1 - q)(sr_g + \bar{p}\,(y_g + y_a)) + q(s(1-x)r_g + \bar{p}\,(y_g + y_a)) \quad (A3)$$

In addition, the variance of income from cheating ($Var_C(I)$) is given by:[14]

$$Var_C(I) = \int_p (1-q)(sr_g + p(y_g + y_a) - E_C(I))^2 f(p)dp$$

$$+ \int_p q(s(1-x)r_g + p(y_g + y_a) - E_C(I))^2 f(p)dp \quad (A4)$$

Consider the first term on the right-hand-side of (A4). Substituting for $E_C(I)$ using (A3) and rearranging gives:

$$(1-q)(y_g + y_a)^2 Var(p) + (1-q)(q(sr_g - s(1-x)r_g))^2 \quad (A5)$$

A similar process for the second term gives:

$$q\,(y_g + y_a)^2 Var(p) + q((1-q)(s(1-x)r_g - sr_g))^2 \quad (A6)$$

where: $Var(p)$ = variance of the grower price.

10 See Mood, Graybill and Boes (1974), p.185

Combining (A5) and (A6) gives:

$$Var_C(I) = (y_g + y_a)^2 Var(p) + ((1-q)q^2 + q(1-q)^2)(sr_g x)^2 \qquad \text{(A7)}$$

Note that the second term on the right-hand-side of (A7) is unambiguously positive.

Consequently, since:

$$y_g > y_b$$

It follows that:

$$Var_C(I) > Var_T(I) \qquad \text{(A8)}$$

where: $Var_T(I)$ = variance of income from "truth-telling"

$$= (y_a + y_b)Var(p)$$

Therefore, as stated in Section 1, even if equation (6) does not hold (expected income from "truth-telling" does not exceed expected income from "cheating"), a risk averse grower may still prefer "truth-telling" because of the overall dominance of the higher variability of total income from "cheating" in the decision. It follows that the attitude to risk of the grower will play a role in determining the success of the proposed modifications. This role is evaluated in the numerical analysis of Section 2.

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FOOTNOTES

1 Empirical estimates of the extent of slippage from this policy are difficult to obtain because of the role of other factors such as technological improvements in yield. However, the simulation results of Rygnestad and Fraser (1996) suggest slippage of up to 30% from the proportion of land taken out of production are feasible. This is consistent with the initial EU approach taken to set-aside, with different rates applying to the rotational and non-rotational schemes. For example, in England the rates were 15% and 18% respectively.

2. Note Bourgeon et al (1995) did also suggest that, in the absence of an incentive-compatible voluntary scheme, the mandatory scheme should at least feature an "opt-out facility" (p 1504). However, as discussed in Froud, Roberts and Fraser (1996), such a feature does exist in the mandatory scheme in the form of contingent compensatory payments.

3. The joint problems of adverse selection and moral hazard in policy mechanism design have just begun to be analysed in the agri-environmental area. See White and Moxey (1999) and Latacz-Lohmann and Webster (1999). Note that Bourgeon et al (1995) did not consider the issue of moral hazard.

4. Note that Bourgeon et al (1995) make the point that this ratio also determines the overall rationale for a set-aside policy.

5. Or in the case of rotational set-aside, this land will be set-aside first. See Rygnestad and Fraser (1996).

6 Note that in the numerical analysis to follow three types of land (good, average and bad) are included in order to be consistent with the treatment of

land heterogeneity in Rygnestad and Fraser (1996). However, the setting-aside of average land is always an inferior option in the context of adverse selection and moral hazard, and so it is omitted in this section in order to simplify the presentation.

7 I am grateful to an anonymous reviewer for pointing out to me that in the situation where yield is also uncertain, and there is a very strong negative covariance between price and yield, this inequality of variances may not hold.

8 Note that because the expected penalty associated with cheating is linear in q and x, it is feasible for the principal to trade-off one instrument against the other. For example, the expected penalty can be maintained despite lowering the probability of detection if the fine from detection is raised proportionately. I am grateful to an anonymous reviewer for pointing this out. See also Polinsky and Shavell (1979).

9 See Fraser (2000) regarding details of the coefficient of variation of price (CV_p). Note that compensation payments have been suppressed as they are constant across land types. In addition, unreported numerical analysis shows that these "optimal" yields are relatively insensitive to the other parameter values in the grower's decision framework. Consequently, they will be fixed at these levels in what follows. Note the precise yields used for y_a and y_b facilitate the base case pattern of results in Table 2.

