Farmer Rancher Grant Program

Final Report Form

I. PROJECT IDENTIFICATION

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Project Title:
Project Number: FNC12-847
Project Duration: 2 years
Date of Report: 07/2014

II. PROJECT BACKGROUND

1. Briefly describe your operation (i.e. how many acres, what crops, types of cropping systems, type of livestock or dairy production, grazing systems, family operation, etc.)

My farm started as a small few acre plot on which the scientist in me found great joy in experimenting with various trees and shrubs; including, but not limited to, pear, apple, hazelnut, black walnut, quince and goumi berry.

I focus on tree and shrubs for production and am fascinated by agroforestry. I am most interested in the integration of farm scale permaculture, agroforestry and cooperative farm models to make these systems work.

I have been wild harvesting much of my supply until planted crops come to bearing age on my acreage. The farm that I bought was originally 106 acres. I own approximately 40 of that. I had gone into the sale with two other families interested in the same models as I. We are exploring developing our own aspects of the acreage for the respective production elements we are interested in, but we are always exploring how we can cross our techniques to establish a more productive system.

While I have enjoyed what I did in this grant, I am most interested in what will come next in my farm and research. With an understanding of what I can do once my crops come to bear, I can now focus on a new form of co-operative farming that will benefit both quality of life for the farmer and the farm.

2. Before receiving this grant, did you carry out any sustainable practices? If so, briefly describe what they were and how long you had been practicing them.

I grew up with a Botanist for a father. Fascination with the natural world was instilled in me at a young age. I remember my father telling me how he was trained to identify trees just by

feeling the bark from one of his professors. As I grew into a young man, my fascination with becoming this familiar with the nature became developed into a passion.

I learned of permaculture in 2007 and decided to pursue a BS in Integrated EcoSocial Science. I focused a lot on farm systems in my studies and after graduating continued to explore knowledge on the subject. I worked many farms mostly dealing with perennial tree crops, but I also got the opportunity to work farms doing large scale grass-fed dairy and organic annual crop production. The best thing about experiencing what you have studied is that it then inspires you to do more.

I worked in the non-profit sector as a community garden coordinator. I studied with Dave Jacke, author of *Edible Forest Gardens,* and continued to teach on subjects ranging from permaculture to tree pruning. Eventually I settled back into my home state of Ohio and bought land.

My main expertise and passion was in perennial agriculture. I was most fascinated by nut trees. They make a great long-term planting for large acreages with great return for decades, and then can be cut for timber later in life. I joined the Northern Nut Growers Association and Ohio Nut Growers Association. I was the youngest member by far in 2009 when I joined these organizations. They have both been around for more than 100 years and had a plethora of knowledge to learn from in regards to the cultivated and wild nuts of north america.

It was fascinating to discover the fact that its members over the years were responsible for many of the nut cultivars we enjoy today. From black walnut to hickory to beech, I soaked up a lot of knowledge about these crops. Their economic and environmental benefits made me decide to plant them on my own land.

Waiting for them to bear I began wild harvesting on my land as well as on other farms that had the trees. I became a conduit for the idea that these nuts had extreme amounts of value in an economically deprived area like southeast Ohio. Being familiar with the farm industry; I took a natural next step and learned more about the processing associated with it. I was most fascinated by the nut industry's lack of processing models and the fact that the industry was so consolidated, very few small farmers were even making a living growing the crops (none the less even bothering to do it). I felt it was necessary to pursue this idea further by researching and developing machinery for the processing of these crops, but with any big idea I started small.

I started with the nut I saw the most promise in, the Hickory nut. I sought a small amount of funding with the NNGA to test machinery that could be promising to mechanize the process of post harvest processing these nuts. Members of the NNGA had been harvesting them for years cracking them out by hand and selling them for on average $40/lb. I had been wild harvesting and selling it already myself but knew that the process had to become mechanized to become any kind of economically sound business pursuit. Interested the model Hammons had developed sourcing wild harvested Black Walnuts and the economic benefit it gave to rural areas, I sought to understand the replication of this for Hickory nuts.

The results were both fruitful and interesting. Through the research, I learned the shortcomings in the nut processing industry for other nuts as well. With the new developments in hazelnut breeding and the growth in the domestic production of hazelnuts and chestnuts, I felt it a better time than any to explore this research with other nuts. Having seen success stories, I thought it best to explore why these models were successful. My intention was to share the information with others and explore more markets for not only the crop but its by-products as well.

