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AGRICULTURAL INDEX INSURANCE PRODUCTS: STRENGTHS AND LIMITATIONS

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Background

Most insurance products pay indemnities based on actual losses incurred by the policyholder (e.g., automobile collision insurance, property and casualty insurance, etc.). This is also true of many Federal Crop Insurance Program (FCIP) insurance products that pay indemnities based on farm-level yield or revenue shortfalls.

Yet for some commodities, such as hay, yield measurement is difficult and often imprecise, especially at the farm-level. Further, since the commodity is frequently used on the farm, rather than sold in the market, sales documents are often not available to verify historic production (and hence, yield) estimates. For other commodities (e.g., pasture and rangeland) farm-level yield measurement is practically impossible. How can one offer insurance protection for these commodities?

USDA's Risk Management Agency (RMA) is currently investigating whether new index insurance designs based on weather variables (e.g., precipitation) can provide farmers with useful risk protection in these situations. Index insurance products pay indemnities based on the value of an index rather than on actual losses experienced by the farmer.

Even when it is possible to measure yield, index insurance products may offer some advantages relative to traditional farm-level insurance products. In fact, a limited number of index insurance products are already sold through the FCIP. The most common of these utilize indexes of National Agricultural Statistics Service (NASS) county average yield estimates. One of the advantages of these products is that purchasers need not provide historic farm-level yield data to establish a yield guarantee. This is particularly beneficial for new farmers, those farming new parcels of land, those who do not maintain historic yield documentation, or those who simply prefer not to disclose their historic yield data. There are also, however, critical limitations to index insurance products.

This manuscript begins by describing the FCIP's traditional farm-level crop insurance product known as Actual Production History (APH) multiple-peril crop insurance. This product is then compared to the Group Risk Plan (GRP) which is an index insurance

product currently offered under the FCIP. Next the manuscript describes the strengths and limitations of index insurance products. The final section of the manuscript discusses the new LGM and LRP livestock index insurance products, the index features of existing farm-level crop revenue insurance products, and other potential applications of index insurance products in agriculture.

Traditional Insurance: Indemnities Based on Actual Losses Incurred

APH Farm-Level Crop Yield Insurance

For APH farm-level crop yield insurance, indemnities are calculated as[1]

$$Indemnity\ Per\ Acre = \max(0, Trigger\ Yield - Realized\ Yield) \times Price\ Election.$$

The *Trigger Yield* is based upon the coverage chosen and the Actual Production History (APH) yield. Specifically,

$$Trigger\ Yield = APH\ Yield \times Coverage\ .$$

The *APH Yield* is an estimate of the long-run average yield for the insurance unit. *Coverage* is 100 percent minus the percent deductible. Available coverage levels range from 50 percent to either 75 or 85 percent in 5 percent increments. The *Price Election* converts an indemnifiable yield shortfall into a dollar amount.

Consider the example shown in table 1. The farm has an APH corn yield of 160 bushels per acre. The grower has selected 75% coverage. Thus, the trigger yield is 120 bushels per acre. The grower has also selected a price election of $2.20 per bushel. If the realized yield is only 90 bushels per acre, the indemnifiable yield shortfall is the difference between the trigger yield and the realized yield or 30 bushels per acre. The indemnity of $66.00 per acre is the product of the indemnifiable yield shortfall and the price election.

Table 1: APH Farm-Level Yield Insurance Example

APH Corn Yield	160 bushels per acre
Coverage	75%
Trigger Yield	120 bushels per acre
Price Election	$2.20 per bushel
Realized Yield	90 bushels per acre
Indemnity Per Acre	$66.00 per acre

[1] The designation "farm-level" is used to differentiate these products from "area-level" index insurance products such as the Group Risk Plan (GRP) and the Group Risk Protection Program (GRIP). In reality, most of the farm-level yield and revenue insurance products can be purchased in sub-farm level basic or optional units.

Note that with APH farm-level yield insurance, indemnities are paid when the realized yield is less than the trigger yield. The trigger yield is simply the APH yield adjusted for the deductible. Thus, much like other traditional insurance products, the indemnity is based on the actual loss (measured as a yield shortfall) incurred, less the deductible.

Group Risk Plan

Index insurance has been part of the FCIP portfolio of insurance products since 1993. In that year, the FCIP began offering the GRP index insurance product. This product pays indemnities based on county average yields (the index) rather than the yield experienced by the insured farmer. For GRP, if the National Agricultural Statistics Service (NASS) estimate of the actual county yield is less than the trigger yield (expected yield × coverage level), the policyholder receives an indemnity. This is true even if the insured farm has not experienced a yield loss. Similarly, if the NASS estimate of the actual county yield is greater than the trigger yield, the policyholder will not receive an indemnity even if the insured farm has experienced a yield loss. Appendix figures 1-6 show regions where GRP is available for various commodities.

When a farm purchases GRP, the indemnity is calculated as

$$Indemnity\ per\ acre = \max\left(0, \frac{Trigger\ Yield - Realized\ Yield}{Trigger\ Yield}\right) \times Dollar\ Amount\ of\ Protection$$

where

$$Trigger\ Yield = Expected\ County\ Level\ Yield \times Coverage.$$

The realized yield is the NASS estimate of the county average yield for the county where the farm is located. *Coverage* levels range from 70 to 90 per cent in 5 per cent increments. The *Dollar Amount of Protection* is calculated as

$$Dollar\ Amount\ of\ Protection = Expected\ County\ Yield \times Price\ Election \times Scale$$

where *scale* is chosen by the policyholder but is limited to between 90% and 150%.

Consider the example in table 2. The expected county corn yield is 120 bushels per acre. The GRP policyholder has selected 90 percent coverage so the trigger yield is 108 bushels per acre. If the realized county corn yield is less than 108 bushels per acre the policyholder will receive an indemnity *regardless of the actual yield on the policyholder's farm*. The policyholder has also selected a 100 percent value for scale. Thus the dollar amount of protection (the product of the expected county yield, the price election, and scale) is $264 per acre. The realized county corn yield was only 81 bushels per acre, a shortfall of 25 percent relative to the trigger yield. The indemnity is the product of the dollar amount of protection and the indemnifiable yield shortfall or $66 per acre.

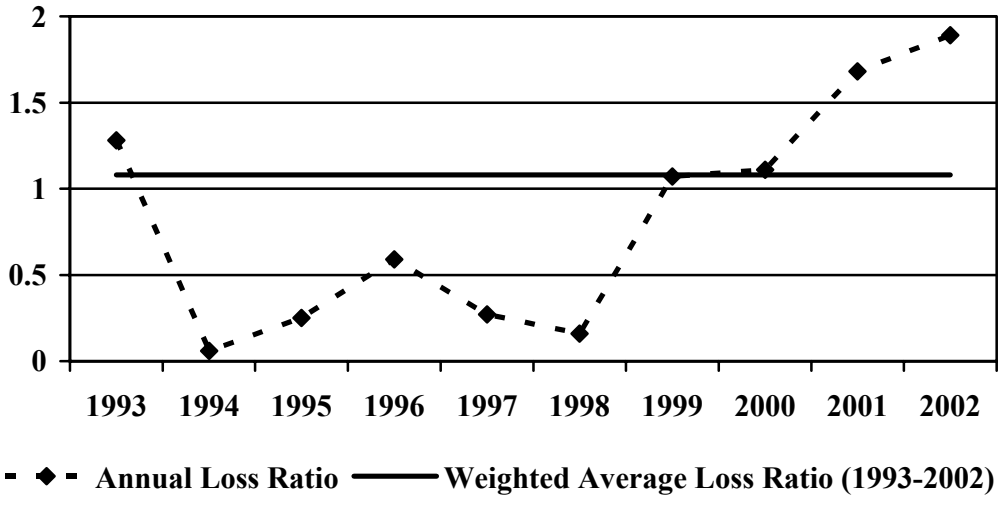
Table 2: GRP Example

Expected County Corn Yield	120 bushels per acre
Coverage	90%
Trigger Yield	108 bushels per acre
Price Election	$2.20 per bushel
Scale	100%
Dollar Amount of Protection per acre	$264 (120 × $2.20 × 100%)
Realized County Corn Yield	81 bushels per acre
Indemnifiable Yield Shortfall	25%
Indemnity per acre	$66 ($264 × 25%)

Policies are sold only in counties with sufficient acreage such that no individual grower's yield will significantly affect the realized county average yield. Thus, unlike APH farm-level yield insurance, GRP indemnities are *not* based on the actual loss incurred by the policyholder. Instead indemnities are triggered when the realized value of an index, over which the policyholder has no control, drops below a trigger level. In the case of GRP, that index is the NASS estimate of the county average yield.

The actuarial performance of insurance products is often measured by a loss ratio which is the ratio of indemnities paid divided by premiums collected. Loss ratios greater than 1.00 indicate that the product paid more in indemnities than was collected in premiums. Figure 1 shows annual GRP loss ratios from 1993 to 2002 where premiums include both farmer paid premiums and federal premium subsidies. The weighted average loss ratio over the period is 1.08. Over the same period the weighted average loss ratio for all FCIP products was 1.03.

Figure 1: GRP Loss Ratios



Group Risk Income Protection

It is possible to construct similar insurance products based on other indexes. For example, the Group Risk Income Protection (GRIP) product is similar to GRP except that the index is based on revenue rather than yield. Specifically, the GRIP index is based on the product of the NASS estimate of the county average yield and an average of closing futures market prices over a specified period. Since the price component of the revenue calculation is based on futures market prices, the policyholder again has no control over the realized value of the index. As discussed later, this is an important feature of index insurance products. GRIP is currently available only for corn and soybeans (appendix figures 7 and 8).

Figure 2 shows annual GRIP loss ratios from 1999 (when the product was first sold) to 2002. The weighted average loss ratio over the period is 0.57. Over the same period the weighted average loss ratio for all FCIP products was 1.12.

