

But What Did They Really Eat?

A Critical Analysis of
Three Sisters' Food Value

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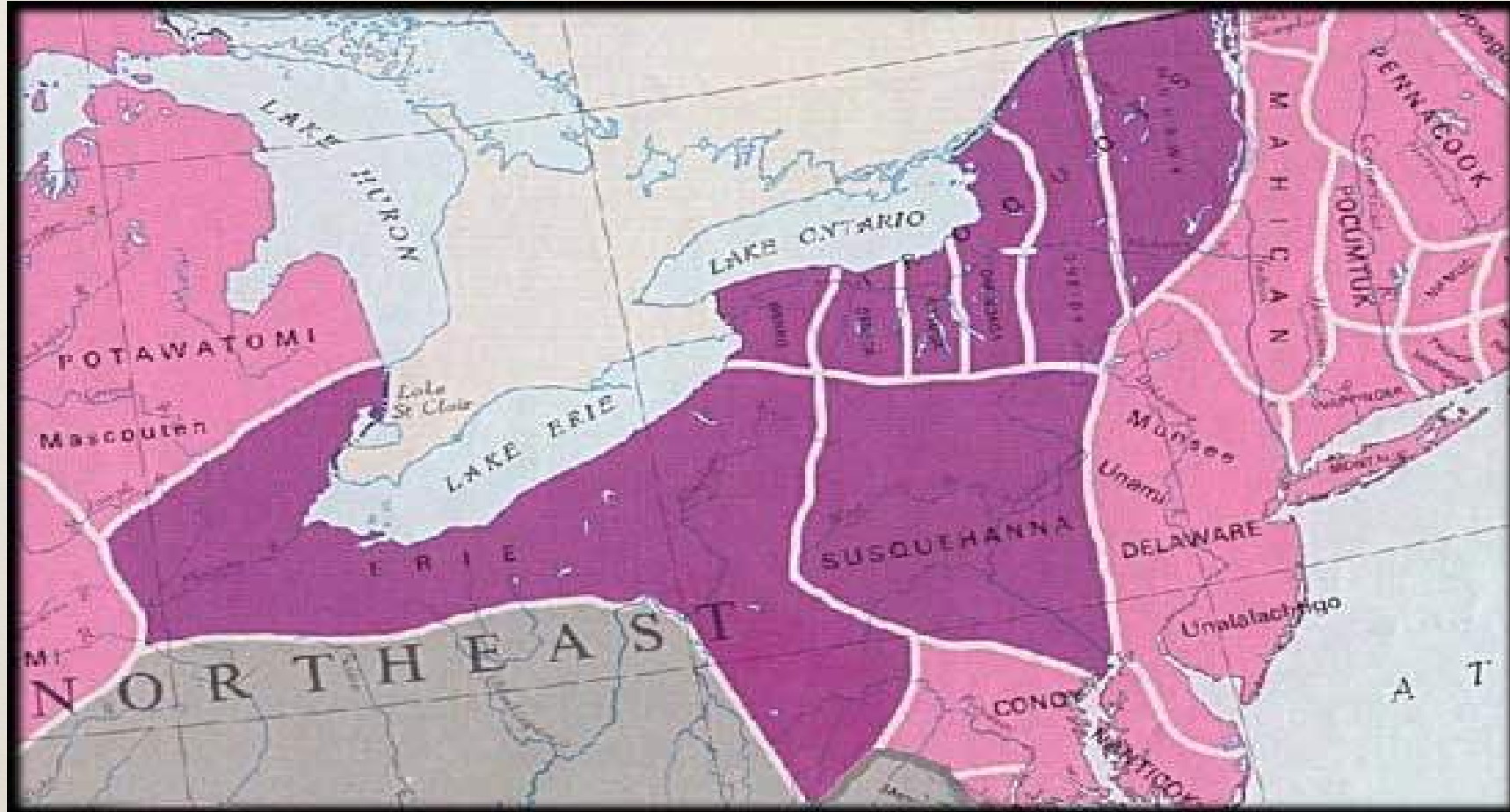
Three Sisters Cropping System



“...symbiotic plant complex of North America without an equal elsewhere.” C. Sauer 1962

“...foundation of (Iroquois) subsistence” .. enabled them to “develop institutions of sedentary life.” W. Fenton 1978

Iroquoia before Colonization



Three Sisters in Iroquoia

- ✧ Central to cultural identity (*Creation Story, Words that Come Before All Else*), social-political power, subsistence.
- ✧ Women controlled most aspects of agricultural production.



Agronomic Characteristics

- * Typically planted on mounds.
- * Usually crops planted as polyculture, but not always.
- * No plows- hand tools only.
- * Continuously cropped- not shifting cultivation.
- * Fertile, productive soils.



