Agriculture and Green Insurance

Green insurance for crops is a new and innovative technique to promote environmental agricultural practices. Farmers are often reluctant to implement conservation practices, fearing the possibility of low yields. Crop insurance can help farmers use sustainable practices and best management plans by reducing risk.

Farmers tend to overuse fertilizers or pesticides to compensate for variable conditions. For example, crops require a certain amount of fertilizer for a typical year of rainfall, which determines the recommended amount of fertilizer. If a farmer applies this amount of fertilizer and it then rains more than expected, the farmer will produce less than the potential yield. If the farmer applies more fertilizer than recommended, it ensures the maximum yield regardless of the rainfall (Van Kooten 1999). The same idea is true of pesticides. Farmers are motivated to overuse pesticides, to counteract the possibility of a particularly bad year of pests.

To farmers, the risks associated with conservation practices outweigh the benefits. A USDA study in 1995 showed that many farmers believe sustainable technologies, such as Integrated Pest Management (IPM) and Best Management Practices (BMP), to be beneficial and economical but too risky to implement (Van Kooten 1999).

In order to persuade risk-averse farmers to adopt BMPs or IPM, mechanisms must be implemented to reduce their real or perceived risk on a year-to-year basis. Insurance is a useful tool that is devised specifically to reduce risk. Insurance reduces the risk of adopting conservation practices by transferring and sharing the risk among participants in the program (Huang et al. 2000). The farmer pays a premium and the insurance company assumes most or possibly all of the farmer’s risk. This transfer of risk from the farmer to the insurance company works because the insurance company is more willing to bear the risk than the farmer, or bearing the risk is less costly to the insurance company than it would be to the farmer. Although the farmer must pay the cost of the premium, he also reduces or may even eliminate the likelihood that income will fall below some specified level (Fleisher 1990).

Traditional crop insurance tends to address weather-related problems and unpredictable hazards to yields. Multiple peril crop insurance (MPCI) and Crop Revenue Coverage (CRC), directed by the Federal Crop Insurance Corporation (FCIC) and the Risk Management Association (RMA), are common
forms of insurance for farmers. Although these insurance policies are underwritten by federal agencies, the policies are sold and serviced by private insurance companies (ATTRA 2003).

The only green insurance on the market today is offered through an FCIC pilot study, and only farmers with MPCI or CRC are offered the option. Although green insurance currently can be purchased only with traditional crop insurance, it differs with a specific goal of upholding environmental practices. (This pilot study is further discussed in a later section.) The insurance levels out the risks associated with variable weather or pests, and reduces chemical inputs on crops by removing the incentive to overuse fertilizer or pesticides. In addition, the crop insurance should cost considerably less than the over-application of chemicals, making the program profitable to farmers and favorable to the environment (Van Kooten 1999).

The concept of crop insurance to promote sustainable farming is extremely new, and very little academic information exists on the subject. A small amount of literature, discussed below, has been written regarding the effect of crop insurance on nitrogen fertilizers and pesticides.

**Pesticides and Green Insurance:**

Crop inputs such as pesticides contribute to widespread nonpoint source pollution problems, including chemical contamination of surface water and groundwater. The dependence of agriculture on high-risk pesticides continues to be a major threat to sustainable ecosystems and biological diversity. Every year, U.S. agriculture introduces over 900 million pounds of pesticides into the environment in the production of food and fiber (WWF, Toxic 2003).

Pesticides are a form of insurance in a sense, as they decrease the risk of lower yield from pest damage. Crop insurance is a potential tool for reducing pesticide use by providing a substitute for the risk management benefits of pesticides (Feinerman et al. 1992). BMPs can be integrated with green insurance policies to compensate producers for losses that may occur due to BMP failure. Although failure is rare, two possibilities of BMP failure could occur; either too much or too little of the pesticide is applied, resulting in profit loss due to reduced yields or wasted expenditures (Mitchell and Babcock 2002).