Figure 2: GRIP Loss Ratios

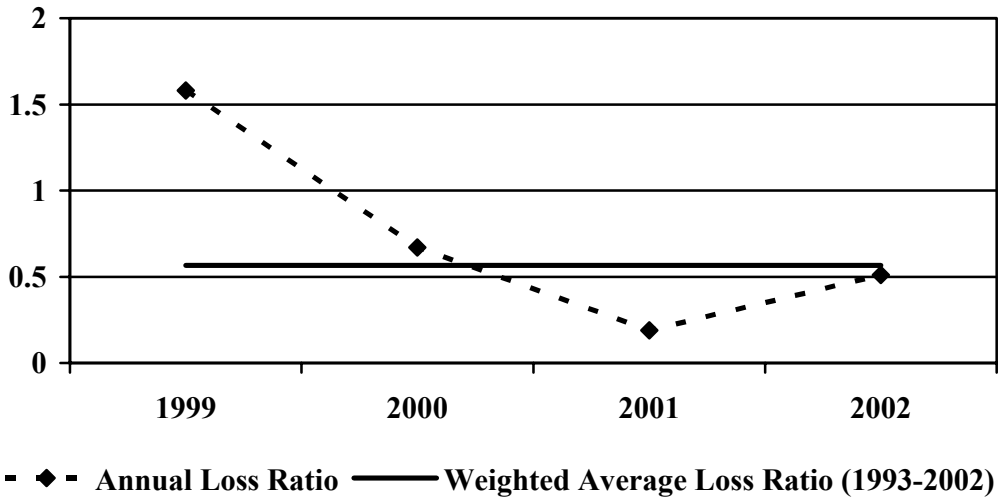


Figure 3 shows annual GRP and GRIP net acres insured. Figure 4 shows annual GRP and GRIP liability. For both products net acres insured and liability have increased over time. However, both products remain a relatively small part of the overall FCIP portfolio. In 2003 GRP and GRIP accounted for only 6.3 percent of total FCIP net acres insured and only 4.0 percent of total FCIP liability.

Figure 3: GRP and GRIP Net Acres Insured

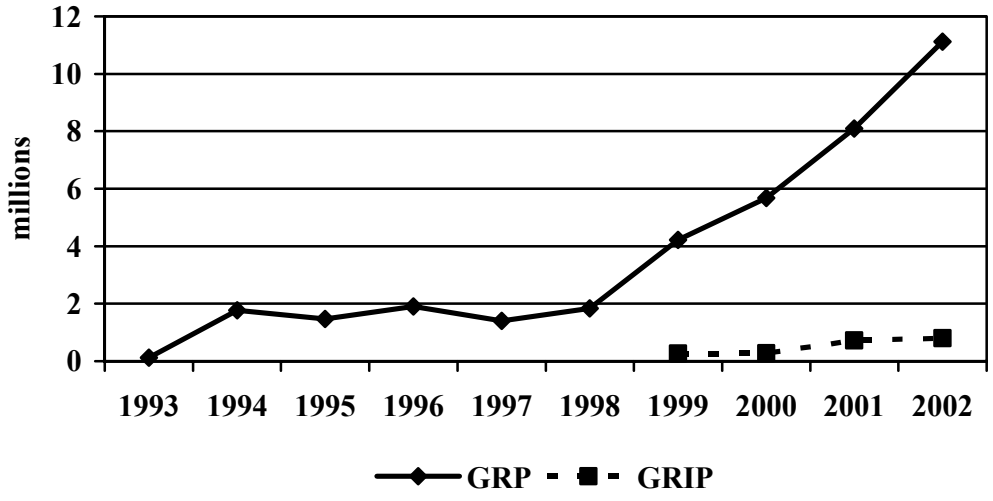
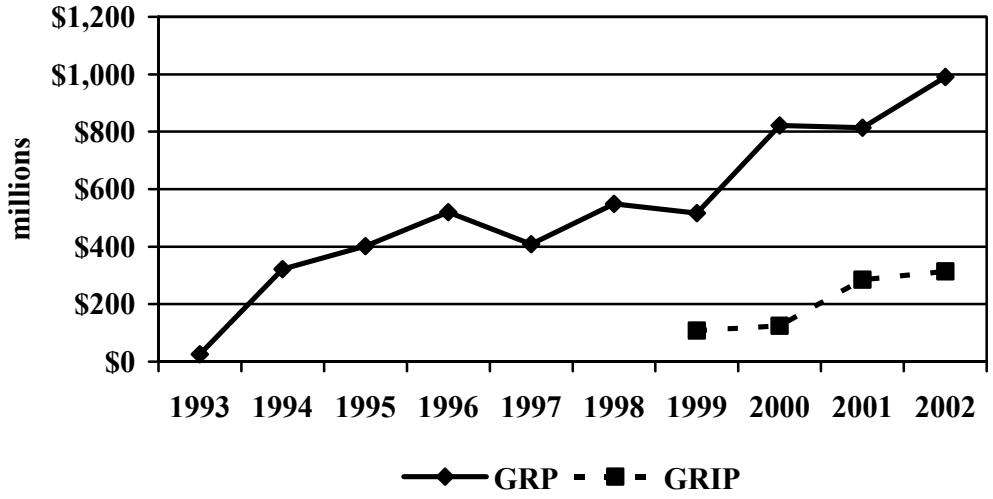


Figure 4: GRP and GRIP Liability



Why Index Insurance?

Since traditional insurance products base indemnities on actual losses incurred, why would anyone want to purchase an index insurance product instead?

Index insurance products have several advantages relative to traditional insurance products. As mentioned previously, one advantage of index insurance products is that no historic farm-level yield data are required.

Another advantage is that index insurance products are not susceptible to the common insurance problems of moral hazard and adverse selection. Both of these problems are

caused by the fact that relevant information is asymmetrically distributed – that is, policyholders (or potential policyholders) typically have better information about their risk exposure than does the insurer. In the long run, both of these problems can cause insurers to increase premium rates, driving lower-risk insurance purchasers out of the market.

Moral Hazard

Moral hazard occurs when, because they have purchased insurance, policyholders change their behaviors in such a way that the likelihood and/or magnitude of a loss are increased. For example, a grower who typically applies a prophylactic pesticide treatment may choose to forego that treatment after purchasing APH farm-level yield insurance. "Why incur the cost of the pesticide treatment," the grower reasons. "If the damage from pests is severe, it will be covered by the insurance policy."

The change in grower behavior increases the likelihood of and/or magnitude of loss. However, due to "information asymmetry" the insurer is unaware of this change in grower behavior. Fraud is an extreme example of moral hazard. However, not all moral hazard behavior is illegal or even unethical. It may simply be a rational economic decision reflecting the fact that the purchase of an insurance policy has increased the grower's willingness to take on risk.

Since moral hazard increases the likelihood of and/or magnitude of loss for the policyholder, the insurer's exposure to risk is also increased. But since the insurer is not aware of the changes in the policyholder's behavior, premium rates do not reflect the increased risk exposure. As a result, over time indemnities will be higher than anticipated. The insurer will respond by increasing premium rates for all policyholders. But this does not correct the underlying moral hazard problem. Those who are not engaged in moral hazard behaviors may choose to quit purchasing insurance rather than pay the higher premium cost. As premiums are ratcheted up over time, those engaged in moral hazard behaviors are more and more disproportionately represented in the pool of insurance purchasers. In extreme cases, the only ones purchasing insurance at the very high premium cost are those who intend to engage in moral hazard behaviors.

Adverse Selection

Adverse selection occurs when the insurer cannot accurately classify potential policyholders according to their risk exposure. Again, the underlying problem is asymmetric information. Potential policyholders likely know far more than the insurer about their true level of risk exposure. As a result, potential policyholders who have been misclassified to their benefit (i.e., they have been charged a premium rate that underestimates their true level of risk exposure) are more inclined to purchase insurance. Those who have been misclassified to their detriment (i.e., they have been charged a premium rate that overestimates their true level or risk exposure) are less inclined to purchase insurance.

Since the pool of insurance purchases is disproportionately composed of those who have been misclassified to their benefit, indemnities will be higher than anticipated. The insurer will likely respond by increasing premium rates for all policyholders. But this does not address the underlying misclassification problem. In fact, it only compounds the problem. With each successive increase in premium rates, those who have been misclassified to their benefit become more and more disproportionately represented in the pool of insurance purchasers.

Index Insurance is Not Susceptible to Moral Hazard and Adverse Selection

A number of studies have identified moral hazard and/or adverse selection problems in the farm-level insurance products offered by the FCIP (Skees and Reed; Quiggin, Karagiannis, and Stanton; Smith and Goodwin; Coble et al.; Just, Calvin, and Quiggin). These problems have led to higher premium rates (though this effect is often masked by federal premium subsidies) and inequities in program benefits (Skees; Glauber and Collins).

Index insurance products, however, are not susceptible to moral hazard and adverse selection because indemnities are based on an index over which the policyholder has no control. Further, the policyholder likely has no better information than the insurer about the potential realized values of the index (and hence, the probability of an indemnity occurring or the potential magnitude of an indemnity).

Consider the example of GRP. Policies are sold only in counties with sufficient acreage such that no individual grower's yield will significantly affect the realized county average yield (i.e., the index). Thus, unlike traditional insurance products, indemnities are based on an index over which the policyholder has no control. Further, there is no reason to believe that grower's have any better information about expected county average yields than does the insurer. Because there is no information asymmetry, there should be no problems with moral hazard or adverse selection.

Less Potential for Error

It is very difficult to make accurate estimates of farm-level expected yields. FCIP farm-level yield and revenue insurance products calculate expected yield (APH yield) as a simple average of four to ten years of historical yields. Policyholders are required to provide documentation of their historical yields. In practice, it is extremely difficult to verify the accuracy of the documentation provided.

However, even if one assumes that the yield documentation provided by policyholders is accurate, an average yield calculated using only four to ten years of historical yield data will often not accurately estimate the true expected yield. To demonstrate this point Skees and Barnett construct a stylized example based on a representative corn farm. For simplicity they assume that the yield on the farm is normally distributed with a mean of 100 bushels per acre and a standard deviation of 35 (which is not unreasonable for marginal corn production areas). If the APH yield is calculated using only 4 years of

farm-level yields, very large errors can occur. More than 15% of the time the APH yield will be so much higher than the true expected yield that 85% nominal coverage will provide effective coverage that is greater than 100%. Conversely, the APH yield may also be much less than the true expected yield. In the same example, more than 15% of the time 85% nominal coverage would provide effective coverage of less than 70% due to the APH yield underestimating the true expected yield.

The limited amount of yield data available for calculating APH yields contributes to misclassification (adverse selection) problems. Those who have been assigned an APH yield that they believe to be higher than their true expected yield will be more likely to purchase insurance. Those who have been assigned an APH yield that they believe to be lower than their true expected yield will be less likely to purchase insurance.

