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► **To cite this version:**

Alexandre Joannon, Richard Moore, Jacques Baudry. A comparison of two modes of dairy farming intensification and their potential impact on water quality in two adjacent watersheds in Ohio, USA. Conference Schedule Amish America: Plain Technology in a Cyber World, Jun 2013, Columbus, United States. 17 p. hal-01210081

HAL Id: hal-01210081

<https://hal.science/hal-01210081>

Submitted on 6 Jun 2020

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A comparison of two modes of dairy farming intensification and their potential impact on water quality in two adjacent watersheds in Ohio, USA

Alexandre Joannon, Richard Moore, Jacques Baudry

INRA SAD Paysage, FRANCE - Ohio State University SENR

International Amish Conference - June 2013

PLAN

- 1 Context - Material and Method
- 2 Results
- 3 Discussion and Perspectives

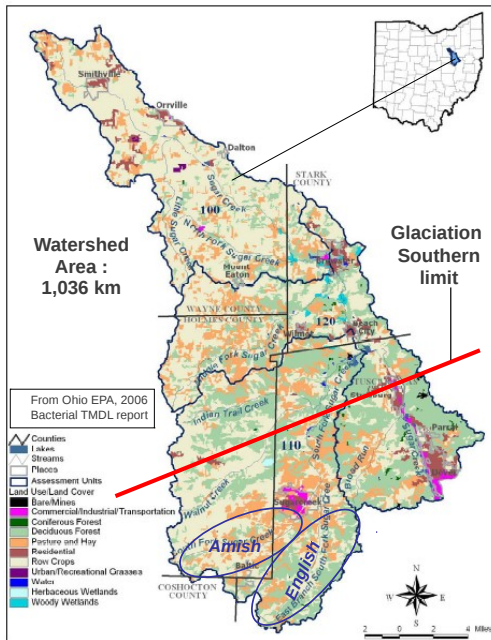


Figure 2-2. Land use and land cover within the Sugar Creek watershed.

Two modes of agricultural intensification

Amish intensification

- When ? Started during the mid 90's
- Which event ? Debate in church districts about social and economic values of milking machines
- Which changes ? Milking machine - bulk tank - 1/3 increase in herd size

Two modes of agricultural intensification

Amish intensification

- When ? Started during the mid 90's
- Which event ? Debate in church districts about social and economic values of milking machines
- Which changes ? Milking machine - bulk tank - 1/3 increase in herd size

English intensification

- When ? Started during the mid 70's
- Which event ? Agricultural vocational education teacher recommended scale increase for profit
- Which changes ? Dairy parlors and 2 to 3 times herd increase

2007 Survey outline

Farmer interview topics

- General characteristics of the farm : area, crop and animal productions, etc.
- Spatial organisation of fields and land use : creation of a GIS database
- Crop and livestock management : rotations, tillage practices, grazing management.

2007 Survey outline

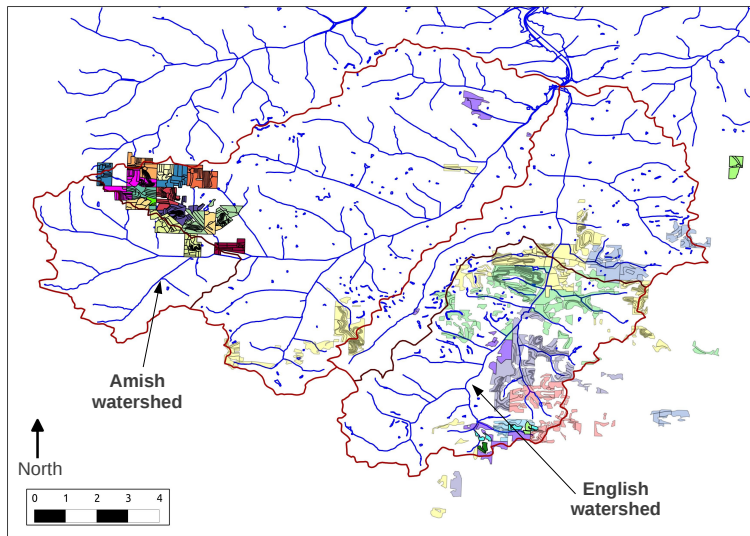
Farmer interview topics

- General characteristics of the farm : area, crop and animal productions, etc.
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Survey coverage

- 28 farmers : 17 Amish and 11 English
- 8,455 ac surveyed : 1,215 ac in Amish farms and 7,240 ac in English farms

Spatial distribution of farms surveyed



Farm characteristics

Production orientation

- Dairy (milking cows or replacement heifers) : 68%
- Cash crops or hay business in 4 English farms : up to 100% of the farm
- Poultry operations in 3 Amish farms : around 100,000 broilers per year
- Part-time farmer with a full time off farm job : 20% on Amish farms vs 35% on English farms

Average level of production

- Farmed land : 80 ac (Amish) / 46 ac (Part time English) and 863 ac (Large English dairy)
- Tillable land : 47 ac (Amish) / 17 ac (Part time English) and 804 ac (Large English dairy)
- Milking cows : 23 (Amish) / 310 (English)
- Production per cow : 15,800 lbs/y (Amish) / 25,200 lbs/y (English)

