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ABSTRACT

Over the last three decades, producers in South Dakota have planted increasingly more acres under corn and soybeans and have moved away from producing oats and barley. The wheat production in the state has also increased during this period. The grain handling industry in South Dakota has also changed over time. The number of commercial elevators has significantly decreased during the past 30 years, and the operating capacities of the remaining ones are much larger. Genetically modified (GM) or transgenic corn and soybeans were introduced in 1996. Presently, South Dakota is leading the nation in adoption of transgenic corn and soybeans. Despite some consumers' reluctance to buy food products containing ingredients from biotech crops, the market demand for non-biotech crops is currently very limited. This paper reviews historic trends in South Dakota's grain production and grain handling system during the last three decades. The paper also assesses the readiness of South Dakota's grain-handling industry to respond to a potentially expanded market demand for non-biotech crops segregated from biotech crops.

1. Introduction

In 2002, South Dakota crop producers received an estimated $1.76 billion in cash receipts, which accounted for 46% of the state's agricultural economy (South Dakota Agricultural Statistics Service, 2002). Over the past 30 years, South Dakota producers have increased production of soybeans and corn. The 1997 Census of Agriculture ranked South Dakota ninth in overall soybean production in the nation and eleventh in production of corn for grain (National Agriculture Statistics Service, 2002). South Dakota leads the nation in adoption of transgenic soybeans and corn (USDA, 2002). During the same period, wheat production also increased, while oats and barley plantings declined drastically.

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South Dakota's grain handling industry has also changed. The number of commercial grain elevators in the state has significantly decreased over the past 30 years, and operating capacities of the remaining ones are much larger. Some newer elevators have more than 1 million-bushel capacity and are designed to load 110-railcar "shuttle trains" within 15 hours. Previously, larger elevators could handle a maximum of 54 railcars at one time.

Consolidation has lead to a number of grain handling entities owning multiple facilities. These changes are typical of the U.S. grain handling industry, which is predominantly designed for moving bulk commodities.

Genetically modified (GM) or transgenic grains with attributes such as increased resistance to certain insects and herbicides were introduced in 1996. These grains have appealed to producers because they offer easier insect and weed control and, in some cases, lower production costs. South Dakota leads the nation in adoption of transgenic corn and soybeans.

However, many consumers, especially those in Europe, are reluctant to buy foods containing ingredients from transgenic crops. It is very unlikely that without substantial consumer benefits and persuasive evidence on the safety of GM foods that these public attitudes will change. There is also evidence that, in reaction to the European controversies, the U.S. public has become increasingly concerned, and a number of food manufacturers have started sourcing non-GM ingredients for baby food and other food lines (Gaskell, 2000).

Despite some consumers' reluctance to use food products containing ingredients from biotech crops, the market demand for non-biotech crops is currently very limited. This demand is very fluid and could expand quickly, and there is the possibility that the U.S. grain marketing system may evolve into two segregated channels: one containing commingled biotech and non-biotech grain, and the second containing non-biotech crops not commingled with biotech or transgenic products and free from biotech material up to a specified threshold level.

The main objective of this paper is to review historic trends in South Dakota's grain production and grain handling system during the last three decades and to assess if South Dakota's grain handling industry is ready to respond to a potentially expanded market demand for non-biotech crops segregated from biotech crops.

In this study, South Dakota is divided into 6 regions: West-River (region-1) consists of all counties west of the Missouri River; and the remaining five regions, namely, North Central (region-2), Northeast (region-3), Central (region-4), East Central (region-5), and Southeast (region-6) are similar to the crop reporting districts commonly used by the South Dakota Agricultural Statistics Service.

The paper is organized into seven sections. Following the introduction, grain production and grain handling industry trends are reviewed in sections 2 and 3, respectively. Adoption of transgenic grains and the market uncertainty and segregation of non-biotech grains are discussed in sections 4 and 5, respectively. In Section 6 the readiness of South Dakota's grain handling system to meet the potential demand for non-biotech grains through segregation and identity preservation is examined. Finally, a brief summary is presented in section 7.

2. Grain Production Trends

Corn has been the most widely produced crop in South Dakota during the last three decades (Table 1). Many farmers use a portion of their corn for silage. In this paper, however, the focus is on corn grain. South Dakota produced 278 million bushels of corn in 1992. By 2001, corn production increased to 369.6 million bushels (a 33% increase). The Southeast and East Central regions have consistently been the top corn-producing regions of the state and have showed modest 3% to 6% increases during the last decades. From 1992 to 2001, the most notable increase in corn production was in the North Central region, where production increased from 22.4 to 60.2 million bushels (an increase of 171%).

Over the past 30 years, soybean production has displayed a spectacular increase in South Dakota. In 1972, only 7 million bushels were produced. By 2001, soybean production increased to over 138 million bushels. Today, soybeans are planted in areas of the state where the crop was unknown in the early 1970s. As in the case of corn, the Southeast and East Central have consistently been the top soybean-producing regions in the state, increasing from 1992 to 2001 by 26% and 32%, respectively. The other four regions also reported dramatic increases in soybean production, the most spectacular being over 1000% in the Central region.

