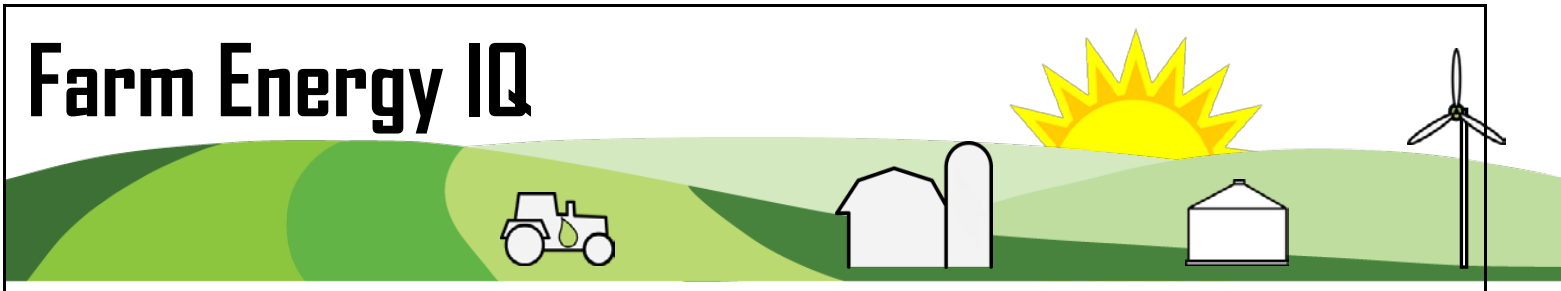
Farm Energy IQ



Field Crop Production ASP Presentation Outline

ZANE R. HELSEL, PHD, EXTENSION SPECIALIST, RUTGERS UNIVERSITY

Slide #	***Topic***
1. and 2.	Title slides
3.	Although an old study, newer information suggests that fuel consumption in field operations is still the second greatest energy use in agriculture.
4.-6.	It is helpful for farmers to understand fuel usage estimates for each tractor and piece of equipment, much as we do with our cars. Then it can be compared to data on slide 5.
7.-9.	If buying a new or used tractor, one of the many things that should be considered is fuel use efficiency. The Nebraska Tractor Test Lab (NTTL) has tested tractors for years and has a wealth of data available. Slide 8 shows one of the NTTL test reports. Slide 9 shows two important measures of fuel efficiency gal/hr and hp-hrs/gal. Larger tractors tend to be more efficient at full hp but inefficient when not fully loaded. Tractordata.com provides graphic data, based on the NTTL results, which can be useful to visually determine efficiency.
10.	The best way to save fuel is to make fewer trips over the fields. Here are three examples of the number of trips required based on tillage system. An older conventional tillage system requires six trips, a conservation tillage system takes four trips and no-till requires only a single trip. You could save 3 to 5 gal/acre of fuel by using no-till compared to the older conventional tillage system.
11.	Another way to save fuel is to match the tractor with the implement size. As mentioned, using a large tractor to do a small job wastes a lot of energy for moving the heavy tractor through the field. Use smaller tractors to do light tasks to save fuel.
12.	If using large tractors you can sometime combine tillage equipment manually or purchase combination tools, saving trips, time, and fuel and reducing compaction.

13. Sometimes when small equipment like sprayers are driven by PTO and only larger tractors are available, then having a separate engine to operate the sprayer can save fuel.

14. As noted earlier, chisel plows are used for conservation tillage. Compared to moldboard plows, they can save about a ½ gal of fuel per acre.

15. Adjusting equipment to reduce draft (forces requiring energy) can not only make equipment operate more smoothly but it can also reduce fuel consumption.

16.-17. Reducing tillage depth is an excellent way to reduce fuel use. There is rarely a need to plow deeper than 6 to 8 in. Plowing at 6-in. vs. 12-in. reduces fuel use by nearly one gallon of fuel/acre. Secondary tillage, as a rule of thumb; should always be at half depth of the previous tillage. Not only does that save fuel, but it also helps create a smooth firm seed bed while avoiding root zone compaction.

18. If a tractor is used that is oversized for the job, use a higher gear and slow the throttle. If you go too far with the throttle or gearing, black smoke/soot comes out of the exhaust. If so, use next lower gear or accelerate.

19. One of the ways new tractors are more efficient, even under somewhat lighter loads, is the use of new constant variable transmissions (CVT, or similar) that essentially perform the old gear-up/throttle-back practice automatically.

20.-21. Excessive wheel slippage (spinning) can waste fuel. So can over-ballasting the tractor to reduce slippage which waste fuel to pull the extra weight thru the field. Ideal wheel slip in fields should be 10 to 15% (closer to 10% on harder surfaces and 15% on loose surfaces). Wheel slip can be measured by recording the numbers in the formula on slide 21. Wheel circumference can be determined by wrapping a cloth or plastic tape around the tires and measuring the length(circumference); tire revolutions can be easily counted by making a chalk or paint mark is on the inside of the tire where it can be seen from the tractor seat and simply counting the revolutions.