Index insurance products require no farm-level yield data. The only data required are historical values of the index. These data are generally available for much longer periods of time than the farm-level yield data required for farm-level yield and revenue insurance products. In addition, the data are typically easily accessible, transparent, and verifiable. For example, the estimate of expected county yield used in GRP is based on at least 45 years of NASS county yield data. Using so many years of data (compared to 4-10 years of data used to calculate APH yields) greatly reduces the potential for overestimating or underestimating the true expected value. The fact that county yield data are also less variable than farm-level yield data also reduces the potential for overestimating or underestimating the true expected value. In addition, the underlying NASS data are easily accessible to all interested parties via the NASS web site.

Another benefit of index insurance products is that they require no farm-level loss adjustment. Skees and Barnett argue that even with careful farm-level loss adjustment procedures, it is simply impossible to avoid errors in estimating true farm-level realized yields. In contrast, there should be far less error in calculating the true realized value for most index insurance products. Again using GRP as an example, NASS employs carefully-developed statistical sampling procedures to estimate realized county yields. In counties with sufficient production of the commodity (recall that GRP is only sold in counties that exceed certain minimum thresholds for planted acreage), these procedures minimize errors in the estimate of realized county yield. The fact that county yield data are less variable than farm-level yield data also reduces the potential for errors in estimating realized county yields compared to farm-level yields.

Lower Transactions Costs

Relative to traditional insurance products, index insurance has lower transactions costs for both policyholders and insurers. The cost savings occur primarily in two areas: establishing the insurance trigger and loss adjustment.

With index insurance products the insurance trigger is based on the expected value of the index rather than individual APH yields. This means that growers are not required to provide historic farm-level yield data. This is beneficial to new growers, or those

farming new parcels of land that do not have access to the historic yield data required to establish an APH yield. Even growers who have been farming the same parcels for many years may find it time-consuming to locate the documents needed to verify historical yield records. Whatever the reason, index insurance products are of benefit to growers who cannot, or do not wish to, provide farm-level yield data. Similarly, sales agents benefit because they are not required to collect and document grower-provided yield records.

Loss adjustment is also less costly for index insurance than for traditional insurance products. Once the realized value of the index has been established (e.g., the NASS county average yield estimate in the case of GRP) a simple mathematical calculation is used to determine the amount of indemnity, if any, due each policyholder. No farm-level loss adjustment is required. With APH insurance, if a claim is being filed, a loss-adjuster must typically see the field before the grower harvests the crop. In certain circumstances, the grower may be allowed to harvest most of the crop but will be required to leave part of the field unharvested for the loss adjuster to inspect. Since index insurance requires no farm-level loss adjustment, transactions costs, for both growers and insurers, are less than with traditional insurance products.

Limitations of Index Insurance

While index insurance products have several advantages relative to traditional farm-level yield and revenue insurance products, they also have one extremely important limitation. This limitation is that index insurance products can be subject to high levels of basis risk.

In commodity markets, basis is the difference between the price on the futures exchange and the local price. Basis risk is the variability in basis due to changes in transportation costs and/or local supply and demand conditions. With index insurance products, basis is the difference between the level of the index (e.g., county yield for GRP) and the farm-level yield or revenue. Basis risk is variability in the difference between the level of the index and the farm-level yield or revenue. Unless the farm-level yield or revenue is perfectly correlated with the index, the basis will vary from year to year. This implies that in some years the index insurance may not pay an indemnity when a loss occurs on the farm. Likewise, index insurance may pay an indemnity when farm-level losses do not occur. If the farm-level yield or revenue is sufficiently correlated with the index, this will occur only rarely. However, if the farm-level yield or revenue is not highly correlated with the index, the basis risk will be so large that the index insurance product will not provide the grower with adequate risk protection. This basis risk is the most important limitation of index insurance products.

The basis risk inherent in index insurance products will vary across regions and even across specific farms within a region. In recent empirical work, Barnett et al. examined the risk protection provided by GRP for corn growers in 10 states and for sugar beet growers in the Red River valley of eastern North Dakota and southwestern Minnesota. They found evidence of regional differences in the risk protection provided by GRP. As expected, GRP provided relatively less risk protection to growers in more heterogeneous

production regions due to the higher basis risk. Deng, Barnett, and Vedenov found similar results for cotton and soybean producers in the southeastern U.S. For an agricultural producer it may be quite difficult to determine whether the correlation between farm-level losses and the index is sufficient for an index insurance product to provide adequate farm-level risk protection.

The FCIP is a public-private partnership. Both premiums received and indemnities paid are shared between private insurance companies and the federal government. Private insurers typically obtain private-sector reinsurance to cover at least some of their potential loss risk on FCIP policies. This implies that any expansion of index insurance products within the FCIP will be conditioned on the ability of private insurers to offset their potential loss risk on these policies through reinsurance or other financial markets.

Since indemnities are not based on farm-level losses, individuals could theoretically purchase agricultural index insurance products without even producing the agricultural commodity that the insurance product is intended to protect. That is to say, individuals could speculate on agricultural index insurance. However, it is important to note that this is not allowed under the legislative authority that authorizes the FCIP. The FCIP is only allowed to offer insurance products to actual producers of the agricultural commodity being insured. So even with index insurance products, insurance sales agents must verify that the producer is actually producing the commodity that is being insured.

Other Agricultural Index Insurance Products

Livestock Price Insurance

In addition to GRP and GRIP, the FCIP is currently pilot-testing two other index insurance products. Livestock Risk Protection (LRP) protects against decreases in the market value of insured cattle or swine. Livestock Gross Margin (LGM), which is available only for swine, protects against decreases in the margin between the market value of the animal and the cost of feed inputs. Both are index insurance products because indemnities are based not on actual prices received and/or paid by the producer but rather on changes in futures market prices (the index) for the animal (in the case of LRP) or the animal and feed inputs (in the case of LGM) during the life of the insurance policy. Thus, both products are, in essence, derivatives based on exchange-traded futures contracts.

Why do LRP and LGM base indemnities on futures market prices rather than actual prices paid and/or received by the producer? Consider a hypothetical insurance product that pays indemnities whenever the actual price received by livestock producers falls below a specified trigger price. If prevailing market prices fall below the trigger price, insured producers have little incentive to aggressively market their livestock so as to attain the highest price possible. After all, the insurance will make-up any difference between the trigger price and the actual price received. In other words, basing livestock price insurance on actual prices received would create severe moral hazard problems. Individual livestock producers, however, cannot significantly affect futures market prices.

Thus, as with GRP and GRIP, basing indemnities on an index rather than on actual farm experience greatly reduces the potential for moral hazard.

When comparing LRP and LGM to GRP and GRIP, it is important to note that price risk (for livestock and major crops) tends to be much more systemic than crop production risk. Crop production shortfalls in one region of the U.S. do not necessarily imply crop production shortfalls in other regions. In contrast, price increases or decreases are much more likely to affect all producers, regardless of where their farms are located. This means that, in general, one would expect less basis risk for index insurance products such as LRP and LGM that provide price risk protection, compared to products like GRP (GRIP) that protect against yield (revenue) risk.

Existing FCIP Farm-Level Revenue Insurance Products

Existing FCIP farm-level revenue insurance products blend features of traditional insurance products with those of index insurance products.[2] They are like traditional insurance products in that the yield component of expected revenue is based on APH yields and the yield component of realized revenue is based on farm-level realized yields. Thus, in part, indemnities are based on actual farm-level yield losses incurred (much like APH farm-level yield insurance).

Existing FCIP revenue insurance products also have a feature that is similar to index insurance products. The price component of expected revenue and realized revenue are calculated based on futures market prices (an index) rather than prices received at the farm-level. Specifically, the price component of expected revenue is based on a pre-planting average of futures market prices on the harvest contract and the price component of realized revenue is based on a harvest-time average of futures market prices on the harvest contract.[3]

Thus, the indemnity is based on two elements. The first is the difference between the APH yield and the realized farm-level yield. The second is the change in a price index (the futures market prices on the harvest contract) from a period prior to planting until harvest. This means that the existing FCIP revenue insurance products do not pay indemnities based on actual losses incurred at the farm-level. Instead, the indemnity is based on yield losses measured at the farm-level and changes in a price index.

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[2] Existing FCIP farm-level revenue insurance products include Crop Revenue Coverage (CRC), Revenue Assurance (RA), and Income Protection (IP). RMA has announced that these products will eventually be combined into a single farm-level revenue insurance product.

[3] In some cases, the definition of the pre-planting period and the harvest period differ among CRC, RA, and IP. Also, the different insurance products sometimes utilize different harvest futures contracts. Presumably these differences will be reconciled when the products are combined into a single revenue insurance product. For simplicity, I have ignored the harvest price option contained in the Crop Revenue Coverage (CRC) revenue insurance product and available as an option in the Revenue Assurance (RA) revenue insurance product. Including the harvest price option does not change the underlying point but further complicates the discussion of the indemnity calculation.

Why do existing FCIP revenue insurance products make use of a price index rather than basing indemnities strictly on revenue shortfalls? As with LRP and LGM, the answer relates back to asymmetric information and the potential for moral hazard if indemnities are based on actual revenue shortfalls.

Potential Agricultural Index Insurance Products

Though not currently available through the FCIP, agricultural index insurance products can also be constructed based on indexes of weather phenomena such as temperature or rainfall (Deng, Barnett, Vedenov, and West; Martin, Barnett, and Coble; Turvey). If production shortfalls are sufficiently correlated with underlying weather variables then weather-based index insurance may provide risk protection to agricultural producers – even those who produce crops for which it is difficult to measure yield. If the weather index is based on measurements taken at official government weather stations, there should be no moral hazard or adverse selection.

As with other index insurance products, the effectiveness of weather-based index insurance is limited by basis risk (Vedenov and Barnett). In the case of weather-based index insurance there are two potential sources of basis risk. Production may not be highly correlated with the weather variable on which the index is based (e.g., temperature or rainfall). Further, weather events on the farm may not be highly correlated with the weather station on which the index is based (Varangis, Skees, and Barnett). This is particularly true for weather events, such as rainfall, that, within a region, may tend to be localized rather than pervasive. Despite these limitations, weather-based agricultural index insurance may prove useful for protecting specific crops against specific risks in specific regions. In particular, weather-based index insurance may prove useful for commodities where it is difficult to measure yield (e.g., pasture).