The wheat production trend in the state has been mixed. Wheat production decreased from 120 million bushels in 1992 to 77 million bushels in 2001 – a decrease of 35.8%.

In the West River region, wheat production increased from 24 million bushels in 1972 to 35 million bushels in 1992. Since then, production decreased to about 24 million bushels in 2001. In all other regions, wheat production at least doubled during 1972 to 1992 and then decreased by as much as 35% in the Central and 80% in the East Central regions. The West River and North Central regions are the top wheat-producing regions in the state. During 2001, these two regions produced 23.9 and 23.4 million bushels, respectively.

In 1972, South Dakota produced 98 million bushels of oats, and the crop was second only to corn. The East Central region produced 20 million bushels, followed by the Northeast and North Central regions, each with about 18 million bushels.

Statewide oats production increased from 98 million bushels in 1972 to 124 million bushels in 1982. Since then, oats production has significantly declined. Between 1992 and 2001, production in East Central, Northeast, and North Central regions decreased by 90%, 88%, and 68%, respectively. By 2001, oats production in South Dakota dropped to 7.8 million bushels (less than 8% of the 1972 level).

In 1972, South Dakota produced about 21 million bushels of barley. During that year, the North Central, West River, and Northeast regions dominated production, with 6.7, 4.3, and 3.9 million bushels, respectively. Barley production remained steady statewide at 20 to 23 million bushels until 1992. Since then production has declined to merely 4.1 million bushels in 2001. In 2001, the North Central and West River regions continued to be the top barley-producing regions in the state. Between 1992-2001, barley production in the North Central and West River regions, however, had decreased by 59 and 63%, respectively. Between 1992 and 2001, barley production in the state decreased from 20 to 4 million bushels (a decrease of 71%).

Between 1972 and 2001, oats and barley production in South Dakota decreased drastically. Wheat production more than doubled from 1972 to 1992 and then decreased by more than a third. During the last three decades, corn production more than doubled while soybean production increased by almost twenty fold. During the past three decades, an increase in the combined production of corn, soybeans, wheat, oats, and barley outpaced the increase in these grains in the U.S., from 334.7 to 597.8 million bushels (+79%) in South Dakota and from 9.5 to 14.7 billion bushels (+55%) in the U.S.

3. Grain Handling Industry Trends

The grain handling industry in South Dakota has also changed during the same time period. The number of elevators has declined, a statewide trend (Table 2). Consequently, average elevator size and total elevator storage capacities are increasing.

The total number of commercial grain elevators in South Dakota dropped from 387 in 1974 to 275 in 1996 (a decrease of 29%). In the same period, average elevator storage capacity rose from 131 to 443 thousand bushels (an increase of 238%) and total elevator storage capacity increased from 57.7 to 121.3 million bushels (an increase of 110%). During this period, the large increase in storage capacity was due to federal grain storage payments to elevators.

In 1974, the average elevator storage capacity in the Southeast region was small, but between 1974 and 1996, its average elevator storage capacity caught up with the rest of the state. During this period, average elevator storage capacity in each of the Northeast, Central, and East Central regions also increased by at least 100%.

During 1996-2001, these trends in grain handling industry continued. All regions showed a decrease in the number of elevators and an increase in average elevator storage capacity (Table 2). All regions, with the exception of Northeast (with an average decrease of 13.8%), showed an increase in total elevator storage capacity. During this period, the total number of elevators in the state decreased from 275 to 203 (a decrease of 26%) and average elevator storage capacity increased from 443 to 659 thousand bushels (an increase of 48.8%).

As of 2001, the Central region, with average storage capacity of close to a million bushels, leads the state in average elevator storage capacity. The North Central region, with a total storage capacity of 27 million bushels, leads the state in total elevator storage capacity, followed by the Southeast and East Central regions with total storage capacities of 25.7 and 24.5 million bushels, respectively.

Grain elevators are well distributed across the regions, and each region has an array of elevators of different sizes (Table 3). During 2001, there were 203 commercial grain elevators in the state, but capacity information was available for only 159. Of these 159, 39 (25%) were large (with a storage capacity of 800 thousand bushels or more). About half of the rest (37%) were small (with a storage capacity of less than 400 thousand bushels). The remaining elevators (38%) were of medium size (with a storage capacity ranging from 400 to 800 thousand bushels). Size distribution is roughly similar in all regions.

During 2002, the state's three largest grain firms, farmers' cooperatives, owned 29% of all elevators, with combined storage capacity of 49.5 million bushels (37% of total elevator storage capacity).

A relatively new phenomenon in the grain handling industry is large elevators built to load 110-car shuttle trains in about 15 hours. The first 110-car elevator in the state was completed in 1997 in East Central South Dakota by upgrading a previously existing 54-car elevator. As of August 2002, South

Dakota has 13 such facilities well distributed around the state (Table 4). Seven are upgrades from 54-car facilities, and the others are newly built. Another 54-car elevator in Central South Dakota is being upgraded to 110-car facility.

