HOW SMITH FARMS PLAN TO PROFITABLY MANAGE THEIR OPERATION INTO THE 21ST CENTURY

Jay Lee Smith, CCA

Smith Farms, 3561 East, Country Road 1600 North

Summitville, Indiana 46070-9478 U.S.A.

Telephone-Fax 1-765-536-2060

e-mail address jaysmith@netusa1.net

ABSTRACT

*In this article the author will describe in detail the plan and implementation of the plan to move Smith Farms profitably into the twenty-first century. He will discuss the investments in human capital and financial capital to **"Site Specific Precision Agriculture."** Some of the new tools and procedures used are geographic information systems (GIS), global positioning systems, (GPS), harvester yield and moisture monitor. New procedures include site specific soil testing, treatments, monitoring, scouting, mapping, and yield and moisture data collection. Discussion will include selection, cost and purchase of systems, set up, use, problems and analysis and use of data. He will discuss using the emerging technology and procedures to economically maximize production potential and profitability into the twenty-first century.*

FERTILITY PROGRAM

We did not approach grid soil sampling with the expectations of reducing the tons of fertilizer applied. We approached it with the desire to attempt to put our fertilizer dollars where they are most needed and will bring the highest return. It was a very pleasant surprise to learn that we have built many areas up to a point of not needing any phosphorus and potassium fertilizer. Other areas only need small amounts. Thus we have reduced phosphorus and potassium expenditures on one farm by 60%. We understand that we have these high test levels because of previous applications based on averages of large areas. In the past, we tested various areas by soil type and gave them special treatments of lime, phosphorus and potassium. We acknowledge that the variations among the grids and within the grids is very large. We are making an effort to increase the productivity by increasing the low test levels, balancing the nutrients and bringing the soil acidity to the desired level.

Soil Grid Sampling (Testing)

In 1996, Smith Farms enlisted two farmer cooperatives and one private consultant to do grid sampling and make recommendations. They were hired with the understanding that they are working for us and that all of the information collected is the sole property of Smith Farms. All three firms have different sampling procedures and one firm does not mix soil types within a grid. They use different software and different G.P.S. differentials. We want independence from all suppliers so we make sure that the five suppliers that we can use have access to our soil tests analysis and G.P.S. grid coordinates to use in variable rate application. It has not been easy to get the grid sampling completed, the grid maps made, soil test analysis and the recommendations. The three companies that we hired to do this service have had their own problems learning the procedure, software, etc. It has been an agonizing, time consuming project. At the time of this writing, supplier "A" has failed to deliver recommendations following the soil test analysis. The last of the soil sampling was done in

October, 1996. We recently learned that supplier "A" does not have the equipment for site specific variable rate application so we have taken the data to supplier "B" for application. The two firms mapping software was not compatible so it would not work for the application. Supplier "A" had to spend $270.00 to have this information digitized so that supplier "B" could use it for the site specific variable rate application. We site specific variable rate applied the lime, phosphorus and potassium on these fields shown in Table 1, Table 2, and Table 3.