These and many more questions brought me to my SARE grant research. I continue to

teach, farm and push boundaries further for this industry. With a holistic approach in mind, great shoulders to stand on and a childlike curiosity I will continue to carry out sustainable practices.

III. PROJECT DESCRIPTION

We conducted our research, outreach and educational events on the basis of what we found to be important in the industry and to meet the needs of what was missing in our community.

Researching the nut industry brought us to numerous processing facilities where we got a great understanding of the nuts and bolts of the process and the industry as a whole. We found great incites through the Northern Nut Growers Association and the Ohio Nut Growers Association as well. This helped us develop an approach to connecting with farmers and landowners that could potentially supply us.

We planned numerous educational events to detail care and development of the nuts crops we researched. It was through these events we began to make connections for raw product and were then able to shift our focus on the processing.

Once again, the Northern Nut Growers and the Ohio Nut Growers Associations came to our aid. Various tinkerers, engineers, current small scale processors and enthusiasts provided a great deal of information for the scale of machinery we were hoping to find.

This is where our partners in the grant began to shine. Dwight Mitchell, an engineer helped us alter existing machinery to meet our goals while Brandon Jeagar helped us to align the process to act as a whole.

We met with various businesses and producers to explore market potential of the products and “waste” products from the tests. We had great success in finding direct and wholesale markets for these products, it was just a matter of scale to provide to them.

We took diligent recordings on processing times for certain keystone machines. This gives potential processors the ability to understand time involved in the facility for processing and to size the machines accordingly for there operation.

Our results are promising and a good sign of what is possible with the nut industry. Further research is always necessary, but we feel with our results a good amount of the path is now behind us and the time for more start up facilities is necessary to further understand this field.

IV. GOALS

Projects Goals:

- Prototype models for regional processing of black walnut, hickory nut, hazelnut and chestnut.
- Create incentive for both cultivation of these crops and the wild harvesting of black walnut and hickory nut in particular.
- Explore co-operative models for processing these crops
- Find and explore various markets for these crops including waste streams in the processing

V. PROCESS

First let me state that our research focused on nut crops that can grow in the midwest and have economic viability for small farmers. This included hickory nuts, black walnuts, hazelnuts and chestnuts. In the subsequent paragraphs I will describe our reasoning for pursuing certain venues with our research while abandoning other. All outcomes of these venues of research can be found in the Results section of this final report

We had two means of sourcing the product. For the black walnut and hickory nuts it became far easier to source from the wild. After one season it became apparent that the best means of sourcing it was to pay others to bring the product to us. This increased the amount that could be harvested in a season, cut down on a lot of overhead costs and justified machine costs. Having various harvest sites that we would hit became uneconomical and it soon became apparent that the Hammons model of a single aggregation center would work best.

We were able to pay more for the raw product under this model without large amounts of fuel costs going from site to site then back to the facility to process. It offered great economic incentive for landowners to simply harvest what they had and bring it to us. We were creating economic value from something that otherwise was going to rot on the ground (and partially go to feed wild life, but the source was abundant).

We experimented with the pricing for the raw product. We followed suit with the Hammons model where people would bring product to a hulling station and be paid by the de-hulled weight. From Hammons' $13/100lbs to our goal of being able to pay $25/100lbs we found the $13/100lbs to be sensible for the cost of the operation and was plenty enough to incentivize people bringing it to us. Under suitable harvesting conditions and with a simple nut wizard we estimated that people could make up to $15/hr collecting these nuts off the ground.

The second means of sourcing the product was through growers themselves. We found this to be uneconomical for the black walnuts and hickory nuts given that so few people were growing them and demanded prices that would not be economically viable for processing. Most growers of black walnuts and hickory nuts do it for preservation of certain cultivars and are not scaled to commercial production. While Hammons will typically double its price for cultivars because they can yield on average twice as much meat and crack out with far more ease, many growers of these crops are still not interested in that price.

We found this to be the justification for sourcing the product from chestnut and hazelnut growers. While large hickory and black walnuts grew in great abundance in the wild, commercially viable hazelnuts and chestnuts did not. We worked closely with the Empire Chestnut Cooperative to source our chestnuts and utilized a hybrid hazelnut crop from an ohio grower.

In the end this gave us an interesting model to work with. We looked at overlap of machinery to be used in these processes and how that could potentially serve the growth of a business looking to process these products individually or all of them. Breaking into processing for a small farmer can be a hard thing to economically justify, so if you know that you can utilize the overhead investment in various ways, you'll be better off. We realized a grower could utilize the wild abundant source of the black walnuts and hickory nuts to process and sell while a more secure and managed crop of hazelnuts and chestnuts would be planted on their land. This offers a large amount of diversification in an operation; subsequently managing risk in hard years with either source of crop.