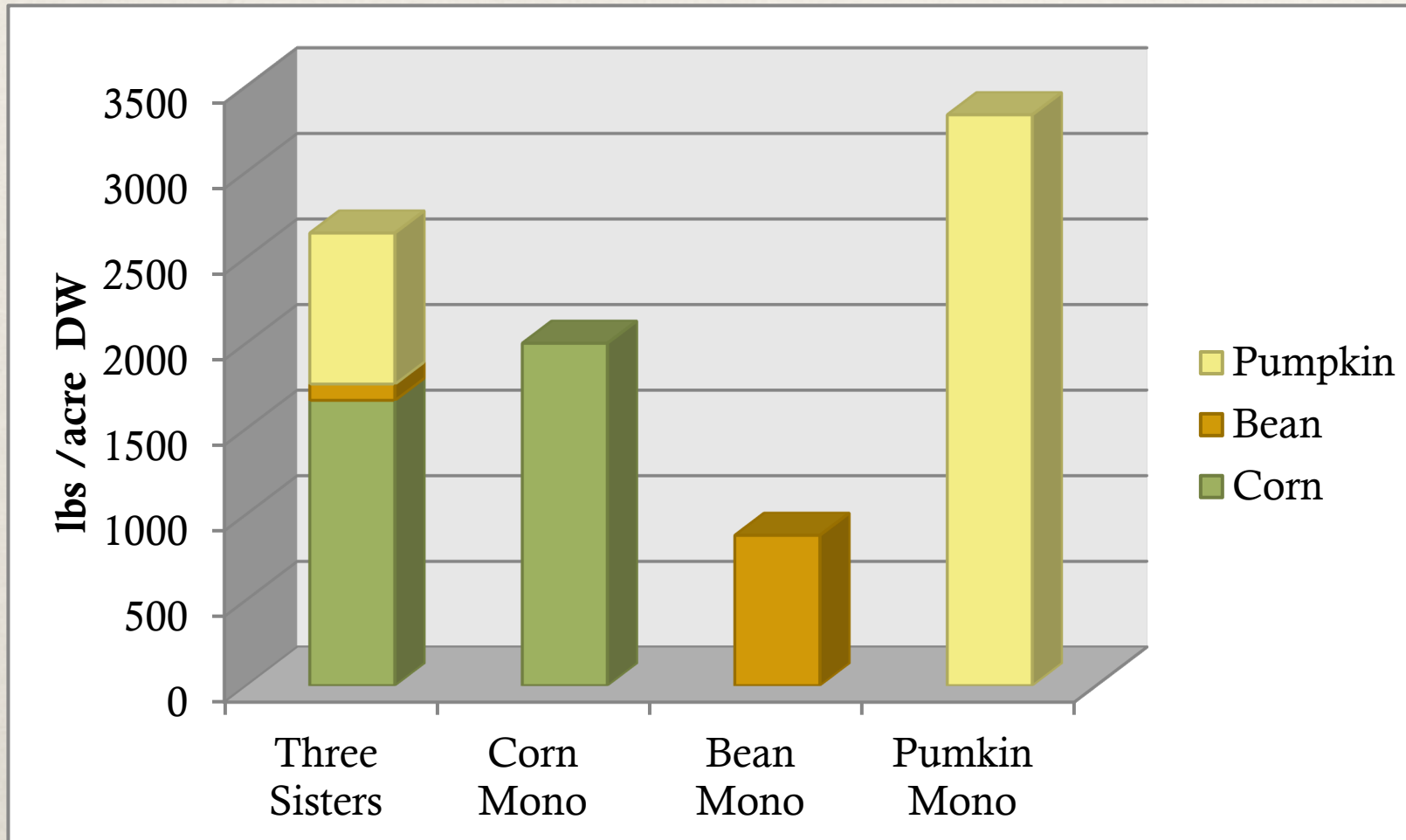
Agricultural Productivity

- * Historic records provide first-hand observations: highly productive agriculture, but no yields.
- * Field experiments (Mt.Pleasant and Burt 2010)
 - * Two sites 1993 to 1997
 - * Musgrave Research Farm, Cayuga County
 - * Private farm, Tompkins County
 - * Crop varieties and agronomic practices similar to what Iroquois would have used in 17th and 18th centuries.

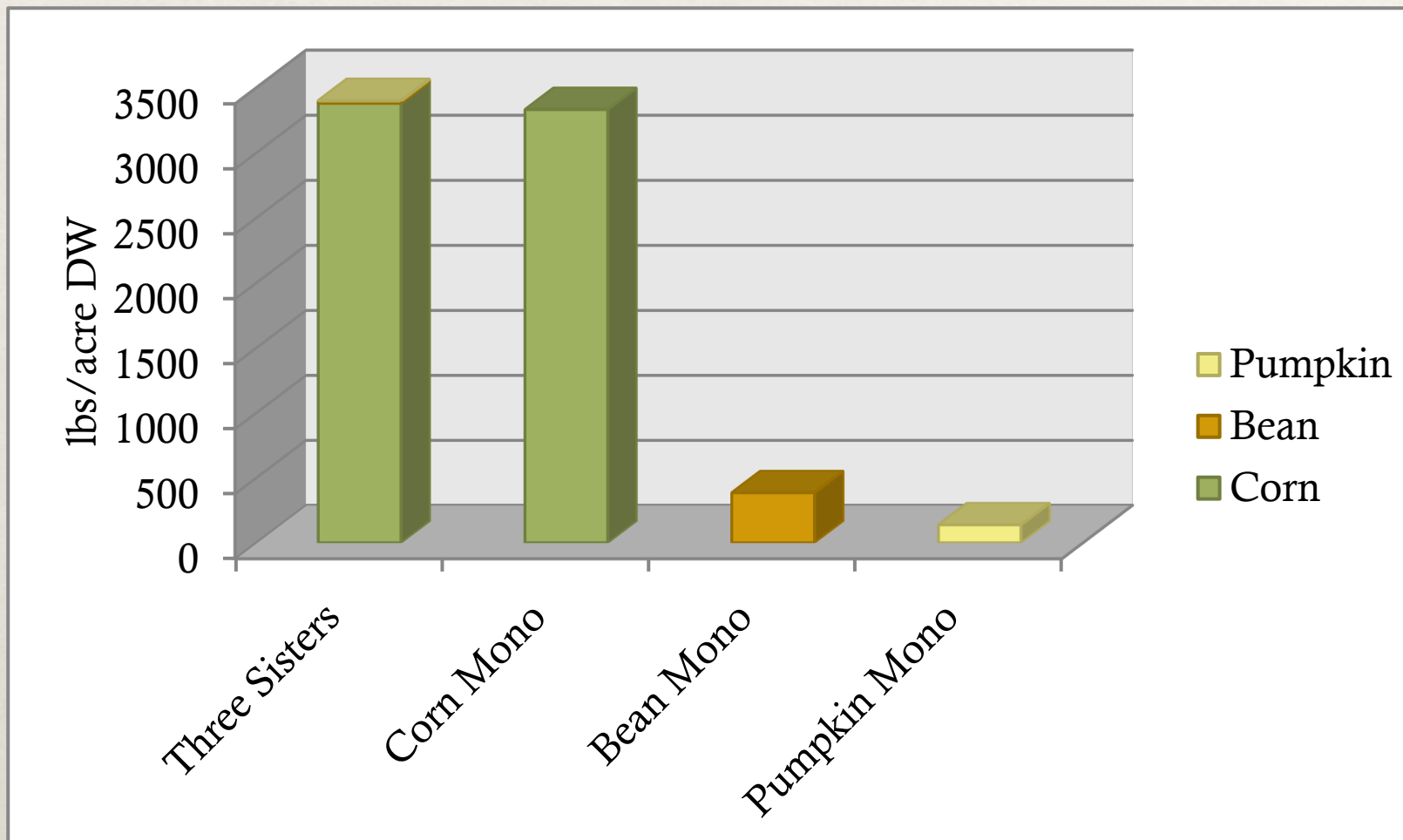
Field Research Sites



Crop Yields: Three Sisters and Monocultures Tompkins County 1993-1994



Crop Yields: Three Sisters and Monocultures Cayuga County 1997



Determining Food Values

- * Focus on **energy** and **protein**
 - * Subsistence farmers first ensure they can supply sufficient energy (kcal).
 - * Next priority is protein.
 - * Most subsistence farmers plant
 - * grain (wheat, **maize** , rice) for energy
 - * legume (**bean**, pea, lentil) protein

But What Did They Really Eat?



Corn



Beans



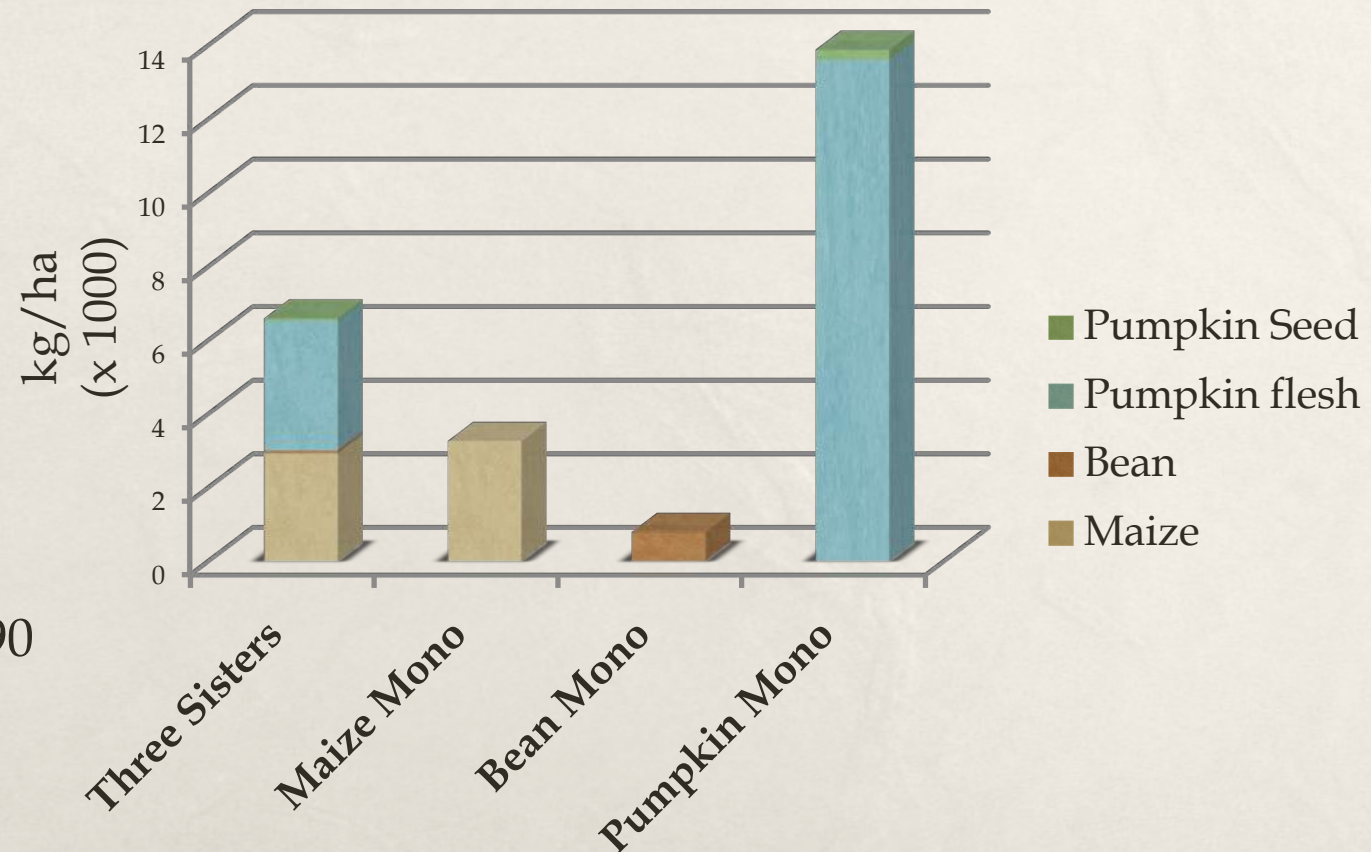
Nutritional Content Depends on Time of Harvest

Crop	Food	Water g/100g	Energy Kcal/kg	Protein g/100g
Maize	Sweet corn	76	86	3
	Corn grain	10	3650	9
Bean	Green bean	90	31	2
	Kidney bean	12	3370	30

Crop Yields To Food Yields?

Crop Weights at Harvest

Averaged over sites and years



Water %

Maize 10

Bean 12

Pumpkin flesh 90

Pumpkin seed 5

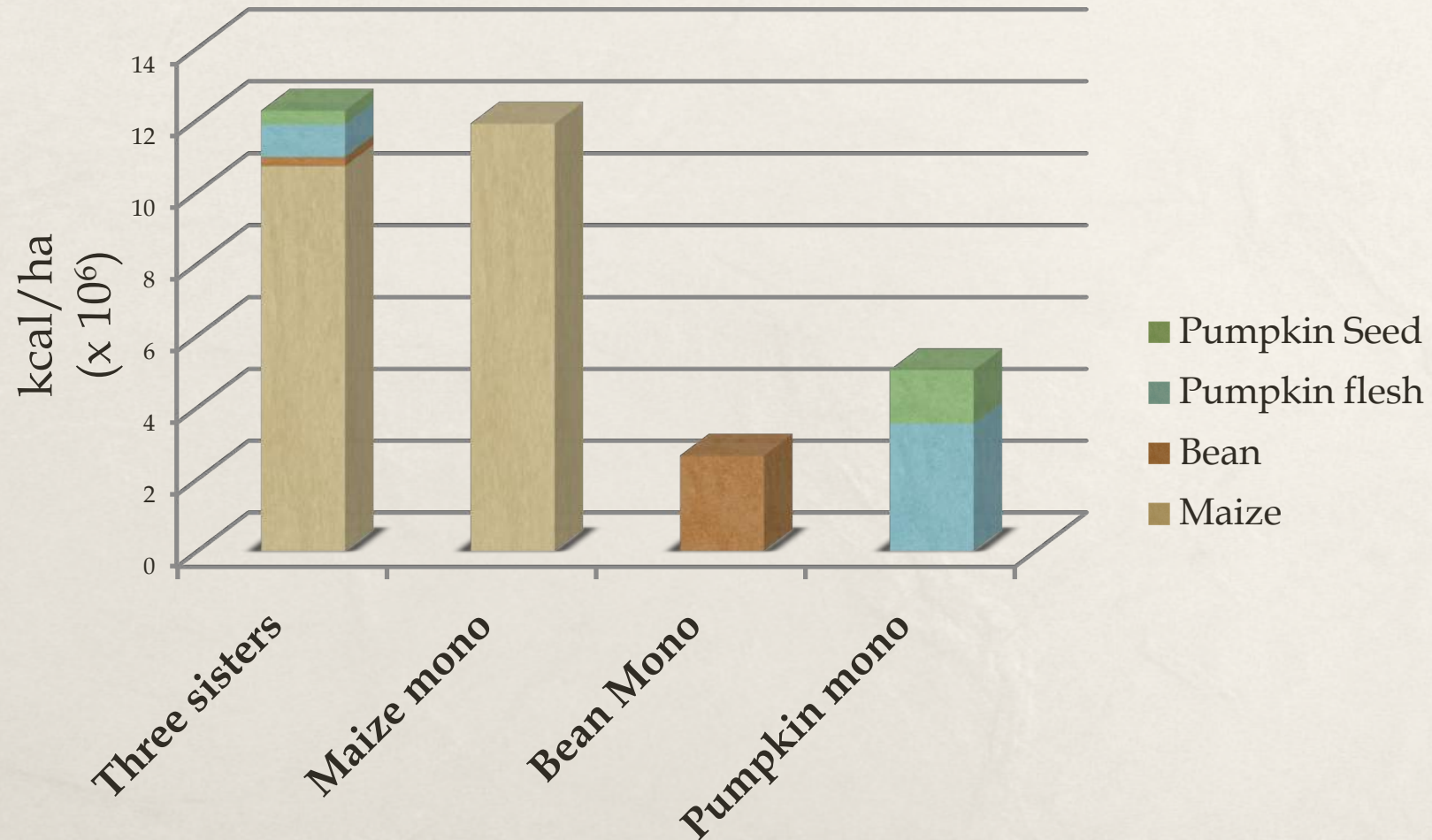
Convert Harvest Weight to Energy and Protein

	Energy kcal/kg	Protein g/kg	Water g/kg
Maize	3650	94	100
Bean	3370	225	120
Pumpkin Flesh	260	10	916
Pumpkin Seed	5590	302	5

All values from <http://ndb.nal.usda>

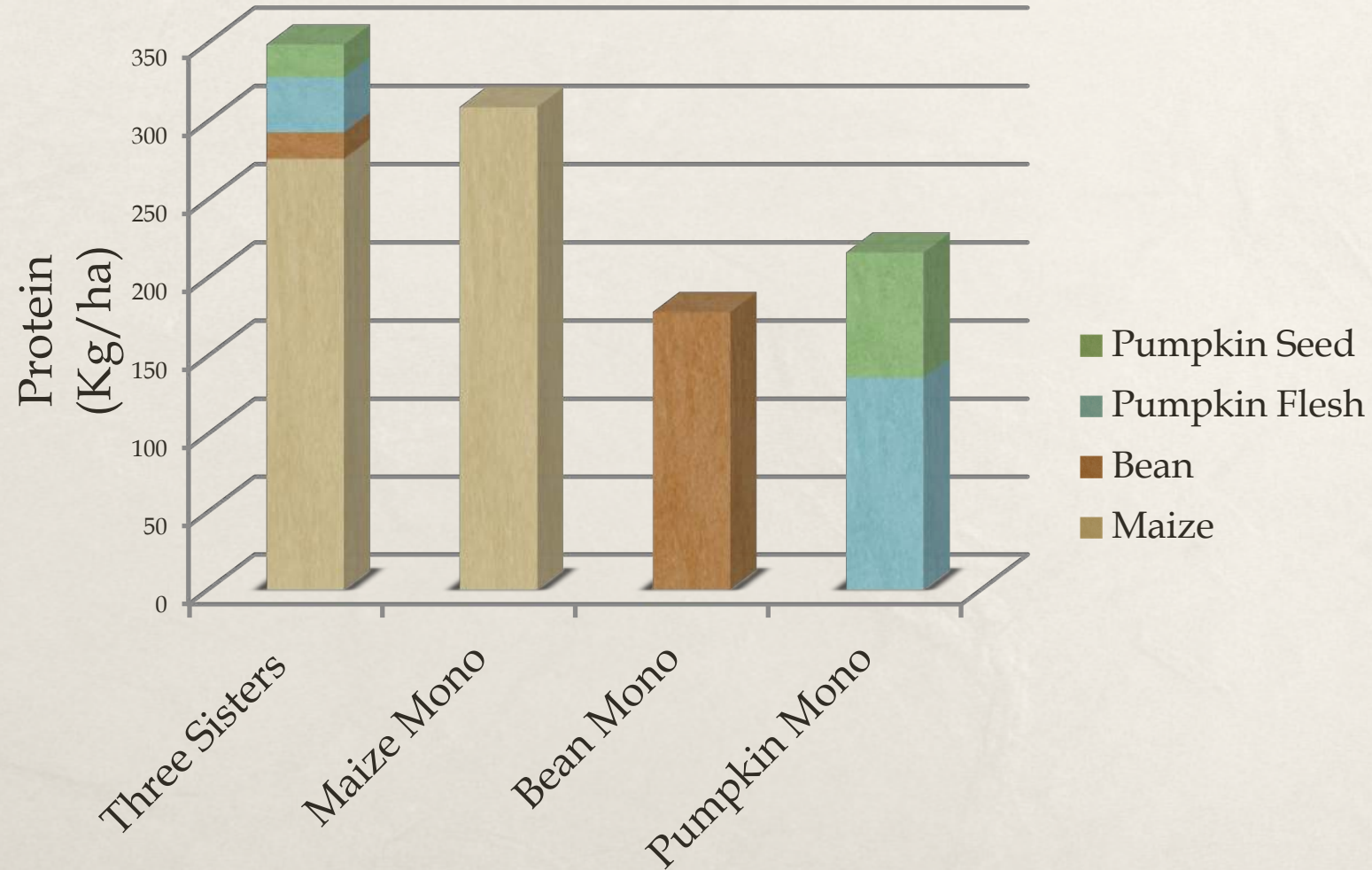
Energy

Three Sisters vs. Monocultures



Protein

Three Sisters vs. Monocultures



Plant Proteins Incomplete, But Complementary

	Maize	Bean	Pumpkin Seed	Pumpkin Flesh
Amino Acid	g/gram N			
Histidine	0.17	0.17	0.23	0.001
Isoleucine	.026	0.38	0.17	0.002
Leucine	0.76	0.78	0.38	0.003
Lysine	0.19	0.41	0.32	0.003
Methionine	0.12	0.07	0.08	0.001
Phenylalanine	0.23	0.36	0.25	0.002
Threonine	0.19	0.27	0.17	0.002
Tryptophan	0.03	0.08	0.10	0.001
Valine	0.28	0.28	0.21	0.002

