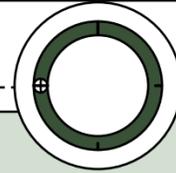


Water Catchment to Sustain Food Production in the Midst of a Changing Climate

Presenters:

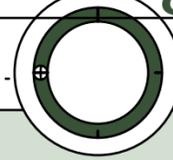
Alicia Ellingsworth, David Dods, Jacob Chapman, Sharon Autry



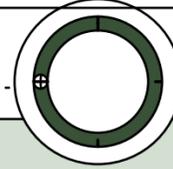
January 9, 2026
Great Plains Growers Conference
St. Joseph, MO



Water Catchment to Sustain Food Production in the Midst of a Changing Climate



Project Goals



Construct three rainwater harvesting systems for high tunnels and one small-scale demonstration system for backyard growers

- KC Farm School (Wyandotte County)
- Moose Paw Farm (Miami County)
- Herdsman House Farm (Miami County)

Document

- Design steps
- Construction Methods
- Material Costs

Monitor and record the performance of each system

- Recording rainfall amounts and irrigation usage

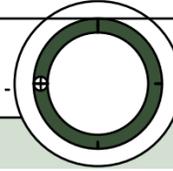
Educate

- Conduct workshops on systems for farmers and gardeners
- Share knowledge on water conservation to help growers adapt to challenging climate patterns.



Our Changing Weather: Impacts for Farms and Water Needs

Fall: warmer and drier Winter: much warmer



Average Monthly Temperature (°F)

Kansas City International Airport

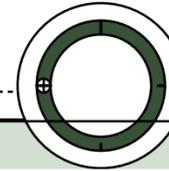
Years	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
1970s	21.9	30.7	43.4	54.8	64.1	73.1	79.0	76.3	67.4	56.8	42.5	31.6	53.5
1980s	28.0	30.7	43.6	54.6	64.4	73.4	79.4	76.8	68.2	55.4	42.9	29.4	53.9
1990s	28.5	36.0	43.5	53.0	63.7	73.4	77.6	76.0	67.4	56.9	42.9	33.4	54.4
2000s	30.4	33.6	44.8	56.2	65.4	73.4	78.3	78.2	68.7	56.2	45.0	31.8	55.2
2010s	28.9	32.0	45.4	55.3	65.2	75.8	79.1	76.6	70.1	56.9	43.6	33.8	55.2
2020-25	24.3	29.1	50.7	56.4	63.6	74.5	79.5	75.2	71.1	62.7	46.2	35.6	55.7
Change, 1980s - 2020s	2.4	-1.6	7.3	1.6	-0.5	1.4	0.5	-1.1	3.7	5.9	3.7	4.0	2.2

Average Monthly Precipitation (in.)

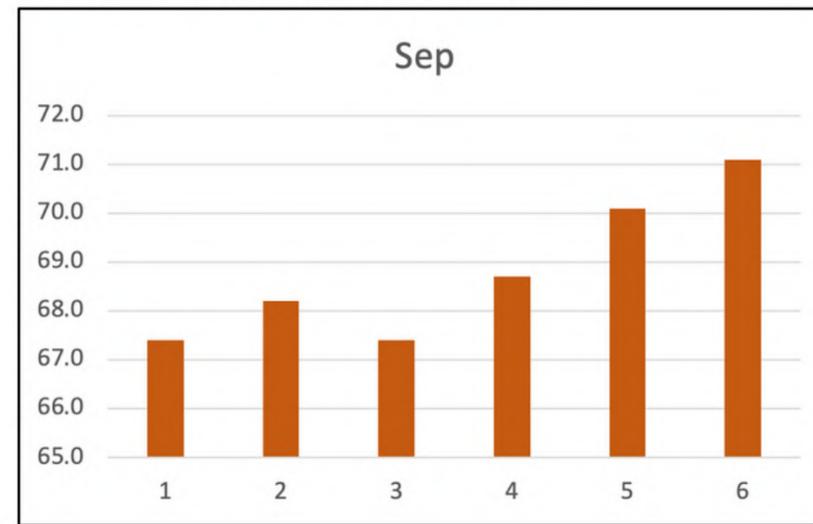
Kansas City International Airport

Years	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
1970s	1.4	1.1	3.1	3.7	5.4	3.8	3.4	3.8	5.1	4.0	2.0	1.1	37.8
1980s	1.0	1.3	2.5	2.7	5.4	4.1	4.1	4.3	5.2	3.6	2.0	2.1	38.1
1990s	1.3	1.5	2.1	4.4	5.6	5.3	5.4	3.1	4.2	2.7	2.8	1.6	39.8
2000s	1.1	1.6	2.6	3.8	4.4	6.0	3.4	4.4	3.9	3.5	1.6	1.4	37.6
2010s	0.9	1.5	2.4	4.0	6.3	4.9	4.4	5.5	4.0	3.8	1.8	1.7	41.1
2020-25	2.0	0.9	3.2	3.9	4.9	4.9	5.7	2.9	1.4	2.6	2.6	1.2	36.1
Change, 1970s - 2020s	0.6	-0.2	0.1	0.2	-0.6	1.1	2.3	-0.9	-3.7	-1.4	0.6	0.1	-1.7

