Case Study

Mountain States Oilseeds: Can Contracts Enhance Safflower Seed Procurement?

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Abstract
This case examines the contracting decisions facing a safflower seed processing company in southern Idaho. Mountain States Oilseeds (MSO) specializes in the procurement, storage, cleaning, drying, packaging, and transportation of safflower seeds. Recent supply chain disruptions coupled with regional drought have greatly decreased safflower seed availability. MSO must adjust their procurement strategy to secure sufficient safflower seed to meet their own commitments to their buyers. This case study illustrates the various hurdles to be overcome in drafting a successful producer-processor agricultural contract (farmer participation, moral hazard, etc.). It also highlights the trade-offs associated with various contractual payment mechanisms common within agricultural contracts (performance payments, acreage payments, and quality adjustments).

1 Introduction

Jason Godfrey, the owner and president of Mountain States Oilseeds (MSO), sits at his desk at the company's headquarters in American Falls, Idaho, following a meeting with his leadership team. Oilseed processing has been a mixed bag for 2022. Consumer demand for processed safflower seed products is currently high, but securing a steady supply of quality safflower seed has been difficult. Jason is under pressure to meet contracts that MSO has previously established with wholesalers and retailers. Without a stable flow of oilseed to the processing facilities, MSO will not be able to meet contractual obligations and could lose important business.

War between Russia and Ukraine has disrupted the supply chain by reducing the amount of oilseeds available on world markets (U.S. Department of Agriculture 2022). In 2021, Ukraine and Russia produced a combined 151,384 tons of safflower seed, which accounted for approximately 24 percent of world safflower production (Food and Agriculture Organization 2023). The war has also led to American farmers experiencing increased costs for fertilizer manufactured in Eastern Europe. Hot weather and persistent drought grip the western United States, forcing growers to rethink crop rotations and focus on allocating water to higher-value crops. These events have pushed U.S. raw safflower seed prices to an unprecedented value of $0.30 per pound.

Despite historically high safflower prices, farmers have been slow to implement it in their crop rotations. Reasons for this hesitance include the ratio of safflower risk to return[1] in the region being low compared to alternatives, unfamiliarity with crop production practices, and the risk involved with producing a crop that sells in a thin market. With the leadership team, Jason has determined that the contracts MSO uses could be updated to include contract mechanisms that increase incentives for grower participation to help stabilize the company's growing need for local safflower production. Jason

[1] Risk to return ratio is defined as the potential loss associated with a given investment divided by the potential gain. In the case of safflower seed, this means that expected profitability per acre is relatively low and that there is a relatively high probability of loss compared with a crop like dryland wheat.

now needs to determine how to structure contracts with farmers to secure high-quality safflower seed while maintaining MSO's own profitability.

1.1 Student Learning Objectives

This case is designed for junior and senior agribusiness and agricultural economic majors. The objective is for students to use agricultural contracting concepts to help a processing plant navigate a thin market and secure its inputs. This study gives students practice working with concepts such as moral hazard, risk sharing, and incentivizing crop attributes. Students should have at least an introductory understanding of agricultural contracting and risk management before attempting the case. More specifically, students should be familiar with the concepts of risk aversion, moral hazard, food attributes, marketing contracts, and production contracts. Student learning objectives are outlined in the following list.

After completing this case, students should:

1. Realize how contract structure shapes price, production, and cost risk between parties.
2. Understand how contracting constraints can impede agricultural contracting.
3. Recognize the various forms of contract payments and how each effects constraints.
4. Gain an understanding of mechanism design and its application to agricultural contracting.
5. Appreciate the impact that changes in markets, production, and supply chains can have on contract structure.

2 Background and Industry Overview

Since its inception in 1974, MSO has continued to grow and prosper. What began as a two-man operation has now grown to 15 employees and three locations. MSO sells safflower, mustard, and flax seed. MSO has become the number one oilseed processor in the United States and one of the world's largest exporters of safflower, mustard, and flax seed. Non-genetically modified organism (GMO) safflower seed is MSO's primary product, averaging 15,000 tons per year. Belgium, Taiwan, and Mexico are the largest buyers of MSO exports.

2.1 Uses and Agronomic Features of Safflower

"Safflower (Carthamus Tinctorus) is an annual thistle-like plant in the sunflower family" (National Integrated Pest Management Database 2016, p. 1). It is harvested for three primary products: oil, meal, and birdseed (National Integrated Pest Management Database 2016). Cultivated varieties are oleic or linoleic according to the type of fatty acids they produce. Seed varieties high in oleic acid are harvested for use as a heat-stable cooking oil that is lower in saturated fatty acids than olive oil and is helpful in the prevention of coronary diseases. Varieties high in linoleic acid are also used for human consumption in salad oils and soft margarine, and as a primary ingredient in moisturizers, soaps, and other cosmetics. This high oil content also makes safflower a potentially attractive input for biodiesel production (Ilkılıç et al. 2011; Yesilurt et al. 2020). Domestic biodiesel production capacity is 2.3 billion gallons per year (Harris 2022). This capacity combined with private and public interest could provide safflower seed another major use in the near future.