Regional changes in total elevator storage capacities relative to the changes in the availability of grain can be helpful in identifying regions with excessive elevator capacities. Between 1974 and 1996, grain available to elevators as well as the total elevator capacity increased in every region (Table 5). During this period, regional increases in grain available to elevators were larger than increases in total regional elevator capacity, resulting in an increase in the average turnover ratio for every region with the exception of the Northeast.

In the Northeast, grain handled by elevators increased from 27.4 to 60.9 million bushels (an increase of 122%) while total elevator storage capacity increased from 9.8 million bushel to 23.9 million bushels (an increase of 144%), resulting in a drop in turnover ratio from 2.8 to 2.6. Between 1996 and 2001, the number of elevators in Northeast region decreased by 41% (Table 2), and total elevator storage capacity decreased from 23.9 to 20.6 million bushels. Consequently, in 2001, the turnover ratio for Northeast region improved to 3.37 (Table 5).

With the exception of the Northeast and North Central regions, total elevator storage capacities continued to increase while the grain available to elevators did not increase, leading to a decline of regional turnover ratios. For 2001, the lowest turnover ratios were for West River and Central regions. Considering that a lower level of grain harvest during 2002 is likely, the elevators in these regions may have an extremely difficult year.

4. Adoption of Transgenic Crops

Rapid adoption of new technologies within U.S. agriculture has resulted in sustained increases in agricultural productivity and ensured abundance of food in the U.S. More recently, U.S. farmers are adopting biotechnology innovations derived from the use of genetic engineering techniques, which modify the organism by recombinant DNA (Fernandez-Cornejo and McBride, 2002). Beyond their impact on productivity, these innovations have caused concern about their potential impact on environment, opening a Pandora's box of issues surrounding consumer choice, particularly in Europe (Fernandez-Cornejo and McBride, 2002).

The most widely and rapidly adopted transgenic crops in the United States are those with herbicide-tolerant (Ht) traits. These crops are developed to survive the application of glyphosate, an herbicide effective on many species of grasses, broadleaf weeds and sedges. Glyphosate-tolerant (Roundup Ready®) soybeans became available to U.S. farmers in 1996 (Fernandez-Cornejo and McBride, 2002). The Ht soybeans were planted on about 17% of soybean acres in 1997, 56% in 1999, and 75% in 2001 (Table 6). Adoption of Ht corn has been much slower; it expanded to 9% in 1998, dropped to 6% in 2002, and rose back to 9% in 2002. It has yet to reach 10% in the U.S. (Table 6).

"Crops inserted with insect-resistant traits have also been widely adopted. Bt crops containing the gene from a soil bacterium, *Bacillus thuringiensis*, are the only insect-resistant crops commercially available. The bacteria produce a protein that is toxic when ingested by certain Lepidopteran insects (insects that go through a caterpillar stage). … Bt has been built into several crops, including corn and cotton." (Fernandez-Cornejo and McBride, 2002, pp.4)

After its introduction in 1996, Bt corn grew to 8% of U.S. acreage in 1997, 26% in 1999, fell to 18% in 2000, and climbed up to 22% in 2002 (Table 6). Transgenic corn containing both Ht and Bt attributes, also called stacked corn, has also been available, but its adoption has been limited to 2% of U.S. acreage (Table 6).

The adoption of Ht soybeans in the United States is independent of farm size. However, adoption of Ht and Bt corn is positively related to farm size. For Ht corn, this appears due to its low overall adoption rate, which implies that adopters were largely innovators and early adopters. As is widely known, adoption, in its early stages, is responsive to farm size. The relationship between Bt corn and farm size may be due to the fact that Bt corn targets a pest problem that is generally most severe in areas where corn-growing operations are largest (Fernandez-Cornejo and McBride, 2002).

South Dakota is the leading state in adoption of both transgenic soybeans and transgenic corn. In 2002, transgenic soybeans accounted for 75% of soybean acres planted in the U.S. compared to 89% of soybean acres planted in South Dakota (Table 6). During 2002, one in three acres of corn planted in the U.S. was planted with transgenic corn whereas two thirds of all corn acres planted in South Dakota were planted with transgenic corn (Table 6).

5. Market Uncertainties and Segregation of Non-biotech Grain

Despite U.S. farmers' rapid adoption of biotech crops, market prospects for genetically modified (GM) crops are uncertain. Some consumers in the U.S. and abroad, particularly in the European Union (EU), remain wary of using these crops as ingredients in food processing, despite the fact that the U.S. Food and Drug Administration has determined that biotech foods currently in the market are as safe for human consumption as their non-biotech counterparts.

Shifts in market demand arising from shifts in consumer preferences have been quite modest so far. However, the U.S. grain handlers, food manufacturers, and others in the global marketing chains are attempting to balance the issue of divergent consumer demand with producers' desire to capture the cost-saving potential of biotech crops. U.S. grain handlers generally take the position that, if buyers are willing to pay premiums for non-biotech crops, some U.S. grain handlers can meet these demands and pass along additional premiums to farmers (Lin, 2002, pp. 262).