The goal of BMPs and green insurance are to not only save farmers money over time, but to also reduce pesticide inputs and improve environmental stewardship. In addition to nitrogen and phosphorus, BMP insurance has been developed for corn rootworm and potato late blight. The following two case studies focus on the effectiveness of corn rootworm IPM (Integrated Pest Management) insurance in the Midwest.
IPM and Corn Rootworm: Study #1

A recent study conducted by Paul Mitchell and Bruce Babcock developed a hierarchical model to analyze the impact of green insurance on incentives to adopt an information-based BMP (Mitchell and Babcock 2002). The focus of the study was an empirical evaluation of corn rootworm and IPM insurance. The representative producer modeled in this study managed a homogeneous unit of land, normalized to one acre, all devoted to the production of corn. The empirical model measured a series of parameters: pest population, pesticide input, and the signal of the true level of the pest population (a function of pest population, taking into account many complex natural processes that determine the pest population). For the BMP, the producer first collects imperfect information concerning the pest population, then chooses the pesticide input (Mitchell and Babcock 2002).

Their empirical findings suggest that farmers have little financial incentive to adopt corn rootworm, and that the benefits of insurance do not justify the administrative and overhead insurance costs. This finding paralleled farmer behavior and some entomological research. The financial gain from adopting corn rootworm IPM insurance is not likely to increase IPM adoption for most farmers because the insurance did not significantly reduce the variance of per acre returns (Mitchell and Babcock 2002).

However, Mitchell and Babcock indicate that their results may not apply to all possible models of insurance for corn rootworm IPM. They suggest an alternative method of evaluating corn rootworm IPM insurance, by collecting and analyzing long-term field data. Unfortunately, conducting such research is both time-consuming and expensive.

IPM and Corn Rootworm: Study #2

The second case study, conducted by Feinerman et al. focuses on corn production in Iowa. Since corn is a primary crop in the Midwest, rootworm presents itself as a major pest in crop rotations with one or more years of continuous corn. Feinerman et al. developed a modeling system that was used to evaluate crop insurance as a substitute for the use of rootworm pesticides on continuous corn. Feinerman et al. indicate that the effectiveness of green insurance programs will depend upon several factors, including the design of the insurance contract, the program’s interaction with explicit chemical restrictions, and other farm programs.

The integrated modeling system used by Feinerman et al. is composed of three main components: (1) the biological component, (2) the policy component, and (3) the farm-level decision
component. The biological component features altering crop rotations as one method of controlling corn rootworm infestations. Rotations with one or more years of continuous corn production were assumed to be subject to increased rootworm infestations in the absence of pesticides. Corn rootworm damage was assumed to be negligible in all crop rotations other than continuous corn. The policy component of the model takes into account the impact of three specific factors on farm-level net returns: federal crop insurance, insecticide application restrictions, and the federal commodity program for corn (as specified in the Food Security act of 1985). The farm-level decision component modeled producer behavior under doubt or uncertainty.

Results from the analyses conducted by Feinerman et al. were reported for three broad insurance scenarios: Scenario A is No Crop Insurance; Scenario B is Crop Insurance; and Scenario C is Crop Insurance with a Cross Compliance Provision Restricting the Use of Corn Rootworm Insecticides. Scenario A considers the optimum activity levels when crop insurance is not offered and pesticide restrictions are not imposed. Feinerman et al. indicate that these activities result in the highest mean returns consistent with a 65 percent corn base. Scenario B allows the farmer to participate in crop insurance and can decide whether or not to apply pesticides. This scenario illustrates that crop insurance does lead to a reduction in pesticide use at most levels of risk aversion. However, these reductions are modest for all but the highest levels of risk aversion. Since the program is optional, the farmer can only benefit from the introduction of crop insurance, but Feinerman et al. also caution that the insurance agent may experience losses due to moral hazard problems.

A complete ban on pesticides can be combined in a number of ways with crop insurance: Scenario A2 is No Insurance and a Complete Corn Rootworm Insecticide Ban; Scenario B2 is Crop Insurance with a Complete Corn Rootworm Insecticide Ban; and Scenario C, as mentioned above. For Scenario A2, the pesticide ban may be successful in reducing pesticide usage, but it also has its costs. The farmer’s yield may be reduced as a result of the insecticide ban, cutting the farm’s expected net returns and increasing the risk associated with growing corn. In addition to eliminating the use of pesticides in scenario B2, there is an increase in the use of insurance at lower levels of risk aversion (compared to B1). Compared to scenario A2, total insecticide reduction costs per pound of active ingredient are generally smaller for B2. Finally, in scenario C, the implementation of pesticide restrictions is tied to participation in crop insurance for corn. Feinerman et al. indicate that cross compliance of this form reduces participation in the crop insurance program.