Dairy cows feeding

Herd feeding (% are related to fodder crops)

	Amish (11 farms)	English (5 farms)
Pasture	All farms – 39%	4 farms - 4%
Animals grazed	All	Dry cows and heifers
Type of grazing	Intensive (5) Rotational (4) Permanent N-D (2)	Permanent (all)
Hay fields grazing	Yes	No
Silage corn	All farms – 4%	All farms – 28%
Hay	31%	51%
Type of hay	Mainly dry hay	Mainly chopped silage hay

- **Amish farms** : complementarity between grazing, dry hay and silage
- **English farms** : more than 80% from silage (hay and corn)

Organic nutrients load to the stream (Phosphorus)

Average values of organic phosphorus produced per farm
(in lbs of P₂O₅ per acre)

	Amish (17 farms)	English (11 farms)
All farms together	39	32
Min	15	0
Max	132	55

Calculation based on French standards
(1 cows = 38 kg of P₂O₅ excreted per year)

Breakdown for all farms

0-6 lbs/ac : 2 English (cash crop)

15-42 lbs/ac : 21 English and Amish

52-55 lbs/ac : 2 English (livestock with no cash crop)

104-132 lbs/ac : 3 Amish (off farm + chicken house)

Crop rotations and their spatial organisation

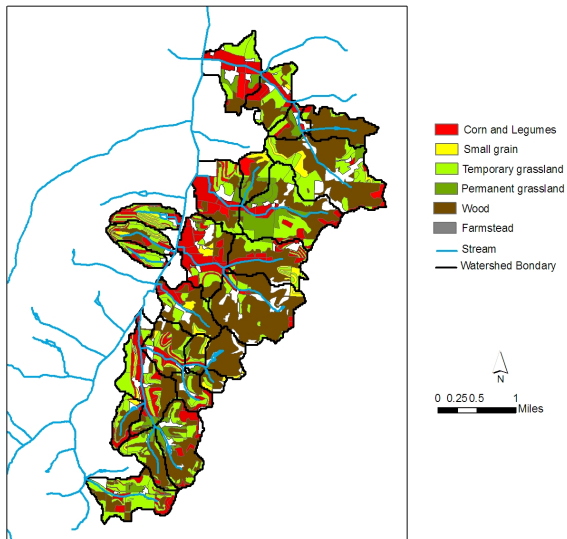
Rotations in Amish farms

- Regular rotation : corn – oat – (spelt/barley/wheat) – hay 4 years
- Usual variations : 2-3 years of corn / 2 to 7 years of hay
- More corn in fields near the silo or in bottom land on clay soil
- Longer hay duration on hills with sandy soil

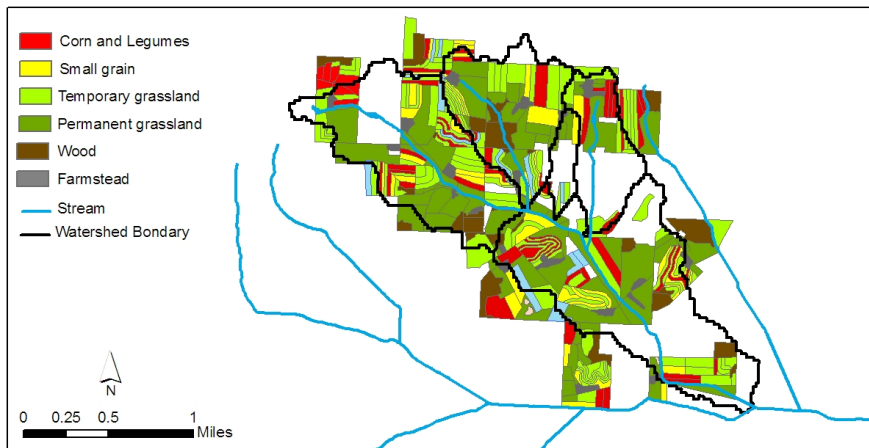
Rotations in English farms

- On bottom land with drained clay soil : continuous corn (soybean)
- On steep slopes : continuous hay (pasture if really too steep)
- On intermediate hill : Corn several years – (wheat) – Hay several years

Spatial aggregation at the landscape scale : English site



Spatial aggregation at the landscape scale : Amish site



Discussion : potential consequences for water quality

A qualitative assessment of both farming systems

	Amish farms	English farms
Organic nutrients outflow	-	+
Level of production	+	-
Landscape heterogeneity	+	-
Manure storage facilities	-	+
Hay and pasture use	-	+
Conservation practices	=	=
Fields spatial heterogeneity	+	-
-> Water quality ?	??	??

No evidence that one system is better than the other regarding nutrient transfers to the streams

Conclusion and perspectives

Two rather different types of intensification

- English dairy farms intensification leads to very large farms with very small remaining part-time non dairy farms
- Amish dairy farm intensification is more homogeneous among farmers leading to small scale dairy farms
- However, both resulting farming systems have potential negative impacts on nutrients loading to streams

Monitoring water quality

- In upper parts of both watersheds where Amish and English farms are not mixed
- Using continuous flow and sampling devices
- Started in spring 2013 and scheduled for the next 5 years



Amish landscape heterogeneity



English landscape heterogeneity

Thank you for your attention !