10 See Hanson and Ladd (1991) and Pope and Just (1991) for arguments supporting the assumptions regarding the mean-variance approximation and the form of the utility function.

11 One anonymous reviewer has pointed out that to specify $q = 0.5$ is certainly too high for EU conditions. Recalling the point made previously that the principal can trade-off q and x to maintain a constant expected penalty, it is clear that in the numerical analysis a "more realistic" value of q could be used in association with a value of $x > 1$ (e.g. the expected penalty is equivalent for $q = 0.5$ and $x = 1$, and for $q = 0.1$ and $x = 5$). However, as can be seen in the Appendix, modifying these values also changes the variance of income from cheating, leading to complex impacts on producer behaviour which are beyond the scope of this paper. Nevertheless, the impact of a 10% lower value of q is considered in the sensitivity analysis which follows.

12 This choice of Z = 1% of $E_T(\pi)$ is based on estimates of the cost of income tax audits and may be inappropriate in other situations. As shown previously, note from equation (8) that if Z was instead 2% then, given the associated parameter values, the cost –effective $\overline{p}_w$ would be 2 units lower.

13 This result applies for $r_g = 9.2$. For $r_g = 9.1$, the requirement is:

$$\overline{p}_w \leq 92.$$

Note once again this result is calculated using equation (8) and the associated parameter values.

14 See Mood, Graybill and Boes (1974), p.185.

Table 1

Numerical Results Relating to Setting Aside Each Type of Land Given the Existing Set-Aside Policy

	Land Quality Set-Aside		
	Good	Average	Bad
$E(\pi)$[a]	790.58	953.83	1188.98
$Var(\pi)$[b]	251935.8	334698.7	480969.6
$E(U(\pi))$[c]	53.40	58.93	66.03
Total Output	13.04	15.03	18.01

Notes a: $E_g(\pi) = \overline{p}(y_a + y_b) + sr_a - (c_a y_a + c_b y_b) - F$

where: c_i = cost/tonne on land type i

F = fixed cost

$E_i(\pi)$ = expected profit setting aside land type i

$E_a(\pi)$ and $E_b(\pi)$ contain appropriate adjustments

b: $Var_g(\pi) = (y_a + y_b)^2 Var(p)$

$Var_a(\pi) = (y_g + y_b)^2 Var(p)$

$Var_b(\pi) = (y_g + y_a)^2 Var(p)$

c: $R = 0.5$

Table 2

Base Case Results for the

Incentive-Compatible Set Aside Policy

	Land Quality Set-Aside		
	Good	Average	Bad
<u>Truth-telling</u>			
$E_T(\pi)$	930.58	925.83	929.98
$Var_T(\pi)$	251935.8	334698.7	480969.6
$E(U_T(\pi))$	58.79	57.88	58.04
<u>Cheating</u>			
$E_C(\pi)$[a]			978.98
$Var_C(\pi)$[b]			603469.6
$E(U_C(\pi))$			57.65

Notes a: $E_C(\pi) = (1-q)(sr_g + \overline{p}(y_g + y_a)) + q(s(1-x)r_g + \overline{p}(y_g + y_a)) - c_a y_a - c_g y_g - F$

b: $Var_C(\pi)$ as given by $Var_C(I)$ in the Appendix (A7)

Table 3

Evaluating the Role of the Grower's

Price Distribution

	Land Quality Set-Aside		
	Good	Average	Poor
$\bar{p}$ = 100[a]			
$E_T(\pi)$	800.21	775.56	749.84
$E_C(\pi)$			798.84
cv_p = 0.2[b]			
$E(U_T(\pi))$	60.29		
$E(U_C(\pi))$			60.30

Notes a: Base Case: $\bar{p}$ = 110

b: Base Case: CV_p = 0.35

Table 4

Evaluating the Role of the Set of

Reference Yields

	Land Quality Set-Aside		
	Good	Average	Poor
$\underline{r_g = 9.2; r_a = 6.8; r_b = 3.4}$[a]			
$E_T(\pi)$	874.58	869.83	866.98
$E(U_T(\pi))$	56.71		
$E(U_C(\pi))$			56.69
$\underline{r_g = 9.1; r_a = 6.7; r_b = 3.4}$[a]			
$E_T(\pi)$	867.58	862.82	866.98
$E(U_T(\pi))$	56.44		
$E(U_C(\pi))$			56.57

Note a: Base Case: $r_g = 10$; $r_a = 7.6$; $r_b = 4.3$