The results of this study provide a broad analysis of the role of crop insurance in reducing corn rootworm pesticide usage. Several conclusions were made by the use of the model, but Feinerman et al. point out that they are “strictly applicable only to the conditions of the representative analysis.” First,
crop insurance was found to lead to a reduction in insecticide usage when the insurance is extended to cover insect damage. The availability of crop insurance also lessens the impact of an insecticide restriction on the farm. The impact of crop insurance depends significantly upon the distribution of risk aversion in the target population. The study also revealed that insecticide restrictions are costly to impose on the farmer, and the insurer. The impact on the farm with insecticide restrictions results in reduction costs ranging from $42 to $53 per pound of active ingredient. Lastly, the cross-compliance provision, which links participation in the crop insurance program to a pesticide restriction, imposes a cost on insurance purchasers.

**Nitrogen Fertilizers and the Environment:**

Agricultural practices, especially the use of chemical and organic nitrogen (N) fertilizers, are major contributors to water quality problems in the United States. Like pesticides, fertilizers are also a nonpoint pollution source, contaminating surface water through runoff and groundwater through leaching. This is an especially large threat to rural drinking water and can cause Blue Baby Syndrome, which is sometimes fatal. Nutrient runoff into streams, rivers, and lakes also causes eutrophication, thereby affecting ecosystems and biodiversity.

BMPs have been developed to address the problem of nutrient runoff and leaching from agriculture. A variety of best nitrogen management practices (BNMPs) have been devised to improve N-use efficiency and consequently reduce residual N and N losses to the environment (Huang et al. 2000). An example of a BNMP is timing the application of N fertilizer to coincide with the biological needs of the crop so that nitrogen is not over-applied. This is different from current agricultural practices, in which most farmers apply fertilizer before the growing season and much of it is lost to runoff or leaching. A split (2 applications) or single application, timed correctly, results in little or no residual nitrogen that can be lost to the environment. Timing-BNMP can reduce nitrogen fertilizer application by over 100 pounds per acre without a decrease in yield (Huang et al. 2001). According to some studies, adopting a BNMP actually increases farming profitability over time (rather than reducing it, as some farmers suspect). Many U.S. farmers have adopted a timing-BNMP with success (Huang et al. 2000, and Huang et al. 2001).

The adoption of BMPs approved for nutrients would undoubtedly improve water quality. However, adequate incentives for farmers to adopt these practices are often lacking. The price of fertilizer is very low, and may even be zero if the farm has livestock that produce manure fertilizer. The possible benefit of high crop yields outweighs the input expense of more fertilizer because fertilizer is
inexpensive when compared to the market value of crops. Although there are high environmental costs such as reduced drinking water quality and eutrophication of aquatic ecosystems, these costs are externalities and may not have an impact on the farmer’s decisions.

**Risk and BNMP:**

Agriculture is an industry in which many decisions are influenced by risk or perceived risk (Horowitz and Lichtenberg 1993). Chemical inputs (i.e. nitrogen and phosphorus) have been shown to be “strongly” risk-increasing (Horowitz and Lichtenberg 1993, and Nimon and Mishra 2001). “Risk-increasing” means that inputs add relatively more output in good conditions than in bad conditions by increasing the discrepancy between the two (Nimon and Mishra 2001).

For example, by following a BNMP that reduces the amount of nitrogen fertilizer used, there is a chance that nitrogen may turn out to have been under-applied if the weather is especially favorable. This can be seen as an example of BNMP failure. Adding more nitrogen fertilizer would have substantially increased the yield, and favorable weather (a “good” condition) increased the risk that nitrogen would be under-applied. On the other hand, if the weather is unfavorable, crop yields are low anyways and the amount of nitrogen fertilizer applied does not limit plant growth as much.

Regulations and incentives are means of implementing change in regards to agricultural nutrient inputs. Since the federal government has a history of subsidizing farm income and agriculture has a strong lobbying force, strict federal environmental regulations are not likely to come into being as means of reducing nonpoint source pollution. Therefore, we are left with the challenge of devising incentives to encourage farmers to adhere to BMPs for nutrients. The federal government has developed some voluntary cost-sharing programs to encourage BNMP adoption, but farmers may not participate in such programs if they are still responsible for paying some of the costs. Even for those programs that are attractive to farmers, federal funds are limited.