Summary

Agricultural index insurance products pay indemnities based on the value of an index rather than on actual losses experienced by the farmer. Relative to traditional insurance products, this reduces the potential for moral hazard and adverse selection. Index insurance products also have less potential for error in establishing the insurance trigger and in loss adjustment. The transactions costs, for both growers and sales agents, are much less than for traditional insurance products.

The primary limitation of index insurance products is that they expose the policy-holder to basis risk. As a result, policy-holders may not always receive an indemnity when they experience losses. Also, on occasion they may receive indemnities when they have not actually experienced losses.

While the price component of existing FCIP revenue insurance products is based on an index, GRP, GRIP, LRP and LGM are the only current FCIP products that base indemnities completely on the realized value of an underlying index. Where available, GRP and GRIP provide alternative insurance products for those who cannot (or do not

wish to) provide the historical farm-level yield data required to calculate an APH yield. They also provide alternatives for growers located in regions where moral hazard, adverse selection, or product design flaws have caused premium rates for the farm-level yield and revenue insurance products to be prohibitively high. Other designs, such as weather-based index insurance, may one day provide growers with other insurance alternatives. Weather-based index insurance may hold promise for specialty crops that are highly susceptible to freezing temperatures or commodities, such as pasture, where it is difficult to measure yield.

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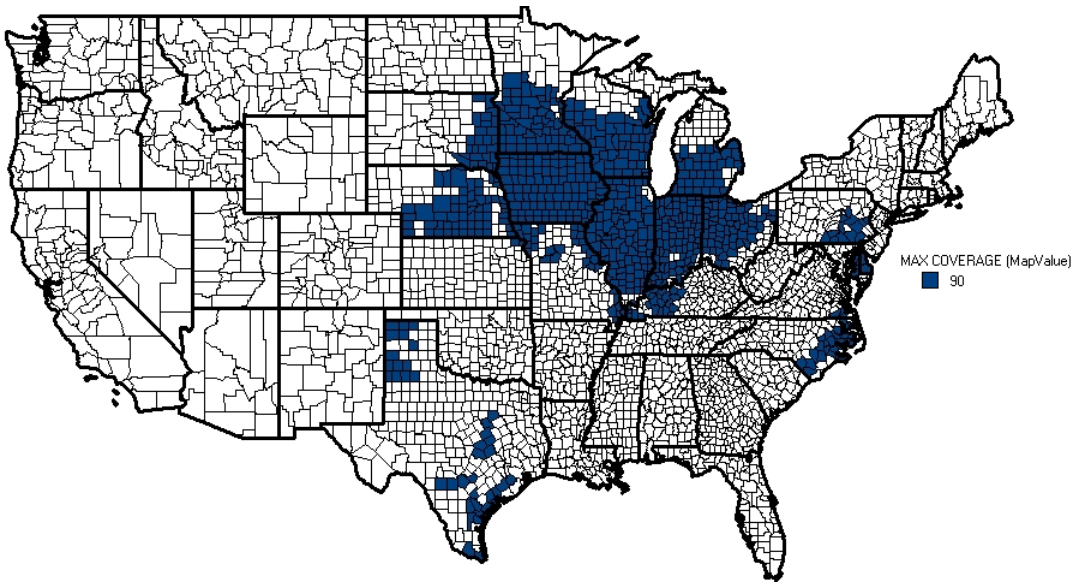
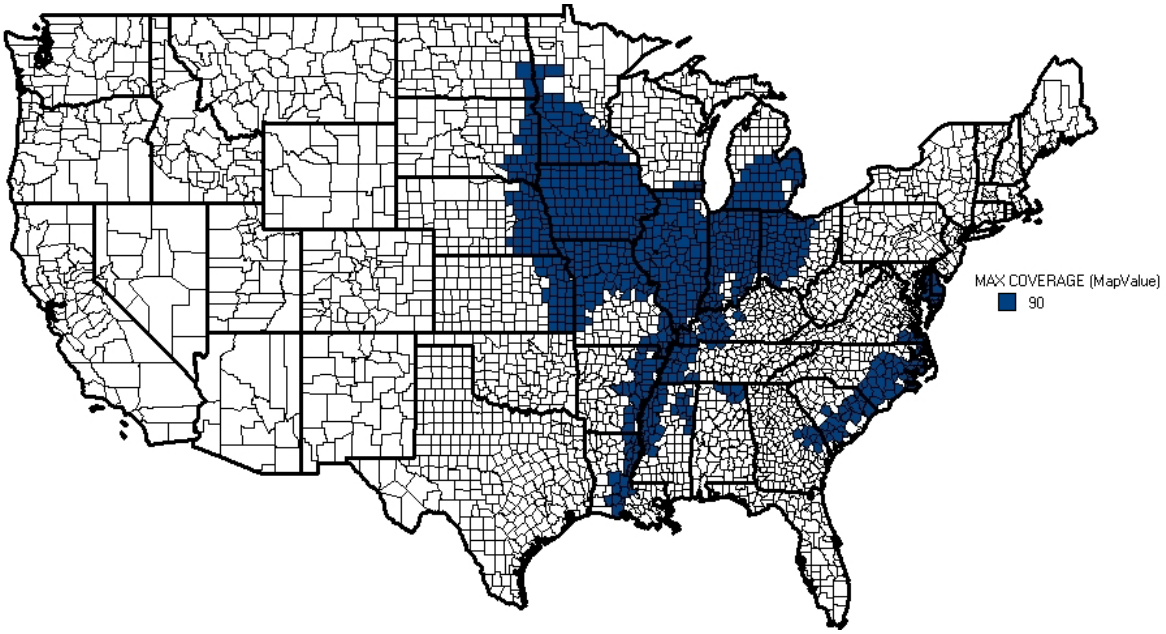
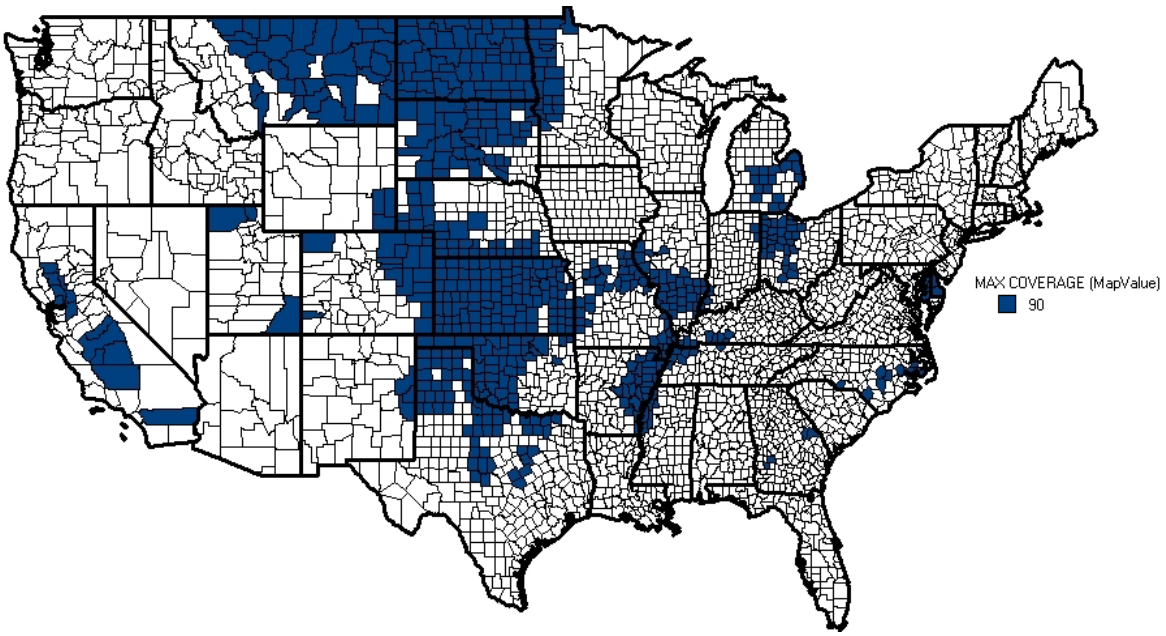
Appendix Figure 1: Counties where GRP is Available for Corn



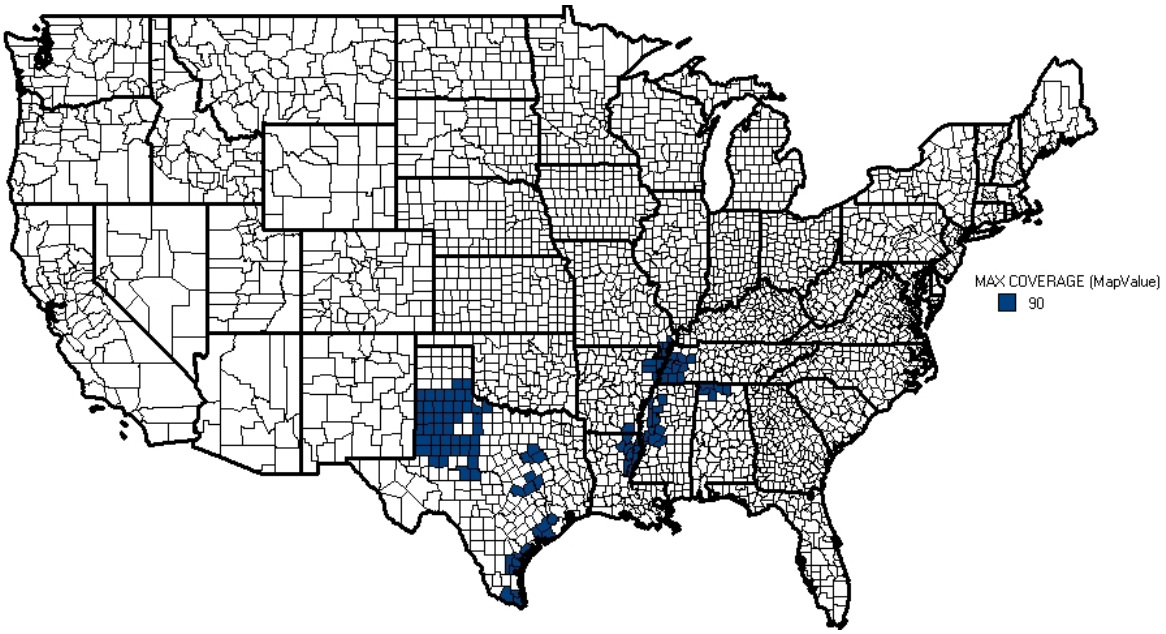
Appendix Figure 2: Counties where GRP is Available for Soybeans