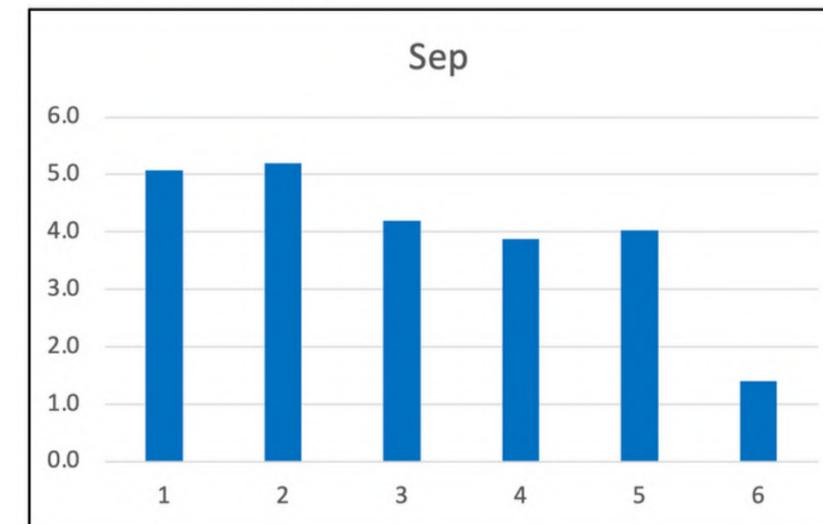
KC: September Temps and Rain by Decade: 1970s – 2020s



Average Monthly Temperature, (F)



Monthly Rainfall, (in)

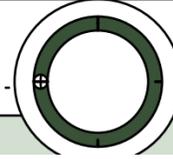


KC Farm School: Monthly Precipitation - 2025

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
1.1	0.1	2.2	5.7	5.3	5.0	11.0	0.0	1.0	1.2	3.1	0.4	35.9

Dry months guide planning for rainwater harvesting

Rainwater Harvesting Calculator



Rainwater Harvesting Calculator for a High Tunnel (Spreadsheet)

Water Source: Rain Falling on High Tunnel Roof

- Roof Area x Monthly Rainfall

Water Used: Irrigation

- Garden Bed Area x Inches/Week of Water

You Enter:

- High tunnel dimensions
- Garden bed irrigation area and rate
- Storage tank size

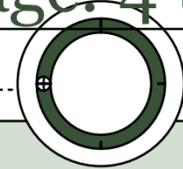
The Spreadsheet Calculates (monthly):

- How much water is available from rain
- How much water is used
- The monthly water surplus or shortfall



Example Water Use Calculations KC Farm School

Rainfall: 2025 Storage: 4 totes = 1,100 gallons



Monthly Water Use from Irrigation

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
Weekly Irrigation Rate ("/week)	0.5	0.5	1.0	1.0	1.0	1.5	1.5	1.5	1.5	1.0	1.0	0.5	
Monthly Irrigation Water Volume Used (gal)	988	893	1,977	1,913	1,977	2,870	2,965	2,965	2,870	1,977	1,913	988	24,297

Rainwater Volume Available = Monthly Rainfall x Roof Area

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
Rainfall - monthly average (inches):	1.1	0.1	2.2	5.7	5.3	5.0	11.0	0.0	1.0	1.2	3.1	0.4	36.1
Runoff Volume (gal)	842	77	1,685	4,364	4,058	3,829	8,423	0	766	919	2,374	306	27,642

Monthly Water Balance:

Rain Collected – Water Used = Tank Storage Volume at the End of the Month

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
Volume of water in tank at start of the month (gal)	0	0	0	0	1,100	1,100	1,100	1,100	0	0	0	461	
Water volume available from rainfall (gal)	842	77	1,685	4,364	4,058	3,829	8,423	0	766	919	2,374	306	27,642
Water used for irrigation (gal)	988	893	1,977	1,913	1,977	2,870	2,965	2,965	2,870	1,977	1,913	988	24,297
Volume of water in tank at the end of the month (gal)	0	0	0	1,100	1,100	1,100	1,100	0	0	0	461	0	
Supplemental water needed (gal)	146	816	292	0	0	0	0	1,865	2,104	1,058	0	222	6,504