The bulk of this research was in the processing end of the nut industry. Post harvest handling machinery, facilities required and co-operations necessary to make this a commercially viable enterprise.

The motivation when researching and seeking out processing machinery was for it to be able to process between 1,000 and 5,000lbs/hr and for it to be able to process more than one nut involved in our research. This would give a potential processor the ability to have their investment into machinery go farther and diversify their income base. It also encourages growers to diversify as well if a facility were buying or capable of processing more than one nut.

We had great success in processing each nut. Each had its difficulties and brought us down their own paths. Regardless, we were able to find great overlap in machinery, not only with our nut processing goals but with other facilities as well.

We partnered with Shagbark Seed and Mill in this grant to explore co-operative models for processing. What we found was a great amount of overlap in sizing and sorting machinery for nuts, beans and grains. The potential for a couple of cost saving models came to mind and proved to be very promising. First, we explored co-operative ownership of the machinery. This made the initial investment of a machine far more feasible when starting out. We did see that as the businesses grew the overlap in processing times may become an issue for certain high use machines. The next was a model of co-packing where we would commission another business to process a crop. The reasoning for this was to find out whether it was easier for a grower to simply hand a crop to a large processor to have it processed and then returned to pack and sell themselves. Under ideal situations this would be great for small farmers, but we found the willingness of processors to do so very limited. The third and final model we explored was the co-operative ownership model in which a farmer would buy into a facility. We found this to be a blend of the first two options and the most feasible for small farmers. You have the benefit of overhead on machinery being far less than a sole venture; the ability for the product to come back to you with your own label to sell locally; but also the ability to aggregate with other farmers and sell regionally to wholesale markets and develop a brand together. We found that this would take around three to four dedicated farmers producing about 20 acres each to make this a worth while model. In doing so, each member would be far more successful than they would be individually. This co-operative model can free up a lot of time for the farmer to focus on what they do best: grow the crop.

Once we had the processing down, the question became what to do with the result. In a small processing facility the best mentality is that everything is for sale. With this in mind we saw nothing as waste and sought to explore markets for everything including shell, nut meal and what is called mill loss - a fine powder of nut meat and shell that results from the cracking process. Black walnuts and hickory nuts generate more “mill loss” than their hazelnut and chestnut counterparts. Much of the findings for this can be found in the results section.

VI. PEOPLE

- Richard Jeffers
    - Richard and his wife own approximately 300 acres where they raise grass fed beef for market. We partnered with them to source and promote the cultivation of the nut crops on their farm. They were a great source of black walnut and hickory nuts throughout the project.

- Bill Dix and Stacey Hall
    - Bill and Stacey own approximately 300 acres where they run a grass fed cow dairy providing Snowville creamery with milk which is located right next door. We partnered with them to source and promote the cultivation of the nut crops on their farm. They were a great source of black walnut and hickory nuts throughout the project.
- Bud Luers, Ken Bauman and Cullen Pfendler
    - ONGA/NNGA members who provided supply of every nut being explored in this grant. They also helped liaison between this project and the ONGA and NNGA for machinery recommendations and alterations.
- Brandon Jeagar
    - Past SARE recipient and Co-Owner of Shagbark Seed & Mill, Brandon helped consult on facility management, regional marketing, conducting co-packing research and provided facility space.
- Dwight Michell
    - Farmer and engineer who helped with machinery alterations and testing. He has since decided to develop farm scale processing equipment and is currently working on an oil press
- Marie DeMange
    - Community Outreach Coordinator. Conducting, tracking and organizing market data from our organization and collaborators.
- Rory Lewandoski, OSU Extension Educator
    - Coordinates Southeastern Ohio Woodland Interest Group (SEOWIG) and helped with our outreach to this and other organizations.
- Tanner Filyaw, Non Timber Forest Products Coordinator for Rural Action (non-profit)
    - Helped spread word of our research to the landowners he worked with
- Community Food Initiatives (non-profit)
    - Coordinated and advertised a lot of our educational events
- ACENet (non-profit)
    - Provided business consultations and space to test machinery in their certified kitchen space

VII. RESULTS

Machines explored:
Dehuller:

The dehuller used was manufactured by a NNGA member named Bill Greer (417-825-0760) to hull black walnuts. Our grant partner and engineer Butch Mitchell got to work on this machine so that we could also dehull the other nuts.