Lime Application

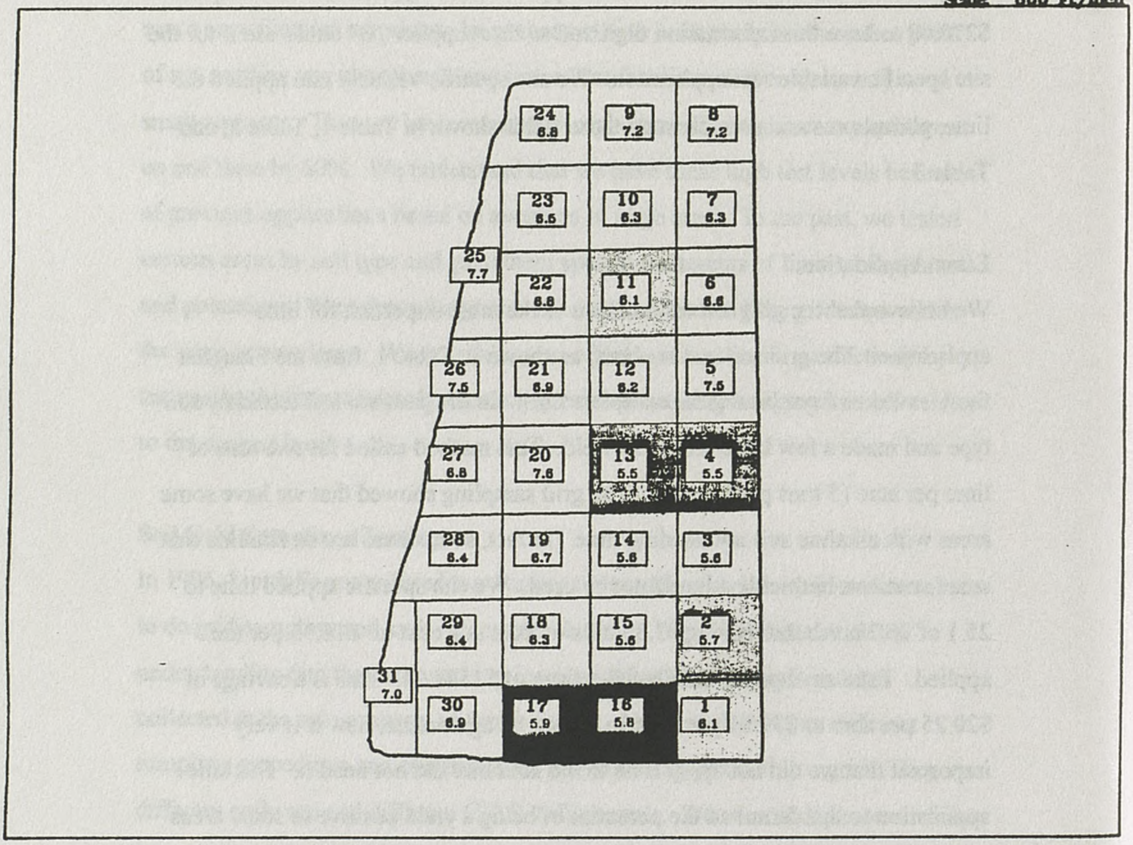
We believe that the grid soil test analysis is the most important for lime application. The grid soil test analysis, as shown in Table 1, from the Flaugher farm, saved us from liming the complete farm. In the past, we soil tested by soil type and made a few large areas in a field. This method called for two tons of lime per acre (5 tons per hectare). The grid sampling showed that we have some areas with alkaline soil not needing lime. In fact, some areas are so alkaline that some sensitive herbicides should not be used. We site specific applied lime to 25.1 of 76.3 acres thus saving 93.35 tons of lime at a cost of $16.55 per ton applied. Total savings for the Flaugher farm of $1544.94. This is a savings of $20.25 per acre or $50.01 per hectare. From an agronomic view it is very important that we did not apply lime to the land that did not need it. The lime application to this farm had the potential of being a yield positive in some areas and a yield negative in some areas. By applying lime only where needed, we expect that we have greatly increased the probability of increasing the yield of the farm. We definitely have reduced the probability of herbicide carry-over that will damage the next years crop.

The grid soil test analysis shown in Table 2 is for site specific lime application on 63.9 acres of 266.3 acre farm.

Table 1 Flaugher Lime

Client: Smith, Jay Lee
Farm: Flaugher
Field: 1
Layer: Soil Test 10/16/96 76.3 Acres