Capturing Rainfall & Irrigation Data

Ambient Weather ws-2000
Home Weather Station

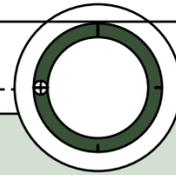
Excel Spreadsheet



HHF High Tunnel Irrigation

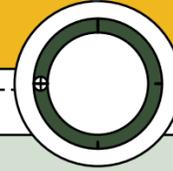
DATE	AMOUNT (per 1 tank (6 tanks total))	NOTES
10.23.25	225 gal	Overhead Sprin
10.25.25	???	Overhead Sprin
11.04.25	138 gal	Overhead Sprin
11.05.25	37.5gal	Overhead Sprin
11.06.25	37.5gal	Overhead Sprin
11.07.25	37.5gal	Overhead Sprin
11.11.25	hose water 10-15 mins	tanks empty
11.15.25	hose water 10-15 mins	tanks empty
11.21.25	Rain Fall -->	240 Gallons fill
11.21.25	50 gal	Overhead Sprin
11.22.25	5 gal	Overhead Sprin
11.23.25	5 gal	Overhead Sprin
11.24.25	75 gal	Overhead Sprin

Water Catchment Systems



Rain Barrel System at KCFS

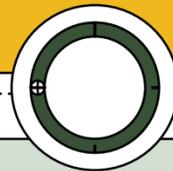
Let's Grow Wyandotte Backyard Grower Demonstration



System Components (excluding tools)	Cost
Rain barrel, 55-gal food grade	\$40
Downspot extension	\$8
Filter parts	\$5
Bulk head fitting & hose bib	\$25
Overflow hose	\$7
Total	\$85

Herdsman House Farm

Location: rural, Miami County, Kansas



Site
Overview

Tunnel Specs

30' X 72'

Single layer poly

5' hips , 2" X 10" wood

Roll up sides

Utilities

Rural water

No power

Frost free hydrant at 50'

Considerations

Shared community tunnel

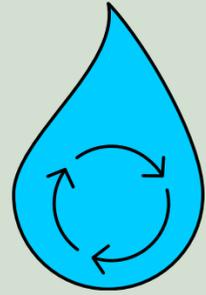
Very exposed to wind

Rented property

4 season production

Herdsman House Farm Goals

Anticipated outcomes of rainwater harvest



Reduce dependence on rural water



Build soil health

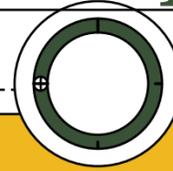


Lower water cost on shared water resource



Educate community

Main Components



Aluminum
5" K-Style
Gutters



6 - 275 gal
IBC totes



1.25" 1hp
220v
pump



Solar
Array

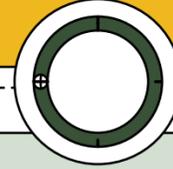


8 - 55Ah
12v
batteries
wired to
220Ah 24v

HHF Build Components	Cost
Gutter Components	\$585.74
4" PVC overflow & wastewater pipe	\$208.52
2" PVC	\$339.86
6 - 275 gal IBC totes	\$720.00
PVC fittings between tank & irrigation	\$261.86
Glues & primers	\$51.82
Solar array/battery/pump	\$4,374.58
9% tax & shipping	\$5,36.54
Total	\$7,087.45

Moose Paw Farm

Location: peri-urban, Miami County, Kansas



Site Overview

Tunnel Specs

30' X 72'

Double layer, inflated poly

6' hips , 2" X 10" wood

Roll up sides

Utilities

Municipal water

Electricity & wood heat

7.8 kw solar grid on site

Considerations

Able to sacrifice farmable space

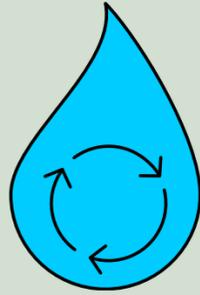
for water resource

4 season production

Hip board has slope

Moosepaw Farm Goals

Anticipated outcomes of rainwater harvest



Water autonomy beyond high tunnel irrigation needs



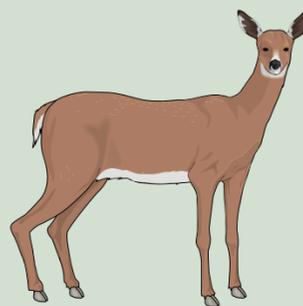
Build Soil Health



Eliminate chlorination from irrigation



Educate community

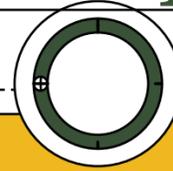


Attract wildlife



Recreation

Main Components



Aluminum
5" K-Style
Gutters



8 oz geotextile
liner pad

EPDM 45 mil
pond liner



Pond
25' x 25' x 10'

