Economic analysis of integrated crop-livestock systems in Iowa


Photo: Iowa Organic Association


Photo: Iowa Beef Center

Hanna Poffenbarger

January 19, 2017

IOWA STATE UNIVERSITY

Benefits of integrated crop-livestock systems

The ruminant advantage

Convert cheap, environmentally-benign feedstuffs into human usable products

- Generate demand for forages, which conserve soil, protect water quality, reduce N fertilizer requirements (alfalfa), and reduce yield losses to pests, diseases and weeds.
- Produce manure, which can increase soil organic matter and reduce fertilizer requirements.
- Diversifying enterprises can increase profits and reduce income volatility.

Goal

To compare the profitability of integrated crop-livestock systems to cash crop systems.

Systems

- 2-yr vs. 4-yr crop rotation
- With and without cattle

Iowa State University Marsden Farm, Boone Co., IA

2-year rotation: corn-soybean (cash grain)

3-year rotation: corn-soybean-oat/red clover (green manure)

4-year rotation: corn-soybean-oat/alfalfa-alfalfa (hay)

Farm enterprises

(1000 acres)

Product	2-yr cash
Corn grain	Sold
Corn stover	--
Corn silage	--
Soybean grain	Sold
Oat grain	--
Oat straw	--
Oat silage	--
Alfalfa hay	--
Fed steer	--

Farm enterprises

(1000 acres)

Product	2-yr cash	2-yr int*
Corn grain	Sold	Fed
Corn stover	--	Bedding
Corn silage	--	Fed
Soybean grain	Sold	Sold
Oat grain	--	--
Oat straw	--	--
Oat silage	--	--
Alfalfa hay	--	--
Fed steer	--	Sold

*Receives manure

Farm enterprises

(1000 acres)

Product	2-yr cash	2-yr int*	4-yr cash
Corn grain	Sold	Fed	Sold
Corn stover	--	Bedding	--
Corn silage	--	Fed	--
Soybean grain	Sold	Sold	Sold
Oat grain	--	--	Sold
Oat straw	--	--	Sold
Oat silage	--	--	--
Alfalfa hay	--	--	Sold
Fed steer	--	Sold	--

*Receives manure

Farm enterprises

(1000 acres)

Product	2-yr cash	2-yr int*	4-yr cash	4-yr int*
Corn grain	Sold	Fed	Sold	Fed
Corn stover	--	Bedding	--	Bedding
Corn silage	--	Fed	--	--
Soybean grain	Sold	Sold	Sold	Sold
Oat grain	--	--	Sold	Sold
Oat straw	--	--	Sold	Sold
Oat silage	--	--	--	Fed
Alfalfa hay	--	--	Sold	Fed/sold
Fed steer	--	Sold	--	Sold

*Receives manure

Livestock systems

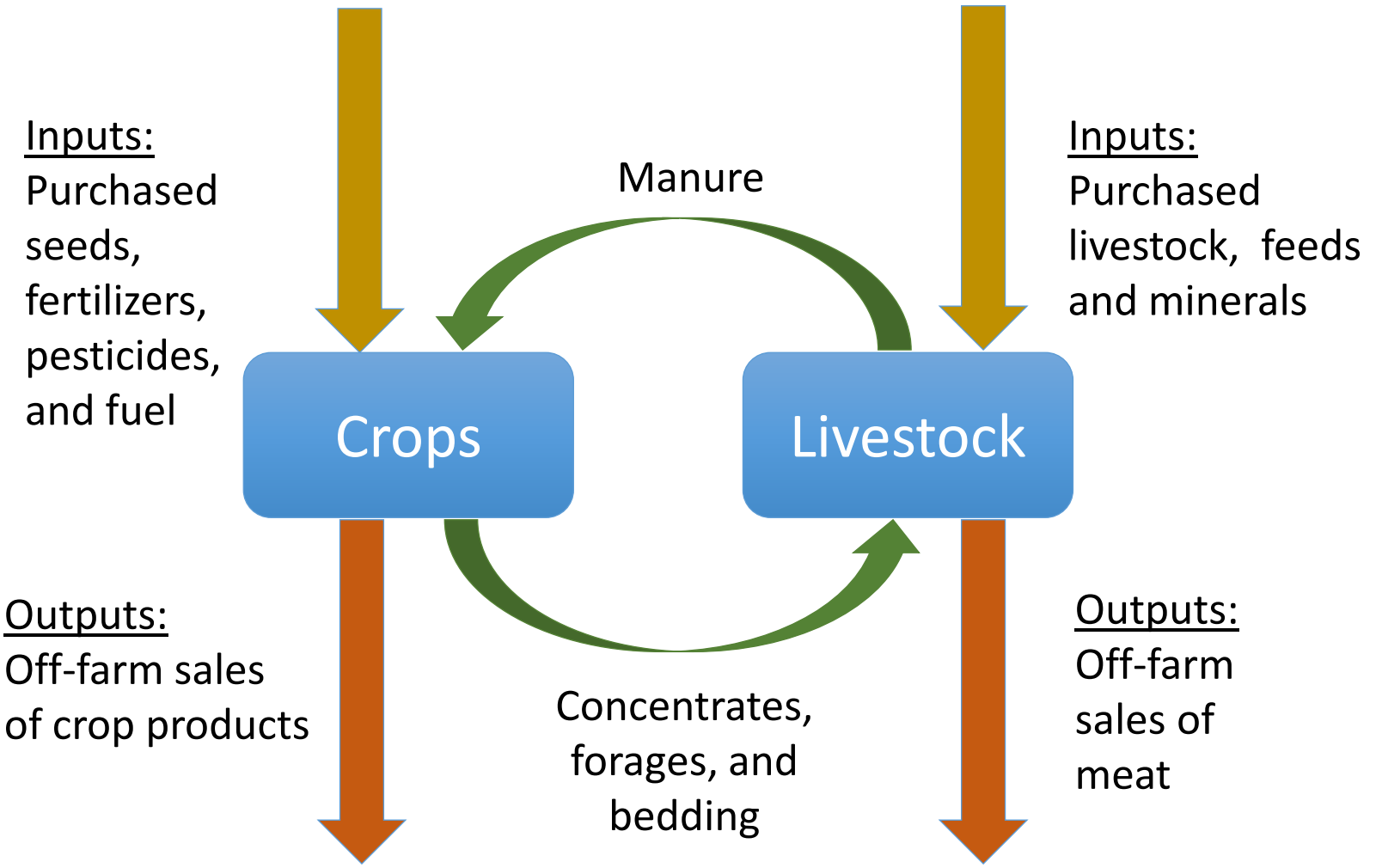
(Deep-bedded confinement)

System	Production system	Starting weight (lbs)	Ending weight (lbs)	Days on feed	Growth cycles per year	Cattle per year*
2-yr int	Finishing	750	1350	176	Feb-July Aug-Jan	1503
4-yr int	Backgrounding + finishing	500	1250	238	Nov-July	760

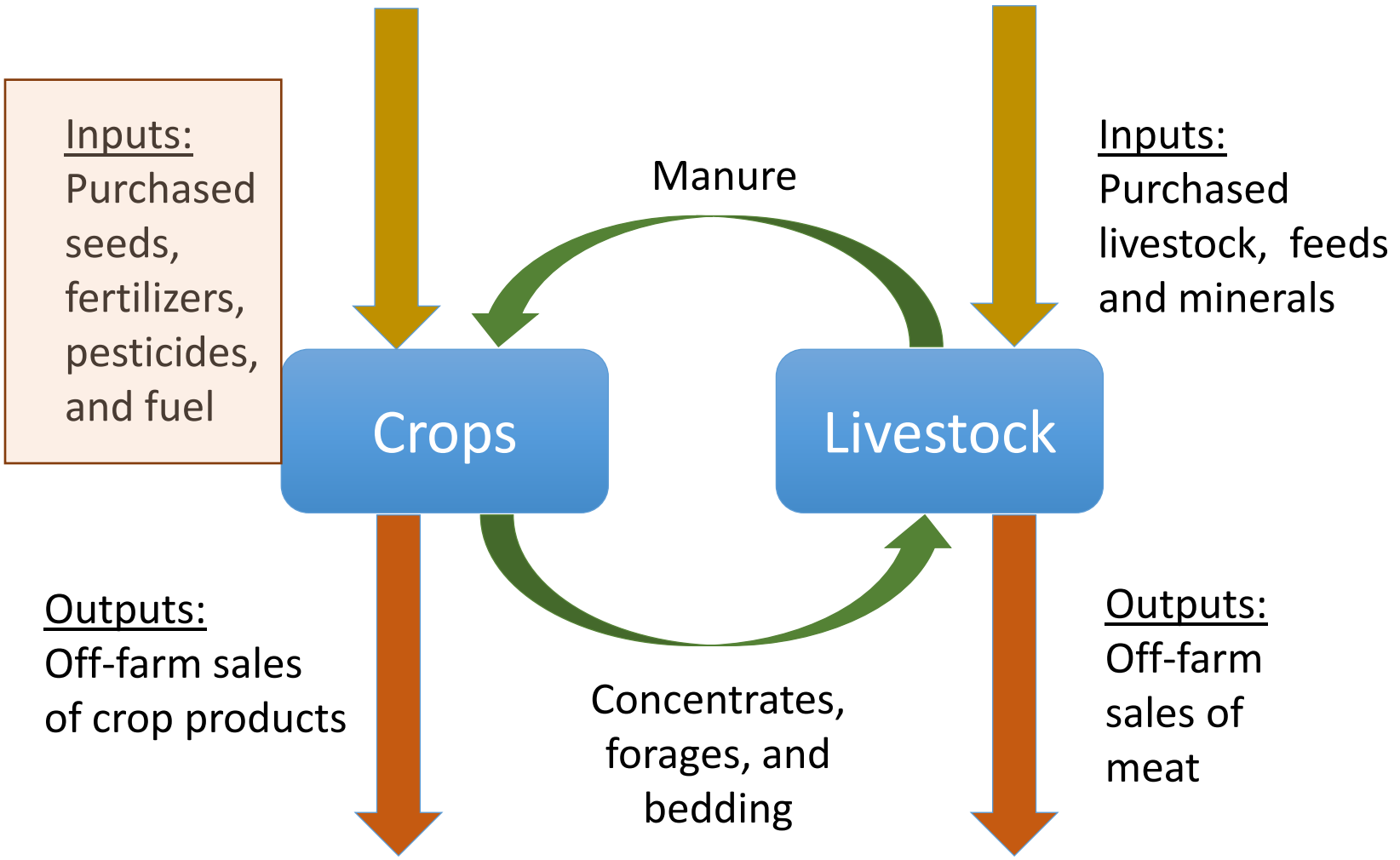
*Number of cattle that can be supported on farm-raised feed.

Feed component	2-yr int	4-yr int
Corn grain (bu)	49.6	64.6
Mod. Distiller's grain (ton)	0.4	0.3
Corn silage (ton)	1.7	
Oat silage (ton)		0.6
Alfalfa hay (ton)		0.4
Mineral/supplement (lb)	144.2	98.7

Integrated crop-livestock production



Integrated crop-livestock production



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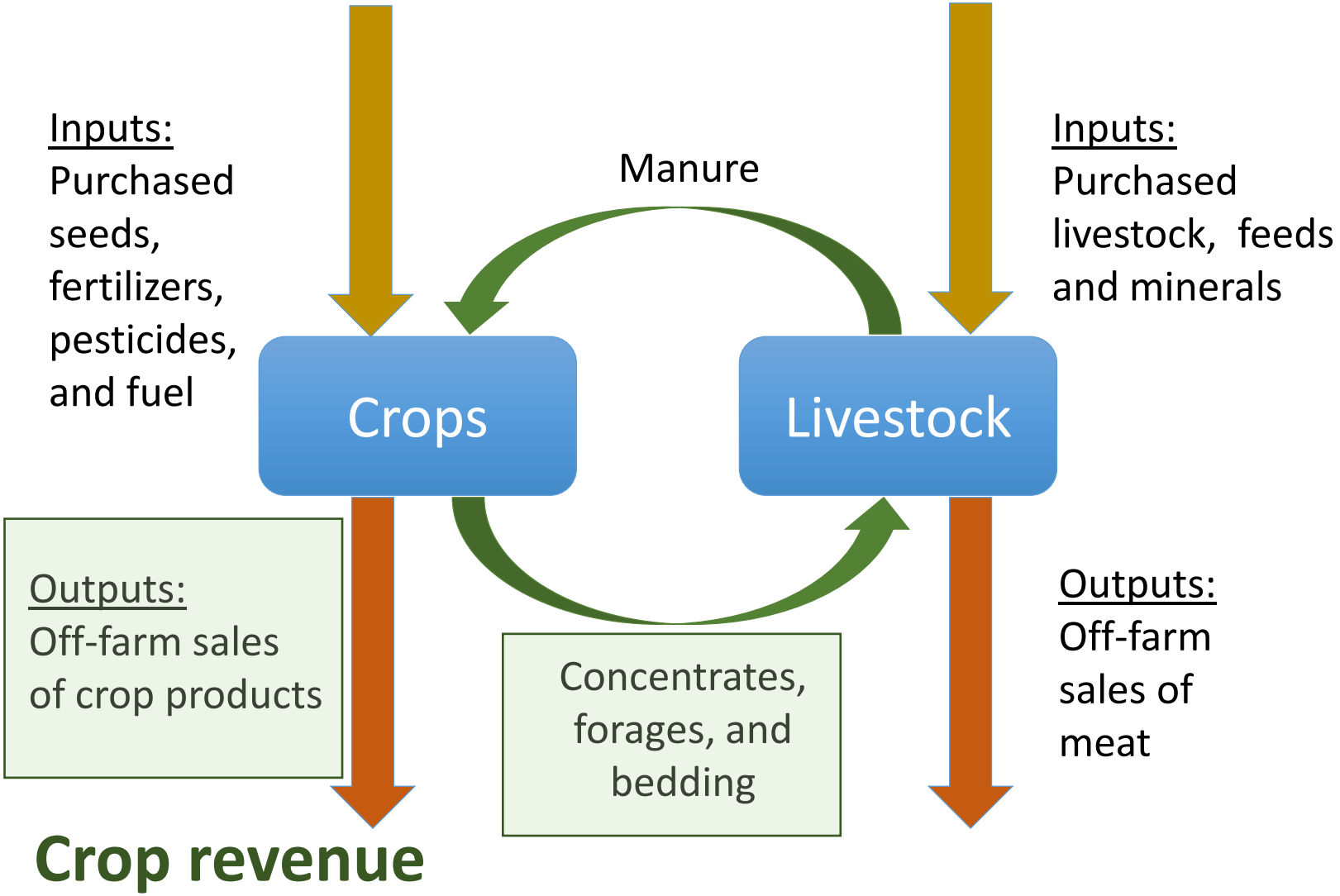
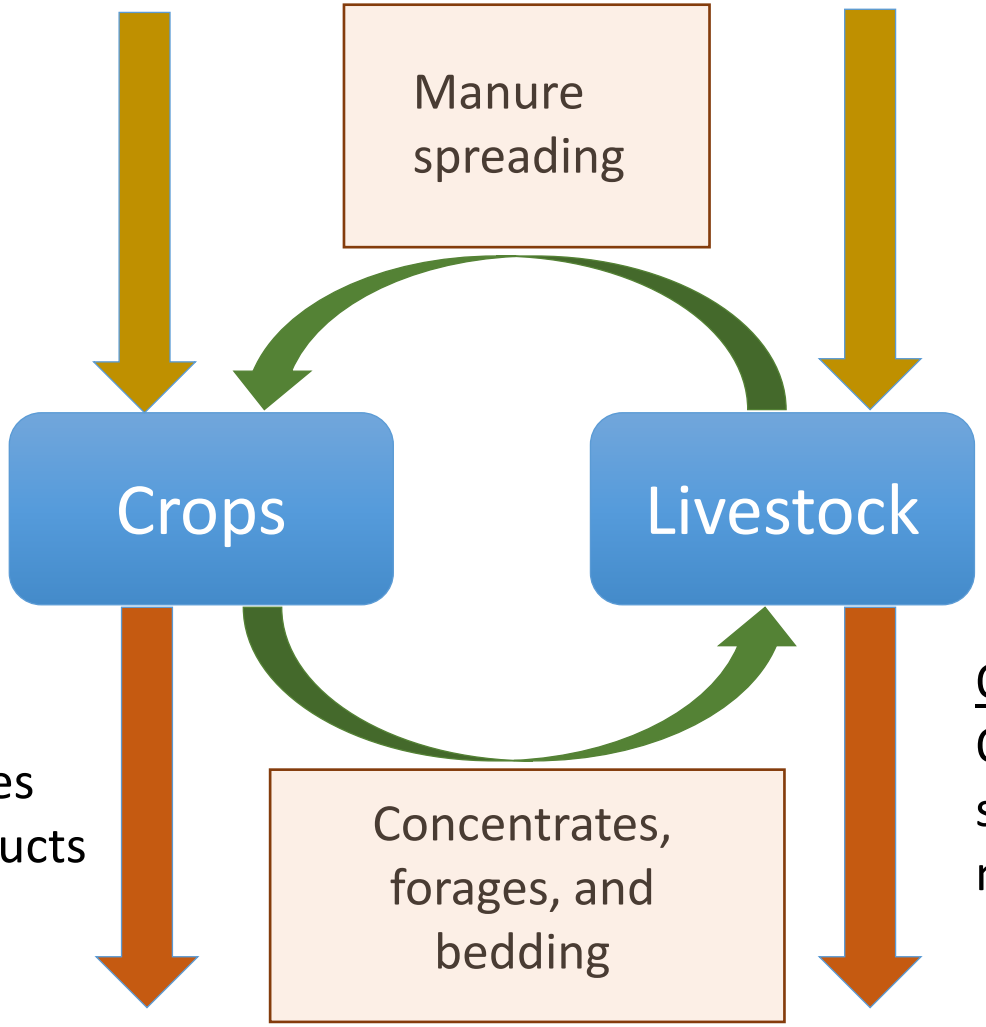


Integrated crop-livestock production



Inputs:
Purchased seeds, fertilizers, pesticides, and fuel

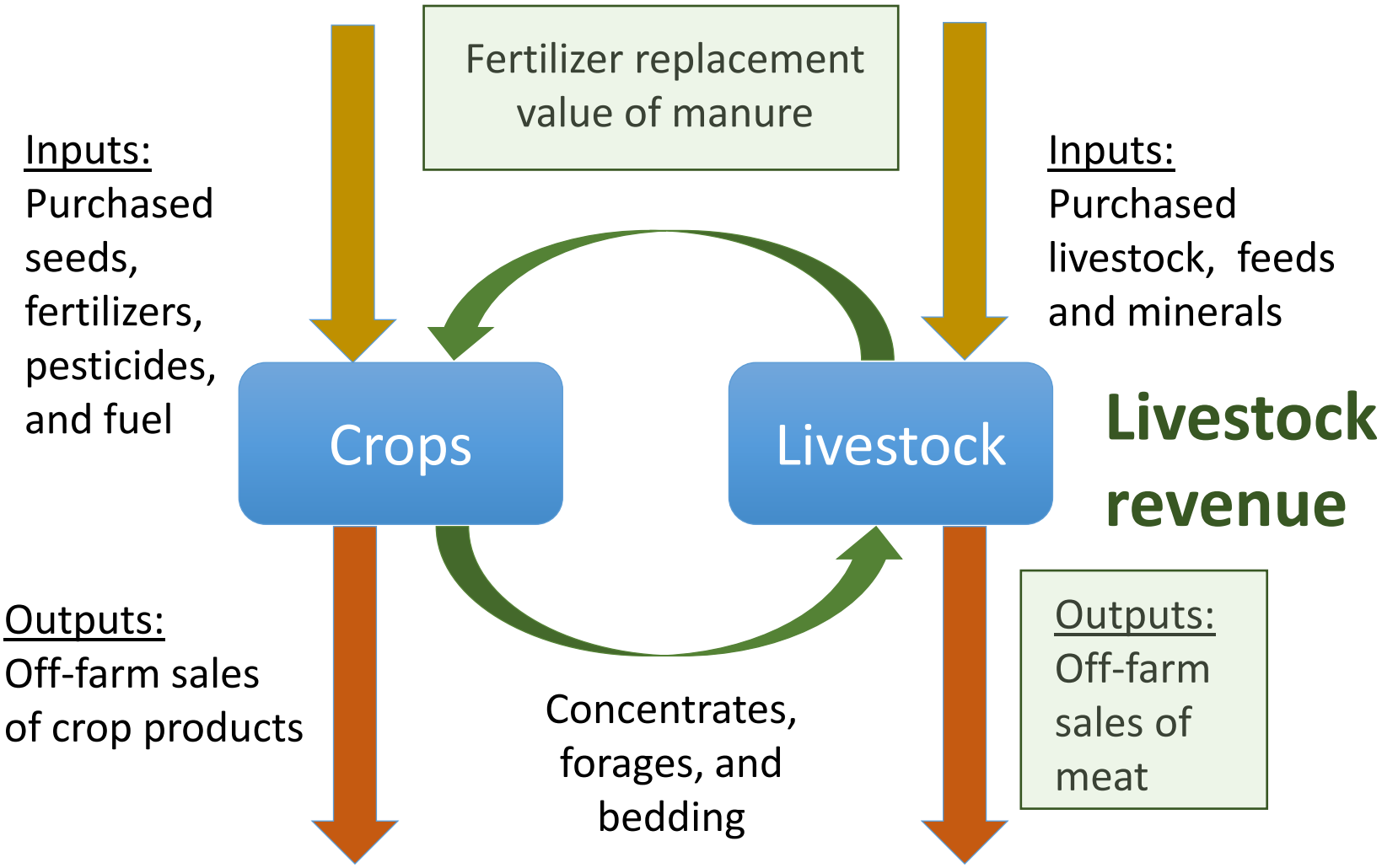
Outputs:
Off-farm sales of crop products

Inputs:
Purchased livestock, feeds and minerals

Livestock costs

Outputs:
Off-farm sales of meat

Integrated crop-livestock production



Calculating profitability

Returns to land and management ($/acre) =
Revenue – Costs*

**All costs except land and management*

Whole farm balance ($/acre) =
Returns to land and management$_{crop}$ +
Returns to land and management$_{livestock}$

Cost and Price Assumptions

- **Grain and hay prices** were taken from Iowa marketing year averages provided by the USDA National Agricultural Statistics Service. Silage prices were estimated using ISU E&O's "Pricing Forages in the Field".
- **Input costs** were taken from ISU E&O's annual report "Costs of Crop Production in Iowa," and from local businesses.
- **Machinery and labor costs** were based on ISU E&O's "Estimating field capacity of farm machines." Custom harvest rates were used for silage.
- **Fertilizer rates** were based on ISU recommendations.
- **Analyses were conducted for 2008-2015.**

Cost and Price Assumptions

- **Cattle prices** were collected from ISU E&O's "Historic Cattle Prices" for the months that they were bought and sold.
- **Feed prices** (corn grain, silage, and hay) were consistent with those used for the crop enterprise budgets from the previous year. Distiller's grain prices were collected from USDA Agricultural Marketing Service.
- **Bedding, labor, facilities, manure spreading costs** were taken from ISU E&O's "Beef Feedlot Systems Manual".
- **Veterinary and marketing costs** were estimated using pen close-out reports.
- **Death loss** was calculated according to ISU E&O's "Livestock Enterprise Budgets for Iowa."

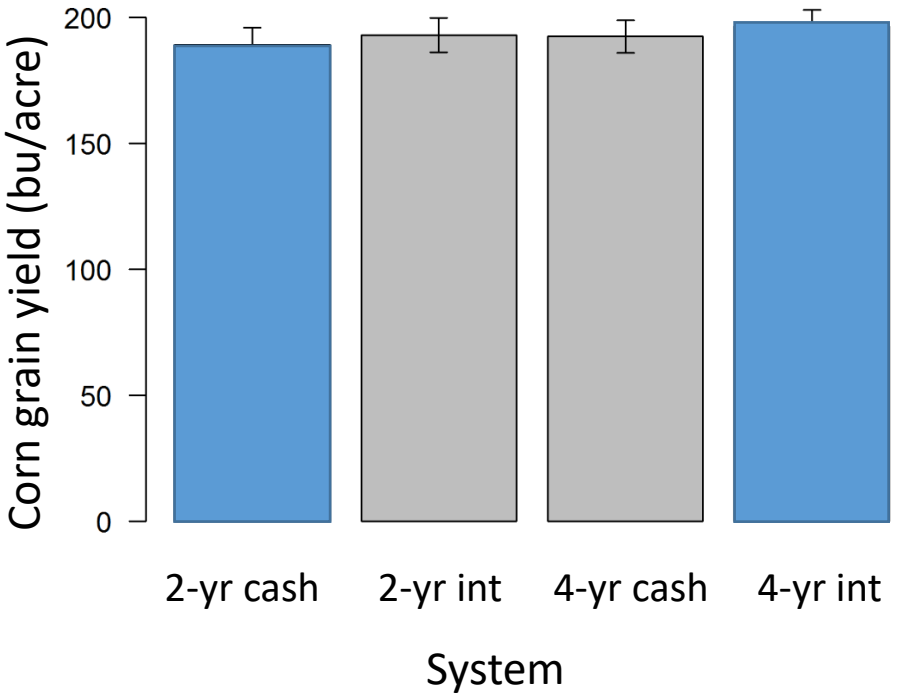
	Plan 1 (simple; 1 acre)			Plan 2 (diversified; 1 acre)		
	$/Unit	Units*	Total	$/Unit	Units*	Total
			Gross income			
Corn grain	$4.72	94.5 bu	$446	$4.72	49 bu	$231
Corn stover				40.00	0.58 ton	23
Soybean	11.20	23.5 bu	263	11.20	14.3 bu	160
Oat silage				54.00	1.98 ton	107
Alfalfa				149.00	1.13 ton	168
Steer calves				116.00	9.5 cwt	1110
Manure				84.00	0.76 head	64
Total gross income			709			1860
			Variable costs			
Corn grain	413.00	0.5 acre	207	399.00	0.25 acre	100
Corn stover				14.00	0.25 acre	4
Soybean	176.00	0.5 acre	88	188.00	0.25 acre	47
Oat silage				227.00	0.25 acre	57
Alfalfa				230.00	0.25 acre	58
Steer calves				1421.00	0.76 head	1080
Total variable costs			295			1340
			Other expenses			
Fixed machinery	61.00	1 acre	61	83.00	1 acre	83
Facilities, equipment				102.00	0.76 head	78
Total other expenses			61			161
Returns to land and management			354			348

*Crop production calculated as the product of acres in production and yield.

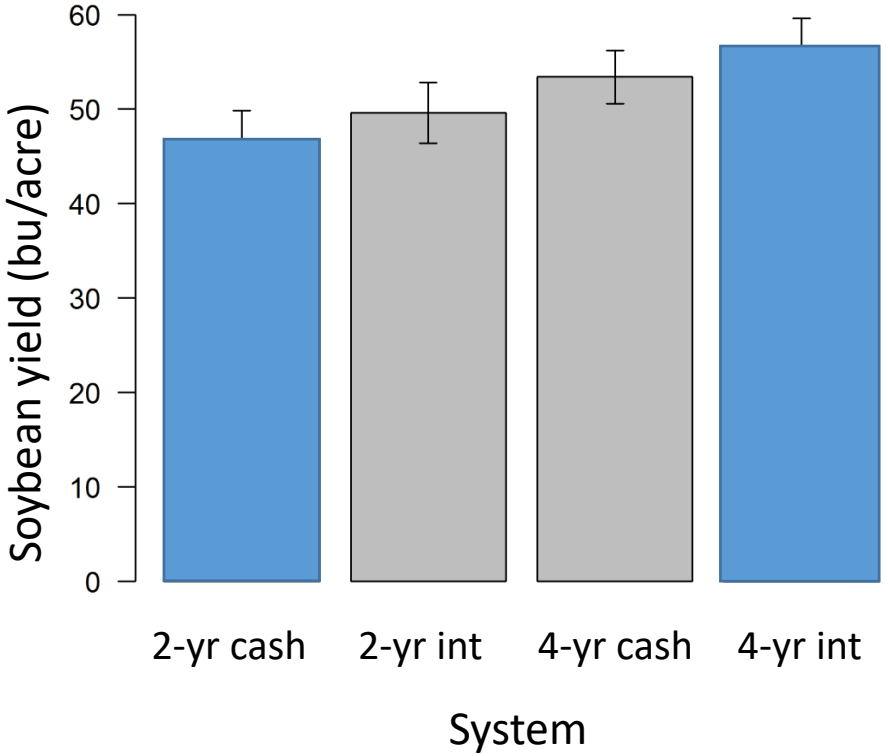
Crop enterprises

Yields increased with greater diversity

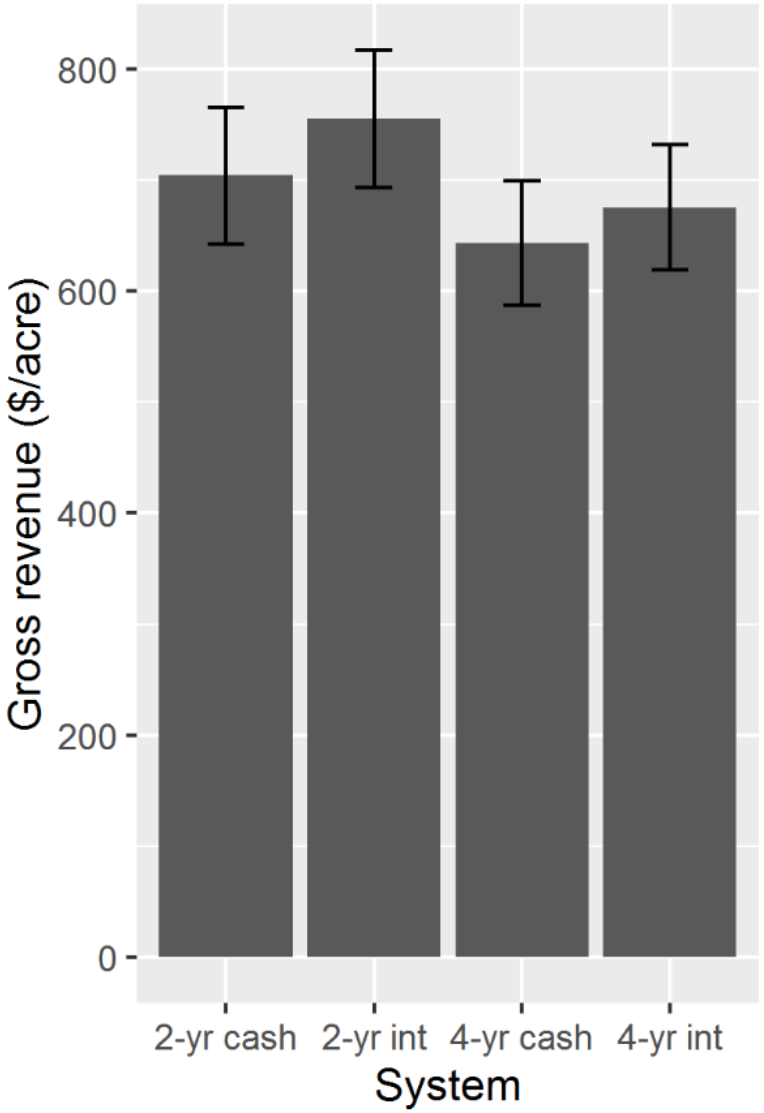
Corn



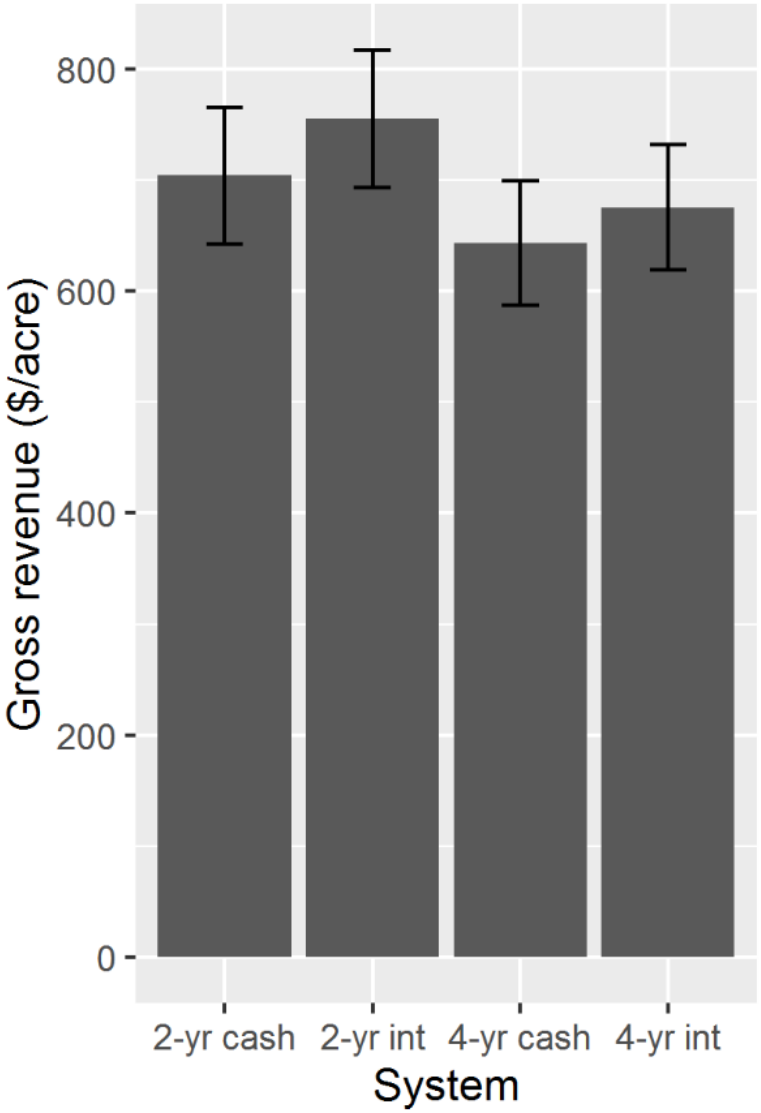
Soybean

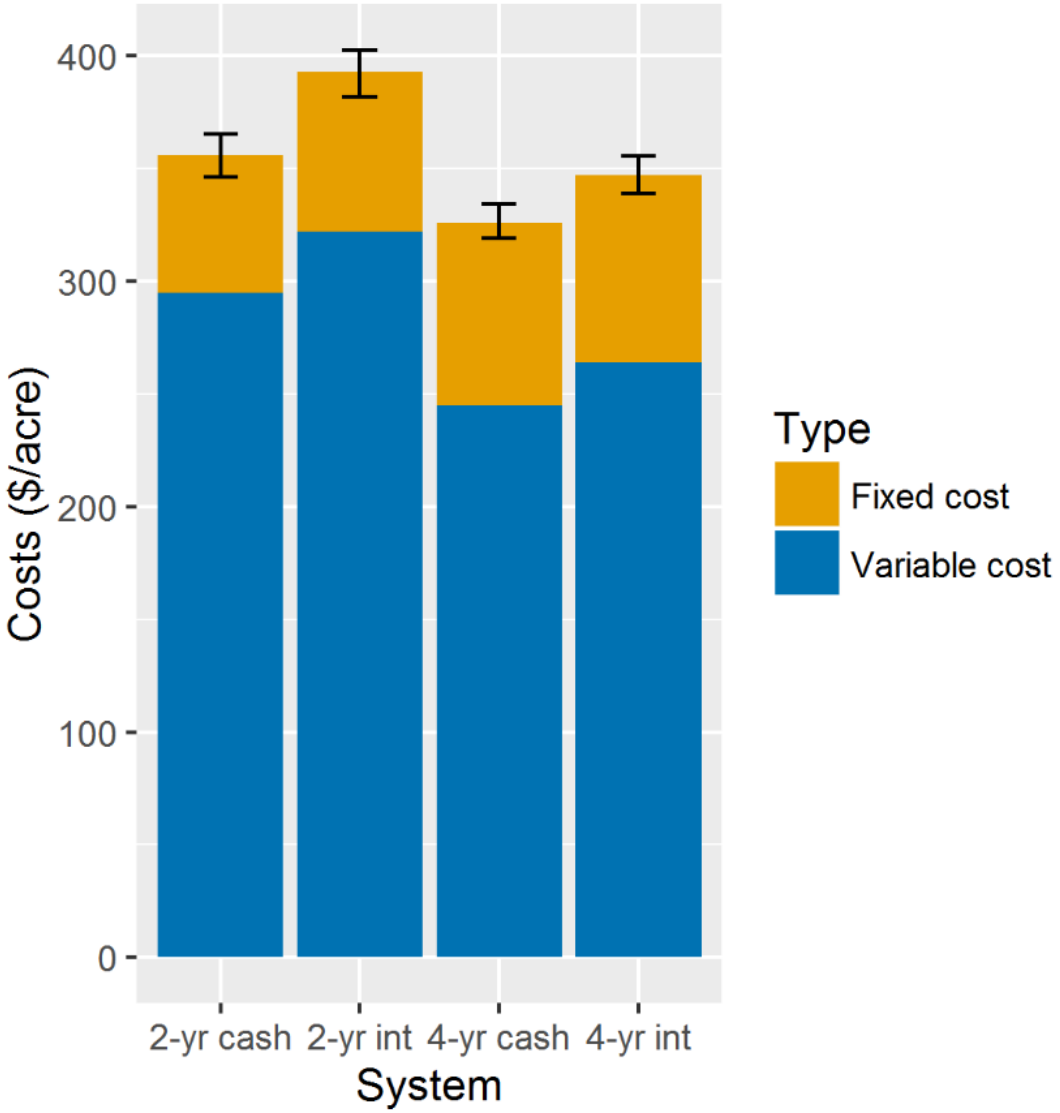


Crop revenue



Revenue and costs of crop production

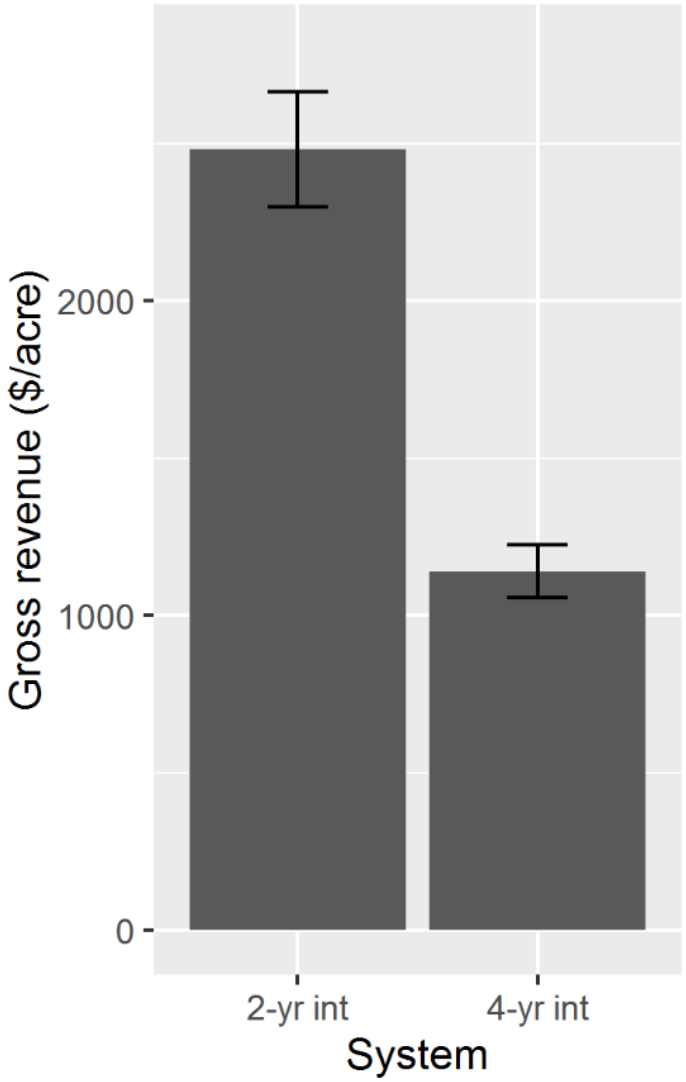




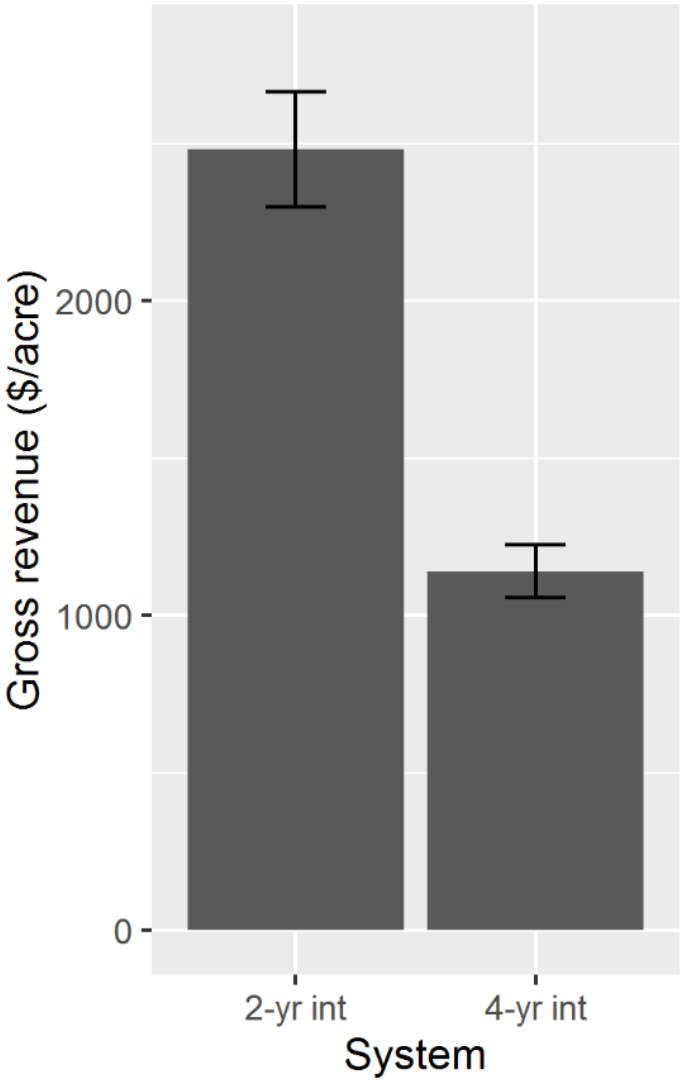
Livestock enterprises

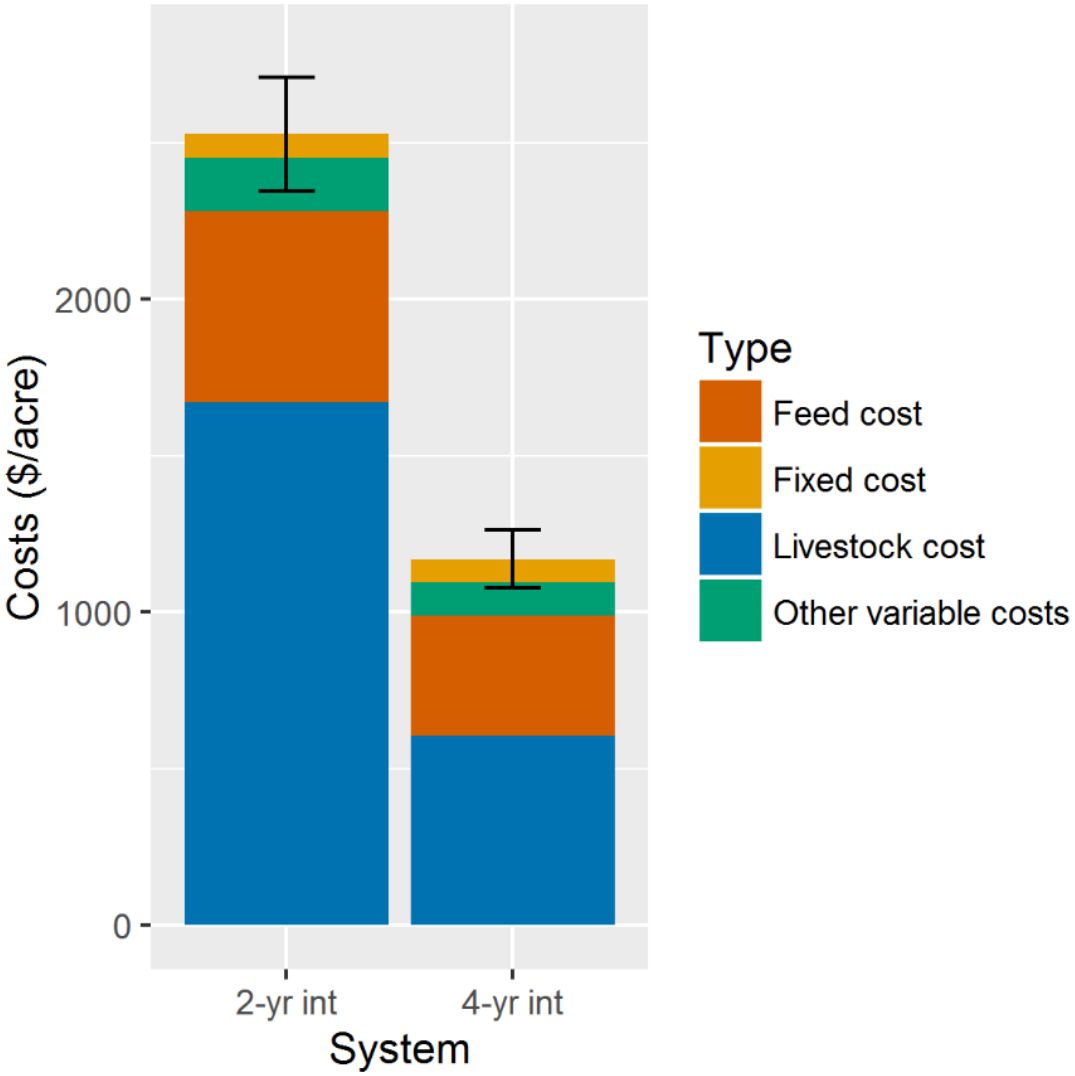
Photos: ModernFarmer.com

Livestock revenue



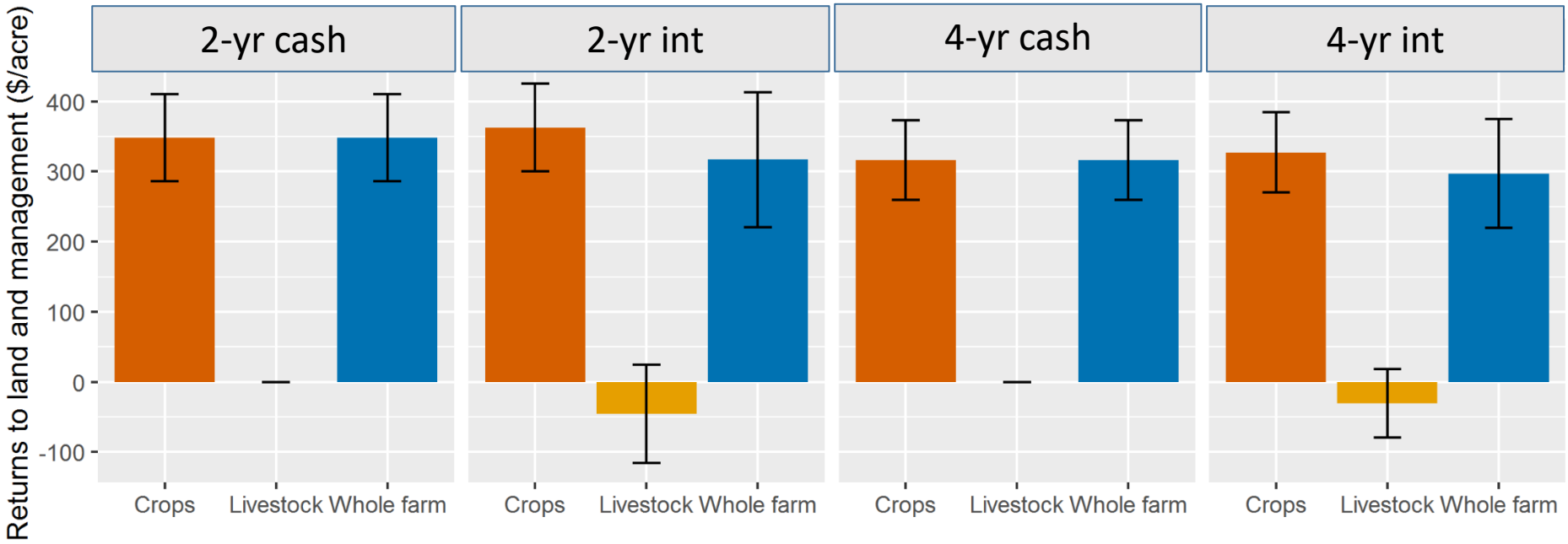
Revenue and costs of cattle production



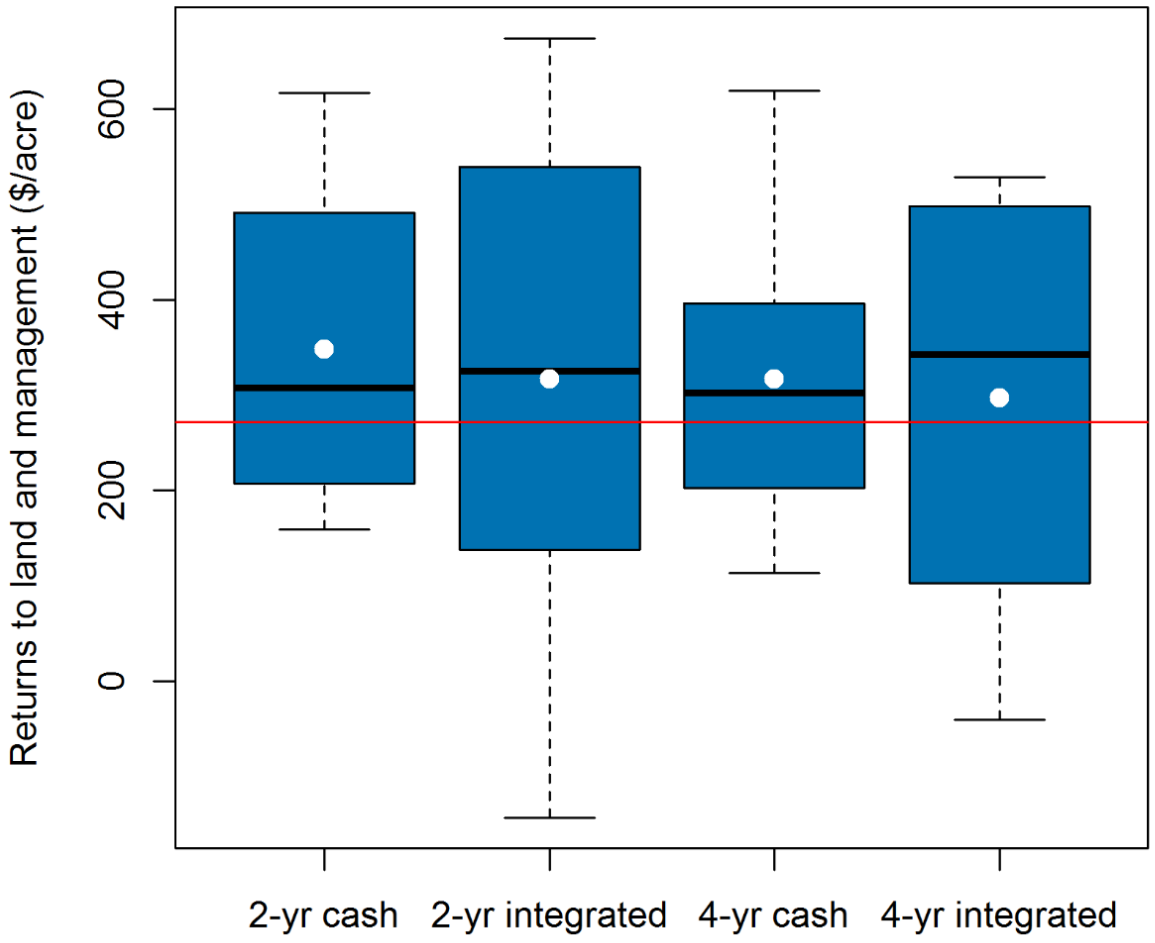



Whole farm

Increased crop enterprise returns largely offset livestock enterprise losses in integrated systems.



Returns to land and management were similar among all four systems.



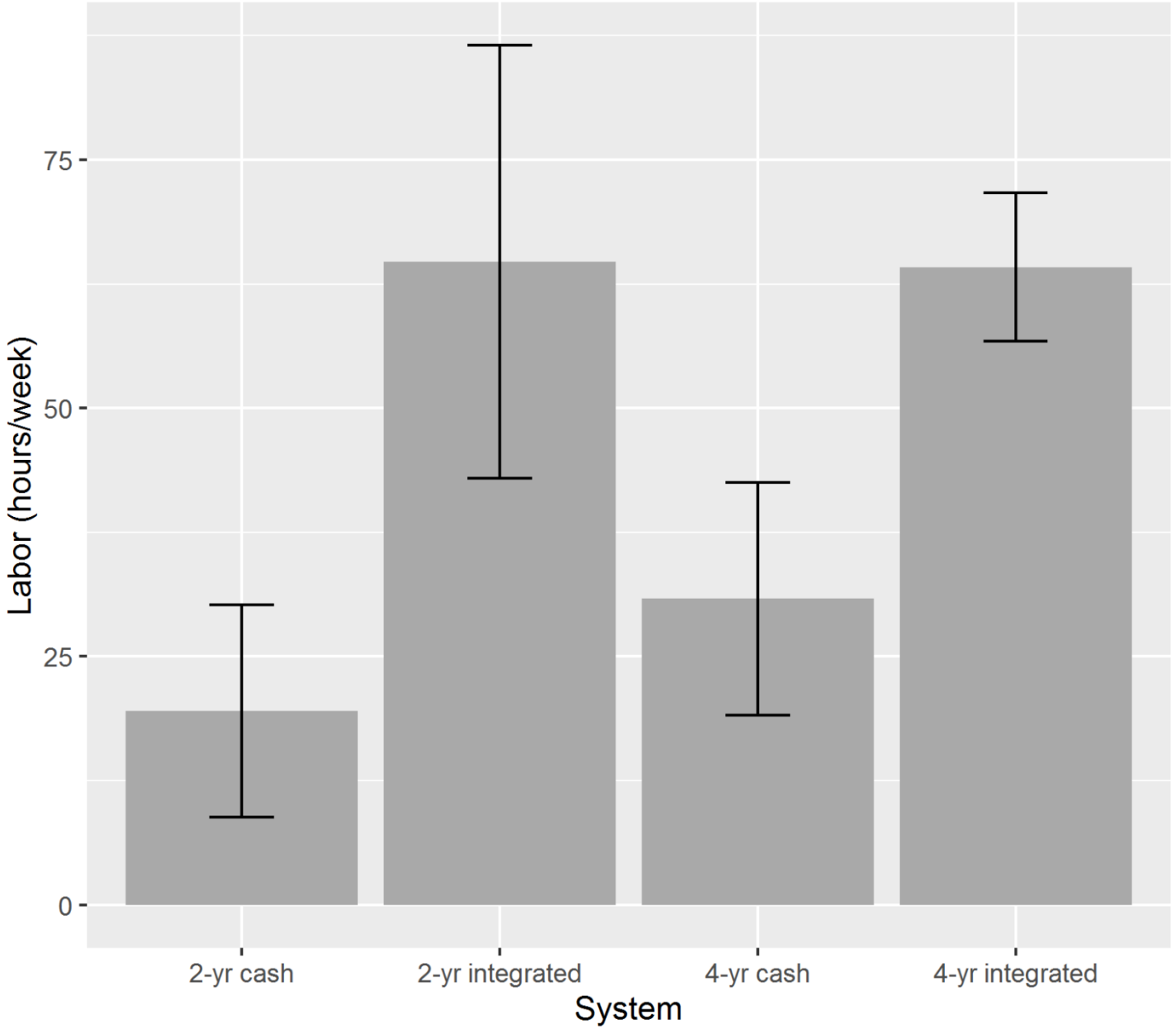
Factors driving variation in returns to land and management between 2008 and 2015.

Source*	Significance
System	NS
Crop price	***
Cattle price ratio (fed price: feeder price)	***
Grain yield	***
Fertilizer N price	***
System x crop price	NS
System x grain yield	NS
System x N price	NS
System x cattle price ratio	*

Labor

Photo: Greene County News

Diversified crop rotations and livestock increased labor requirements.



Conclusions

1. Diversified crop rotations and integrated crop-livestock systems provide environmental benefits.

2. Returns to land and management are similar for simple and diverse farming systems with and without livestock.

3. However, more complex farming systems have a greater workload and management intensity.

Special thanks to:

- Matt Liebman
- Georgeanne Artz
- William Edwards
- Ann Johanns
- Alejandro Plastina
- Lee Schulz
- Mark Hanna
- Craig Chase
- Guiping Hu
- Mark Rasmussen
- Jim Russell
- Joe Sellers
- Garland Dahlke
- Meghan Filbert

Questions?