22. If there is too much slippage, weights can be added to the rear wheels first then the front if 4WD. “Duallies” are also a solution in some cases.

23. 4WD/assist tractors can help tractive ability but should be disengaged when not needed (hay field vs tilled fields) to save fuel and wear and tear on drive trains.

24. Reduce turning time by having long narrow fields and larger fields (get rid of fence rows) which saves energy by reducing non-productive work energy.

25. Speeding doesn’t necessarily waste fuel if loads are lighter. Properly matched tractors and implements should be pulled in the 3-8 mph range, 5-6 mph is ideal.

26. The concept of controlled wheel traffic (tramline farming in Europe) has most all wheel traffic occurring in the same wheel tracks, thus reducing overall field compaction and also reducing wheel slippage in the compacted zones used for all wheel tracks because of the harder-formed surfaces.

27. Fuel can be lost to the atmosphere in storage, so keep fuel tanks as cool and dry as possible. Shaded areas are best, but having fuel in white or reflective painted tanks can keep losses to a minimum.

Nutrient Use & Pest Control

Slide #	***Topic***
1. (28)	Title Slide: Conserving Energy in Nutrient Use and Pest Control
2.(29)	Although no recent data is available, we know that nearly half the energy use in agriculture is for fertilizers and, of that, 80% is for the manufacture of nitrogen from natural gas. As a side note, agriculture as a whole only uses 1.4% of all the energy used in the U.S.
3.-4.(30-31)	The two key components to conserving energy in nutrient use are to test soils to see what is needed and use less or only what is needed. Calibrating equipment puts on the proper amount. Using manures and legumes as alternatives requires some energy but not nearly as much as manufactured fertilizer. Reducing losses once applied; reduces the need to reapply more. Fertigation, if available, can help supply small amounts as needed by the plant and saves an application trip. Soil conservation should be practiced to prevent nutrients that are held by the soil from leaving the field and further potentially causing water quality problems. Taking soil samples properly and understanding test results are critical to proper nutrient use. Surveys suggest nearly half our farmers still don't test soil for nutrients.
5. (32)	Where nutrient tests are low, nutrient applications make economic sense. At high levels little or no fertilizer may be needed because of the lack of economic response.
6. (33)	Each crop has unique nutrient needs and these are used to make application recommendations once a soil test is completed.
7. (34)	Banding fertilizer near the row is the most efficient way (other than fertigation) to apply fertilizers at planting or side dress when the plant needs them. Normally less fertilizer can be used with this method compared to broadcast fertilization.
8. (35)	It is important to calibrate fertilizer spreaders, manure spreaders, and other equipment to ensure accurate amounts are applied.
9. (36)	Lime is necessary for good overall plant growth and the availability of most nutrients. Over-liming wastes energy and can cause reduced nutrient availability.
10. (37)	Using legumes in the rotation is a great way to reduce nitrogen needs from manufactured fertilizers.
11. (38)	This table represents potential nitrogen credit from various legumes. This example is from Penn State but other universities have similar recommendations.
12. (39)	Manures can further reduce the need for purchased fertilizers. The manure should be tested for available nutrient content, incorporated as close to crop growth as possible, and, to prevent over-application, manure application equipment should be calibrated.
13.-15.(40-42)	These tables from the PSU Agronomy guide can provide additional details on manure use.

16.(43) The key to pest control is a good overall integrated pest management program that relies on determining the presence of specific pests, knowing their life cycles relevant to the crops and the levels that can cause economic loss. Many non-chemical and low energy options exist for control compared to pesticides but normally the most efficacious of the methods should be the first priority. If not, more energy might get spent on repeated treatments.

17. (44) The Pest Triangle suggests that you need three things to cause pest damage—a susceptible crop, a virulent pest, and favorable environmental conditions.

18. (45) This table provides a list of selected pesticides and the energy "invested" in their manufacture and use. Newer pesticides are not listed because they are still under patent. Although a farmer could select a lower energy pesticide, the differences are not great. Efficacy of the treatment method should be first priority—a poor performer would likely require another application and, in the end, greater overall energy use.

19. (46) To apply pest control products in an efficient manner, use the lowest rate and spray volume (means less ferrying to water source) as well as applying through the irrigation system, where available and labeled. These practices can all reduce energy.

20. (47) A common question is: can you save energy by mechanically controlling weeds instead of applying herbicides. A detailed calculation in the *Encyclopedia of Pest Management* indicates there is little difference in overall energy investment in the two. Thus, the option which produces better weed control should be used.