A number of countries now require that foods containing biotech ingredients be labeled. The EU, Japan, South Korea, Australia, New Zealand, and China among other countries either require or plan to require mandatory labeling for bio-engineered foods (Lin, 2002, pp. 263). Moreover, polls of American adults have also found that a strong majority (62% to 70%) of respondents would like genetically engineered foods to be labeled (Center for Science in Public Interest, 2002). This widening interest in food labeling regulation is an additional reason for farmers and grain handlers to assess their ability to segregate major crops to meet potential demand for non-biotech and biotech crops (Lin, 2002, pp. 263).

The market demand for non-biotech corn and soybeans is currently very limited, accounting for about 1 to 2% and 2 to 3% of 1999 U.S. corn and soybean production, respectively. These demands are largely from Japan, EU, and a handful of domestic food manufacturers that use only non-biotech ingredients (Lin, 2002, pp. 261). However, the demand for non-biotech commodities is highly fluid and could expand quickly, depending upon consumer preferences for non-biotech food products and use of non-biotech ingredients in livestock feed. If the demand for non-biotech were to strengthen, it would be necessary to form supply chains on a larger scale that would keep the non-biotech products separate from commodity products. This can be achieved through either “segregation” or “identity preservation (IP).” These marketing practices, aimed to preserve a commodity’s unique characteristics, are similar to the practices already used to preserve differentiation in markets. Such practices are commonly used for value-enhanced commodities such as high-oil corn and STS soybeans –(non-biotech herbicide tolerant soybeans) (Lin, 2000, pp.30).

“Segregation requires that crops be kept separate to avoid commingling during planting, harvesting, loading and unloading, storage, and transport. This supply chain system requires cleaning of equipment such as combines and augers, as well as transport and storage facilities. Such a handling process may not involve containerized shipment, but testing to check for the presence of biotech content throughout the marketing system is critical” (Lin, 2002, pp.263).

Effective segregation begins at the farm level and is particularly difficult for corn because of cross-pollination. In addition, farmers are also required to clean combines during harvesting and may need to expand on-farm storage facilities for segregating grains into biotech and non-biotech varieties (Lin, 2002, pp., 263).

At the elevator, segregation can cause delays during peak harvest periods and slow the rate of turnover. There also may be additional costs of cleanout (Lin, 2002, pp. 263-64). The elevator's ability to segregate depends in large part on the size of the operation and the type of facilities at each location.

Segregation may require new investment for some elevators. According to the National Grain and Feed Association, roughly 5% of the nation's elevators can achieve segregation without major new 8investments if the tolerance level for biotech content is set at a low level approaching 1% (Lin, et al., 2000, pp. 31).

A recent University of Illinois study examined segregating costs based on a survey of U.S. grain elevators and specialty grain firms (Bender et al., 1999). This study concluded that segregation of specialty grain adds, on an average, $0.06 per bushel for high oil corn and $0.18 per bushel for STS soybeans over and above the customary costs of handling standard bulk commodities at country elevators (Lin, et al., 2000, pp.32). The USDA Economic Research Service (ERS) adjusted these costs to reflect a two-tier segregation (first, segregating biotech from non-biotech varieties, and then separating biotech varieties into those approved for shipment to the EU and those not approved for shipments to the EU) and higher testing costs for biotech contents. After adjusting, it was concluded that segregating non-biotech corn could add about $0.22 per bushel (excluding premiums to producers) to the cost of handling non-biotech corn from country elevator to export elevator (Lin, 2002, pp. 265). According to industry sources, the purchasing premiums in 2002 ranged from $0.05 to $0.10 per bushel for non-biotech corn (Lin, 2002, pp. 268).

For segregating soybeans, there is only need for a one-tier segregation (into non-biotech and biotech soybeans), as only Round-up Ready® soybeans, presently grown commercially in the U.S are EU-approved. Accordingly, the testing costs for non-biotech soybeans are about $0.01 per bushel at each of the elevator points (country elevator, sub-terminal elevator, and export terminal).

ERS estimated that if the segregation of non-biotech soybeans is patterned after the STS soybean segregation model, it would add $0.54 per bushel (excluding premiums to producers) to the usual cost for handling soybeans from country elevators to export elevator (Lin et al., 2000, p 32). In a later study, however, Lin (2002, p. 268) argues that the cost of segregating non-biotech soybeans by following the handling process used for high oil corn adds only 18 cents per bushel (excluding premium to producers) over the usual cost for handling commodity soybeans. According to industry sources, the purchasing premiums in 2002 ranged from $0.10 to $0.15 per bushel for non-biotech corn (Lin, 2002, pp. 268).

Segregation can also pose logistical problems for grain transportation. Currently, grains are commonly transported in unit trains of up to 110 cars or by barge. If segregation makes it necessary to shift away from unit trains toward smaller units, transportation costs could increase, depending upon the tolerance level for biotech grain contamination. According to industry sources, the increase in transportation costs would, however, be modest if the threshold is set at 5% or higher (Lin et al., 2000, pp.31).