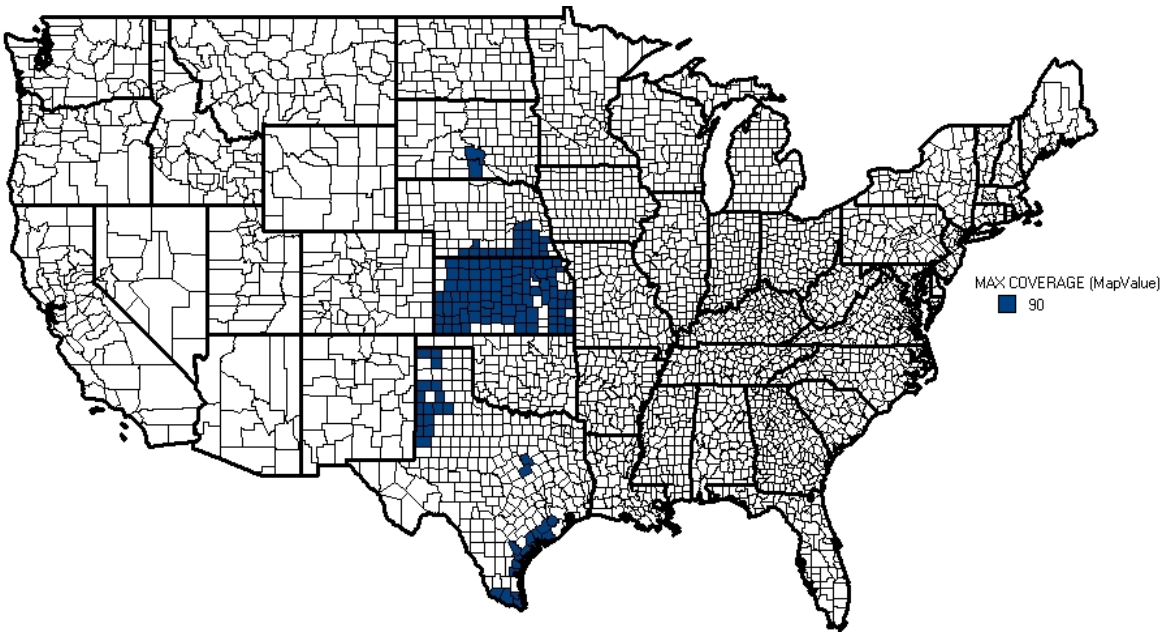
Appendix Figure 3: Counties where GRP is Available for Wheat



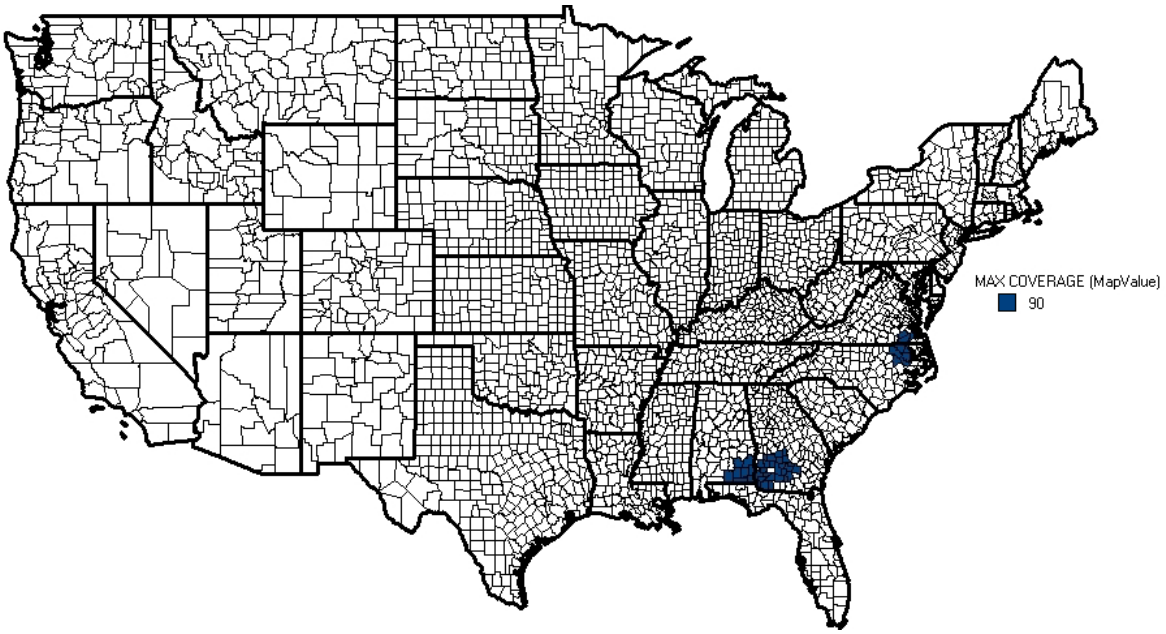
Appendix Figure 4: Counties where GRP is Available for Cotton



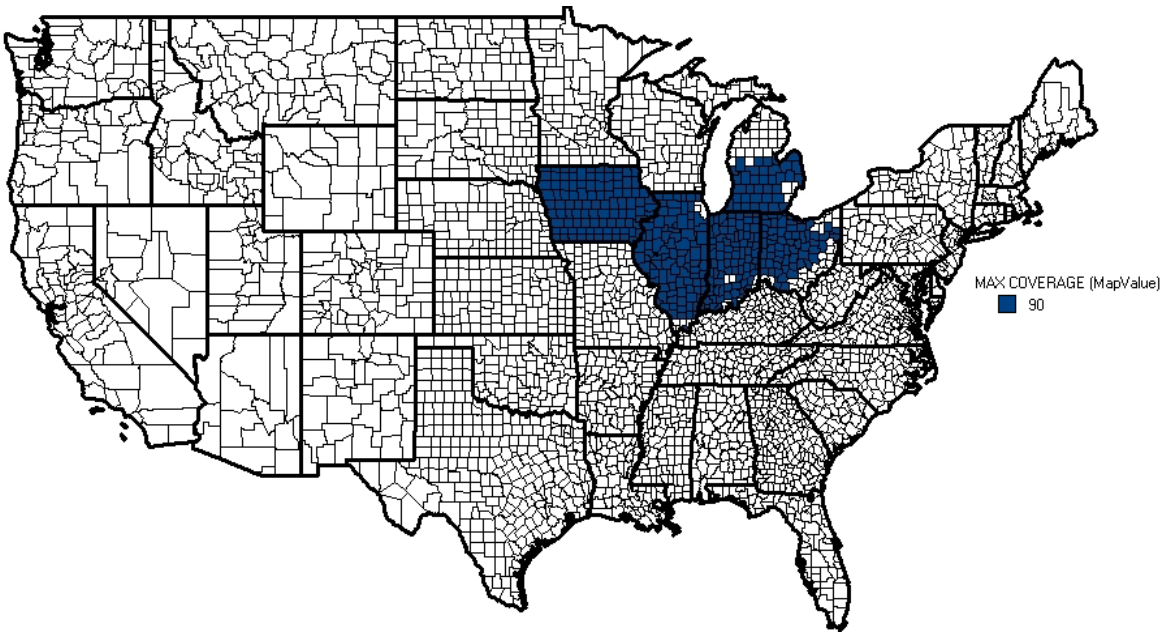
Appendix Figure 5: Counties where GRP is Available for Grain Sorghum



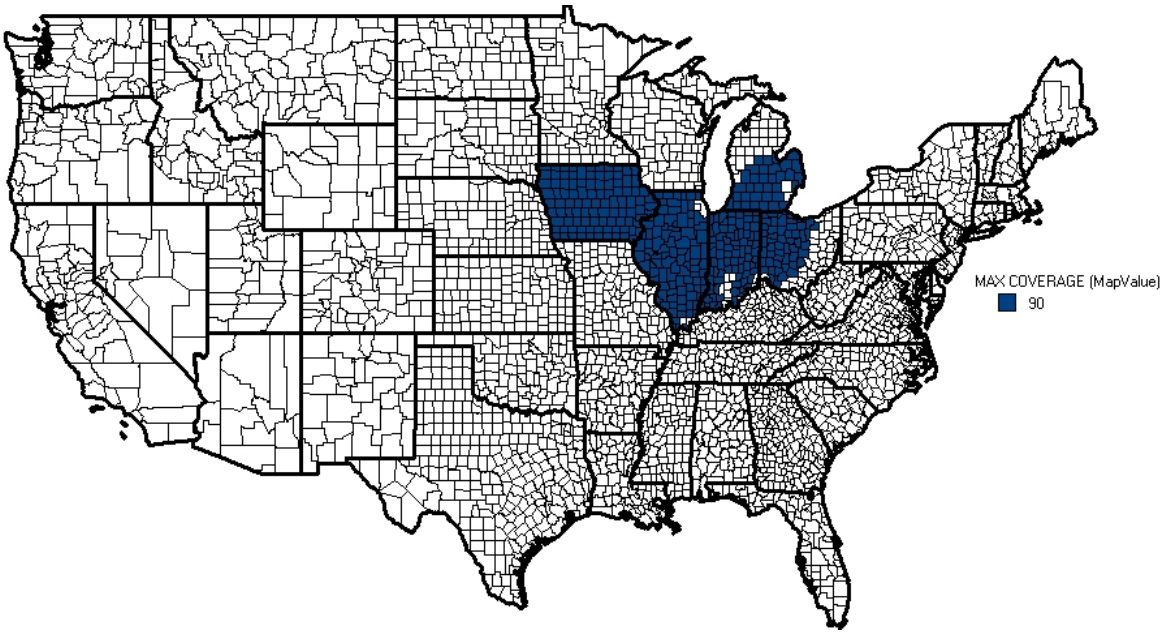
Appendix Figure 6: Counties where GRP is Available for Peanuts



Appendix Figure 7: Counties where GRIP is Available for Corn



Appendix Figure 8: Counties where GRIP is Available for Soybeans



Agricultural Index Products: Strengths and Limitations

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Traditional Insurance

- Pays indemnities based on actual losses incurred by the policyholder.
  - Example: Actual Production History (APH) farm-level yield insurance sold through the Federal Crop Insurance Program.