A major reason discouraging farmers from adopting a timing-BNMP is possible income loss caused by adverse weather conditions. The reasoning is that if the farmer waits for the application timing recommended by the timing-BNMP, but is then unable to enter the field at that time due to unfavorable weather conditions, optimal yields will not be reached (Huang et al. 2000, and Huang et al. 2001). Although BNMP adoption is likely to increase profits over time, this benefit may be outweighed by the risk (or perceived risk) of the potential loss of income due to unfavorable weather. Even if the benefits of BNMP adoption are shown to outweigh the risk of potential income loss in the long run, many farmers will be unwilling to accept the risk that their income may be lower in a given year. This is
especially true for a risk-averse farmer who needs to maintain a certain level of net farm income annually (Huang et al. 2000, and Huang et al. 2001). In fact, most farmers have been shown to be risk-averse (Huang et al. 2000).

**Nitrogen and Green Insurance:**

Because risk is a serious factor for farmers, insurance is a useful strategy to promote sustainable practices, such as the timing-BNMP. The amount of the insurance premium would be directly related to the probability that unfavorable weather conditions will prevent the farmer from applying N fertilizer at the optimal time specified by the BNMP (Huang et al. 2000). A study by Huang et al. found that insurance would promote the adoption of timing-BNMPs if there were a 10% chance that the farmer would not be able to apply fertilizer due to adverse weather conditions (2000, and 2001). The premiums for such an insurance policy would be between $10 and $30 per acre (Huang et al. 2000, Huang et al. 2001). Overall, this study showed that insurance can be used to help farmers adopt BNMPs, the insurance program can be structured to reduce the farmer’s cost of bearing the risk associated with the BNMP, and the adoption of the BNMP with insurance can increase net returns for the farmer (Huang et al. 2000).

Insurance can be enticing to farmers who feel morally inclined to adopt BMPs to improve environmental quality, but are unwilling to accept the risk of lower yields and consequently lower profits. Nonpoint source nutrient pollution is correlated to areas with high agricultural yields because these areas tend to over-apply fertilizer regularly in order to maintain their high yields year after year. Interestingly, insurance purchases are also more likely to occur in these high yield areas (Horowitz and Lichtenberg 1993). Since these areas have high yields and chemical inputs tend to be risk-increasing, farmers perceive that by reducing nutrient inputs, they run the risk of lower yields. Buying insurance is seen as a means of offsetting this risk.

It should be noted that under different BNMPs, farmers will be compensated by the insurance company under different conditions. For example, in a timing-BNMP, the farmer will be compensated if *unfavorable* weather prevents fertilizer application at the recommended time. With certain other BNMPs, the farmer will be compensated if especially *favorable* weather would have led to higher than average yields if more fertilizer had been applied. In either case, the farmer benefits from the assurance that profits will not be reduced by BMP adoption, and society and the environment benefit from a reduction in nonpoint source nutrient pollution.
Green Insurance on the Market:

In both the private and public sector, the concept of green insurance is still in developmental stages. Agren Inc, an agricultural and environmental consulting firm, has worked on the idea of green insurance for eight years. The firm is active in the study of crop insurance policies for BMP and IPM, and works with insurance companies to develop insurance policies (Agren Inc, 2002). Agricultural insurance companies such as IGF Insurance, American Agrisurance, and Farm Bureau Financial Services have tried to make this insurance available over the last few years (Tevis 2000). A few months ago, however, before any green insurance was offered, American Agrisurance (the second largest agricultural insurance company) filed for bankruptcy. IGF went down as well, having merged with American Agrisurance prior to the financial troubles. As of this date, no company has offered a green insurance policy to its customers without government support. (Buman 2003).

It is difficult for private companies to offer any kind of crop insurance successfully with no government subsidies. If a company develops an innovative idea like green insurance, it cannot be patented. Other companies are free to incorporate new policies that come out on the market, which leaves the pioneer companies in a bad situation.

Many other factors contribute to the difficulty of offering green insurance independent of the government. Companies must educate agents and staff on how to offer new and radical policies. Also, when a bad year hits, most farms will need to be compensated for loss. Insurance companies need deep pockets to cover all the claims that are filed in a particularly bad year. Adjustment procedures also need to be established, since every farm has different conditions and different output. Tom Buman of Agren, Inc. believes that it may be financially feasible for a private company to offer green insurance without government support, but it is probably not technically feasible (2003).