Scale: 600 Ft./Inch

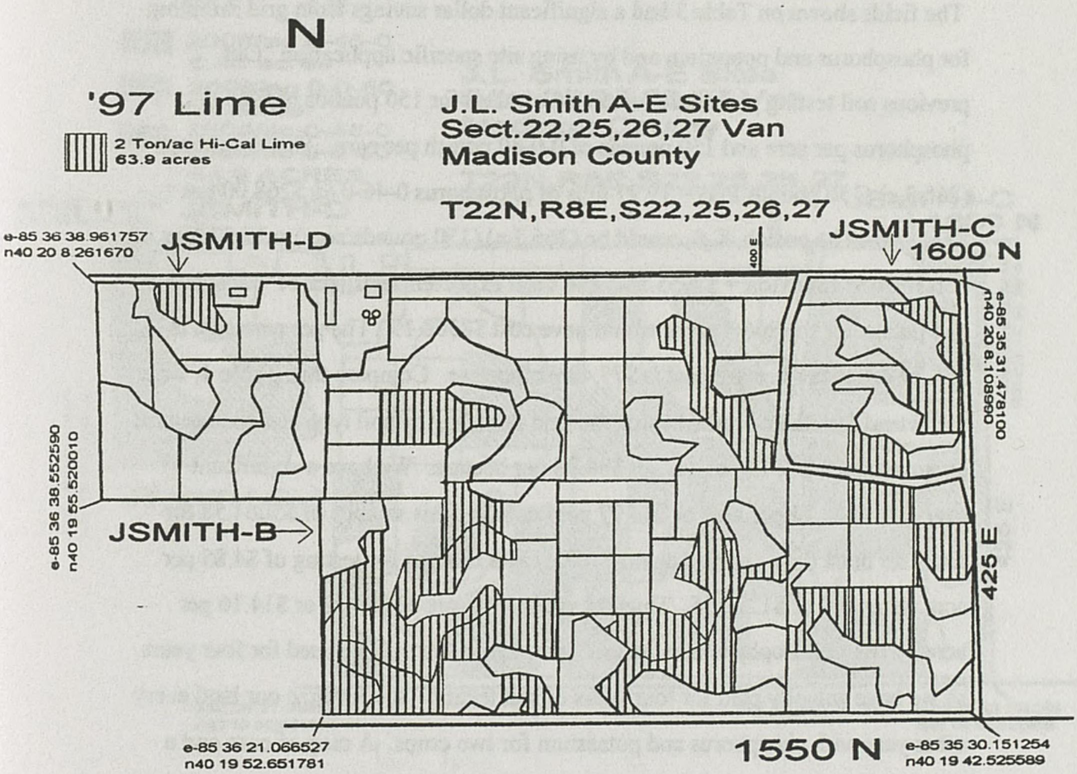


pH Results and Limestone Recommendations

Weighted	Above 6.2	no limestone needed	50.9 Acres	Tons
Field = 6.45	6.0 - 6.1	1 Ton/Acre	5.0 Acres	5.0
Average	5.8 - 5.9	2 Ton/Acre	4.8 Acres	9.6
	5.7	2.5 Ton/Acre	2.5 Acres	6.25
	5.8	3.0 Ton/Acre	7.7 Acres	23.1
	Below 5.6	3.0 Ton/Acre	5.1 Acres	15.3
	Tons of Lime Applied			59.25

Table 2 266.3 Acre Farm

Site Specific Lime Application Map



pH Results and Limestone Recommendations

Weighted	Above 6.2 no limestone needed		50.9 Acres	Tons
Field = 6.45	6.0 - 6.1	1 Ton/Acre	5.0 Acres	5.0
Average	5.8 - 5.9	2 Ton/Acre	4.8 Acres	9.6
	5.7	2.5 Ton/Acre	2.5 Acres	6.25
	5.8	3.0 Ton/Acre	7.7 Acres	23.1
	Below 5.6	3.0 Ton/Acre	5.1 Acres	15.3
	Tons of Lime Applied			59.25

Phosphorus and Potassium Applications

The underlying philosophy that we are using is to have our soil test in the 300-350 pounds per acre range for potassium and 80 or above for phosphorus. This will vary some, depending on the CEC (cation exchange capacity) of the soil.

The fields shown on Table 3 had a significant dollar savings from grid sampling for phosphorus and potassium and by using site specific application. Our previous soil testing procedure would have called for 150 pounds of 0-46-0 phosphorus per acre and 150 pounds of 0-0-60 potash per acre. That would be (266.3 a) (150 pounds P/a) = 19.97 tons of phosphorus 0-46-0 @ $268.00/ton = $5351.96. The potash, K_20, would be (266.3 a) (150 pounds/acre) = 19.97 tons of potash @ $148.00/ton = $2955.56. The **total expected fertilizer** of phosphorus and potash for the 266.3 acres would have cost $8308.19. The per acre cost is $31.19 or the per hectare cost is $77.40 per hectare. Compare this, Table 4, with the **actual fertilizer applied** using the grid sampling by soil type and site specific application of $12.18 per acre or $30.08 per hectare. We have a significant savings of $18.91 per acre or $46.97 per hectare. This savings of $5064.58 for fertilizer must have charged against it the extra charges for testing of $4.85 per acre for a total of $1291.55. Thus the net savings are $3773.02 or $14.16 per acre. The philosophy is that the grid sample soil test will be used for four years so we have actually paid for four years of soil testing. We fertilize our land every other year with phosphorus and potassium for two crops. A crop of corn and a crop of soybeans. We have been using this procedure of fertilizing every other year for twenty-five years.

Weed Thresholds

We only have one year of site-specific yield data; but with this data we are inclined to believe that the weed threshold that significantly affects yield, is much lower than herbicide companies and Universities have led us to believe. We expect that the weed scientists will obtain data to substantiate the lowering of the

Table 3

Site Specific Phosphorus and Potassium Application Map
Grids contain only one soil type.

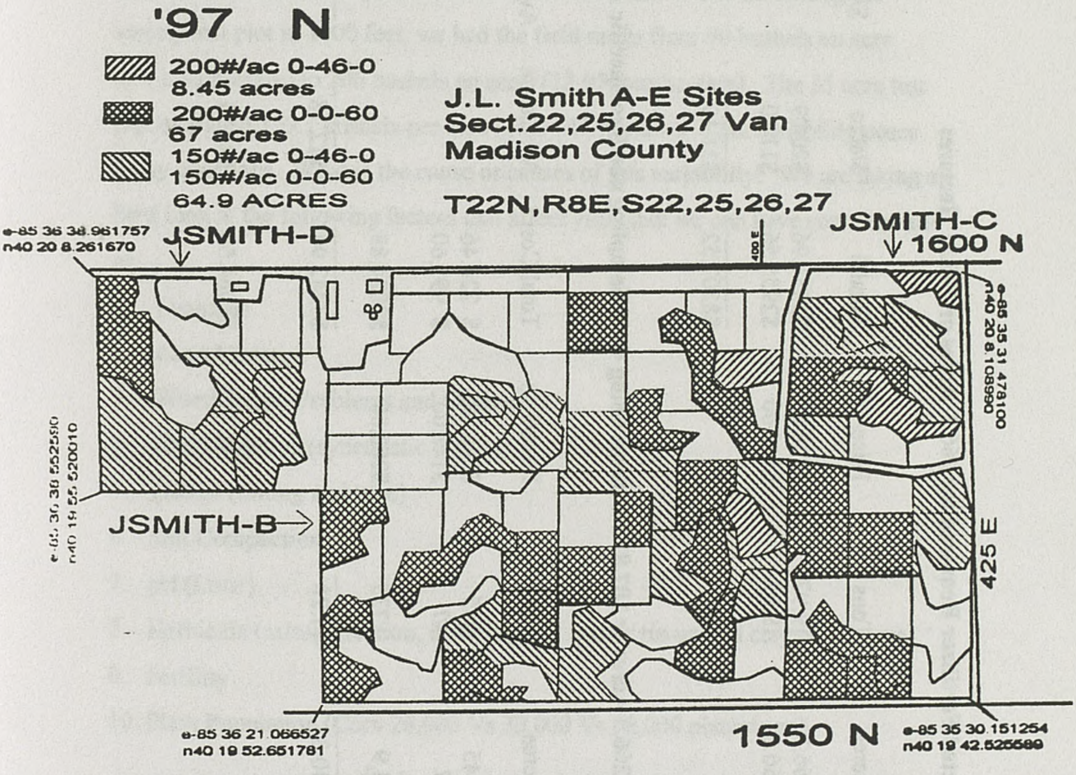


Table 4

Expected Fertilizer Required for 266.3 Acres or 107.81 Hectares

Pounds/a	Product	Acres	Tons	Price/Ton	Total $	$/acre	$/hectare
150	P_2O_5 46%	266.3	19.97	$268.00	$5351.96	$20.09	$49.64
150	K_2O 60%	266.3	19.97	$148.00	$2955.56	$11.10	$27.41
					$8307.52	$31.19	$77.05

Actual Fertilizer Applied on 266.3 Acres or 107.81 Hectares Using Grid Sampling and Site Specific Application

Pounds/a	Product	Acres	Tons	Price/Ton	Total Cost	Av. Cost/a	Av. Cost/ha
200	P_2O_5 46%	8.45	.845	$268.00	$ 226.46		
200	K_2O 60%	67	6.7	$148.00	$ 991.60		
300	P_2O_5 23%						
	K_2O 30%	64.9	9.735	$208.00	$2024.88		
		140.35	17.28		$3242.94	$12.18	$30.08
Fertilizer Cost Savings					**$5064.58**	**$18.91**	**$46.97**

economic thresholds of various weeds. We will rescue spray based on lower thresholds.

Yield Monitor

We were amazed at the yield variability in our fields. While harvesting our variety test plot in 1000 feet, we had the field range from 90 bushels an acre (5.6 tons/hectare) to 206 bushels an acre (12.95 tons/hectare). The 35 acre test plot averaged 159.1 bushels per acre (10.0 MT/hectare). This variability poses many questions. What is the cause or causes of this variability? We are taking a hard look at the following factors that affect yield that we can have some control of:

1. Drainage
2. Crop Variety
3. Weed, Insect Problems and Outbreaks
4. Crop Rotation (synergistic effects)
5. Tillage (timing and type)
6. Soil Compaction
7. pH (Lime)
8. Herbicide (misapplication, drift, organic matter tie-up and clay percentage)
9. Fertility
10. Plant Population (Corn 28,000 Vs 30,000 Vs 32,000 plants/acre)

Moisture Monitor

We are using the Ag Leader moisture monitor on a John Deere 9600 combine. The moisture sensor is our greatest frustration. Opening up a field can have enough green material and weed seed to create a problem requiring the sensor to be cleaned.

TEST PLOTS

Variety Test Plots

We started conducting variety test plots, and other research plots in 1975. We use a weigh wagon to weigh these plots. This past season we also used our yield monitor. We had significant variation between our monitor and the weigh wagon. This season, when harvesting test plots, we will stop at the crop and turn on the G.P.S. and at the end we will stop and turn off the G.P.S. Hopefully this will give us more accurate data to use in our comparisons. We will continue to use the weigh wagon until we are convinced that the yield monitor is accurate to do test plots.

WEED CONTROL WITH G.P.S. MAPPING

Markers

When we purchased the Ag Leader Yield Monitor we also purchased a field spot marker for $285.00. This was so new for them that there was no manual and nobody seemed to have answers as to how to use it. Our first year we did not use it as the program was designed and thus it was of little value. The software program is still very poor; but we have plans to use it this year in a beneficial way.

Marking Weed Location at Planting

We field cultivate soybean stubble one time immediately prior to planting corn. At this time when the operator sees a thistle patch or a patch or clump of quackgrass the operator will till around it, thus leaving the thistles and quackgrass undisturbed. This results in larger, healthier and easy to see weeds to spray with special selective herbicides. We will also have the G.P.S. marker on the corn planter tractor and will mark these patches and then make a map. We can then measure the acreage in each field that needs to be specially sprayed and properly prepare the mix. The previous two seasons we have sprayed the thistles with the very expensive two-thirds pint of Stinger (chlorpyralid) per acre. This year we are using the product Hornet. Hornet is a combination of Stinger (chlorpyralid) and Broadstrike (flumetsulan). This combination product is a less expensive method of obtaining the two-thirds pint of Stinger per acre and it covers a much broader weed spectrum. We can use the map to locate these patches and spray them. Theoretically, it can be done automatically with the data map providing the locations to turn on and off the sprayer. At this time, we plan to manually turn the sprayer on and off using the map as a guide in finding the locations and in assisting the manual turning on and off of the sprayer. We do not want to miss any of these problem, expensive weeds. For twenty years we have used various programs and products in an attempt to eradicate these perennial weeds. We have greatly reduced the volume that they rob from our harvest; but we can economically further reduce their impact on our production and profits. We plan to have the sprayer mapping when the sprayer is turned on. We can then look at the sprayed areas with our harvest yield maps. We expect this information to provoke many questions for us to attempt to find some possible answers.

Marking Weed Location at Harvest

The marker will be in the combine during harvest. The marker can mark four different items. We plan to mark thistles and quackgrass, foxtail (giant, green, yellow), other broadleaves (velvetleaf, giant ragweed, vines, etc.), tile ditch holes and rocks that require a loader to pick up. We can directly compare the thistle and quackgrass spray map with the combine thistle and quackgrass map to see the effectiveness of our special spraying for these pests.

EQUIPMENT PURCHASED (to collect site specific information)

Computer, Printer, Monitor

To start this project we decided that we needed to start with new power in the office so we purchased a 133mhz Pentium processor with 16RAM and 2.1 gigabytes of hard drive memory. The machine is equipped with a 28.8 phone modem and has 4X-CD ROM and runs on *Windows 95*. The machine was a lemon and we finally returned it and received in its place a Compaq Presario with a 200 MHz Pentium processor with 32 RAM and 2.6 gigabytes of hard drive memory. To make our color maps, we purchased a Hewlett Packard DeskJet 855C color printer. We decided that we needed a big screen monitor to be able to see, so we purchased a 17 inch monitor. We are pleased with these specifications.