Identity preservation (IP) is a more stringent (and expensive) handling process and requires that strict separation, typically involving containerized shipping, is maintained at all times (Lin, et al. 2000, pp. 30). IP implies that food and feed ingredients can be traced back through the marketing chain, ultimately to the producer. The explicit and implicit costs of IP systems can range from facility cleaning expenses to underutilized storage capacity and increased shipping costs (Maltsbarger and Kalaitzandonakes, 2000). Typically, in the case of IP, testing is done just before containerization. IP lessens the need for additional testing as control of the commodity changes hands. This handling process might be required to meet stringent threshold levels of biotech content, such as the 1% required under EU labeling regulations. However, no IP system can guarantee 100% purity (Lin, 2002, pp. 263).

IP is often used for marketing food grade corn and soybeans. There also has been an increased interest in marketing wheat under IP. For example, a number of firms in Kansas, Washington, and Arizona have reported selling specific varieties of wheat under IP. The Manitoba Pool Elevators in Canada also has sold IP wheat to a United Kingdom company on a variety and location basis. Several internet-based firms (e.g. Farmer Connect, Amerigrains, IP.com, and ICE.com) are attempting to sell IP grains (Dahl and Wilson, 2002, pp.4). IP has also been used to keep genetically modified canola and its by-products segregated in Canada for channeling to markets accepting these products (Smyth and Phillips, 2001).

So far the genetically engineered corn and soybeans available to producers mostly have the attributes known as "input traits," which may lower the cost of production but have no added value to the consumer. However, the genetically modified crops to be released in the next round are expected to have "output traits," which would add value rather than altering production practices. Crops with these value-enhanced attributes will have to be handled through some IP system to preserve the integrity of their premium-capturing attributes (Ginder, 2001).

Producers planting IP crops are usually subjected to the opportunity cost forgone by not utilizing the cost-reducing traits of alternative varieties or production systems, and they also may incur higher storage, handling, and drying expenses. They also incur additional costs in the form of the time and labor spent to clean equipment and storage bins (Ginder, 1999).

6. Potential for Segregation and Identity Preservation

Obviously, an elevator can handle a non-biotech crop segregated from its biotech counterpart only if the elevator storage facility can be divided into a number of separate units. For example, an elevator handling two crops (say, corn and soybeans) needs to have a facility with four separate storage units. If the manager of an elevator decides to adopt two-tier segregation for corn, the storage facility needs to be divided into at least five separate units. We can assume that the ability to divide the storage facility into five separate units in an indicator that the elevator is equipped to segregate non-biotech from biotech corn and soybeans without additional investment.

Storage facilities at 17% of the elevators in the state can be divided into five separate units (Table 7). In West River and North Central regions, 27% to 32% elevators have storage facilities that can be divided into five separate units (Table 7). For the remaining four regions, 8 to 14% elevators have the capability to divide the storage space into five separate units.

The National Grain and Feed Association estimated that at a 1% or lower tolerance level for biotech content, roughly 5% of the nation's elevators can achieve segregation without new investments (Lin, 2000, pp.31). We feel that the South Dakota grain handling system is well equipped to segregate corn and soybeans at about 10 to 15% of the elevators in the state. Additionally, if the market demand for non-biotech grain expands, some elevators may switch over to exclusively handle non-biotech crops. This may be an alternative for medium-size elevators facing a strong competition from new, larger elevators.

Recently two individuals, producing IP soybeans for tofu under contract for a Japanese company, purchased a grain handling facility in the North Central South Dakota. This facility, with 400 thousand bushel storage capacity, was a commercial elevator and will be dedicated exclusively for cleaning and storing the IP soybeans prior to containerization.

In a recently completed survey, South Dakota elevator managers were asked about their willingness to consider IPs and the average premiums they expect for handling different IP grains. Their answers are summarized in Table 8. Among those who handled corn, 29% of elevator managers in the state are familiar with the IP and 53% indicated their willingness to consider IP's for an average premium of $0.28 per bushel. The North Central, Northeast, East Central, and Southeast are the four top corn-producing regions. In these regions, 42 to 72% elevator managers are willing to consider IPs with a premium of $0.23 to $0.30 per bushel.

Of those who handled soybeans, 30% of elevator managers are familiar with IP and 58% indicated their willingness to consider IPs at an average premium of $0.37 per bushel. In the top four soybean-producing (North Central, Northeast, East Central, and Southeast) regions 31 to 73% of elevator managers are willing to consider IPs with an average premium of $0.30 to $0.50 per bushel.

Among those who handled wheat, 47% of elevator managers are familiar with IP and are willing to consider IPs if the average premium is $0.38 per bushel. In case of the top four wheat-producing (West River, North Central, Northeast, and Central) regions, 40 to 67% of elevator managers are willing to consider IPs for the average premium ranging from $0.29 to $0.53 per bushel.

As in case of non-IP grains, the costs of handling IP grains are volume dependent. Accordingly, the premiums for different IP grains, reported by elevator managers, must be considered as ballpark figures at an average level. The cost of handling IP grains and the associated premiums will decrease as the market demand for these IP grains increases or the quantity of IP grain handled by an elevator increases. The availability of farmer owned storage for storing IP grains can also influence the feasibility of handling IP grains.