The only nut that it did not show promising results with was the chestnut. This nut, being extremely soft, was not up to the throughput and abuse that the machine put out. In the end we explored another route in processing the chestnuts given that they were free dehiscent, meaning they fell free from there hulls and often did not need to be dehulled.

The machine consisted of a 3-point hitch, a pto drive, a car tire inside a rebar cage, a hopper ontop to feed the product and an outlet where the dehulled nuts would come out the other side. Hulls would fall through the gaps in the rebar cage but we had to make a few alterations for this to occur. We added a motor to the other side so that it could also be utilized in a facility setting and added small metal dowel rods in between the 1/2" rebar to tighten up the spaces around the tire so that smaller nuts would not fall through with the hulls.

Another improvement that could be made would be making the cage adjustable against the rotating tire to get better results with one run on the small nuts. Hickories and hazelnuts in particular would benefit from this.

Illustration 1: Dehuller and Float Tank

Throughput/Run Time:

- Black walnut and Hickory: 15,000-18,000lbs/hr. This varied greatly due to the variable size of the nuts being fed. The chock point for this machine to run continuously is the ability to have the float tank run continuously or have numerous float tanks.
- Hazelnuts: averaged 20,000lbs/hr. Further machine alterations need to occur to improve the dehulling process for these nuts. The cage needs to be tighter around the tire. Like we described in the improvements paragraph; making the cage adjustable will solve this
- Chestnuts: Not applicable

Float Tanks:

Once dehulled, the nuts went directly into the float tanks. Our tanks were 275 gallon tanks with a 3" valve on the bottom. The water in these tanks was sustained at 145 degrees fahrenheit for 20 minutes in order to kill weevils and their larvae that were present in the nuts. This helps manage any further hatchings in what were currently good quality nuts and kill any live ones which made them easier to separate out.

The float tanks also served the purpose of separating bad nuts from good ones. Nuts that were not fully matured or hollow inside, (also known as pops) and nuts with live weevils and damage to the meat inside would float. Good nuts would sink making it easy to simply sift off the bad nuts on top while the nuts were being sterilized.

Float tanks are sold in a number of different fashions. Our's were fashioned from heat tolerant, food grade IBC tanks. They can be sold with conveyors in them to move the floats out

quickly with large ball valves and hopper bottoms to drain out the good nuts. This model would be ideal because it would require very little human maintenance and could be continuously ran with nothing but a bit of hot water added every time the temperature dropped below 145 degrees fahrenheit.

Throughput/Run Time:

- All nuts took the 20 minutes to soak and sterilize. We were doing 200lbs/275 gallon tank. That was plenty of time to get the bad nuts skimmed of the top at that amount and did not overload the tank This could be improved greatly with the continuous run system described above.

Dryer:

Once floated, we placed the nuts in tote bags with hopper bottoms which are used in the grain industry. Approximately 1,500 lbs could be placed in each bag. We placed the totes on a stand which would attach the hopper bottom to a 24" blower fan and heater. This was the most efficient means of drying the nuts to prevent them from molding. Most growers we knew were passively drying them on screens with one layer of nuts. This required great deals of space and time (up to 1.5 months). We found we could even dry them under this situation without the heater within 2-3 weeks depending on humidity. With the heater, the nuts moisture content could be brought down to a storable level with 3-6 days.

Illustration 2: Dryer with reducer to attach to totes

It took us a while to decide that this machine was the best for the drying job. We at first were trying to do it passively but there was no way the volume required to justify machine cost could all be passively dried on screens. We then used a batch dryer, but still were unsatisfied. Many moldy nuts later, we decided to pursue this option - which is what they very often use in the grain and peanut industry. This was the best means to solve any mold issues, and utilize as little space and human hours as possible.

Throughput/Run Time:

- This machine seamed to have no limits. In 2 weeks, with just the fan, all nuts were below 15% moisture while chestnuts took 3 weeks to get there. With the heat, all nuts took 3 days, while chestnuts took 6. You could always turn on the heat and get better times, but we averaged this time on a low heat of 80 degrees farenheit.

Cracker:

The MoHaBi nut cracker (can be found online) is the cracker we eventually decided to test for this operation. We chose this machine because it was designed to crack the harder nuts like black walnuts and hickories, but could also be adjusted for other nuts. The cracker had a rolling pin with small metal grooves attached to a motor. The grooves would catch the nuts and force them against an adjustable hammer plate. This was a piece of ½" steel that could either be moved tight against the pin or up to 2" away. This was how we were able to crack black walnut, hickory nut and hazelnut with great success.