As an animal feed, safflower has been valued for improving performance and efficiency in sheep, beef cattle, and dairy cattle. Though striped or partial hulls are higher in oil content, bird enthusiasts prefer crisp, white seed, which is most effectively produced in Utah, Idaho, and California due to the region's warm and dry climate (Bergman and Kandel 2019). Immature safflower can also be grazed or stored as hay or silage material for livestock feed.

Safflower is particularly popular for dryland farming. As a taproot, it does well at extracting moisture from the deeper layers of the soil, up to five feet, and is hardy in Idaho's dry climate. The deep taproot is exceptionally effective at using limited moisture and residual nutrients throughout the soil profile. This contributes to many benefits for soil health, including "building organic matter, improving soil tilth, and promoting water percolation throughout the soil" (Adjemian et al. 2016). Safflower is used in rotation with other crops to help control grassy weeds like jointed goats-grass. Safflower is immune to herbicides that kill both grass and wheat, making it useful in wheat rotations to improve the effectiveness of chemical weed control mechanisms. The grass seed lifecycle is interrupted in a wheat-safflower-fallow cycle, and no grass usually emerges after six years (Pace et al. 2015).

2.2 World Safflower Production and Trade

Global safflower consumption is increasing, and the raw seed market is expected to reach a compound annual growth rate of 5.7 percent by 2025 (Mordor Intelligence 2021). As of 2020, the United States is one of the top five producing countries, by tonnage, of raw safflower (Figure 1), with more than 50 percent of production occurring in California. Meaningful safflower production also occurs in the Dakotas, Idaho, Montana, and Utah. In 2020, the Food and Agricultural Organization (FAO) of the United Nations estimated world safflower production at approximately 756,663 tons. Safflower was produced in 17 countries, led by Kazakhstan, the Russian Federation, Mexico, the United States, and India. These top five growing nations combine to produce 76 percent of the world's safflower output (Food and Agricultural Organization 2020).

World safflower production decreased from 732,524 tons in 2010 to 645,243 tons in 2019. In 2020, production increased more than 100,000 tons. The FAO has yet to release production values for 2021 and 2022, but with the war in Ukraine disrupting supply chains globally, production is expected to be lower (Food and Agricultural Organization 2020).

2.3 Domestic Safflower Production and Prices

Table 1 displays the annual production and price data for safflower seed production at the national level. While acreage dedicated to safflower seed production has remained relatively constant the past few

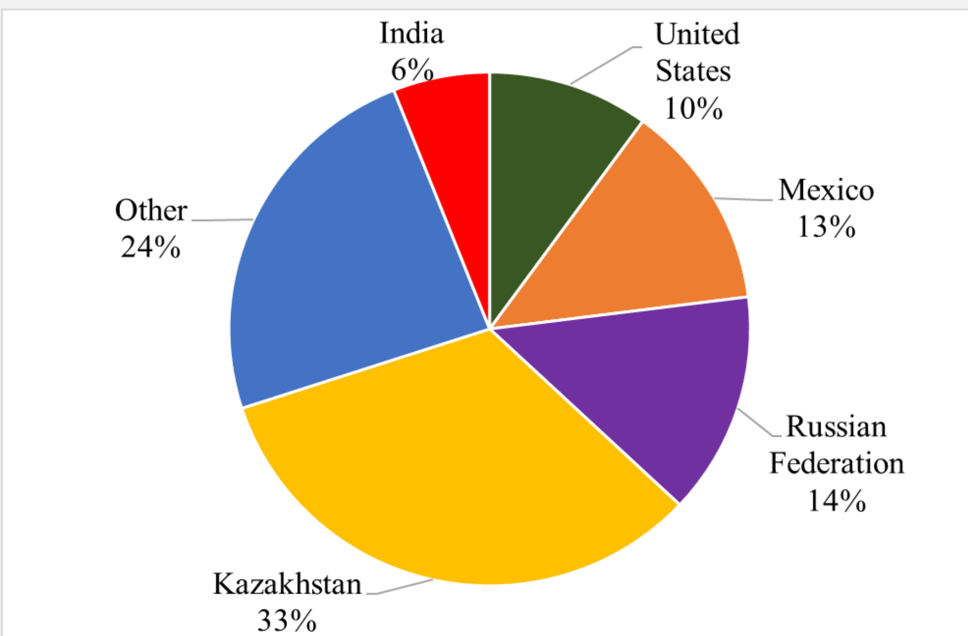

Figure 1: Percentage of World Safflower Production by Country (Source: Food and Agricultural Organization 2020)

Table 1: Historical U.S. Safflower Production Year

Year	Harvested Acreage	Average Yield (lbs/acre)	Total Production (lbs)	Average Price ($/lb)[a]	Value of Production
2016	152,700	1,432	218,625,000	$0.21	$45,170,000
2017	145,200	1,212	176,025,000	$0.19	$32,725,000
2018	156,300	1,512	236,270,000	$0.20	$47,976,000
2019	151,500	1,273	192,900,000	$0.20	$38,335,000
2020	128,400	1,185	152,125,000	$0.22	$32,844,000
2021	135,000	1,001	135,175,000	$0.26	$34,418,000
5-year % change	-11.6%	-30.1%	-38.1%	+23.2%	-23.8%

[a]Price represents the price paid to producers of raw safflower seed in nominal terms.

years, the yield and subsequent total production of safflower seed varies widely across seasons. Safflower seed is typically grown as a dryland crop with over two thirds of production occurring in California, Idaho, and Utah. These states are relatively dry to begin with, which makes dryland crops particularly susceptible to the increasingly common droughts experienced within the region. When the American west experiences drought, domestic safflower output plummets.

Due to MSO's location in southern Idaho, they source much of their seed from Idaho and Utah. Idaho accounts for approximately 11 percent of total U.S. safflower production, with most production occurring in the southern region of the state. The area harvested for safflower has increased from 17,500 acres in 2016 to 31,500 in 2021 (Table 2), yet total production of raw safflower in Idaho has declined recently due to the effects of the prolonged drought. Despite similar harvested acreage in 2019 and 2021, total production fell over 45 percent in that time interval.

Utah accounts for approximately 5 percent of total U.S. production, with most production occurring in the northern region of the state. Trends in Utah have been similar to Idaho with planted acres growing over time but yield per acre declining due to prolonged drought (Table 3).

MSO requires 30,000,000 pounds of safflower annually to run their cleaning, drying, storage, packaging, and transport operation at full capacity and typically has buyer commitments for close to this number every year. They source from Idaho and Utah whenever possible to help manage transportation costs. However, it is often necessary to contract with producers outside of that region to

Table 2: Historical Idaho Safflower Production, 2016–2021

Year	Harvested Acreage	Average Yield (lbs/acre)	Total Production (lbs)	Average Price ($/lb)	Value of Production
2016	17,500	850	14,875,000	$0.17	$2,529,000
2017	21,500	900	19,350,000	$0.17[a]	$3,270,000[a]
2018	21,000	830	17,430,000	$0.17	$2,928,000
2019	28,500	940	26,790,000	$0.18	$4,929,000
2020	26,500	880	23,320,000	$0.20	$4,687,000
2021	31,500	470	14,805,000	$0.23	$3,390,000
5-year % change	+80.0%	-44.7%	-0.5%	+35.3%	34.0%

Note: Price represents the nominal value paid to producers for raw safflower seed.
[a]2017 Idaho price data was unavailable; average of 2016 and 2018 price data used (U.S. Department of Agriculture, National Agriculture Statistics Service 2022).*2017 Idaho price data was unavailable; average of 2016 and 2018 price data used (U.S. Department of Agriculture, National Agriculture Statistics Service 2022).

ensure MSO has sufficient safflower to meet the commitments of their buyers. This has been especially true in recent drought years with the decreased yields in the region. Historically, MSO has sourced anywhere between 0 percent to 35 percent of their safflower seed from outside of the region. Safflower seed prices have been trending upward (Table 3), with the 2022 price pushing $0.30 per pound. This rally has been driven by supply chain disruptions, drought in safflower producing states, and high commodity prices, which raise the opportunity cost of growing safflower. While a modest price decrease is possible for 2023, Jason predicts that safflower prices will remain above historical averages for the 2023 growing season due to the persistence of the aforementioned factors.

Table 3: Historical Utah Safflower Production, 2016–2021

Year	Harvested Acreage	Average Yield (lbs/acre)	Total Production (lbs)	Average Price ($/lb)	Value of Production
2016	13,500	810	10,935,000	$0.17[a]	$1,859,000[a]
2017	16,500	900	14,850,000	$0.17[a]	$2,495,000[a]
2018	13,000	840	10,920,000	$0.16	$1,769,000
2019	12,700	1,050	13,335,000	$0.17	$2,280,000
2020	22,000	820	18,040,000	$0.19	$3,428,000
2021	16,000	460	7,360,000	$0.22	$1,582,000
5-year % change	+18.5%	-43.2%	-32.7%	+29.4%	-14.9%

Note: Price represents the nominal value paid to producers for raw safflower seed.
[a]Utah price data unavailable for 2016 and 2017; observed Idaho price and estimated Idaho price used for 2016 and 2017, respectively (U.S. Department of Agriculture, National Agriculture Statistics Service 2022).

2.4 Safflower Market and Supply Chain

Securing safflower seed typically requires more coordination between processors and producers than traditional commodity crops. Safflower seed has a limited number of producers and processors. Thin crop markets make spot transactions less desirable because both producers and processors want some assurances from the other before making a commitment such as planting a field or adding processing plant capacity (Adjemian et al. 2016). Attributes are also important for safflower. The price Jason receives from his buyers is influenced by the seed moisture content, GMO status, and amount of debris with the seeds. While MSO has the ability to dry and clean seed, it is prohibitively expensive to clean seed that is too dirty or dry seed that is especially wet.

The complications of safflower seed transactions often require producer-processor contracts (Pace et. al 2015). Agricultural contracting allows both MSO and the farmers they work with to make investments ahead of time knowing they have a partner lined up to deliver or purchase the seed. It also provides additional coordination through which MSO can identify and incentivize production practices that lead to seed attributes that their buyers desire.

3 Methodology for Agricultural Contracting

This producer-processor contracting problem will be examined using intuition from mechanism design. Although students will not be required to set up and solve an optimization problem, the key insights from the constraints to be overcome within an agricultural contract and the payment mechanisms required to satisfy them will be imperative.[3]

3.1 Mechanism Design and Its Application to Processor-Designed Contracts

Mechanism design is a useful method for designing agricultural contracts. Mechanism design problems are solved in reverse of many other economic problems, where a desired outcome is defined and then

[3] Interested students looking to gain additional detail on mechanism design-applied agricultural contracting problems should refer to Hueth et al. 1999; Alexander et al. 2012; Viana and Perez 2013; Yang et al. 2016; Bellemare, Lee, and Novak 2021; and McCarty and Sesmero 2021.

incentives are introduced to achieve that outcome (Hurwicz 1973). From an agricultural contracting perspective, a processor will design a contract to maximize their profit, or risk adjusted profit. Contract design includes both the size and type of farmer payments embedded within a contract. The processor then offers that contract to the producer who will either accept or reject it.

There are numerous obstacles that can cause a contract to fail. These obstacles are referred to as constraints. If any constraint is not overcome or "satisfied" in the final proposed contract, one or both parties will be unwilling to accept the contract, and no transaction will occur. Constraints are addressed through different types of payment mechanisms. A processor will offer a contract where the type and level of mechanisms maximizes their profit, while satisfying the aforementioned contractual constraints. Sections 3.2-3.4 explains the key constraints for a successful producer-processor safflower seed transaction. Sections 4.1-4.5 highlights the key contractual payment mechanisms available to overcome those constraints.

3.2 Farmer Participation Constraint

The farmer participation constraint requires that a contract offered to a farmer must be attractive enough for them to accept. If the proposed contract does not provide the farmer a higher expected return (or risk adjusted return) than their next best alternative, they will not accept it. Figure 2 denotes a budget of costs incurred for producing an acre of safflower seed on unirrigated land within the region. Safflower production requires about $185 per acre to produce, harvest, and deliver.

Because agricultural land has multiple uses, a contract must also cover a farmer's opportunity cost (i.e., provide a better expected return than a farmer's next best alternative). The opportunity cost will vary by region and through time. Within Utah and Idaho, the relevant opportunity cost crop is typically dryland wheat. Dryland wheat is simultaneously a complement and substitute for safflower production. Farmers not growing safflower will usually grow dryland wheat for a year followed by a fallow year to allow moisture to re-accumulate in the soil. Farmers that grow safflower seed in the region typically grow a rotation of wheat, safflower, and fallow. Safflower can be grown in this three-year rotation because its deep taproots allow for water extraction at levels deeper than wheat can reach. These factors demonstrate that the opportunity cost of dryland safflower in Utah and Idaho is expected to be relatively low; it is not zero.

Given that wheat prices are expected to remain high into 2023, Jason expects farmers would require at least another $35 per acre on top of the total costs reported in Figure 2 to make it comparably attractive to a conventional dryland wheat rotation. Additionally, reported spot prices for safflower seed sold on spot markets have recently been trading at $0.30 per pound. Not only will a contract have to be attractive enough to convince farmers to add safflower into their crop rotations, it will also have to convince them selling safflower to MSO is a better deal than selling it on the spot market at harvest.

Another factor influencing a farmer's willingness to accept a contract is the level of risk exposure. Most farmers are risk averse and, all else equal, will prefer a contract that exposes them to less risk. Prices, costs, and output are all sources of risk for producers. The scale of MSO is sufficient that Jason believes they can consider exploring contract options that transfer a limited amount of risk (e.g., through a fixed selling price or acreage payments) from the farmer to MSO as the processor, reducing grower risks and incentivizing contract participation. With this in mind, farmers will only accept a contract that offers them a sufficiently attractive risk-return profile relative to their next best alternative. With winter wheat trading at relatively high prices around $8.25 per bushel in Idaho (U.S. Department of Agriculture, National Agriculture Statistics Service 2022), Jason recognizes that contract options will need to be quite enticing for the coming year to convince farmers to produce safflower seed.

Costs of Non-Irrigated Safflower Northern Utah	Quantity per acre	Unit	Price per Unit	Value per Acre	Sub Total	Total
Inputs and Services						
Fertilizer						
46-0-0 Urea	40	Units	$0.56	$22.40		
Application	1	Acre	$5.00	$5.00		
Herbicides				$0.00		
Sonalan (ethalfluralin)	2	Pints	$8.79	$17.58		
Application	1	Acre	$5.00	$5.00		
Seed	18	Lbs.	$0.34	$6.12		
Labor	1	Acre	$8.56	$8.56		
Crop Insurance (NAP)				$1.25		
Subtotal Inputs and Services					$65.91	
Field Operations	Times	Unit	Per Unit	Acre		
Fall Chisel Plow	1	Acre	$11.00	$11.00		
Spring Chisel Plow	1	Acre	$11.00	$11.00		
Planting	1	Acre	$12.00	$12.00		
Harvesting	1	Acre	$25.00	$25.00		
Hauling	1150	Lbs.	$0.01	$11.50		
Subtotal Field Operations Cost					$70.50	
Interest on Operating Capital	Rate	Term	Principle			
	5%	0.5	$132.91		$3.32	
Total Input, Service and Field Operation Costs						$139.73
Overhead						
Accounting, Liability Insurance, Vehicle Cost, Office Expense				$10.00		
Cash Lease for Land (includes propery tax)				$35.00		
Total Overhead						$45.00
Total Costs						$184.73

Figure 2: Cost Budget for Non-Irrigated Safflower for Northern Utah in 2019 (Pace et al. 2019)

3.3 Moral Hazard Constraint

Despite contracts being popular in coordinating safflower production, they can lead to information imbalances between parties. Unlike spot markets, which pay based solely on performance, agricultural contracts may contain payment provisions independent of crop output level or quality to share risk with the farmer. While this risk sharing helps satisfy the participation constraint, it can lead to a misalignment of incentives between MSO and the farmer when there is unobservable farmer action. Poorly structured contracts may incentivize farmers to avoid following the best possible management practices, such as applying fertilizer or pesticides. This can lead to low yields or low quality, which can hurt MSO. As an example, if safflower output is a function of farmer effort and local pests, which only the farmer views, a contract with weak performance incentives (low amounts of performance-based payments) could lead to farmer shirking and then blaming a low output on pests rather than low effort.

To minimize moral hazard and likelihood of shirking, elements of a complete contract should be observed: (1) the contract must be able to contemplate all relevant contingencies and agree upon a set of actions for every contingency, (2) what constitutes satisfactory performance must be measurable, and (3) the contract must be enforceable (Besanko et al. 2017). In practice, it is not economical or realistic to spell out every possible future contingency or measure every single performance input, but a good contract should consider and plan for likely contingencies. In the context of safflower, the additional revenue that the farmer receives from following unobservable best management practices (applying fertilizer and herbicide) should be greater than the cost of following those practices. In other words, marginal benefit associated with higher yields should be greater than the marginal cost of achieving those yields.

Additionally, it is possible to align incentives by reducing the information asymmetry between parties from the outset. Monitoring entails an agreement between the farmer and the processor, allowing the processor to oversee production and only compensate the farmer if they adhere to the agreed-upon practices. Monitoring has the potential to reduce or eliminate moral hazards. However, there are drawbacks to monitoring, such as its cost, as the processor would need to allocate resources to send workers to inspect the fields. It is also often viewed as an undesirable contract provision by farmers who dislike oversight. It raises the payment threshold required for a farmer to accept a proposed contract.

3.4 Quality Constraints

MSO supplies non-GMO safflower to retailers and wholesalers. Thus, any seed entering the facility must also comply with non-GMO standards. Additionally, the harvested oilseed must be free from GMO contamination by other crops and cultural practices. The land should be clean and free of trash and debris. All equipment and storage facilities should be cleaned appropriately during all phases of the safflower production period to avoid any food safety liability.

Safflower seed supplied to MSO must also comply with the moisture and dockage (e.g., foreign material including dirt, stones, sticks, and other grains) requirements. Raw seed with high moisture levels, excessive dirt, or dockage must undergo drying and cleaning procedures before the seed is ready for processing. As cleaning and drying is expensive, MSO prefers harvested safflower seed contains less than 5 percent foreign material (e.g., other grains, sprouts, dirt, etc.) and have less than 9 percent moisture content. If foreign matter rises above 22 percent or moisture rises above 13 percent, it becomes prohibitively expensive for MSO to clean or dry the harvested safflower. This suggests MSO should consider stipulating cleanliness and dryness standards within grower contracts to help ensure non-GMO, clean, and dry safflower seed is produced. Additionally, they may consider additional per-pound payment provisions that compensate (dock) farmers for safflower seed exceeding (falling short of) a baseline cleanliness or moisture expectation.

4 Decisions Under Consideration (Payment Mechanisms and Other Contract Provisions)

Jason has a lot to consider in the contract that he will offer. He must come up with a contract structure that simultaneously provides the farmer an attractive combination of expected return and risk exposure (farmer participation constraint) and strong incentives to follow best management practices to support high yields (moral hazard constraint). This contract must also incentivize the production of safflower seed that is low in water content, low in foreign matter, and produced organically (quality constraint). This contract needs to do all those things while still maintaining profitability for MSO. This will be a challenge, but with careful consideration and analysis of trade-offs associated with various payment mechanisms, he should be able to create a contract that secures a quality and reliable supply of safflower seed to process and sell. In the following sub-section, the various types of payments available, along with their relative strengths for satisfying various constraints is laid out.

4.1 Performance Payments: Spot Market Price

The spot market is a financial market where crops are traded for immediate delivery. "Delivery refers to the physical exchange of the commodity with a cash consideration. The spot market is also known as the cash market or physical market because cash payments are processed immediately, and there is a physical exchange of assets" (CFI Team n.d.). There is the potential for farmers to capitalize on high prices, but the spot market is associated with a greater probability of downside risk and loss. MSO could consider spot market contracts wherein payment for production is based upon the spot market price for safflower seed at the time of sale.

Performance Payments: Spot Market Price Characteristics

- Transactions are settled at the spot price or the current market rate.
- Price is not fixed until assets exchange hands.
- Selling price is uncertain for farmers.
- Input cost is uncertain for MSO.
- Tying farmer income to safflower output helpskeep incentives aligned.

4.2 Performance Payments: Fixed Price

Fixed price performance payments are often used in oilseed markets where a farmer and processor agree on a price per pound at the beginning of the year that will be paid at harvest. Fixed price payments eliminate downside price risks to the farmer and allow the processor to lock in the cost of acquiring safflower seed. Conversely, significant market price changes can render contracts untenable for one party. During periods of low market prices, the processor may have an incentive to void or renege on the contractual commitment, while the inverse would be true for the producer in times of high market prices.

Performance Payments: Fixed Price Characteristics

- The pricing system ensures clarity by determining the price early in the year.
- It reduces risks for farmers in price fluctuations and lowers input costs for processors.
- Renegotiation may occur in the future, in response to significant price changes.
  Tying farmer income to safflower output helps keep incentives aligned.

4.3 Acreage Payments

Under this payment mechanism, payments are paid on a per-acre basis. Whether delivered yearly or as an establishment payment, this mechanism provides revenue to the producer regardless of the field's performance. Price and yield risks are removed from the producer and transferred to the processor. All else equal, reducing farmer's risk exposure to growing a crop will help satisfy the farmer participation constraint and bring more land into production. Acreage payment mechanisms shift significant risk to the processor. In bad years, processors get left paying high input costs with few inputs to show for it. This increases costs while simultaneously decreasing expected revenue. Since not all actions of a safflower farmer are directly observable, a strict lump sum acreage payment contract mechanism violates the moral hazard constraint. Contracts should avoid exclusively making payments acreage-based because this can easily lead to a misalignment of incentives between growers and processors.

Acreage Payment Characteristics

- It lowers both price and yield risk for growers, promoting stability in agriculture.
- This method can ease farmer participation constraints.
- With a simple structure, it can be easily adjusted with other mechanisms.
- It may unintentionally create moral hazard scenarios.

4.4 Quality Adjustment Payments

Oilseed attributes are important for MSO's buyers. Foreign matter content must be below 22 percent and water content below 13 percent to ensure MSO can reduce costly drying and cleaning efforts. Yet, as cleaning and drying costs are nonlinear, MSO would really prefer seed with less than 5 percent foreign material and 9 percent moisture. Percentages below these levels require only minimal effort (i.e., cost) on MSO's part. Ensuring that farmers follow practices that produce safflower to these standards requires incentives to pursue the appropriate production practices. This incentive can come in the form of penalties for high foreign material and moisture, bonuses for low levels of foreign material and moisture, contracting provisions that void the agreement for levels of foreign material and moisture above a given level, or a failure to achieve non-GMO status.

Quality Adjustment Characteristics

- Quality adjustments penalties or bonuses subtracted or added to a performance payment.
- They are used to incentivize safflower attributes desirable to MSO.
- They can add additional price risk to the farmer.

4.5 Combinations of Payments

Multiple payment mechanisms can exist within one contract. In other words, it would be possible to offer a contract with a baseline fixed price that is adjusted up or down based upon harvested seed quality. Since different payment types help alleviate different constraints, mixing various payment mechanisms into one contract can help facilitate successful contracts between farmers and processors. Finally, Table 4 presents a concise description of the aforementioned payment types.[3,4]

4.6 Marketing Contracts, Production Contracts, and Coordination

The level of potential coordination between producers and processors can be thought of as falling on a spectrum between buying/selling on a spot market (no coordination) to vertical integration (complete coordination). Agricultural contracting exists between the two extremes. The visualization of this can be seen in Figure 3.

In agriculture, marketing and production contracts play pivotal roles in shaping the dynamics between farmers and processors. These contracts establish price arrangements prior to harvest, but they differ significantly in terms of decision-making authority and input ownership.

[3] Performance payments that are tied to a market price are most commonly used for the good being contracted. However, it is possible to use an index to tie the contracted performance price to other factors such as the cost of inputs or the opportunity cost crop.

[4] Establishment payments are paid at planting to cover upfront costs such as seed.

Table 4: Various Payment Mechanisms MSO Can Offer in a Contract

Type	Definition	Description
Performance payment (market price)[a]	Farmer is paid a per-unit price ($/pound) at harvest. The price is determined by the safflower spot market at harvest.	Performance payments provide incentives to follow best management practices because the farmer is compensated for high output. Performance payments are required for overcoming the moral hazard constraint. The market price component allows the farmer to take advantage of potential rises in safflower prices throughout the growing season but is risky for the farmer because it exposes them to falls in prices. This payment provision exposes the farmer to price, production, and cost risk.
Performance payment (fixed price)	Farmer is paid a per-unit price ($/pound) at harvest. The price is locked in at planting	Being performance-based, this payment provision will also help satisfy the moral hazard constraint. The key difference is that the price, getting locked in ahead of time, eliminates the farmer's price risk and reduces the cost risk for MSO.
Acreage payment	Farmer is paid per acre of safflower grown. Typically paid at harvest but can also be paid as an establishment payment.[5]	This payment provision locks in farmer revenue. All else equal, farmers prefer payments with less risk, so acreage payments are especially effective at inducing farmer participation. It also shifts a considerable amount of risk to the processor.
Quality adjustment payments	The farmer is either paid a per-pound premium for safflower with desirable qualities (low moisture content, low foreign matter content, GMO free). Or is forced to pay a per-pound penalty for safflower with undesirable qualities. The size of any adjustment moves with the quality.	Oilseed attributes are important for MSO's buyers. Seed must be GMO-free. Foreign matter content must be below 22 percent and water content below 13 percent to ensure MSO can reduce costly drying and cleaning efforts. Yet, as cleaning and drying costs are nonlinear, MSO would really prefer seed with less than 5 percent foreign material and 9 percent moisture. Percentages below these levels require only minimal effort (i.e., cost) on MSO's part. Ensuring that farmers follow practices that produce safflower to these standards requires incentives to pursue the appropriate production practices. Having performance incentives in the contract should help satisfy quality constraints.

[a]Performance payments that are tied to a market price are most commonly used for the good being contracted. However, it is possible to use an index to tie the contracted performance price to other factors such as the cost of inputs or the opportunity cost crop.

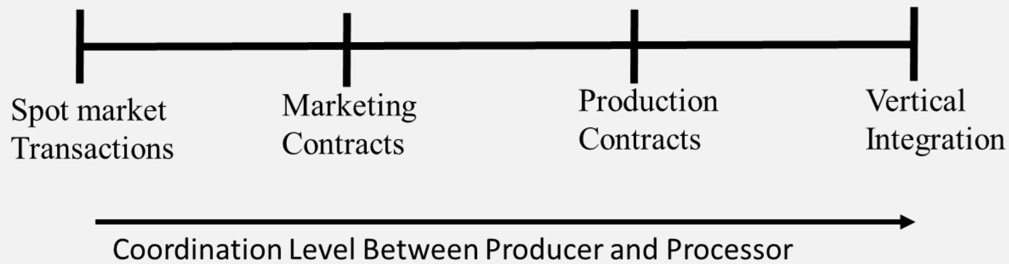

Figure 3: Spectrum of Possible Relationships Between Producers and Processors and the Extent to Which a Given Relationship Is Coordinated Between Parties

Production Contracts: In contrast, production contracts place the bulk of management decisions on the processor's shoulders. Processors dictate the production practices and required inputs for the crop. They often provide or own these inputs. Production contracts serve to mitigate information asymmetry by ensuring the processor's control over inputs. Moreover, they shift production risks from the farmer to the processor.

However, in reality, there can be some overlap between these contract types. For instance, a contract might allow the farmer freedom in certain production decisions, provided they use seed supplied by the processor. In this case, the contract exhibits characteristics of both marketing and production contracts.

The choice between marketing and production contracts is a crucial decision for MSO. MSO must consider factors such as the desire to maintain a non-GMO designation for safflower seed. This designation necessitates specific seed and production practices, which may be better suited for a production contract where the processor provides seed and additional inputs while exerting more oversight. However, this approach comes with added costs due to oversight and input provision, potentially dissuading some farmers who prefer more control over production decisions. Therefore, MSO faces a trade-off between enhancing harvested seed quality and reducing information gaps at the expense of reducing the willingness of farmers to participate.

Another consideration closely tied to coordination is whether to include monitoring in the contract. Monitoring involves sending representatives to the farmer's fields to ensure compliance with specific production practices or input use. While this can also reduce information asymmetry, encourage desired seed attributes, and lower testing costs, it may also discourage farmers who do not appreciate constant oversight. Embedding monitoring in a contract could even deter farmers from entering into a contract in the first place. In conclusion, marketing and production contracts in agriculture offer distinct approaches to managing the relationship between farmers and processors. The choice between these contracts and the inclusion of monitoring should be made carefully, considering factors such as harvested seed quality, information asymmetry, and farmer preferences. Achieving the right balance is essential to fostering successful partnerships.

5 MSO Strategy Questions

5.1 Reflection

Those who think agricultural processors have it easy have never been tasked with securing 15,000 tons of safflower seed amid the chaos anticipated in the current production environment Jason muses to himself. Acquiring this quantity of safflower seed, while maintaining MSO's seed standards and serving its core goal of maintaining profitability for the company and those farmers they contract with, is going to be even more challenging than usual. Relationships matter in agriculture, particularly in niche markets like safflower seed. Maintaining these relationships through contracts brings many benefits to the transaction but also adds complexity. Drawing up a contract that simultaneously satisfies all contractual constraints while maintaining profitability is going to be challenging but imperative for MSO's continued success.

In Jason's time running MSO, he has built it from a regional level oilseed storage and processing facility, into the largest oilseed storage and processing facility in the United States and a key player in safflower seed internationally. Continued success for MSO and the farmers they work with is going to require innovative solutions for the transactional relationship between the two parties.

5.2 Discussion Conceptualizing the Problem

1. Ignoring risk for a moment, how much would a farmer in Idaho need to be paid per acre to cover both their cost of producing safflower seed along with their opportunity cost of not growing dryland wheat as often? What does this work out to be per pound?

2. Do you think for the same expected return, a farmer would be willing to adopt safflower seed into their dryland wheat rotation? Why or why not? Be sure to consider things such as risk, adoption of a new crop, and agronomic benefits in your answer.

3. The current safflower spot price is $0.30 per pound. To encourage farmers to sell their safflower production to MSO instead of the spot market, how much do you believe they would require as a minimum payment under an MSO contract, taking into account this new information and your responses to questions 1 and 2?

4. From MSO's perspective, would they be better off offering contracts that are more marketing-based or production-based? Which inputs, if any, should MSO provide to farmers, and how much would that cost (recall Figure 2)? Also, how much monitoring, if any, should MSO provide in the safflower production process? Why do you feel these are the correct levels of coordination between MSO and farmers?

Designing a Contract

5. Based upon your answers to questions 1 to 4, what contract structure would you recommend that MSO offer to farmers? Remember that contracts can have multiple payment structures embedded into them (e.g., fixed price performance payment = $X per pound, acreage payment = $Y per acre, and quality adjustment = $Z per percent below a threshold). Write your proposed contract structure and spell out the details? For an example contract, see Appendix A.

6. Does your proposed contract structure for question 5 satisfy the farmer participation constraint? Why or why not? If it does not satisfy farmer participation constraint, update it and

write out a new contract structure that does. (As you update the contract structure, be sure it does not violate previous constraints that have already been solved.)

7. Does your updated contract structure for question 6, satisfy the moral hazard constraint? Why or why not? Expected performance payments ($price \times yield$) should at least be greater than the combined cost of fertilizer, herbicide, and labor (see Table 2) to ensure the farmer is compensated for their unobservable effort. If it does not satisfy incentive compatibility, update it and write a new contract structure that does. Note: If your contract includes monitoring, you can ignore some or all of these costs in calculating the moral hazard constraint, depending on when/how the field is being monitored.

8. Does your updated contract structure for question 7, satisfy the quality constraint and ensure that MSO will receive dry and clean safflower seed? Why or why not? If it does not satisfy the quality constraint, update it and write a new contract structure that does.

Strategy

9. Write out your final contract here, and calculate how much you expect the cost of acquiring one ton of safflower seed to be under that contract. (Be sure to also include any costs of providing inputs or monitoring if that is part of your contract.)

10. Based on your answer to question 9, if it costs MSO an additional $250 per ton to process the seed on top of acquiring it, will they achieve a positive margin if they sell their refined safflower seed for $950 per ton?

11. Based upon your answer to question 10, how confident are you that MSO will maintain a positive margin for the coming year in the face of production, price, and input cost risk?

Contingency Planning

12. A well-thought-out contract will cover all realistic future contingencies ex ante. If domestic growers believed there was a reasonable chance that the Black Sea Grain deal that allows Ukraine to export its safflower to world markets will fall through and raise prices in the future, they may be less willing to accept or stick with a contract over time. What provision or payment may need to be added to your contract (question 9) to ensure farmers will both accept the contract and be willing to stick with it, should that change occur?

13. It is possible for MSO to acquire too much seed. If MSO ends up with more than 30,000,000 pounds of safflower seed, they will not be able to process it all and could be forced to sell that safflower at a loss. Based upon this consideration, would you change anything in your contract structure established (question 9) and/or the amount of acres you would expect MSO to contract? Explain your answer.

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Appendix A: Example of a Proposed Contract Structure for Question 5

Note: The following contract structure is not a suggested solution to question 5; it merely provides an example of how to respond to question 5.

Performance payment (fixed price) = $0.20/lb x lbs. of safflower seed harvested

Acreage payment (paid at planting) = $200/acre

Quality adjustment payment/fee for foreign material percentage = For each percentage point that foreign matter content is below 5 percent, MSO will add a $0.01 per pound premium to performance payments, and for each percentage point that foreign matter is estimated to be above 5 percent, MSO will charge a $0.01 per pound penalty to performance payments (for example, if foreign matter content is estimated by MSO to be 3 percent, then the final performance price would be $0.20/lb + $0.02/lb = $0.22/lb).

Quality adjustment payment for moisture content = For each percentage point that MSO measures seed moisture content to be under 9 percent, they will pay an additional premium to performance payments of $0.01 per pound. For each percentage point moisture content is above 9 percent, MSO will charge a $0.01 per pound penalty to performance payment.

Additional details: The farmer will grow safflower seed provided by MSO. Farmers will have no oversight or monitoring in production beyond that. However, MSO will test moisture content, foreign material, and presence of inorganic compounds in the safflower. Any crop tested above 22 percent foreign material, above 13 percent moisture content, or containing residues from inorganic herbicides or pesticides, will constitute contract breech upon which the farmer’s crop will be returned to them. In such a case, the farmer is expected to pick their safflower seed harvest up.

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