Irrigation

Slide #	***Topic***
1. (48)	Introduction/Title Slide: Energy Efficiency in Irrigation
2. (49)	The two major ways to reduce energy consumption in irrigation are to use less water (i.e., pump less) and to apply water more efficiently (i.e., with less loss).
3. (50)	Different crops need different amounts of water at different growth stages. See the next three slides for details.
4. (51)	Wheat normally needs less supplemental irrigation than other crops because its growth takes place during shorter, cooler days when there is less moisture loss. Corn requires large amounts of water because it grows during the hottest part of the year and during the longest days. Soybeans require little supplemental water until they begin pod development and fill. Because this stage of development occurs during August in the Northeast, soybeans can have significant water needs.
5. (52)	The greatest water need for corn occurs about two weeks before tasseling to between two and four weeks after.
6. (53)	Because corn roots grow to a greater depth than soybeans, corn may need twice as much water to fill the profile. However, it requires less frequent applications due to the deeper roots. A clay pan or hard pan may restrict this growth to lesser depths.
7 .(54)	Some irrigators overwater because they don't realize that soils may not hold as much or be able to take water in as fast.
8.(55)	Farmers should know each of their field's Available Water Holding Capacity (AWHC) so they don't over irrigate and experience runoff. Root zone restrictions such as hardpans and clay pans could also limit availability.
9. (56)	Infiltration rates govern how fast irrigation can be applied. Sandy soils or those with higher organic matter can take water faster without runoff.
10.(57)	There are several methods for measuring soil moisture—from the rather crude (feel) method to using devices such as tensiometers or moisture blocks to estimate available soil moisture and thus when to irrigate and how much.
11. (58)	After matching water needs to irrigation amount applied, energy savings can be attained by efficient pumping and distribution. Having efficient and well maintained motors, pumps and distribution are keys to energy savings. Keep irrigation system resistance low by reducing pumping distance, pumping pressure, minimizing restrictions and bends in the line to reduce energy consumption. New monitoring devices are available to check for systems water friction losses.
12. (59)	Pump choice is typically determined by depth, but there are other factors in choosing pumps and proper maintenance is key. Electric motors are normally more efficient than diesel engines, but diesel engines may be used at remote sites.

13. (60) Once the water leaves the pump it's important to keep flow restrictions and leaks to a minimum and be sure nozzles are clean. Uniform coverage at the rate needed should be monitored.

Grain Drying

Slide #	***Topic***
1.(61)	Two key ways to reduce energy use in drying grain are to harvest clean, dry grain, then, if needed, dry with fans/heat efficiently.
2. (62)	Harvest practices to promote efficient drying include: • Choosing corn hybrids with rapid dry down characteristics. Most other grain crop varieties do not differ much in dry down rate. • During the combining process it's important to have cylinder/concave settings adjusted to maximize residue separation from grain (without damaging grain) and have fan speed as high as possible to remove the residue from the grain. • With most crops, except soybeans, canola and buckwheat, combine heads can be kept well off the field surface to reduce the amount of residue going through the combine. • Minimizing grain damage is important not only for grain quality but for reducing "fines" in the grain which limits air flow in the bin. • If the field is full of green vegetation (i.e., weeds), herbicides, desiccants, or frost can be used to dry down this vegetation so it does not add trash and wet material to the grain.
3. (63)	All components of the dryer, motors and bin should be cleaned and well-maintained. Grain should be loaded to proper depth and be level and uniformly distributed in the bin. Using natural air or lower temperatures reduces fuel use but may increase drying times that cannot be tolerated because of rapid harvesting. Dryeration and similar concepts can be used to reduce fuel costs by allowing "absorbed heat" to continue to work in drying grain. See fact sheet for more detail. Maintaining appropriate stored grain moisture levels by periodically using fans and when not in use, fan covers.
4. (64)	Energy needed to dry grains using various methods is presented. Although methods that require less energy input (Btu) will be more energy efficient, their extended drying time may be unacceptable during rapid wet fall harvests.
5.(65)	Typical in-bin dryer using low or no heat to dry newly added wet levels of grain to already dried grain. Depth of added wet grain can be determined from reference publications.
6.(66)	The basic concept of dryeration is using high temperature, high speed drying, then moving to a dryeration bin to remove the last 2-3% moisture by using cooling fans to remove condensing moisture.
7. (67)	Grain spreaders and stirrers are useful to get evenly distributed grain and uniform moisture grain mixes through-out. Stirrers may cause splits in soybean if they are low in moisture.
8. (68)	Once grain is dried to proper moisture and temperatures, fan covers can help prevent high humidity air from naturally rewetting grain.

9. (69) Typically, gas is the best and most uniform choice of fuel. The final choice is likely based on availability and price. (Biogas is available only if there is a nearby anaerobic digester). Using fuel oil is typically more expensive, say than natural gas, and provides less temperature control. Waste oil (from tractor oil changes etc.) is being used by a few farmers where large continuous amounts of heat are not needed. The same is true for biomass, such as corn cobs, which has traditionally been used in the Midwest to dry seed corn.

10. (70) Questions?

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