45° slopes

approx.
35,000 gal
storage

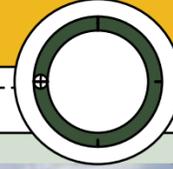


2-inch gas
trash pump

MPF Build Components	Cost
Gutter Components	\$585.74
Pond liner (with tax & shipping)	\$4,095.55
Glues & primers	\$29.94
Tax	\$55.41
Total	\$4,766.64

KC Farm School

Location: urban, Wyandotte County, Kansas



Site Overview

Tunnel Specs

20' X 72'

Single layer poly

5' hips , 2" X 10" steel

Drop down sides

Utilities

No on-site power

Frost free hydrant at 50'

(municipal water)

Considerations

Undermined location-no ponds,

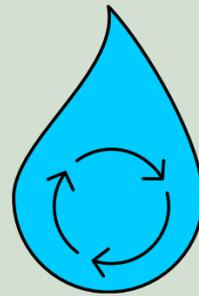
permanent structures

3 season production

Sloped hips

KC Farm School Goals

Anticipated outcomes of rainwater harvest



Reduce dependence on municipal water



Build soil health

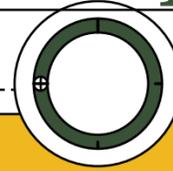


Educate community



Provide community access to replicable water catchment models to fit a range of growers

Main Components



Aluminum
5" K-style
gutters



4 - 275 gal
IBC totes



1.25" 1hp
220 v
electric
pump



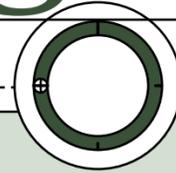
Solar
Array



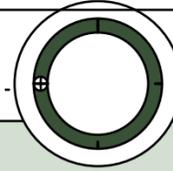
8 - 55Ah
12v
batteries
wired to
220Ah 24v

KCFS Build Components	Cost
Gutter Components	\$536.36
4" PVC overflow & wastewater pipe	\$208.52
2" PVC	\$198.86
4 - 275 gal IBC totes	\$480.00
PVC fittings between tank & irrigation	\$167.10
Glues & primers	\$41.84
Solar array /battery/pump	\$4,374.58
9% tax & shipping	\$496.91
Total	\$6,504.17

Connecting to Drip Irrigation

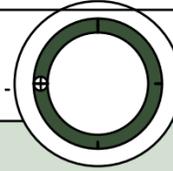


Comparison: Cost & Estimated Storage



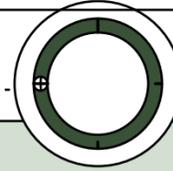
Herdsman House Farm	Moose Paw Farm	KC Farm School
\$7,087.45	\$4,766.64	\$6,504.17
29,000 gal	38,000 gal	18,000 gal

Site Challenges



Herdsman House Farm	<ul style="list-style-type: none">• Loss of 150 gal storage. Hip board not tall enough, gutter drain pipe enters through the side of the tank rather than the top• 2 in 1 primer glue combo failed at temp above 109° causing joints to leak• Pump is an indoor pump. Must be winterized.
Moose Paw Farm	<ul style="list-style-type: none">• Installing heavy, floppy pond liner difficult• Delayed install of pond liner after digging pond invites weeds
KC Farm School	<ul style="list-style-type: none">• Installing on metal hip boards with limited space between hip and roof due to drop down sidewalls versus roll up

Other Considerations

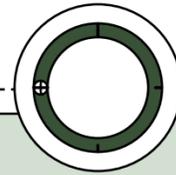


- ✓ Cover or paint IBC totes to prevent algae growth
- ✓ Biological water quality-contamination
- ✓ Leaf covers for gutters
- ✓ Use 1st flush diverter
- ✓ Install sedimentation tank
- ✓ Add a biochar, swimming pool bog filter or wetland filter in pond
- ✓ Plan for ease of re-roofing a tunnel with gutters

Opportunities for Future Research

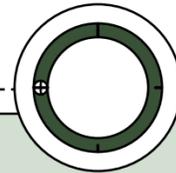
- Monitor water quality
- Monitor soil quality
- Rain water catchment for ag uses beyond irrigation
- Effective filtration methods

Questions?





Thank You!



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SARE PROJECT NUMBER ONC23-122

“Water Catchment to Sustain Food Production in the Midst of a Changing Climate ”