The federal government is currently experimenting with the idea of a “Nutrient BMP Endorsement” program. The USDA Risk Management Authority has approved the insurance project, which is currently being piloted with corn farmers in Iowa, Minnesota, Wisconsin, and Pennsylvania (Agren, 2002). The Federal Crop Insurance Corporation (FCIC) reinsures this Nutrient BMP Endorsement. The program targets reduction of nitrogen and phosphorus fertilizer application on corn crops, and the insurance went on sale in January for the 2003 crop year. Results will not be available for some time (RMA 2003). For the time being, the Nutrient BMP Endorsement is only available for non-irrigated, non-continuous corn crops (RMA 2003). The BMPs supported by the endorsement are based on nitrogen and phosphorus fertilizer recommendations made by land-grant universities in each participating state.
The policy is supervised and subsidized by the federal government. As mentioned in the introduction, the green insurance is sold by private companies and is only offered to farmers who purchase MPCI or CRC. This limitation is to account for other hazards that may reduce yield, but are unrelated to chemical inputs. The MPCI or CRC policies cover part of an insurance claim, and then the Nutrient BMP Endorsement covers the rest of the claim. Without the restriction, the green insurance may have to pay for claims that are problems unrelated to fertilizer reduction (RMA 2003).

The major issue with any insurance policy is how to determine when indemnities are paid or withheld. Before the growing season, a government-approved crop advisor recommends a BMP with specific rates of N and/or P for each participating farm. Before fertilizer is applied, a crop consultant chooses the location of a comparison strip, also known as a check strip, where the farmer will apply the same amount of fertilizer as he did in previous years. This check strip is 40-60 ft wide and runs the length of the field. On either side of the check strip is a BMP strip that has the same dimensions as the check strip. The amount of recommended fertilizer is applied to the BMP strips as well as to the rest of the field, except for the check strip.

Adjacent BMP strips are used in the case of BMP failure. If the yield on the BMP strips are significantly less than on the check strip, the farmer can be compensated for the difference, subtracting a 5% deductible (Agren, Inc. 2002). The cost of the Nutrient BMP Endorsement is $7-10 per acre (RMA 2003).

**Conclusion:**

Green insurance for agriculture is an extremely new and innovative concept, which has seen very few real-world applications. Probably because this strategy is still being established, it is addressed by a negligible amount of academic literature. Although many agricultural, economic, or scientific journals refer to general crop insurance policies, very few articles focus on green insurance. Since this environmental strategy has not been fully tested, it is difficult to determine its viability. The concept is theoretically feasible but for green insurance to work in practice, many obstacles must be overcome.

One problem with crop insurance in general is that it may encourage farmers to take more risks, for example, by cultivating more marginal land (Goodwin 2001). This may also prove to be problematic in insurance programs aimed at encouraging farmers to adopt BMPs. Federally subsidized revenue insurance programs have had the effect of increasing pesticide use and decreasing fertilizer use on U.S. wheat farms and corn farms (Babcock and Hennessy 1996, and Nimon and Mishra 2001). This indicates
that unreasonably risky pesticide use may be more of a problem than risky fertilizer use under a BMP insurance program.

To avoid this problem of farmers taking excessive risks, the BMP insurance would need to be based on the assumption that the farm has an approved management plan and its cultivation practices are environmentally sound. A means of assessing the appropriateness of adopting BMPs at each insured site would need to be developed in order to prevent farming on marginal land. Compliance with BMPs after the insurance agreement was made would also need to be monitored (Fleisher 1990).

An additional difficulty is that developing the insurance program may have high administrative costs and high transaction costs for both the farmer and the insurance provider. For green insurance policies to be successful, they must be cost-effective for the farmer. If the various expenses associated with buying insurance counteract the profit from applying less chemical inputs, the insurance program will most likely fail.

A private insurance company also needs to be careful about staying afloat when indemnities are paid out. The nature of agricultural insurance leads to “systemic risk,” where most customers can file claims in a given year due to conditions that affect everyone. If particularly favorable weather occurs in a year, most farmers will make a declaration of BMP failure and the insurance company must be able to pay indemnities to all claimants without going bankrupt (Buman 2003).

Because green insurance is such a new concept and because it faces many obstacles, its future is difficult to predict. The information to date suggests that nutrient insurance may be more successful than pesticide insurance, but the information is far from complete and no clear-cut conclusions exist. Perhaps when further studies and pilot programs are conducted, green insurance will emerge successfully.
Works Cited:


