Perceptions of water quality in rural Alberta associated with livestock

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Lethbridge

Outline

- Background
- Rationale for this study
- Methods
- Results
- What's next?
- Significance of study (so what?)

Background

- What are *perceptions*?

*The state of being or process of becoming aware of something through the **senses***

Perception is a human being's primary cognitive contact with the environment … simply the way in which we understand the world around us using our senses.

Deonna, 2006

Background

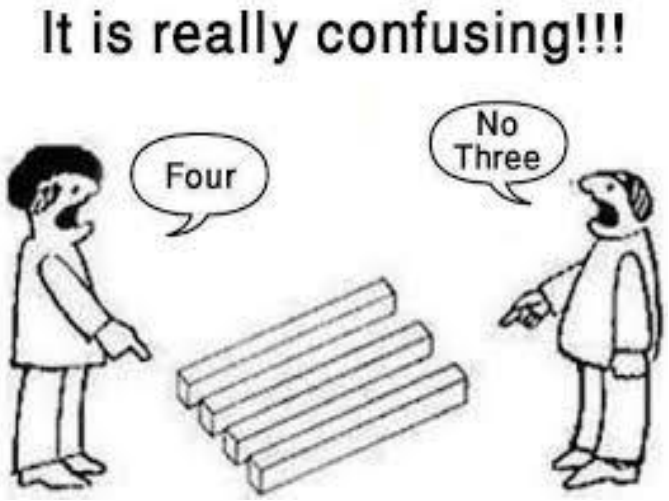
- Risk perception*:*

*A **subjective** judgement that an individual makes about the characteristics and severity of a risk*

Slovic et al., 1982

Background

Background



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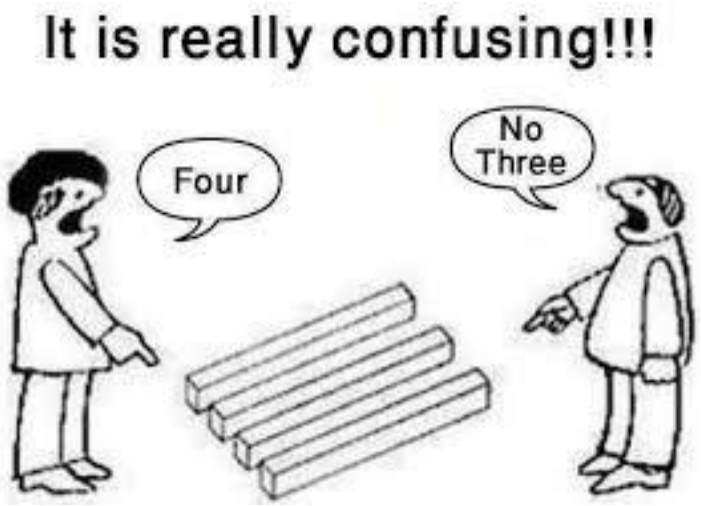
Background



Water Quality

Water Quality: Irrigation water

Environmental Quality Guidelines for Alberta Surface Waters

Table 2. Water quality guidelines for the protection of agricultural water uses (continued).

Water Quality Variable(Substance or Condition)	Category	Unit	Irrigation	Source & Date	Livestock Water	Source & Date	Notes and Direction
Chromium - total:	Metal	µg/L					
-Hexavalent (Cr VI)			8.0	CCME 1997	50	CCME 1997	Livestock water guideline is interim. See footnote C.
-Trivalent (Cr III)			4.9	CCME 1997	50	CCME 1997	Irrigation and livestock water guidelines are interim. See Footnote C.
Cobalt - total	Metal	µg/L	50	CCME 1987	1000	CCME 1987	See Footnote B. No CCME fact sheet available.
Coliforms, fecal (*Escherichia coli*)	Biological	#/100 mL	100	CCME 1987			Interim. Derived to address potential risk to human health of consumption of irrigated raw produce. No CCME fact sheet available.
Copper - total	Metal	µg/L	200 to 1000	CCME 1987	500 to 5000	CCME 1987	Irrigation guideline is 200 µg/L for cereals and 1000 µg/L for tolerant crops. Livestock water guideline is 500 µg/L for sheep, 1000 µg/L for cattle and 5000 µg/L for swine and poultry. No CCME fact sheet available.