APH Farm-Level Yield Insurance Example

APH Corn Yield	160 bushels per acre
Coverage	75%
Trigger Yield	120 bushels per acre
Price Election	$2.20 per bushel
Realized Yield	90 bushels per acre
Indemnity	$66 per acre

APH Farm Level Yield Insurance

- Limitations:
  - Potential for moral hazard.
  - Potential for misclassification (adverse selection).
  - Potential for sampling errors when calculating APH yields.
  - Potential for errors in loss adjustment.
  - High transactions costs.
  - Not always feasible to measure farm-level yield (e.g., hay, pasture, or rangeland).

Index Insurance

- Pays indemnities based not on actual losses incurred by the policyholder but rather on changes in the value of an index.
  - Example: Group Risk Plan (GRP) area-yield insurance product sold through the Federal Crop Insurance Program.

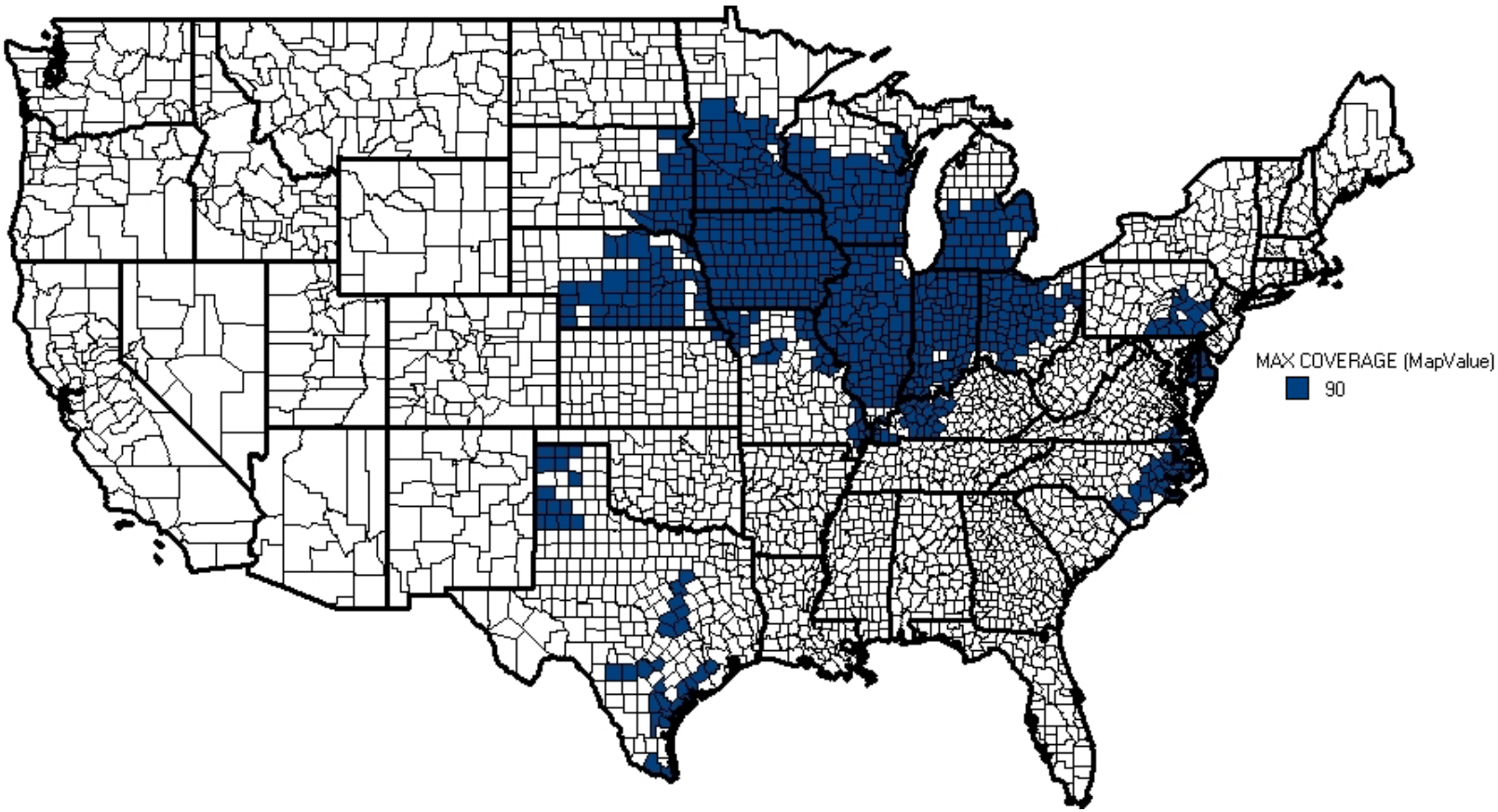
GRP Area-Level Yield Insurance Example

Expected County Corn Yld.	120 bushels per acre
Coverage	90%
Trigger Yield	108 bushels per acre
Price Election	$2.20 per bushel
Scale	100%
Protection per Acre	$264 (120 × $2.20)
Realized County Yield	81 bushels per acre
County Yield Shortfall	25%
Indemnity per Acre	$66 ($264 × 25%)

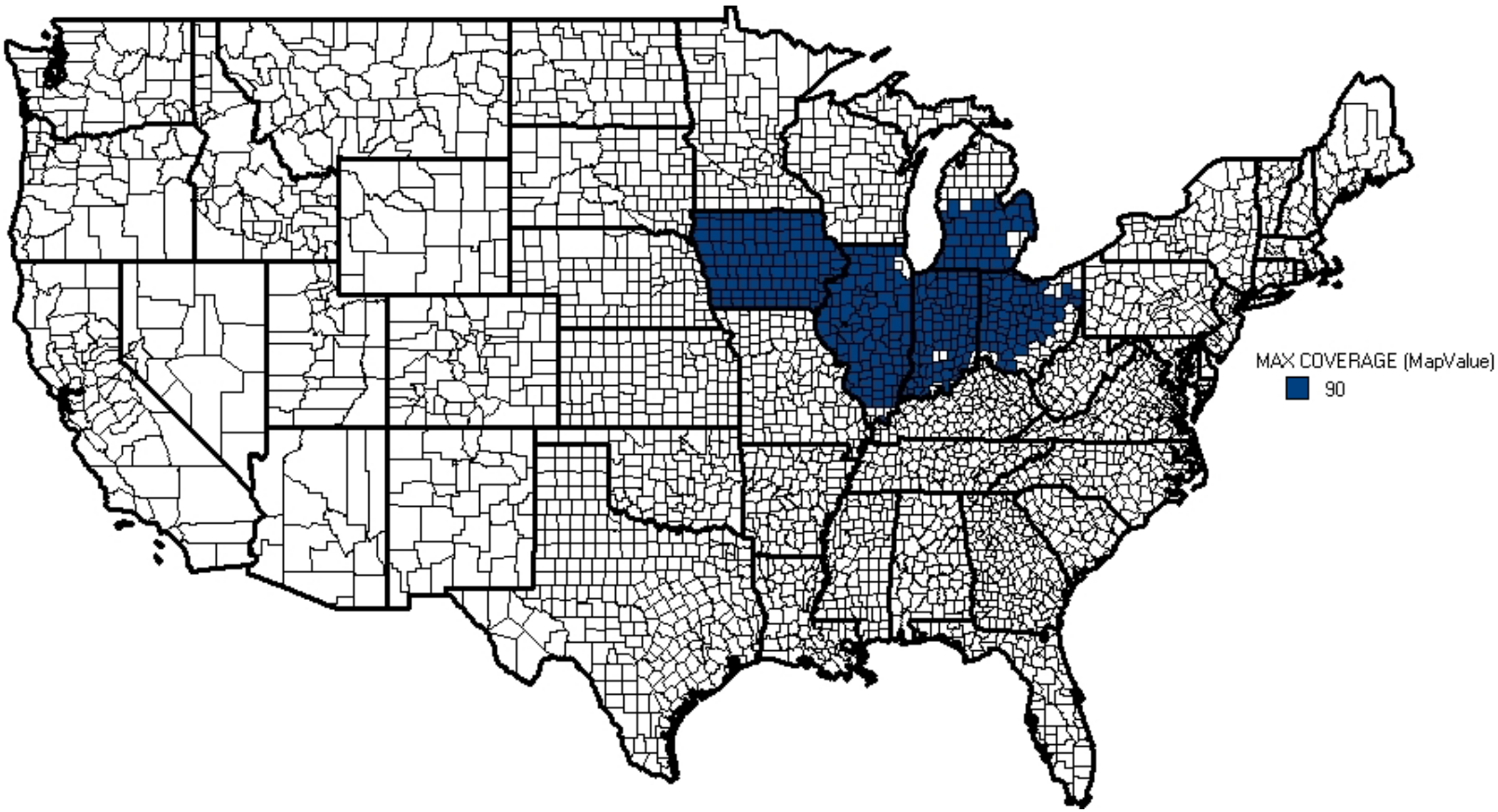
Area-Based Index Insurance

- Notice that the indemnity received by the policyholder is based not on the yield shortfall experienced on the policyholder's farm, but rather on the yield shortfall experienced in the county where the farm is located.
- The county average yield is the index.
- Group Risk Income Protection (GRIP) is an area-based revenue insurance product.

