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A COMPARISON OF SEMI-CONFINEMENT AND OUTDOOR ISOLET REARING SYSTEMS FOR SWINE

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SUMMARY

Two swine production systems -- Semi-Confinement and Outdoor Isolets -- were evaluated to document production and economic inputs and outputs, to evaluate the feasibility of an isolet system in North Dakota, and to prepare a microcomputer generated economic analysis for each system to aid lenders and entry level producers in their decision making process. Overall systems comparison favored all in/all out semi-confinement rearing during all phases of production, but the Isolet system performed quite well and would be a very effective entry level system. Daily gestation intake was similar, but the isolet system sows, which farrowed spring, mid-summer and fall, consumed more total feed because their non-productive period was longer. Daily lactation feed intake was significantly lower for the semi-confinement sows, eating 5.15 pounds less feed head/day. Farrowing performance of sows farrowed in crates was similar for pigs born alive (Semi- 10.4 vs Isolet- 10.6), but death loss after farrowing was 0.6 pig less/sow (Semi- 1.98 vs Isolet- 2.83). While several criteria contributed to the losses, being laid on was the most frequent cause. Confinement pigs were more efficient, but the higher nutrient dense diets resulted in a higher nursery period cost of $1.02 per head. Growing/finishing pigs developed in the confinement nursery were more efficient through to slaughter, consuming an average 28 pounds less feed/head. Feed costs/head were $1.34 less for the pigs started in confinement (Semi- $34.70 vs Isolet- $36.04). Economic analysis was prepared using NDSU's Swine Production Analyzer software. Analysis of both systems, using two year averages for production data and total costs for facilities and equipment, was favorable for both profitability (opportunity costs) and feasibility (cash flow) analysis. Net returns to operator to cover unpaid family labor, management and equity capial costs for the profitability and feasibility analysis were $159/sow and $102/sow for semi-confinement, and $138/sow and $89/sow

for the isolet system.

INTRODUCTION:

North Dakota is the nation's leading producer of several field crops (wheat, barley, oats, sunflowers and flax). As a major crop producing state, two-thirds of all farm income is derived from a combination of crop production and government payments. The remainder is derived from livestock marketings (ND Ag. Statistics, 1994). Historical review of income source figures compiled by the ND Agricultural Statistics Service, indicate that demand for income from livestock has declined steadily since 1950, and averaged about 24% during the 1980's. Livestock production has shifted from a general distribution statewide to its present distribution in which livestock income exceeds crop income in one-third of the states' counties located primarily in the central, westcentral and southwestern counties. Farmer decisions to replace livestock with more specialized farming has been stimulated largely by export growth, government farm subsidies and periods when crop prices were substantially higher than livstock prices. Hog numbers in the state declined 32% from 1950 to 1985, then began increasing to their present level of approximately 320,000 head.

North Dakota represents a disproportionate environment with respect to hog production, since the state is the nation's largest producer of feed barley, but is also one of the smallest pork producing states, raising only 1% of the nation's hogs. As a region, North Dakota is ideally suited for hog production because of its large feed grain base, generally favorable environment, low farm density, minimal swine disease, and work ethic. A logical inference from this is that farmers within the state could utilize these resources to increase net farm income by increasing hog production.

Without careful swine enterprise analysis, entry into the hog business can easily become capital intensive creating unmanageable debt resulting in business failure. The purpose of the present investigation was to evaluate two swine rearing systems, Semi-Confinement and Outdoor Isolets, as alternatives to total confinement, by documenting production and economic inputs and outputs, followed by preparation of microcomputer generated economic analysis for each system to aid lenders and entry level producers in their decision making process.