The chestnuts were a great challenge once again with the cracker. The soft shell, even once dried to 15% moisture, was still completely turned to mush on the other end of the cracker. We had to switch gears with our machine test on the chestnut. Butch and myself sought out a student engineering group at Ohio University to tackle the problem. We had a design in mind so it was easy to approach them with the idea and get it built. Details for this machine are found in the "chestnut peeler" section below.

Improvements that came to mind for the MoHabi cracker were to allow the rolling pin to be easily changed out for others with different sized grooves. This would allow for better efficiency with smaller or larger nuts. The groove size that the machine comes with are ¼" deep making small nuts hard to crack fully and large nuts hard to feed quickly at an efficient throughput.

Illustration 3: MoHaBi Cracker

Throughput/Run Time:

- Hickory and Black walnuts: 770-1,200lbs/hr to run through and get them fully cracked with no meat still attached to shell. This variable amount was dependent on the size of the nut. Surprisingly the smaller nuts took longer because you had to choke up on the hammer plate to get them fully cracked with no shell attached to meat.
- Hazelnuts: 2,500lbs/hr, also dependent on size, but great results with this cracker
- Chestnuts: Not applicable

Chestnut Peeler:

The chestnut peeler became essential when we could not find means to get the chestnut out of shell using any conventional cracker. Chestnuts are 50% moisture at harvest and practically have no oil content. This sets them apart from the rest of the nut research which can exhibit up 30% moisture at harvest and 30% oil content.

The chestnut has not only a flexible shell but a fine brown skin under the shell that is bitter to taste and is essential to remove. Some methods involve steam which is a high intensity processing method to remove both. We found no cost effective means of doing this at the scale we were aiming for. Other methods involve blades that actually peel the chestnuts shell, brown skin and a layer of the meat itself. This method is effective and has many small processing models that will perform this task. However, the chestnut ends up looking like a peeled potato and has little appeal to consumers. This method might be more useful to a value added market like flour of meal because of its appearance.

The peeler we ended up modeling consists of a couple high powered fans and an anvil. The nuts are fed into the air stream where they reach speeds over 70

Illustration 4: Chestnut Peeler

miles/hr and then hit an anvil at the end which bursts the shell and skin from the nut. If the nut is dried down prior to peeling (25% or lower) the machine will reach almost 100% efficiency. The only down side to this is the loss in weight when drying chestnuts and the the greater price you must charge in comparison to the already steady fresh market. The chestnut also has a very short shelf life in comparison to other nuts. We will go into further detail on this in the specific section dedicated to chestnuts.

Improvements to this machine would involve a greater velocity fan with a larger fan and anvil to achieve more throughput. Having greater variable speed control would also allow the machine to be used as an air leg in nut and shell separation.

Throughput/Run Time:

- Chestnuts: 7,200lbs/hr.

Seed Cleaner:

The seed cleaner was used to size nut meat and shell prior to separation. There are various forms of this machine in the nut industry. We found the seed cleaner to be most useful because it can also be used for beans and grains and has a built in aspirator. This overlap allows this machine to be a shared cost with another venture.

This machine was excellent for sizing of post cracked material. This was only really needed for the hickory and black walnut due to the large variation in size of cracked material because of the ribbed nature of the nut. There were usually three sizes, large and small kernels and mill loss. This machine made the subsequent separation of meat and shell for black walnuts and hickory nuts far more efficient.

We did not find much use for this machine in the case of the hazelnuts of chestnuts. The sizing of these nuts prior to cracking (while in shell) can be needed if the crop being processed contains a large amount of variation in size. There is an economic benefit to separating nuts by size before cracking given that nuts that are large demand a more premium price. The cracker also operates more efficiently when the material being fed is of an even size. This sizing before cracking would be important for the hazelnut, while the chestnut could be sized after the peeler.

Illustration 5: Seed Cleaner and Cracker set up

Machines for sizing nuts in shell can be far more simple than the seed cleaner. A number of options exist for this process. One is a large cylinder that rotates with various sized holes. The cylinder has an angle of repose that is adjustable so the material being fed will slid down the cylinder to larger and larger holes. On the way down they will fall through their respective sized hole and into hoppers. Another and far more simple example is the chute model in which rebar fans out from one point allowing the material to eventually fall through the ever widening gaps and into hoppers below.