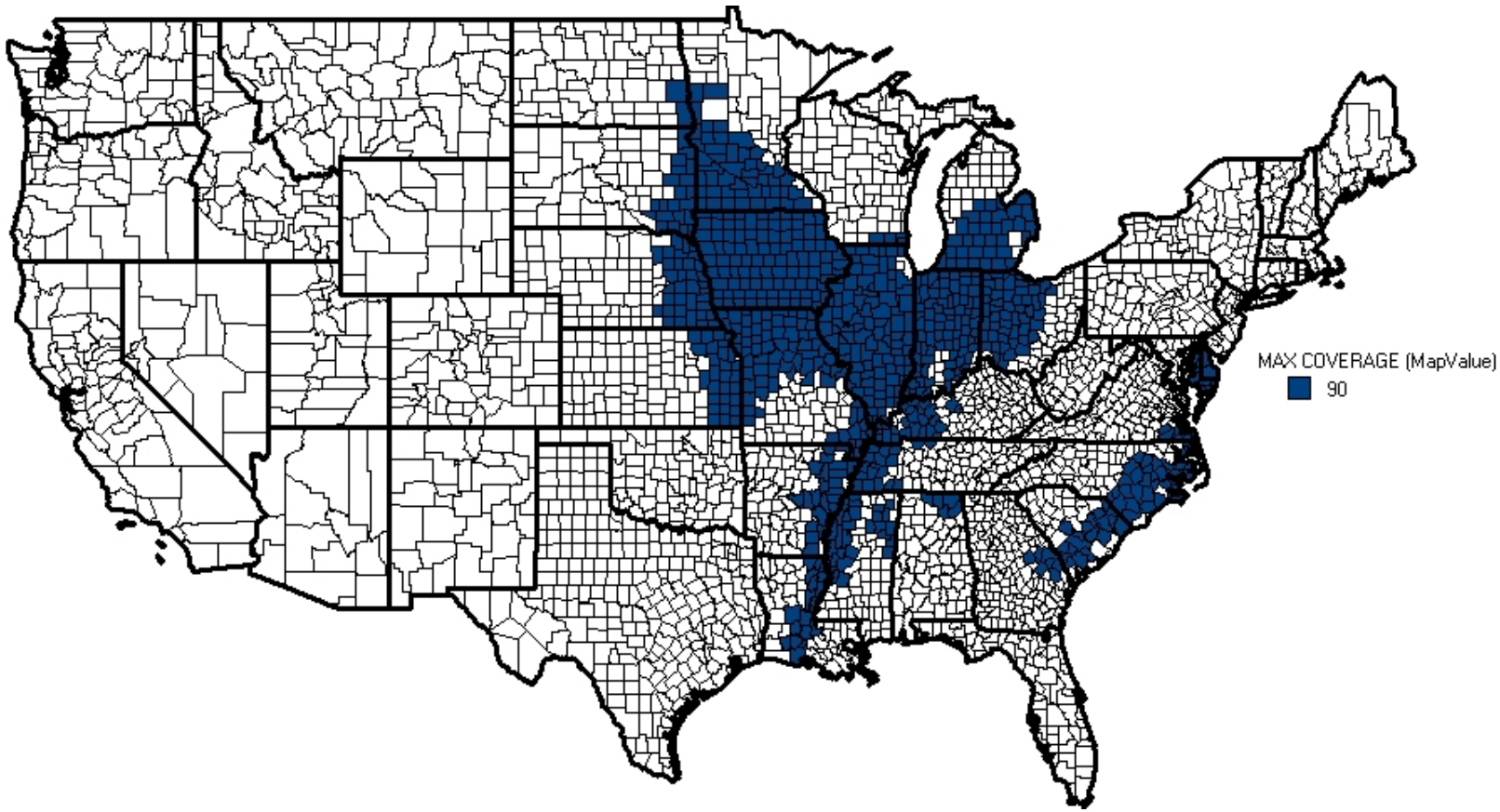
Corn GRP Availability



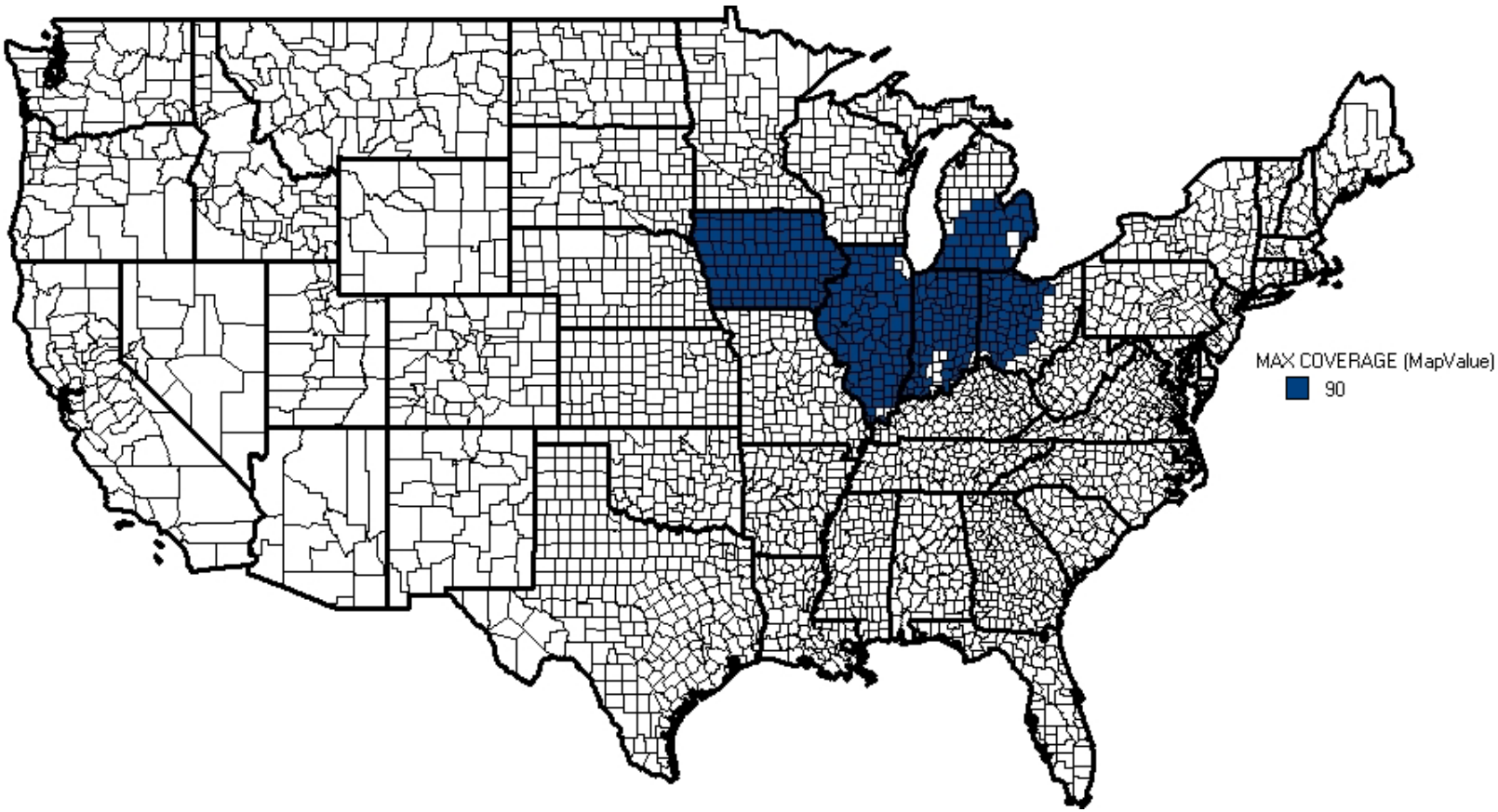
Corn GRIP Availability



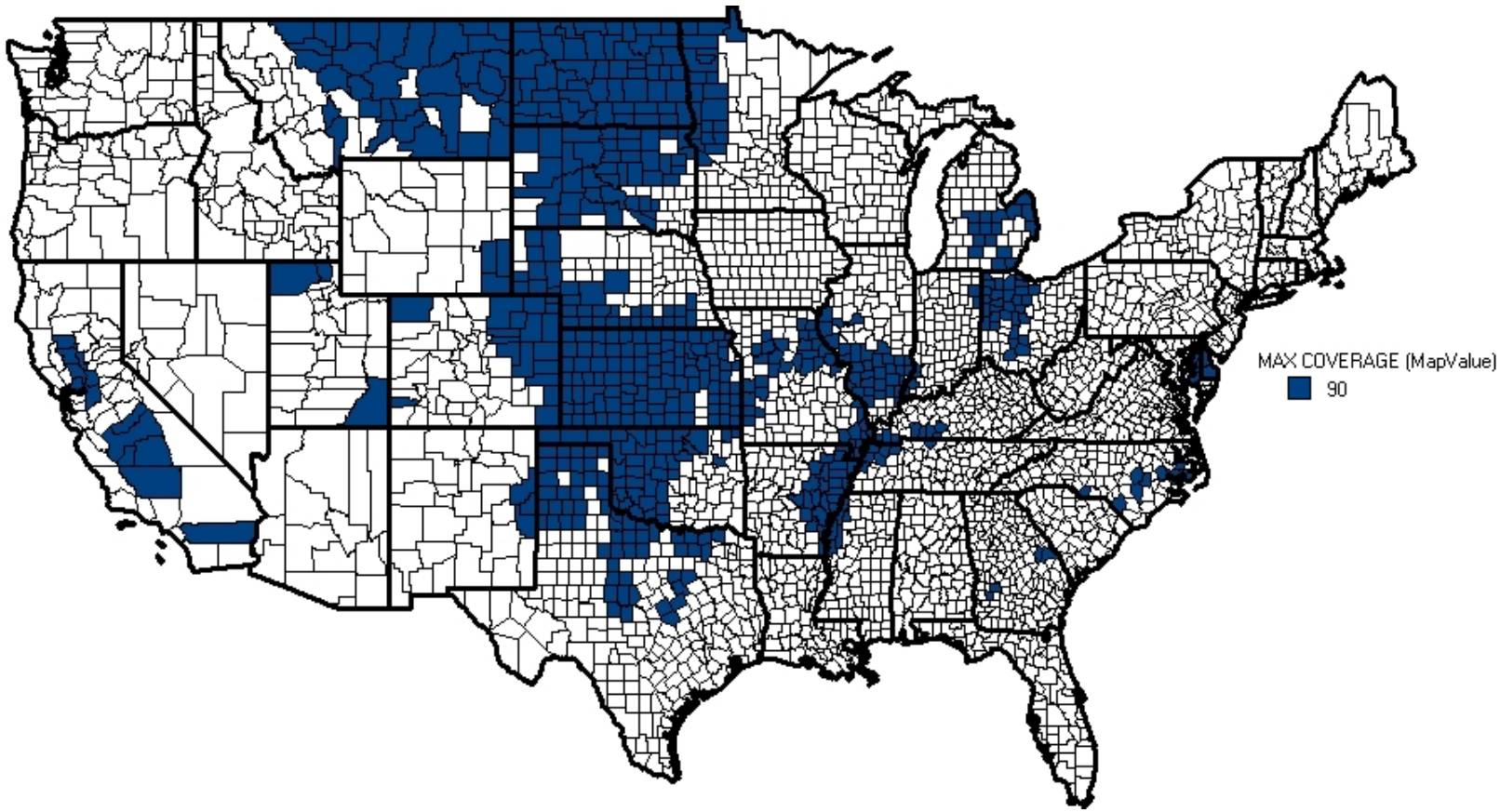
Soybean GRP Availability



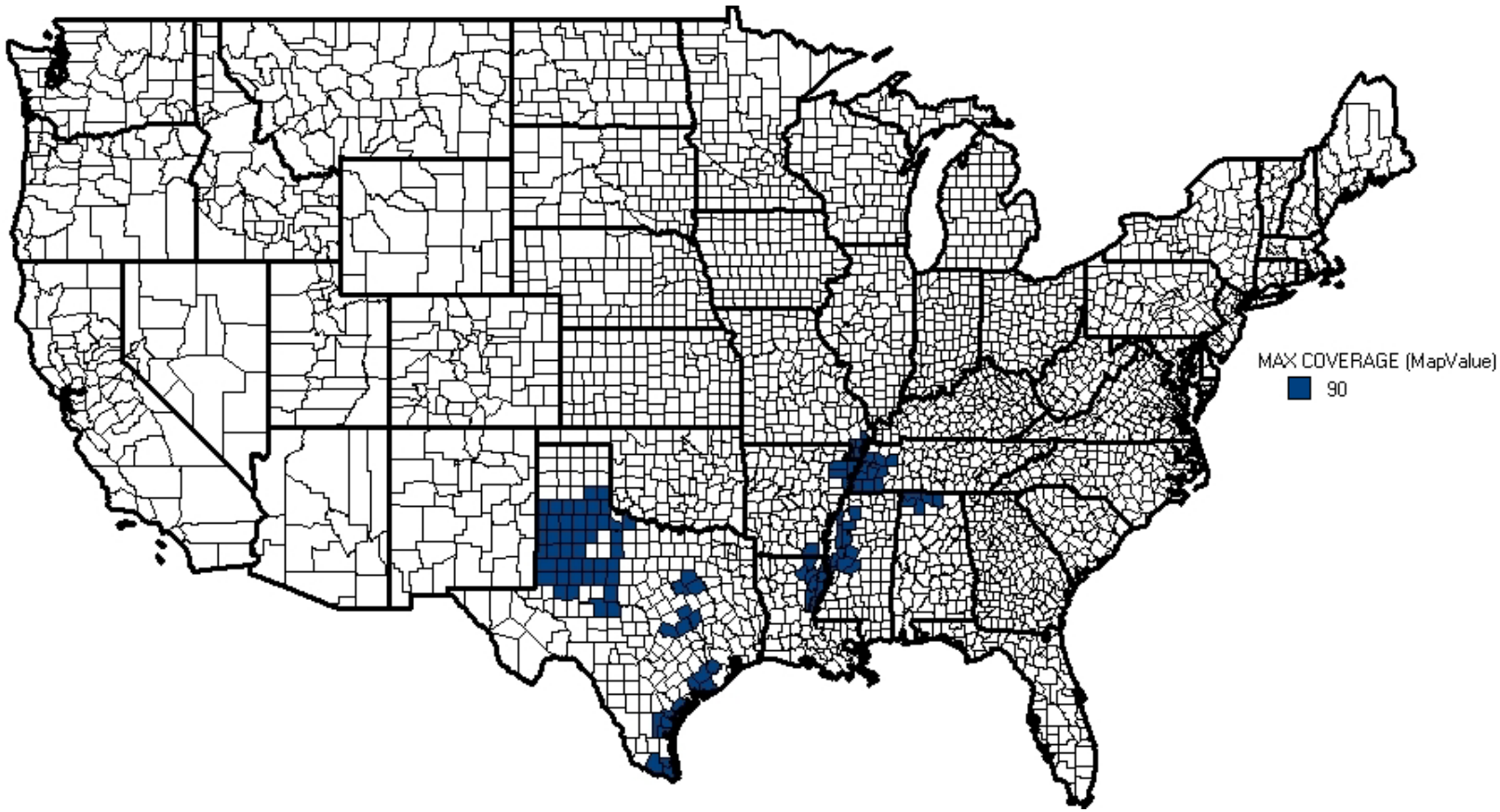
Soybean GRIP Availability



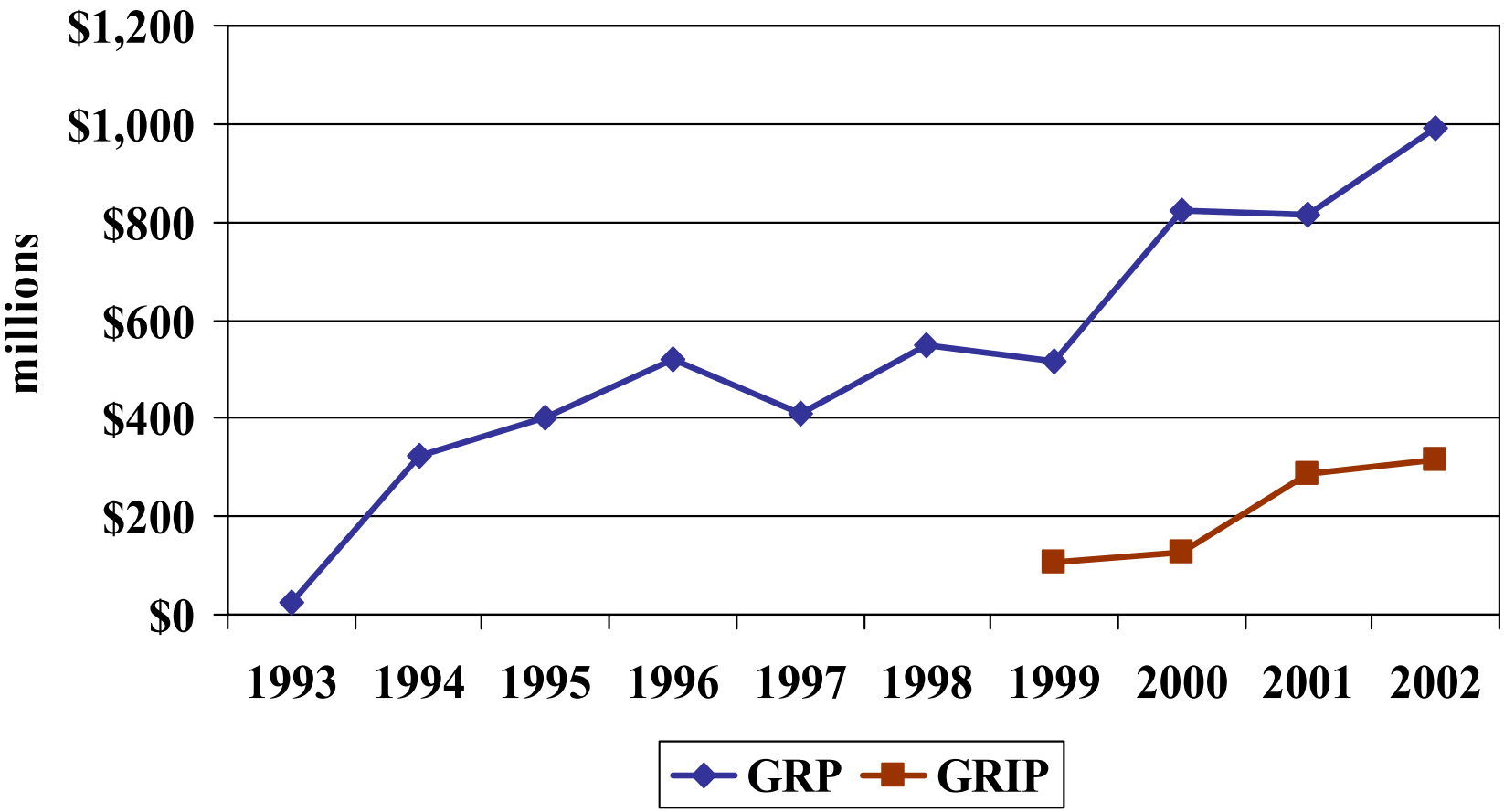
Wheat GRP Availability



Cotton GRP Availability



GRP and GRIP Liability



GRP and GRIP

- In 2003 GRP and GRIP accounted for only 6.3% of total acres insured, and only 4.0% of total liability, in the Federal Crop Insurance Program.

Why Index Insurance?

- Lower transactions costs.
  - No historic farm-level yield data are required.
  - No farm-level loss adjustment is required.
- No moral hazard (policyholder cannot affect the realized value of the index).
- No need for risk classification.
- Transparency (index is easily accessible).

Limitations of Index Insurance

- Basis Risk!
  - It is possible for a policyholder to experience a loss but not receive an indemnity.
  - It is also possible for a policyholder to not experience a loss but yet receive an indemnity.
  - Are farm-level losses highly correlated with the index?
  - Basis risk varies across commodities, regions, and farms.

Limitations of Index Insurance

- Not always easy for producers to determine whether farm-level losses are correlated with the index.
- Private-sector insurers must be able to offset their loss risk exposure through reinsurance or other financial markets.
- Under Federal Crop Insurance Program authority, the policyholder must be producing the crop that is insured. No speculating. No cross-hedging.