Environmental Quality for Alberta Surface Waters 2014

Water Quality: Drinking water

Guidelines for Canadian Drinking Water Quality — Summary Table (October 2014)

Parameter (approval)	Guideline	Common sources	Health considerations	Applying the guideline
Enteric protozoa: *Giardia* and *Cryptosporidium* (2012)	Treatment goal: Minimum 3 log removal and/or inactivation of cysts and oocysts	Human and animal faeces	*Giardia* and *Cryptosporidium* are commonly associated with gastrointestinal upset (nausea, vomiting, diarrhoea). Less common health effects vary. *Giardia* infections may include prolonged gastrointestinal upset, malaise and malabsorption. *Cryptosporidium* infections, in immunocompromised individuals, can occur outside the gastrointestinal tract including in the lungs, middle ear, and pancreas.	Monitoring for *Cryptosporidium* and *Giardia* in source waters will provide valuable information for a risk-based assessment of treatment requirements. Depending on the source water quality, a greater log removal and/or inactivation may be required.
Enteric viruses (2011)	Treatment goal: Minimum 4 log reduction (removal and/or inactivation) of enteric viruses	Human faeces	Commonly associated with gastrointestinal upset (nausea, vomiting, diarrhoea); less common health effects can include respiratory symptoms, central nervous system infections, liver infections and muscular syndromes	Routine monitoring for viruses is not practical; characterize source water to determine if greater than a 4 log removal or inactivation is necessary.
Escherichia coli (*E. coli*) (2012)	MAC: None detectable per 100 mL	Human and animal faeces	The presence of *E. coli* indicates recent faecal contamination and the potential presence of microorganisms capable of causing gastrointestinal illnesses; pathogens in human and animal faeces pose the most immediate danger to public health.	*E. coli* is used as an indicator of the microbiological safety of drinking water; if detected, enteric pathogens may also be present. *E. coli* monitoring should be used, in conjunction with other indicators, as part of a multi-barrier approach to producing drinking water of an acceptable quality.