Throughput/Run Time:

- Hickory and Black walnut: 800-1,000lbs/hr. This machine had to have is screen cleaned out of all the jagged shell about every 2hrs.
- Hazelnuts and Chestnuts: Not applicable

Barrel Float:

Illustration 6: Skimming nut meat off top of Barrel Float

The barrel float was strictly used for the hickory nut to separate meat from shell. This machine used a 75 gallon water tank that gets filled with water and salt for buoyancy. You leave a decent amount of room at the top and add about 20lbs at a time. You close the top and flip the motor on and the machine puts the vat of water under pressure. Under these conditions the shell absorbs water more readily and sinks. You then flip the motor off, open the release valve, open the top and skim off the nut meat float at the top.

This machine worked very well for the hickory alone. We tried every nut and found it astonishing that we were not able to replicate results with any other nut. The only downside to this machine is that after the meat is skimmed off it then needs to be dried. Scaling the barrel float throughput to the dehydrator's becomes very important to avoid a choke point in processing.

Improvements to this machine would be a separate tank that could act as a pressure release not requiring you to turn off the motor or release the pressure. This would still require the opening of the top and loading, but there are models of this machine that are continuous feed/run.

Throughput/Run Time:

- Hickory nuts could be loaded at 20lbs intervals with a run/load time of 5 minutes and a max capacity of 100lbs before you have to empty the tank and start over again. Shell was reduced to 5% by weight in the nut meat as a result of this machine

Re-Run Aspirator:

The re-run aspirator was chosen for its versatility and size. It is a key component in chestnut and hazelnut shell and meat separation. It is simply a few chamber with a feed point and a fan that pushes the material to one of 2 respective outlets. The material is separated by relative density and helps to have it sized before entering the machine.

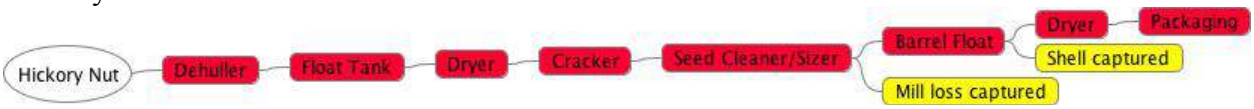
We had this machine tested off site due to the wide amount of models of aspirators we did not see it fit to spend the grant money on buying one for this simple test. Our goal was simply to provide ample evidence that the machine could be used for the purpose of separation for hazelnuts, chestnuts and black walnuts.

Improvements to this machine may be achieved by adding other like it. The Air Leg and Cyclone combined with the aspirator may serve a black walnut, hazelnut and chestnut processor well. All operate on the same principles of air flow and separation by relative density. The difference is that the air leg is unique in separating larger material, while the cyclone can capture

fine particles and the aspirator is good for things in between of similar size but not density.
Throughput/Run Time:

- All nuts averaged 300lbs/hr. The one exception is the black walnut which needed the air intake fully dampered and the fan speed all the way up to produce any results. Many models above this exist that would have better throughput and results. This end of separation needs further research and is dependent on what size and scale a processor wishes to produce.

Processing Schematic for each nut involved:
Hickory Nut:



The hickory nut offered many challenges, but also great success. We had to explore options to capture some of the loss revenue from the mill loss associated with the cracking of this nut. The hickory nut, like the black walnut, is a ribbed nut, meaning the shell is intertwined with the nut meat. This requires a great deal of cracking and much of the meat and nut end up being pulverized into a powder as a result. We found that this nut meal was a great source to press oil from. We managed to recover 30% oil from the mill loss.

Once oil is pressed from the meal the left over cake makes a great ingredient in brewing beer. We experimented with a local brewery with great success. The breweries that use nuts in their beers must cook the oil in the nut off before brewing with it because it can cause spoilage in the beer. We essentially were saving them a step by pressing it first and allowed us to sell the product twice. We were selling the meat at $20/lb, this meal at $15/lb and the oil at $20/8oz. This made the mill loss the most profitable part of the processing given that it took less to process to a finished product and we were selling it twice.

We also explored selling the mill loss for feed. The results are below, but we found this to be the less profitable option than oil and selling the cake for beer. The one advantage is that you do not need any added machinery to sell mill loss as feed. It can just be packaged and sold immediately after the seed cleaner/sizer. This high oil feed does require refrigeration though.