Livestock Price Insurance

- Livestock Risk Protection (LRP).
  - Protects against decreases in the market value of insured cattle or swine.
- Livestock Gross Margin (LGM).
  - Protects against decreases in the margin between the market value of swine and the cost of feed inputs.
- Both are index insurance products because indemnities are based not on prices received (and paid) by the producer but rather on changes in futures market prices (the index).
- Since they cover price rather than yield, basis risk is much lower than for GRP or GRIP.

Weather-Based Index Insurance Products

- Not currently available in the federal crop insurance program. Research is underway.
- Pays indemnities based on the extent to which various weather phenomena (precipitation, temperature, etc.) differ from expected levels.
- Is the weather phenomenon highly correlated with farm yields?
- Is the weather phenomenon measured at an official government weather station highly correlated with realized weather on the farm?

Weather-Based Index Insurance Products

- Likely would be a niche market.
- May hold potential for commodities where it is difficult to measure yield (hay, pasture, rangeland, etc.)

Conclusions

- Index insurance products are not a “silver bullet.” They are an alternative product that may be useful for:
  - Producers who do not have farm-level yield data;
  - Areas where problems have caused premium rates on farm-level products to be prohibitively high;
  - Commodities for which it is difficult to measure yield;
  - Commodities that are highly susceptible to specific weather events (e.g., early freeze).