7. Summary and Conclusions

During the last three decades, oats and barley production in South Dakota decreased drastically and wheat production increased. Corn production more than doubled and soybean production increased by almost twenty fold. Corn, soybeans, wheat, oats, and barley, combined, increased by 79%, outpacing the 55% increase in the U.S.

The number of elevators in the state has declined in the same three decades. Smaller elevators have been replaced by larger facilities and total elevator storage capacity has increased. A relatively new phenomenon is the larger elevators built to load 110-car shuttle trains in about 15 hours. In recent years, total elevator capacities in most regions have increased faster than the quantity of grain handled by elevators, leading to a decline in turnover ratios.

U.S. farmers are rapidly adopting genetically modified or transgenic crops with herbicide-tolerant (Ht) traits as in case of Roundup Ready® soybeans and insect resistant traits as in case of Bt corn. South

Dakota has been a leading state in adoption of transgenic crops; 89% and 66% of soybean and corn acres, respectively, are planted to these biotech crops.

It is estimated that 10 to 15 % of South Dakota elevators can easily segregate non-biotech grain without any additional investment. Additionally, if the market demand for non-biotech grain expands, some elevators may be dedicated to exclusively handle non-biotech crops. Roughly half of elevator managers are willing to consider handling identity preserved grains for an average premium of \$0.28, \$0.37, and \$0.38 per bushel of corn, soybeans, and wheat, respectively. In our opinion, South Dakota's grain handling industry is reasonably ready to participate in segregation as well as identity preserved grains if the demand for non-biotech expands.

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Table 1. Production of major grains in South Dakota, by region, 1972-2001.

Grain/Region	1972 (mil bu)	1982 (mil bu)	1992 (mil bu)	2001 (mil bu)	1992-2001 (% Change)
Corn					
1. West River	7.0	8.6	9.9	18.5	86.87%
2. North Central	15.5	11.1	22.4	60.5	170.09%
3. Northeast	16.1	22.6	32.6	55.7	70.86%
4. Central	13.5	20.4	26.7	40.2	50.56%
5. East Central	45.0	68.8	88.1	90.9	3.18%
6. Southeast	58.2	62.4	98.3	103.8	5.60%
South Dakota	**155.3**	**193.9**	**278.0**	**369.6**	**32.95%**
Soybeans					
1. West River	0.0	0.0	0.3	2.0	566.67%
2. North Central	0.0	0.1	5.0	30.0	500.00%
3. Northeast	0.6	2.4	10.3	27.7	168.93%
4. Central	0.0	0.3	1.1	12.4	1027.27%
5. East Central	1.5	7.3	18.7	31.9	70.59%
6. Southeast	4.9	14.2	27.5	34.6	25.82%
South Dakota	**7.0**	**24.3**	**62.9**	**138.6**	**120.35%**
Wheat					
1. West River	24.6	35.2	23.0	23.9	3.91%
2. North Central	13.4	23.8	40.1	23.4	-41.65%
3. Northeast	6.8	15.7	24.2	13.5	-44.21%
4. Central	7.4	15.6	21.0	13.6	-35.24%
5. East Central	0.8	5.5	7.0	1.4	-80.00%
6. Southeast	0.6	2.6	4.4	1.0	-77.27%
South Dakota	**53.6**	**98.4**	**119.7**	**76.8**	**-35.84%**
Oats					
1. West River	15.1	14.0	7.2	2.1	-70.83%
2. North Central	17.8	13.2	6.8	2.2	-67.65%
3. Northeast	18.1	18.5	6.0	1.1	-81.67%
4. Central	10.0	12.7	4.8	0.6	-87.50%
5. East Central	20.0	35.2	9.2	0.9	-90.22%
6. Southeast	17.0	30.1	8.9	0.9	-89.89%
South Dakota	**98.0**	**123.7**	**42.9**	**7.8**	**-81.82%**
Barley					
1. West River	4.3	2.0	3.2	1.4	-59.38%
2. North Central	6.7	6.2	8.4	1.6	-63.10%
3. Northeast	3.9	6.5	4.4	0.7	-75.00%
4. Central	2.0	2.6	2.3	0.2	-91.30%
5. East Central	2.7	4.7	1.4	0.1	-92.86%
6. Southeast	1.0	1.2	0.8	0.1	-87.50%
South Dakota	**20.6**	**23.2**	**20.5**	**4.1**	**-71.22%**

Source: South Dakota Agricultural Statistics Service (2002).

Table 2. Grain elevators in South Dakota, by region, selected years.

Region/State	1974[a]	1996[b]	2001[c]	1974-96 (% change)	1996-2001 (% change)
		…..… **Number of elevators** ………			
1. West River	61	40	32	-34.4%	-20.0%
2. North Central	81	49	39	-39.5%	-20.4%
3. Northeast	69	56	33	-18.8%	-41.1%
4. Central	35	23	19	-34.3%	-17.4%
5. East Central	75	58	38	-22.7%	-34.5%
6. Southeast	66	49	42	-25.8%	-14.3%
South Dakota	**387**	**275**	**203**	**-28.9%**	**-26.2%**
		... Avg. elevator capacity (in th bu) …			
1. West River	167	383	525	129.3%	37.1%
2. North Central	206	512	692	148.5%	35.2%
3. Northeast	142	435	624	206.3%	43.5%
4. Central	177	548	937	209.6%	71.0%
5. East Central	125	395	645	216.0%	63.3%
6. Southeast	83	444	612	434.9%	37.8%
South Dakota	**131**	**443**	**659**	**238.2%**	**48.8%**
		... Total elevator capacity (in mil bu) …			
1. West River	10.18	15.19	16.80	49.2%	10.6%
2. North Central	16.65	24.19	27.00	45.3%	11.6%
3. Northeast	9.79	23.91	20.60	144.2%	-13.8%
4. Central	6.20	12.58	17.80	102.9%	41.5%
5. East Central	9.39	23.39	24.50	149.1%	4.8%
6. Southeast	5.49	22.04	25.70	301.5%	16.6%
South Dakota	**57.70**	**121.30**	**132.40**	**110.2%**	**9.2%**

[a] Source: Lamberton and Rudel (1976)

[b] Source: Qasmi and McDaniel (1997)

[c] Source: South Dakota Public Utilities Commission (2002)

Table 3. Grain elevators in South Dakota, by size, 2001.

Region/State	Small (<400 th bu)	Medium (400-800 th bu)	Large (>800 th bu)	Others[a]	Total
1. West River	10	8	4	10	32
2. North Central	11	12	7	9	39
3. Northeast	9	11	6	7	33
4. Central	5	4	6	4	19
5. East Central	9	15	8	6	38
6. Southeast	15	11	8	8	42
South Dakota	**59**	**61**	**39**	**44**	**203**

[a] Capacity information not available.

Source: South Dakota Public Utilities Commission (2002)

Table 4. Elevators equipped to handle 110 car shuttle trains in South Dakota, 2001.

Region/State	110 Car Elevators	Completion Year (Upgraded[a]/New)
1. West River	2	2001(New), 2002(Upgraded)
2. North Central	3	1999(New), 2000(Upgraded), 2000(Upgraded)
3. Northeast	0	-
4. Central	1	1999(New)
5. East Central	4	1997(Upgraded), 1998(Upgraded), 2001(Upgraded), 2001(New)
6. Southeast	3	Upgraded (1997, 1998), New (1998)
South Dakota	**13**	

[a] From 54 railcars to 110 railcar facility.

Source: South Dakota Grain & Feed Association (2002).

Table 5. Elevator capacity and grain availability in South Dakota, by region, 1974-2001.

Year/Region	Grain Production (mil bu)	Grain Handled by Elevators (mil bu)	Total Elevator Capacity (mil bu)	Turnover Ratio
1974[a]				
1. West River	36.73	14.25	10.18	1.40
2. North Central	23.37	21.65	16.65	1.30
3. Northeast	22.71	27.40	9.79	2.80
4. Central	23.94	8.06	6.20	1.30
5. East Central	67.14	30.99	9.39	3.30
6. Southeast	65.22	24.14	5.49	4.40
South Dakota	**239.11**	**126.49**	**50.60**	**2.50**
1996[b]				
1. West River	58.28	46.52	15.19	3.06
2. North Central	97.75	74.38	24.19	3.07
3. Northeast	87.25	60.91	23.91	2.55
4. Central	75.93	54.04	12.58	4.30
5. East Central	135.76	84.14	23.39	3.60
6. Southeast	171.69	106.16	22.04	4.82
South Dakota	**626.66**	**426.15**	**121.30**	**3.51**
2001[c]				
1. West River	47.95	36.57	16.80	2.18
2. North Central	117.69	84.64	27.00	3.13
3. Northeast	98.70	69.39	20.60	3.37
4. Central	67.04	46.58	17.08	2.73
5. East Central	125.19	79.33	24.50	3.24
6. Southeast	140.35	88.12	25.70	3.43
South Dakota	**596.92**	**404.63**	**131.68**	**3.07**

[a] For year 1974, production and handling data include wheat, corn, barley, oats, sorghum, flax, and soybeans. Sorghum production in the state for the year was 5.44 million bushels of which 2.0 and 2.6 million bushels were produced in the West River and Southeast regions, respectively. Flax production in the state for the year was 3.8 million bushels of which 2.1 and 1.1 million bushels were produced in Northeast and East Central regions, respectively. Regional elevator capacity estimates are based on the turnover ratios and grain handled information from Lamberton & Rudel (1976), and accordingly do not add up to the total elevator capacity in the state. Regional turnover ratios are the averages of the turnover ratios for different size elevators in the region weighted by the size.

[b] For year 1996, production and handling data include wheat, corn, barley, oats, and soybeans. The proportions of the production available to elevators are based on Qasmi & McDaniel (1997) estimates (52% of corn, 96% of soybeans, 100% of wheat, 34% of oats, and 32% of barley).