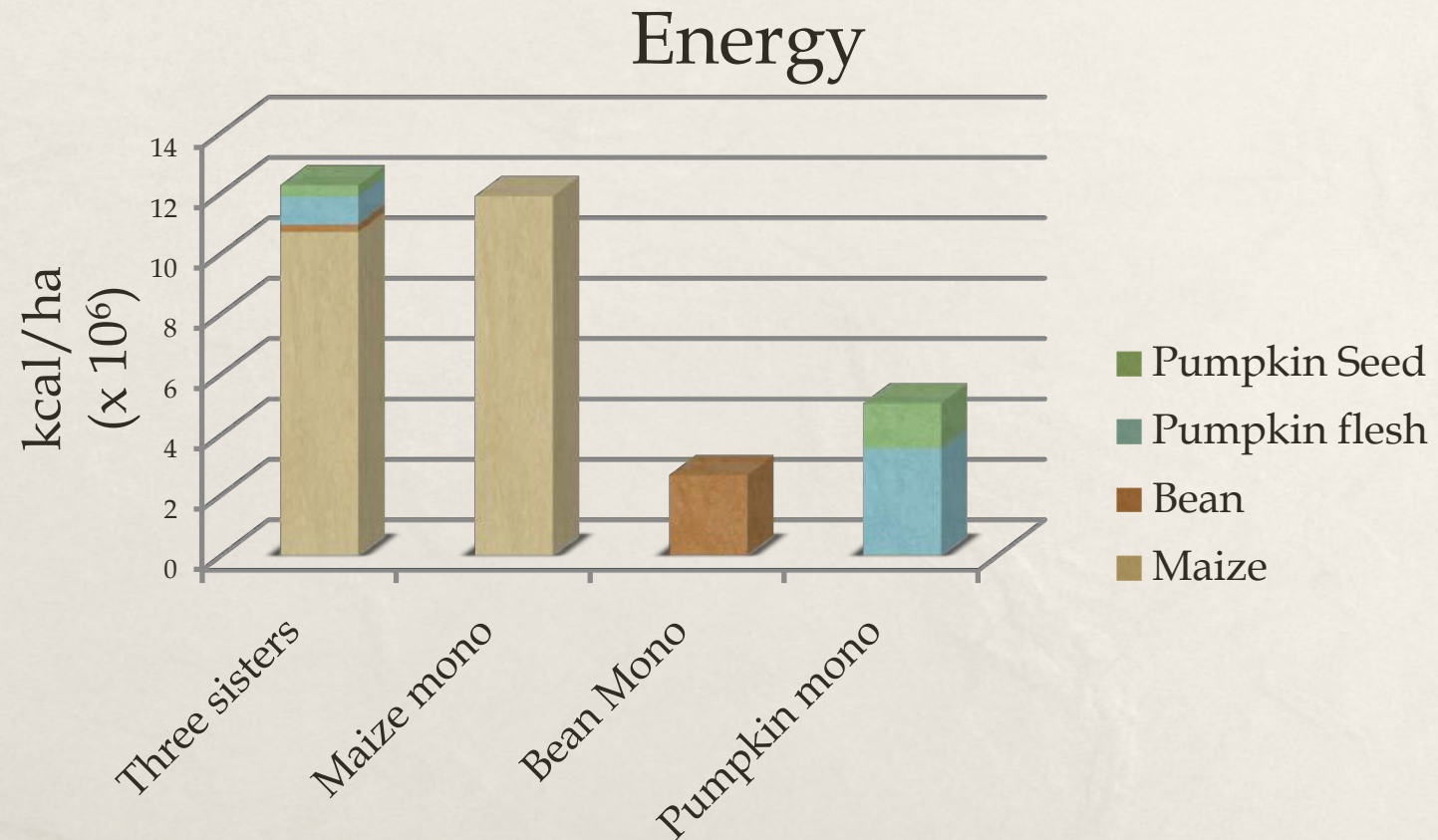
Calcium, Vitamins A and C, and Niacin

	Calcium mg/100g	Vitamin A IU/100g	Vitamin C mg/100g	Niacin mg/100g
Maize	7	0	0	3.63
Bean	83	0	4.5	2.11
Pumpkin flesh	21	8513	9.0	0.6
Pumpkin Seed	46	15	1.9	4.99
RDA	1000	5000	60	15

Nixtamalization

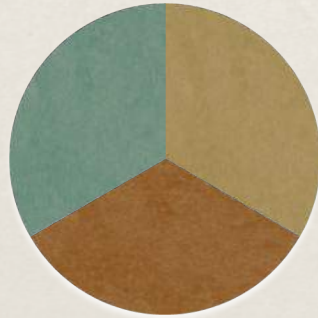
- * Maize soaked and/or cooked in alkaline solution.
- * Reduces cooking time.
- * Increases calcium content 100 to 400%
 - * Calcium ions (from wood ash) attracted to maize starch grains.
- * Improves protein quality
 - * Increases relative amounts lysine, tryptophan, histidine, methionine and threonine.
- * Increases niacin (B vitamin), preventing pellagra
 - * Increased tryptophan, precursor to niacin, increases niacin