Tape Backup and Splitter Switch

We also purchased a tape backup to attempt to preserve our data. We are using it; but in reality have not tested to see if we really can retrieve our data from it if we have a data loss.

Software

Purchasing the software was a very agonizing process. We finally decided on the Agri-Logic Survey Professional Mapping Program. It has been very difficult to use and finally they came out with an update that has made it much simpler. We also purchased the Ag Leader Marker and learned after the season was over that the software for the office mapping of the marker had not been developed. The market software came with the updated mapping software.

Yield Monitor and Marker

The yield monitor for the combine was another story. Finally, we decided on the Ag Leader Yield Monitor at a cost of $2800.00. The marker costs $285.00.

Global Positioning System GPS

After much investigation we decided on the Trimble Ag G.P.S. 120 Receiver using the coast guard signal for the differential. After one season it appears that it was a good choice in that we rarely loose signal. We had a lot of trouble at first because we did not know what we were doing and also did not have the receiver

Table 5

Capital Investment in Collecting Site Specific Information

Office Equipment		$5108.72
Packard Bell Computer (Pentium speed 133mhz, 16MB RAM, with hard drive storage of 2111.9 MB, 28.8 AMSP modem)	$2659.92	
Sony Monitor (17 inch)	$ 854.92	
Hewlett Packard DeskJet 855C Color Printer	$ 521.92	
Printer Cord	$ 12.99	
Hewlett Packard Colorado Tape Backup	$ 199.99	
Two Tapes	$ 58.00	
Switch	$ 15.99	
Surge Protector	$ 34.99	
PCMCIS Card Reader	$ 150.00	
2 Meg PCMCIA Cards (2)	$ 350.00	
Miscellaneous	$ 250.00	
Office Software		$ 700.00
Agri-Logic Instant Survey Professional	$ 350.00	
Agri-Logic Instant Crop Professional	$ 350.00	
Site Specific Equipment and Yield Monitor		$5685.00
Trimble Ag GPS 120 Receiver	$2600.00	
Ag Leader Yield Monitor 2000	$2800.00	
Ag Leader Field Marker	$ 285.00	

Summary:

Office Equipment	$5108.72	
Office Software	$ 700.00	
Site Specific Equipment and Yield Monitor	$5685.00	
Total Capital Investment		$11,493.72

mounted high enough. We first had it on the combine cab and when the grain tank extensions were full of grain, we would loose signal. So we moved the receiver up on top of the grain tank extensions and that has solved the problem. This receiver cost $2600.00.

Total Equipment Costs

The total equipment costs to date for this project are $11,493.72 as shown in Table 5.

Conclusions and Recommendations

After one season we are pleased with our decision to use site specific technology. The soil grid analysis and application has reduced our input costs of production. We have made the decision that we will not apply lime to a farm without first grid sampling the field. We hope that we can further reduce our costs of production through increase in yields. The yield monitor is supplying data that raises many questions for us to address. We feel that the accumulation and analysis of this data will lead to increased profitability for the farm. The global positioning marker is helping us to more efficiently improve our weed control. We now believe that the use of this technology will be mandatory to remain competitive into the twenty-first century.

BIOGRAPHICAL SKETCH

Jay Lee Smith is a farmer/owner/manager of 1126 acres in east central Indiana. The current farm operation devotes half of the acreage to soybean production and half to corn. Jay is a 1969 graduate of Purdue University with a Bachelor of Science degree in Agriculture Education. After teaching Vocational Agriculture and serving as a Young Farmer and FFA advisor for three years, Jay purchased his first 260 acres of farmland in 1971. Although Jay's occupation as a classroom Agriculture teacher ended in 1975, he has continued to share his knowledge and love of agriculture by serving as a consultant and technical advisor in foreign countries. He has completed fourteen consulting projects in seven countries: they are Kingdom of Swaziland, Bolivia, Latvia, Ukraine, Angola, Lithuania, and Romania. He has assisted clients of the Farmers Home Administration as they tried to improve financial planning and decision making skills. Jay's love of farming, travel and people have been combined in his study and observation of agriculture in fifty-four countries.