The second waste stream we explored was the shell. We were getting large amounts of shell out of the barrel float that were slightly moist since the barrel float is a wet process. This can be used for smoking just like hickory wood chips. The sustainability of using hickory shells rather than chips was appealing to many local smokers and we were able to sell them for $3/lb

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Date Reported: 02/11/2014
Lab Number: 14-383
SAMPLE I.D.: Grain
Sample A Hickories

Item		Units	As Sampled Basis	Dry Matter Basis
Moisture		%	6.94	
Dry Matter		%	93.06	
Crude Protein		%	12.04	12.94
Available Protein		%	11.68	12.55
Adjusted Crude Protein		%	12.04	12.94
A.D.F. Protein		%	.36	.39
N.D.F. Protein		%	.62	.67
Soluble Protein		%		
Protein Solubility		%		
Lignin		%	11.99	12.88
Acid Detergent Fiber		%	40.00	42.98
Neutral Detergent Fiber		%	49.31	52.99
NFC (Non-Fiber Carbohydrate)		%		
Sugar		%		
Starch		%		
NSC = Starch + Sugar		%		
Crude Fat		%	50.72	54.50
TDN		%	114.14	122.65
NEl		Mcal/lb.	1.216	1.307
NEm		Mcal/lb.	1.333	1.432
NEg		Mcal/lb.	.966	1.038
Ash		%	2.00	2.15
Lignin Insoluble Ash		%	1.38	1.48
Calcium	(Ca)	%	.18	.19
Phosphorus	(P)	%	.25	.27
Magnesium	(Mg)	%	.13	.14
Potassium	(K)	%	.35	.38
Sulfur	(S)	%	.08	.09
Sodium	(Na)	%	.023	.025
Chloride	(Cl)	%		
Copper	(Cu)	ppm	8	9
Manganese	(Mn)	ppm	183	197
Zinc	(Zn)	ppm	55	59
Iron	(Fe)	ppm	24	26
Molybdenum	(Mo)	ppm		
Aluminum	(Al)	ppm		
Nitrate	(NO3)	%		Negative
pH				
RFV (Relative Feed Value)				
Horse	DE	Mcal/lb.		
Horse	TDN	%		
Crude Fiber		%		
DCAD		meq./100g DM		
DCAD		meq./1 lb.DM		

Black Walnuts:

The black walnut followed the same processing path as the hickory until shell and nut meat separation. This is due to the nuts physical similarities, but chemical differences.

Illustration 7: Oil Pressing tests for black walnut and hickory nut

The black walnut had the same results with mill loss, oil yields and prices; but had its own respective feed analysis and shell use. We found that large industries are using the shell for various purposes, but would be hard to meet for small scale processors. We then discovered that the shells of the nuts have some value for heating in pellet stoves. We never sold the shells for such purposes, but burned them with great success. Wood pellets only sell for about 13 cents/lb so the market for such a product may not be worth pursuing unless creating a lot of shell waste.

Below is the feed analysis results.

HOLMES LABORATORY INC.
3559 OH 62
Millersburg, OH 44654
Phone (330) 893-2933
E-mail: holmeslabinfo@wifi17.com

FORAGE/FEEDSTUFF
ANALYSIS REPORT
[A Vital Key to Todays Agriculture]
www.holmeslab.com
Test Performed: 9

Customer: Kurt Belser

Kurt Belser
42963 Carsey Rd.
Albany, OH 45710

Date Reported: 02/11/2014
Lab Number: 14-384
SAMPLE I.D.: Grain
Sample B Blk Walnuts

Item		Units	As Sampled Basis	Dry Matter Basis
Moisture		%	7.01	
Dry Matter		%	92.99	
Crude Protein		%	15.77	16.96
Available Protein		%	15.18	16.32
Adjusted Crude Protein		%	15.77	16.96
A.D.F. Protein		%	.60	.64
N.D.F. Protein		%	1.10	1.18
Soluble Protein		%		
Protein Solubility		%		
Lignin		%	17.29	18.59
Acid Detergent Fiber		%	45.50	48.93
Neutral Detergent Fiber		%	47.69	51.29
NFC (Non-Fiber Carbohydrate)		%		
Sugar		%		
Starch		%		
NSC = Starch + Sugar		%		
Crude Fat		%	32.84	35.32
TDN		%	87.40	93.99
NEl		Mcal/lb.	.920	.989
NEm		Mcal/lb.	.992	1.067
NEg		Mcal/lb.	.694	.746
Ash		%	1.91	2.05
Lignin Insoluble Ash		%	.60	.64
Calcium	(Ca)	%	.09	.10
Phosphorus	(P)	%	.35	.38
Magnesium	(Mg)	%	.11	.12
Potassium	(K)	%	.39	.42
Sulfur	(S)	%	.10	.11
Sodium	(Na)	%	.017	.018
Chloride	(Cl)	%		
Copper	(Cu)	ppm	8	9
Manganese	(Mn)	ppm	49	53
Zinc	(Zn)	ppm	40	43
Iron	(Fe)	ppm	38	41
Molybdenum	(Mo)	ppm		
Aluminum	(Al)	ppm		
Nitrate	(NO3)	%		Negative
pH				
RFV (Relative Feed Value)				
Horse	DE	Mcal/lb.		
Horse	TDN	%		
Crude Fiber		%		
DCAD		meq./100g DM		
DCAD		meq./1 lb.DM		

Chestnuts:

We found chestnuts to have little waste besides the shell. Of which there was little to do with

Hazelnuts:

Hazelnuts as well as chestnuts had few waste products to speak of. Hazelnuts shells also have promise for pellet stove feed, but again the price was not worth it unless dealing with large amounts of shell.

Most nut waste, like the chestnuts, were just bad nuts and could not be repurposed for other markets. We found feeding these wastes to animals totally acceptable, but not an economical pursuit. The quality and reliability were just not up to par for a sellable product.

VIII. DISCUSSION

This grant has aided me and my farm operation in understanding the economic costs of starting a nut processing facility. This certainly was a barrier due to the estimated overhead, but I am glad to see that it can pay off under the proper circumstances.

The models we have developed have their inherent risks, but with our research the risks are far less than what someone would have suffered before reading this grant. Farms scaling up and looking to find means to tap into value added markets in the crops that we have identified now have a stepping stone to do so. They can now assess their regional needs, understand the risks, need and yields of a facility based on those elements and make an informed decision whether or not to pursue something like this.

I would highly recommend farmers and ranchers to band together and seek co-operative models for processing their crops to reach larger markets. This gives the growers more buffer for risk, larger markets to have influence in the industry and sets them up to adapt to the economy of scale.

IX. OUTREACH

- Attended the Ohio Nut Growers Associations spring meeting handed out promotional material to the over 50 attendees and gave a speech to inform growers and land owners on our research which secured us a reliable source of crop to use if wild harvesting had not fallen through.

- Held a nut grafting workshop at Solid Ground Farm in which 12 people attended, furthering our relationships with landowners and growers.
- Attended a town hall meeting for local business owners, farmers and non-profits to share their stories and promote themselves and what they are doing, discussion followed amongst the 40 speakers and 80 attendees.
- Spoke on a local food processing panel at the Real Food-Real Local-Real Good Institute held by the 30 mile meal projects of Athens Ohio 34 people sat in on discussion and then proceeded to tour the facility we had arranged for processing that fall.
- Held 3 Tree pruning workshops out at Solid Ground Farm in which 22 people attended at one, 15 at another and 13 at another. These focused on nut tree pruning for better production in 2011, 2012 and 2014

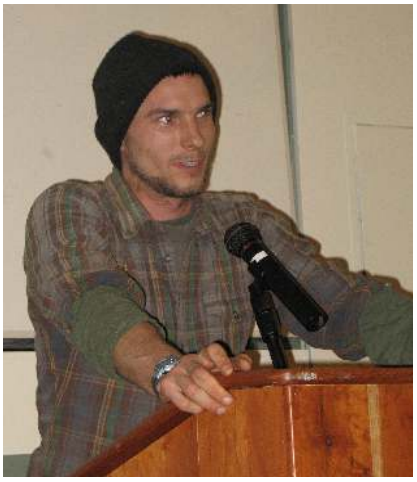

Illustration 8: Speaking at Town Hall Meeting

Illustration 10: Nut tree care workshop at Solid Ground Farm

Illustration 9: Nut tree care workshop at Solid Ground Farm

- Held a Nut tree management and processing workshop at the 2013 PawPaw festival in which 21 people attended.
- Have had numerous phone conversations/conference calls with small to large scale growers and processors. Heartland Nuts 'n' More, Southern Nut 'n' Tree and Empire Chestnut Company to name a few.
- Spoke at the Ohio Ecological Food and Farming Associations 2014 conference on behalf of SARE and our project in which 13 people attended

X. BUDGET SUMMARY (emailed separately)