[c] Year 2001 production and handling data are for corn, wheat, soybeans, oats, and barley. The quantity of grain available to elevators was estimated using the proportions from Qasmi & McDaniel (1997).

Sources: Lamberton & Rudel (1976), Qasmi & McDaniel (1997), South Dakota Agricultural Statistics Service (2002), South Dakota Public Utilities Commission (2002).

Table 6. Adoption rates of transgenic grains in the U.S. and South Dakota, 1996-2002.

	1996	1997	1998	1999	2000	2001	2002
In United States:	**…. Percent of respective grain acres planted ….**						
Ht Soybeans	7.4	17.0	44.2	55.8	54.0	68.0	75.0
Bt corn[1]	1.4	7.6	19.1	25.9	18.0	18.0	22.0
Ht corn[2]	3.0	4.3	9.0	8.0	6.0	7.0	9.0
Stacked corn	0.0	n.a.	n.a.	n.a.	1.0	1.0	2.0
All GE corn	4.4	11.9	28.1	33.9	25.0	26.0	33.0
In South Dakota:	**…. Percent of respective grain acres planted ….**						
Ht Soybeans	n.a.	n.a.	n.a.	n.a.	68.0	80.0	89.0
Bt corn[1]	n.a.	n.a.	n.a.	n.a.	35.0	30.0	33.0
Ht corn[2]	n.a.	n.a.	n.a.	n.a.	11.0	14.0	23.0
Stacked corn	n.a.	n.a.	n.a.	n.a.	2.0	3.0	10.0
All GE corn	n.a.	n.a.	n.a.	n.a.	48.0	47.0	66.0

[1] Estimates for herbicide-tolerant and Bt corn for U.S. for the years 1997 to 1999 include stacked varieties (containing both Bt and herbicide-tolerant genes). This means that the percent of acres devoted to stacked varieties are included in both the Bt and herbicide-tolerant crop estimates. For the years 2000-2002, the percent of acres in stacked varieties are known.

[2] Includes seeds obtained by traditional breeding but developed using biotechnology techniques that were used to identify the herbicide-tolerant genes.

n.a. Not available.

Data Sources: Fernandez and McBride (2000); USDA (1999, 2000,and 2002).

Table 7. Elevators capable of segregating in South Dakota, 2002.

Region	Elevators with Separable Facilities (number)	Elevators with Separable Facilities (%)	Total Separable Capacity (mil bu)	Total Separable Capacity (%)
	…..... Elevators with 4 or more separable units …...			
1. West River	6	40%	2.45	42%
2. North Central	6	46%	3.61	35%
3. Northeast	2	14%	2.47	21%
4. Central	3	33%	4.31	58%
5. East Central	1	8%	0.79	8%
6. Southeast	6	33%	3.37	21%
South Dakota	**24**	**29%**	**16.99**	**27%**
	………... Elevators with 5 separable units ………...			
1. West River	4	27%	2.10	36%
2. North Central	4	31%	2.66	26%
3. Northeast	2	14%	2.47	21%
4. Central	1	11%	3.10	42%
5. East Central	1	8%	0.79	8%
6. Southeast	2	11%	1.45	9%
South Dakota	**14**	**17%**	**12.57**	**20%**

Note: Based on a sample of 82 South Dakota grain elevator managers surveyed in August 2002.
Source: Qasmi et al., forthcoming.

Table 8. Elevator managers willing to consider handling identity preserved grains and their expected premiums, South Dakota, 2002.

Region	Respondents (number)	Respondents Familiar With IP (%)	Respondents Willing to Consider IP (%)	Avg. Expected Premium to Consider IP (cents/bu)
	……………..... **Elevators handling corn** …………………			
1. West River	12	16.7%	25.0%	34
2. North Central	12	50.0%	66.7%	30
3. Northeast	14	21.4%	42.9%	23
4. Central	8	12.5%	62.5%	37
5. East Central	12	16.7%	41.7%	23
6. Southeast	18	44.4%	72.2%	25
South Dakota	**76**	**28.9%**	**52.6%**	**28**
	…………. **Elevators handling soybeans** ………………			
1. West River	4	25.0%	25.0%	18
2. North Central	11	54.5%	72.7%	50
3. Northeast	14	14.3%	64.3%	42
4. Central	7	14.3%	57.1%	39
5. East Central	13	23.1%	30.8%	31
6. Southeast	18	38.9%	72.2%	30
South Dakota	**67**	**29.9%**	**58.2%**	**37**
	……………….. **Elevators handling wheat** …………………			
1. West River	15	33.3%	40.0%	47
2. North Central	12	50.0%	66.7%	29
3. Northeast	13	15.4%	46.2%	38
4. Central	6	33.3%	50.0%	53
5. East Central	6	0.0%	33.3%	18
6. Southeast	6	50.0%	33.3%	50
South Dakota	**58**	**46.6%**	**46.6%**	**38**

Note: Based on a sample of 82 South Dakota grain elevator managers surveyed in August 2002.
Source: Qasmi et al., forthcoming.