Three Sisters vs. Monocultures: Unrealistic Comparisons

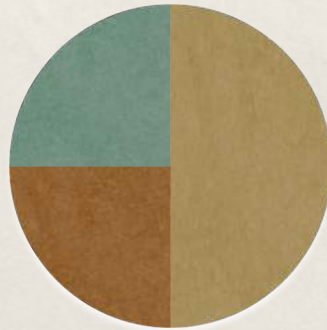


Monoculture Mixtures

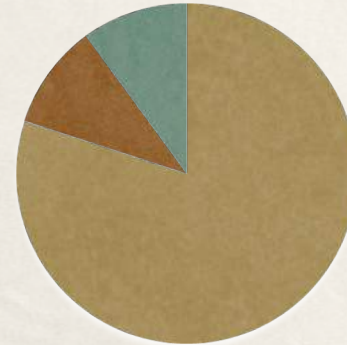
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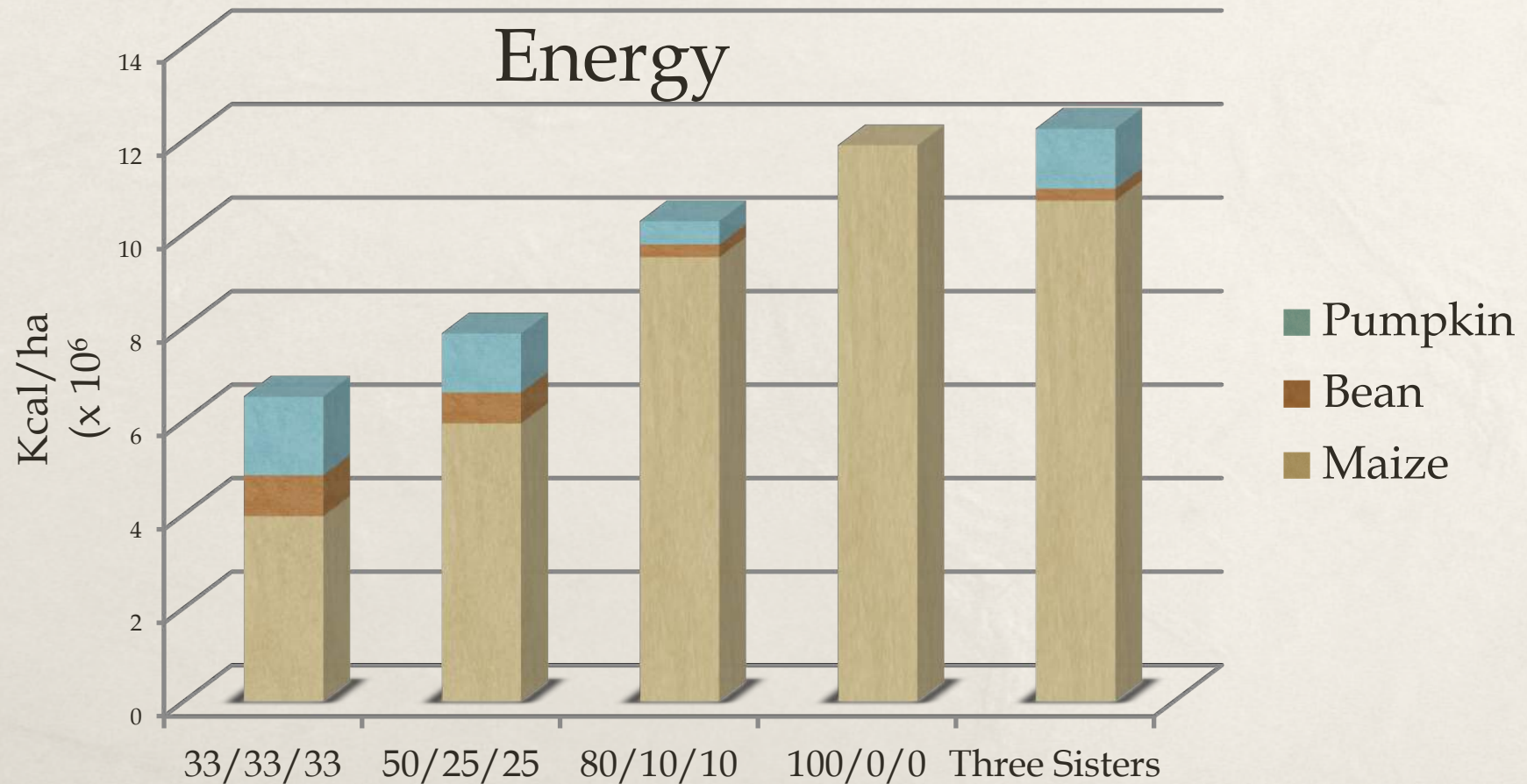
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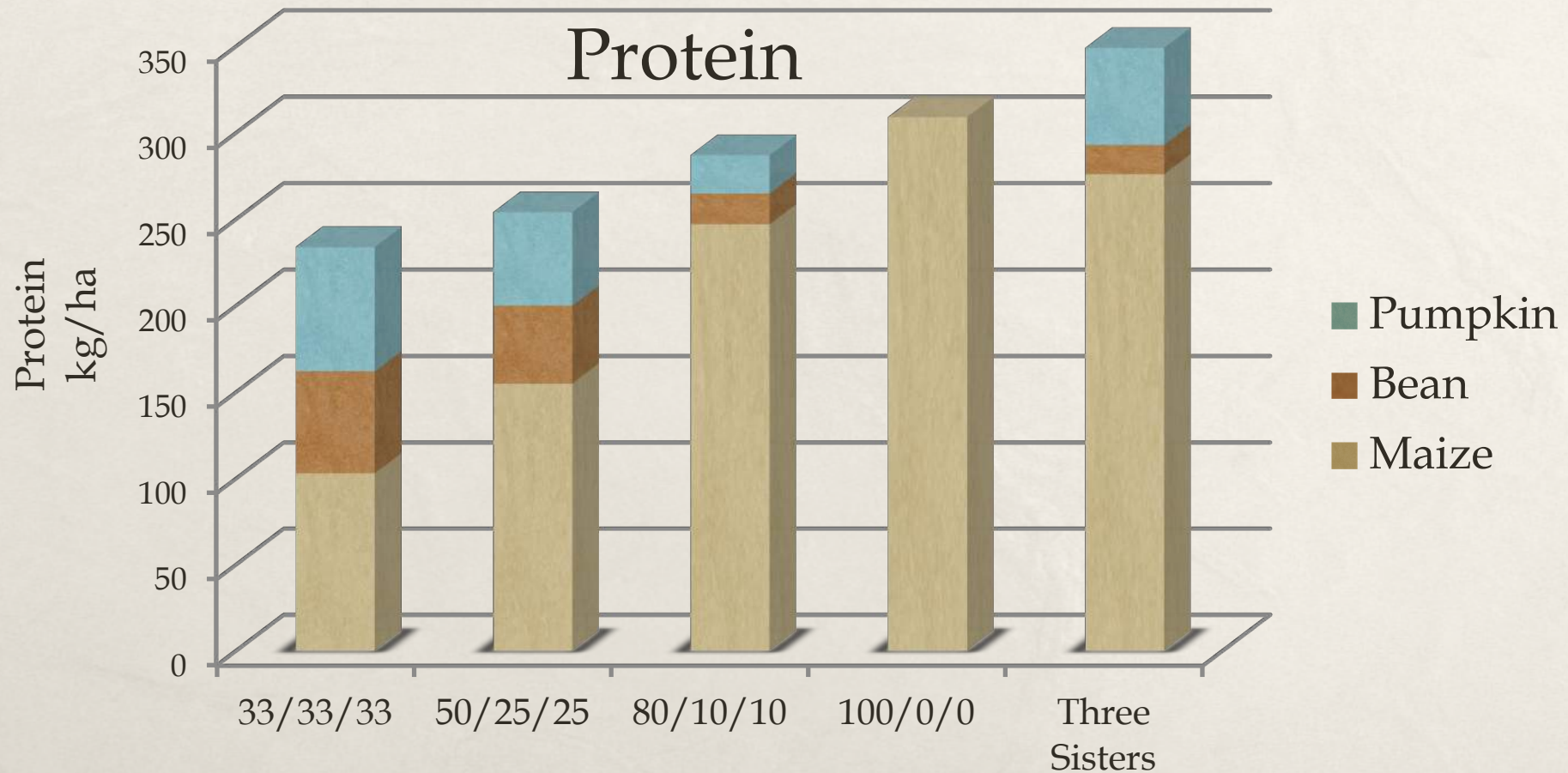
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Monoculture Mixtures vs. Three Sisters