MATERIALS AND METHODS:

Two rearing systems *1) Semi-confinement, and 2) Outdoor Isolet* were established at the Dickinson Research and Extension Center. As a supplemental source of income to an existing farm enterprise, several assumptions were made. It was assumed that grain storage and handling equipment, farm tractor, water well, pickup and trailer, and electricity were available. Constructed at the Research Center's Ranch Headquarters, the two systems were populated with backcrossed Largewhite X Landrace sows that were bred to Hampshire boars. The herds were maintained at 30-40 sows each during the two year period of the study, and all breeding was done naturally. The two systems are described as follows:

SEMI-CONFINEMENT SYSTEM

The semi-confinement system combined totally confined farrowing and nursery facilities with outdoor breeding, gestation, growing and finishing. Females were farrowed in groups year round. Four week weaning and five week intervals between farrowing groups allowed one week for cleanup. Sows were bred on their weaning heat using muliple sire breeding. Elevated farrowing crates and nursery pens were used in a remodeled 26'x 60' insulated building with concrete floor that sloped to a center gutter running the full length of the building. Manure solids were scraped weekly into the center gutter and then the floor and solids in the gutter were flushed with a high pressure hose into an outside underground holding tank. Underground manure storage was provided by a discarded 16,000 gal. oil field tank that was pumped periodically with a tractor driven hydraulic pump and the manure spread on cropland. Thermostatically controlled variable speed fans and air inlets provided summer ventilation and a heat exchanger provided winter ventilation and tempered incoming winter air. Weanling pigs were developed using a commercial starter ration the first week after weaning followed by a three phase meal type starter diet. Pigs weighing 50-60 pounds were sold as feeders or retained and fed to finish. Approximately one-third of the pigs produced were retained and finished.

OUTDOOR ISOLET SYSTEM

The outdoor isolet system evaluated was a two litter system the first year and a three litter system the second year of the study. In year one gilts and then sows were farrowed spring and fall, and in year two sows were bred for spring and fall farrowing, and a group of gilts selected from the market hogs were bred to farrow mid summer before being sold. Sows were farrowed in sixteen Smidley Farrowing House units (isolets) purchased from Marting

Manufacturing, Inc., Britt, Ia. Half of the isolets were attached to 8'x 8' porches equipped with tip out feed pans and 55 gal. drum water barrels with drinkers. The other half were attached to 6' x 16' dirt runways that had a feed and entrance gate at one end. The gate was equipped with a divided cast iron folding pan for feed and water. Pigs were weaned at five weeks of age, and when they reached 50-65 pounds were either sold as feeder pigs or were fed to finish. Sows were bred the first week of December for April farrowing, and the third week of May for mid September farrowing. Gilts farrowed mid summer were bred in early march and sold after their pigs were weaned.

Diets fed in this system were the same as those fed in the semi-confinement system, and are also shown in table 2. Creep feed was not offered to the pigs in this system, but they had access to sow feed with their mothers.

Production data accumulated from the two production systems were subjected to profitability and feasibility analysis using NDSU's Swine Production Analyzer, an NDSU Extension microcomputer software package.

RESULTS AND DISCUSSION:

PRODUCTION ANALYSIS

Two swine production systems, Semi-Confinement and an Outdoor Isolet System, were evaluated to document production and economic inputs and outputs, to evaluate the feasibility of an isolet system, and to prepare a microcomputer generated economic analysis for each system to aid lenders and entry level producers in their decision making process.

Overall production favored the semi-confinement system. Two year combined averages for the two systems are shown in table 1. Gestation costs were similar for the systems because the sows were limit fed the same level of intake, but during lactation sows housed in the isolets ate a significant 5.15 lbs. more feed/head than the sows confined to crates (17.70 lbs. vs 12.55 lbs.). Additional exercise and piglet feed sharing experienced by isolet sows increased daily lactation cost $.23/sow/day.

Overall farrowing performance favored sows confined to crates in the semi-confinement system. Sows in both groups farrowed nearly the same number of pigs born alive (Semi -10.4 vs Isolet -10.6), but death loss within two days after birth was significantly greater among the isolet sows that roamed freely (Death Loss: Semi -1.98 pigs/sow vs Isolet -2.83 pigs/sow). While several factors contributed to the losses recorded, the most prevalent cause was due to more pigs being laid on. Sows confined to crates weaned 0.6 more pigs/sow than those in the isolets.

Nursery performance reflected differences in the two rearing environments as well. Pigs in confinement were weaned directly from crates to nursery pens at 4 weeks of age. Totally confined nursery pigs were more efficient converting 1.90 pounds of feed/pound of gain. Isolet pigs consumed 2.13 pounds of feed/pound of body gain. Pigs in the less intense isolet system nursed their mothers for five weeks and therefore were heavier and more developed at weaning. The isolet pigs received no creep feed, but ate lactation feed with their mothers. Since the isolet pigs were heavier at weaning, post weaning starter diets were less nutrient dense and the pigs were switched to grower diets sooner. Also, since the isolet pigs were heavier at weaning, they ate more feed during the post weaning period, but the feed cost per pound was less expensive making the gains more economical. Nursery feed cost/head ranged from $5.30 for the isolet pigs to $6.32 for the pigs reared in confinement.

Growing/finishing pig performance between the two systems was similar. This is understandable because, like with the gestation phase, the growing/finishing phases for each system were as conducted as identically as possible. Six separate groups of pigs from each system were fed side by side during the two year study. The averages in table 2 represent the combined averages for the separate groups fed. Pigs reared in confinement were more efficient during the finishing phase consuming 28 lbs. less feed. Feed cost per head ranged from $34.70 for the pigs born in confinement to $36.04 for the pigs born in the isolets.

ECONOMIC ANALYSIS

Production data is essential to establishing realistic budget analysis reports for enterprise profitability and feasibility. A swine producers decision to invest in a production technology needs to be based on his projected answers to two fundamental economic questions. First, is my proposed production system projected to be profitable over the long-run? Economic profitability question is based on the assumption that the swine enterprise has to pay the "opportunity cost" of the resources consumed. That is, if the long-run average corn price is $2.40/bushel, the swine enterprise has to pay the $2.40 opportunity cost for the corn consumed. This opportunity cost concept should be used for all resources consumed by the swine enterprise.

If the answer to the profitability question is no, then that investment probably should not be executed. If the long-run projected answer to the profitability question is positive, a second feasibility question needs to be asked before initiating the investment. The second question, is my proposed swine enterprise projected to be feasible i.e., will it cash flow? Cash flow requirements change substantially if the investment is financed with equity capital or with debt capital. Feasibility determines if the swine enterprise is projected to supply sufficient cash to pay its own cash obligations or will the swine enterprise need to be subsidized by other farming enterprises?

Profitability is determined by the returns to unpaid labor, management, equity capital and risk. Cash flow is determined by the amount of cash left over each year after that year's bills are paid. It is recommended that a producer invest in a production technology only if the answer to these two critical questions is "yes". Yes, my proposed technology investment proposes to be profitable and yes, my proposed investment projects to cash flow.

The two production systems -- Semi-Confinement and Outdoor Isolets -- were each subjected to a profitability and feasibility analysis. NDSU's Swine Production Analyzer, an NDSU Extension microcomputer software package, was used to analyze the profitability and feasibility of the two systems. Results of these analysis are presented in tables 3 and 4.

PROFITABLITY ANALYSIS of SEMI-CONFINEMENT

The economic analysis for the Semi-Confinement System is summarized in table 3. The investment in buildings ($265/sow), equipment ($256/sow), brood sows ($136/sow) and boars ($300/boar) totaled $688/sow. The analysis was based on 100 percent debt capital -- A WORST CASE SCENARIO. This worst case scenario was used even though most farmers would normally have to put up some equity capital before a banker would participate in this type of investment.

The actual gross income generated from this 39 sow enterprise was 2,591 pounds of pork from the sale of slaughter hogs, feeder pigs, cull sows, cull boars, adjusted for purchased replacement gilts and sow death loss, totaled $861 per sow. The feed consumed per sow was made up of 107 bushels of barley, 0.17 tons of alfalfa, 0.12 tons of premix, and 401 pounds of soybean protein supplement. The feeds fed to this herd were all purchased so that the opportunity cost and the cash flow cost both totaled to $339 per sow.

Livestock costs are made up of vet and medicine ($29), marketing (49), repairs for building and equipment ($26), bedding ($5), power fuel utilities ($76), herd performance fees ($0), and miscellaneous expenses ($13) totaled $198 per sow. It was assumed tht all operating capital was borrowed at 9 percent interest for 6 months. This resulted in an additional operating interest charge of $24 per sow. When combined with feed costs, operating capital required for this enterprise was $561/sow.

Fixed costs for capital assets were based on some common farm management rules of thumb. The 8.67% fixed asset cost for buildings was based on a 15 year depreciation schedule (6.66%), a one percent (1%), annual repair cost, and a one percent (1%) annual insurance cost. The 17.29% equipment cost was based on a 7-year depreciation (14.29%), annual repair cost (2%), and insurance cost (1%). Annual depreciation and insurance on boars were figured at 36% per year. No insurance cost was assumed on the sow breeding herd. Fixed expenses totaled to $78/sow in the profitability analysis.

Interest paid on borrowed investment capital is an opportunity cost that needs to be taken into account. Principal payment, however, only reflects who owns the asset on the balance sheet and is not a legitimate opportunity cost. The interest cost for the Semi-confinement System totaled $63/sow. Total opportunity costs for the semi-confinement system totaled $702 per sow. Return to operator was $159/sow ($861-$702).

FEASIBILITY ANALYSIS of SEMI-CONFINEMENT

Since all feed was assumed purchased, the cash flow feed costs and cash flow livestock costs paralleled the economic analysis. A practicing farmer may well raise the feeds fed to the sows so he would include his cash cost of producing the farm raised feeds. Depending on his unique cash costs of producing his farm raised feeds, these cash costs of his farm raised feeds may exceed or be less than the market price used on the opportunity cost side.

Depreciation is not a cash cost so the cash flow fixed costs covered only repairs and insurance. The farm management rules of thumb used for annual cash costs were 2% for buildings, 3% for equipment, and 36% annual cost for boar replacements. This gave a total cash cost of $24 for the buildings and equipment. Interest on debt capital totaled to $63/sow and principal payments on debt capital totaled to $110/sow. Total cash costs (feasibility) of production was $758/sow. Cash return to operator was $102/sow ($861-$758).

Final economic analysis for the semi-confinement system is based on the calculated returns to unpaid labor, management, equity capital and risk. This bottom line is used because any farm family's total contribution to the swine enterprise is the family's unpaid labor, management and equity capital. Risk is also included in the bottom line definition because pure profits are the rewards to risk. This 39 sow semi-confinement generated a $159/sow return to unpaid family labor, management, equity capital, and risk. Yes, this investment was profitable in the two years covered by this research project. The break even price for this semi-confinement system was calculated at $38.11 per hundred weight of slaughter hogs produced.

PROFITABILITY ANALYSIS of OUTDOOR ISOLETS

Economic analysis for the outdoor isolet system is summarized in table 4. Investment in isolets with porches ($297), equipment ($221), brood sows ($115) and boars ($300/boar) totaled $663/sow. Gross income per sow from this 30 sow outdoor isolet enterprise was $798/sow (2,731 lbs. marketed/sow), and was generated from slaughter hogs, feeder pigs, cull sows and boars, and adjused for purchase of replacement gilts and sow death loss.

Across herd feed consumption per sow was made up of 126 bushels of barley, .13 ton of alfalfa, .12 ton of premix, and 400 pounds of soybean protein supplement. Opportunity cost and cash flow costs were equal because all feeds were purchased.

Livestock costs were vet and medicine ($14), marketing ($52), repairs for buildings and equipment ($17), bedding ($7), power fuel and utilities ($24), miscellaneous ($13), and totaled $125/sow. Combined feed and operating costs per sow were $525/sow.

Fixed costs for capital assets were depreciated using the same rates and time intervals applied to the semi-confinement system. Isolet fixed expenses totaled $75/sow in the profitability analysis.

Interest paid on borrowed investment capital is an opportunity cost and totaled $61 per sow. Total opportunity cost for feed, livestock expense, interest on feed and livestock expense, and fixed expenses in the isolet system was $660/sow.

FEASIBILITY ANALYSIS of OUTDOOR ISOLETS

Feed consumed in the isolet system was also all assumed to have been purchased. Therefore, profitabiltiy costs and feasibility costs (cash flow) were similar are shown as like values in table 4.

Since depreciation is not a cash cost, cash flow fixed cost covered only repairs and insurance. Total cash cost for buildings and equipment amounted to $23/sow. Interest on debt capital totaled $61, and principal payments on debt capital totaled $100 per sow. Total cash costs (feasibility) of production was $709/sow. Cash returns to the operator were calculated to be $89/sow.

Overall final economic analysis for the isolet system is also based on the calculated returns to unpaid labor, management, equity capital, and risk. Unpaid labor, management, and equity capital are the farm family's contribution to the swine enterprise, and as such profits are the reward for risk taken. The 30 sow outdoor isolet system generated $138/sow return to unpaid family labor, management, equity capital and risk. Using the isolets in a farrow to finish rearing system was profitable over the two year period of the investigation. Break even price for this system was calculated to be $36.97 per hundred weight of market hogs produced.

Comparison of the two systems shows profitable scenarios for both rearing systems, although the semi-confinement system yielded a greater return to unpaid labor, management, equity capital, and risk ($159 vs $138).

Results from the isolet system evalutated certainly indicate that they can be effectively used in a lower investment farrow to finish swine enterprise by entry level producers that want to step into hog production without putting up permanent buildings. As with any enterprise that is to be successful, efficiencies within the system must be maximized. Farmers considering the use of isolets should focus on maximizing the number of farrowings/isolet just as a producer would that uses farrowing crates in a permanent structure. Keeping isolets full is a key success factor that is attainable only by careful advance planning to insure that an adequate supply of replacement gilts are available when each sow group is bred, and through adherence to a rigid breeding, end breeding, return heat check (pregnancy testing), farrowing and weaning schedule. Failure to adhere to rigid scheduling results in a rapid deteriation of pig flow resulting in a reduced number of farrowings/isolet/year, a reduction in the number of farrowings/sow/year, and an increase in the number of non-productive sow days.

Farmers considering the use of isolets should also consider the following:

1. Porches attached to the isolets keep pigs cleaner, eliminate rooting, and catching pigs is easier.
2. The effective time frame for use in North Dakota is from mid March through November. Supplemental heat must be provided otherwise pigs cuddle to their mothers closely and are easily laid on. Schedule breeding so no farrowings occur during December, January, February, and early March.
3. Summer heat is stressful. Sows are subject to heat stroke if shade isn't provided, especially during farrowing labor. Portable shade can be provided in a variety of ways, and should not be overlooked.

LITERATURE CITED

North Dakota Agricultural Statistics. 1994. Compiled by the North Dakota Agricultural Statistics Service, P.O. Box 3166, Fargo, ND 58108-3166.Table 1. Semi-Confinement and Outdoor Isolet Production Summary

Table 1. Semi-Confinement and Outdoor Isolet Production Summary		
	SEMI-CONFINEMENT	ISOLET
GESTATION		
Feed/Head, lbs.	8.41	8.18
Feed Cost/Head, $	$.35	$.33
LACTATION		
Litters/Year	67	41
Feed/Head/Day, lbs.	12.55	17.70
Feed Cost/Head/Day, $	$.66	$.89
FARROWING		
Litters/Sow	1.73	1.34

Pigs Born Alive	10.4	10.6
Pigs Born Dead	1.98	2.83
Pigs Weaned/Sow	8.4	7.8
NURSERY		
Number of Head	1,087	609
Days Fed	38.7	31.5
ADG, lbs.	.82 [1]	1.07
Feed/Head, lbs.	60.3	70.8
Feed/Head/Day, lbs.	1.56	2.28
Feed/Gain, lbs.	1.90	2.13
Feed Cost/Head, $	$6.32	$5.30
GROWING/FINISHING		
Number Finished	279	314
ADG	1.61	1.63
Feed/Head, lbs.	677	705
Feed/Head/Day, lbs.	4.98	5.71
Feed/Gain, lbs.	3.10	3.50
Feed Cost/Head, $	$34.70	$36.04
Months: Birth to Market	5.95	6.0
(Range)	(5.8 to 6.1)	(5.7 to 6.3)

[1] Reduced performance due to Strep. suis outbreak in the second year of the study.

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Table 2. Nutrient Composition of Diets (Expressed In Percent)							
INGREDIENTS	GESTATION	LACTATION	START 1	START 2	START 3	GROWER	FINISHER
Wheat	--	--	23.3	20.0	--	--	--
Barley	97.4	71.7	20.0	36.8	73.8	84.7	92.6
SBOM	--	19.0	19.9	17.3	9.4	11.2	5.0
Dried Whey	--	--	24.5	15.0	--	--	--
Fish Meal	--		6.0	3.0	--	--	--
Dical Phos.	.75	1.2	.35	.90	1.66	.85	.95
Limestone	.75	1.9	.80	.95	.71	1.0	.75
TM Salt	.60	.5	.45	.45	.45	.45	.35
XP-4 Phos.	.38	1.0	--	--	--	--	--
Vit. A,D&E	.062	.05	.05	.05	.05	.05	.05
Vit. B Complex	.075	.17	.17	.17	.17	.17	.17
Zinc Sulfate	.012	.03	.012	.012	.012	.012	.012
Lysine	--	--	.35	.30	.20	.125	.16
Medication	--	--	1.1	1.1	1.07	--	--
Sunflower Oil	--	4.5	4.0	4.0	2.5	1.5	--
CALCULATED ANALYSIS:							
Protein	13.2	18.1	20.3	18.6	18.5	16.3	14.7

Lysine	.35	.81	1.50	1.25	1.00	.75	.65
Calcium	.52	1.1	.82	.67	.77	.67	.58
Phosphorus	.57	.85	.82	.67	.67	.51	.52
Met. Energy/lb.(kcal)	1,346	1,415	1,446	1,439	1,386	1,384	1,353

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TABLE 3. SEMI-CONFINEMENT FARROW TO FINISH PROFITABILITY & FEASIBILITY SUMMARY(39 SOWS & 100% DEBT CAPITAL)					
INVESTMENT/SOW	$688	PROFITABILITY		FEASIBILITY	
DEBT PER SOW	$688	(OPPORTUNITY)		(CASH FLOW)	
EQUITY CAP/SOW	$ 0	-------------	--------	-----------	-----
GROSS INCOME	PER SOW:		$861		$861
FEED COSTS:					
CORN		$0		$0	
BARLEY		$200		$200	
WHEAT		$0		$0	
PREMIX		$89		$89	
PROTEIN		$41		$41	
PAST & HAY		$8	$339	$8	$339
LIVESTOCK EXPENSE					

VET & MED		$29.05			
MARKETING		$49.22			
REPAIRS		$25.64			
BEDDING		$5.12			
POWER & FUEL		$76.02			
PIGS FEE		$0.00			
MISC		$12.82	$198	$12.82	$198
INTEREST ON FEED & LIVESTOCK EXP			$24		$24
FIXED EXPENSE:					
HIRED LABOR			$0		$0
BLD, FAC & SOWS			$78		$24
INV INTEREST/SOW			$63		$63
PRINCIPAL PAYMENT			XXXX		$110
TOTAL COSTS/SOW			$702		$758
FAMILY LIVING DRAW			XXXX		$0
RETURNS TO OPERATOR & UNPAID			$159		$102
FAMILY LAB, MGT & EQUITY CAPITAL $($/SOW)					

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TABLE 4. OUTDOOR ISOLET FARROW TO FINISH PROFITABILITY & FEASIBILITY SUMMARY (30 SOWS & 100% DEBT)					
INVESTMENT/SOW	$663	PROFITABILITY		FEASIBILITY	
DEBT PER SOW	$663	(OPPORTUNITY)		(CASH FLOW)	
EQUITY CAP/SOW	$ 0	-------------	--------	-----------	----
GROSS INCOME	PER SOW:		$798		$798
FEED COSTS:					
CORN		$0		$0	
BARLEY		$235		$235	
WHEAT		$0		$0	
PREMIX		$94		$94	
PROTEIN		$41		$41	
PAST & HAY		$7	$377	$7	$377
LIVESTOCK EXPENSE					
VET & MED		$13.83		$13.83	
MARKETING		$51.90		$51.90	
REPAIRS		$16.66		$16.66	
BEDDING		$6.66		$6.66	
POWER & FUEL		$23.50		$23.50	

PIGS FEE		$5.00		$5.00	
MISC		$12.82	$125	$12.82	$125
INTEREST ON FEED & LIVESTOCK EXP			$23		$23
FIXED EXPENSE:					
HIRED LABOR			$0		$0
BLD, FAC & SOWS			$75		$23
INV INTEREST/SOW			$61		$61
PRINCIPAL PAYMENT			XXXX		$100
TOTAL COSTS/SOW			$660		$709
FAMILY LIVING DRAW			XXXX		$0
RETURNS TO OPERATOR & UNPAID			$138/SOW		$89/SOW
FAMILY LAB, MGT & EQUITY CAPITAL $($/SOW)					

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