Monoculture Mixtures vs. Three Sisters

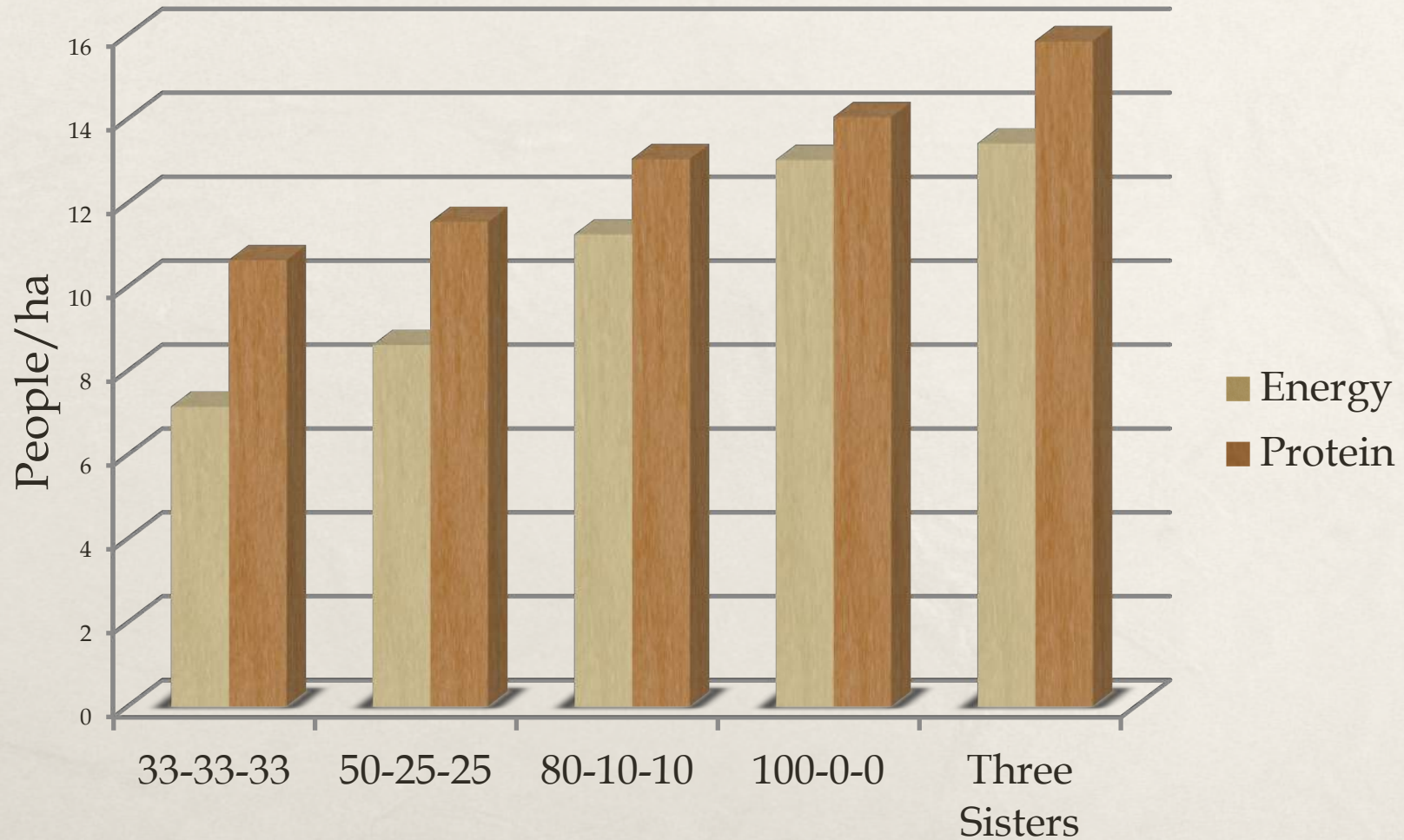


One Last Question: How Many People/Hectare Could Three Sisters Support?

- * First determine adult energy and protein requirements on daily and annual basis.
 - * **Daily:**
 - * 2500 kcal/day
 - * 60 g protein/day
 - * **Yearly**
 - * 912,500 kcal
 - * 22 kg protein
- * Then use energy and protein produced by Three Sisters and monoculture mixtures.

People Supported

Monoculture Mixtures vs. Three Sisters



Conclusions

- * Intercropped maize , bean, and pumpkin highly productive cropping system that largely satisfied Haudenosaunee dietary needs.
- * Maize, anchor of the system, with its very high crop yields produces very large amounts energy and significant protein.
- * Three Sisters provides more energy and protein than individual crop monocultures and more than monoculture mixtures of three crops.

Conclusions

- * Bean and pumpkin seeds increase protein and improve protein quality.
- * Pumpkin flesh provides lots of Vitamin A.
- * Maize nixtamalization
 - * Decreases cooking time
 - * Increases calcium 100 to 400%
 - * Improves protein quality
 - * Increases niacin, preventing pellagra
- * Three Sisters provides (based on yields from field experiments)
 - * Energy for 13.4 people/ha/yr
 - * Protein for 15.9 people/ha/yr