GCDWQ (Guidelines for Canadian Drinking Water Quality) 2014

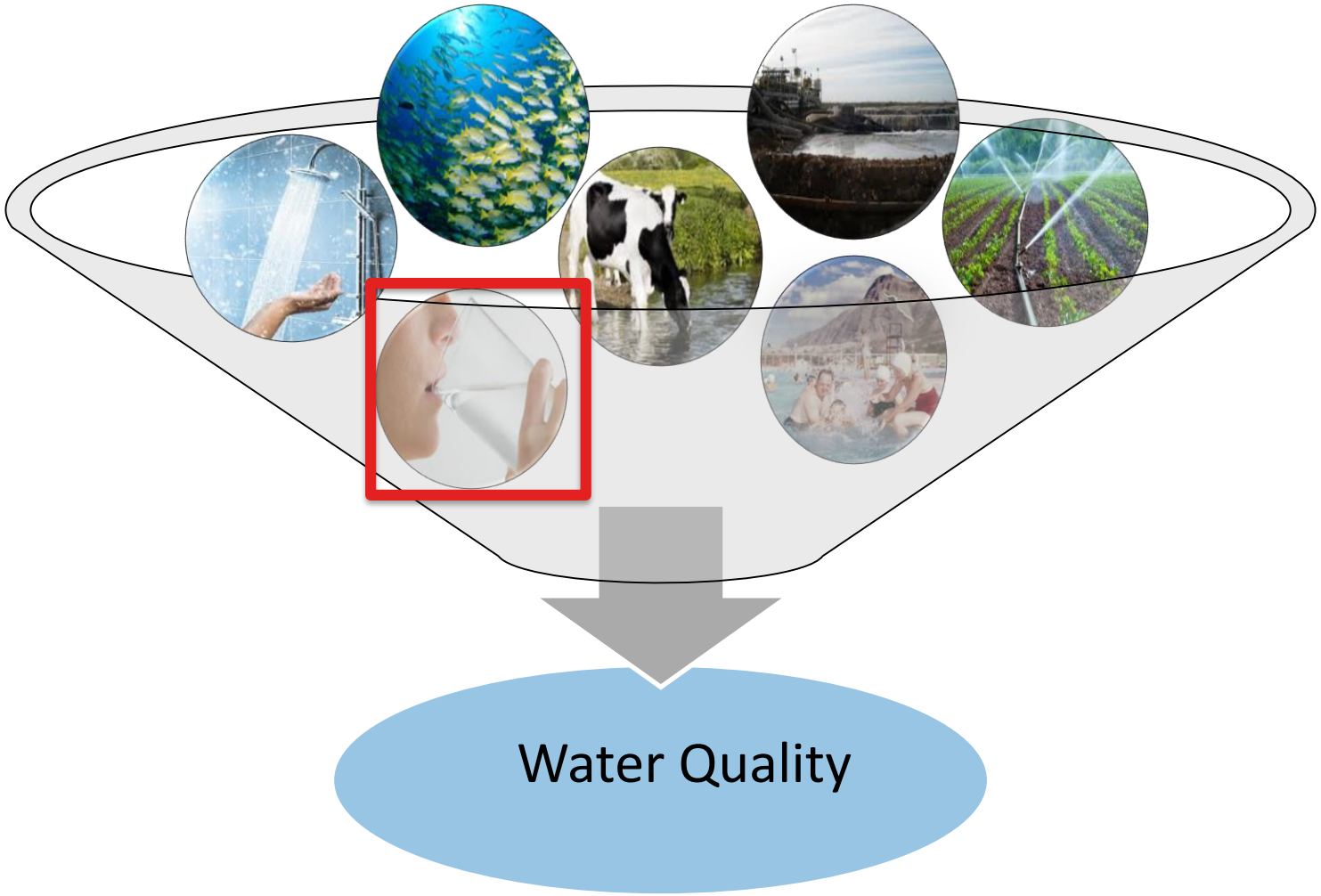
Water quality differences

Table 2. Use of CDWQG parameters in Canadian provinces and territories.

Jurisdiction	No. of Parameters Same as CDWQG (Out of 94)	No. of Parameters Less Stringent Than CDWQG	No. of Parameters More Stringent Than CDWQG	No. of CDWQG not Applied by Jurisdiction	No. of Parameters Applied by Jurisdiction, but not Listed in CDWQG	Total # Parameters Used by This Jurisdiction
British Columbia (BC)	94	0	0	0	0	94
Alberta (AB)	72	0	0	22	0	72
Saskatchewan (SK)	56	6	0	32	3	65
Manitoba (MB)	90	1	0	1	3	94
Ontario (ON)	79	3	3	9	21	106
Québec (QC)	36	2	35	21	10	83
New Brunswick (NB)	93	1	0	0	0	94
Prince Edward Island (PE)	94	0	0	0	0	94
Nova Scotia (NS)	93	1	0	0	2	96
Newfoundland & Labrador (NL)	92	0	1	1	1	94
Yukon (YK)	27	0	0	68	1	28
Northwest Territories (NT)	94	0	0	0	0	94
Nunavut (NU)	94	0	0	0	0	94

Dunn et al., 2014

Water Quality



Water wells

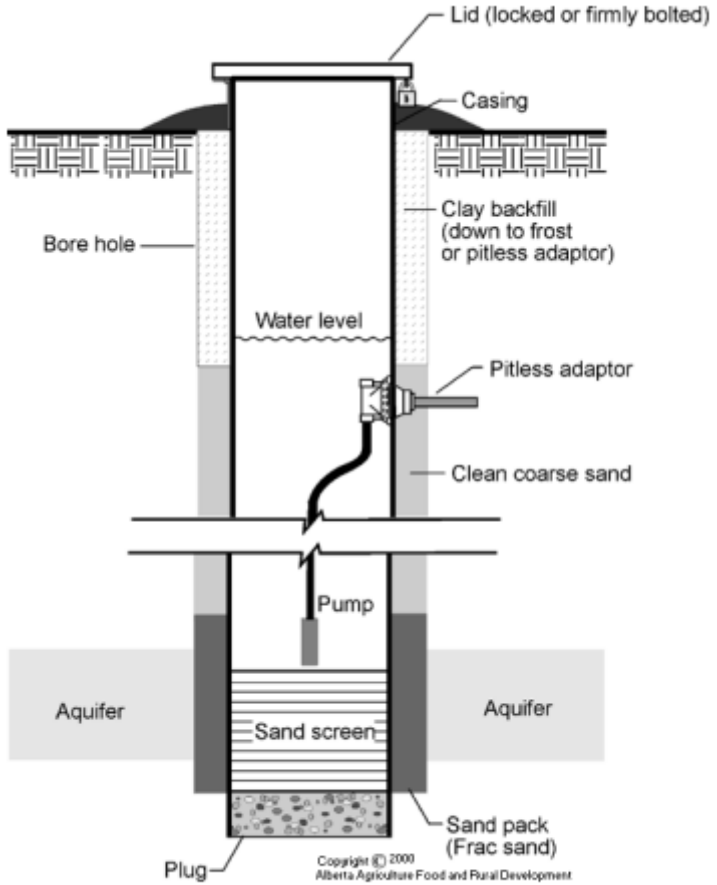
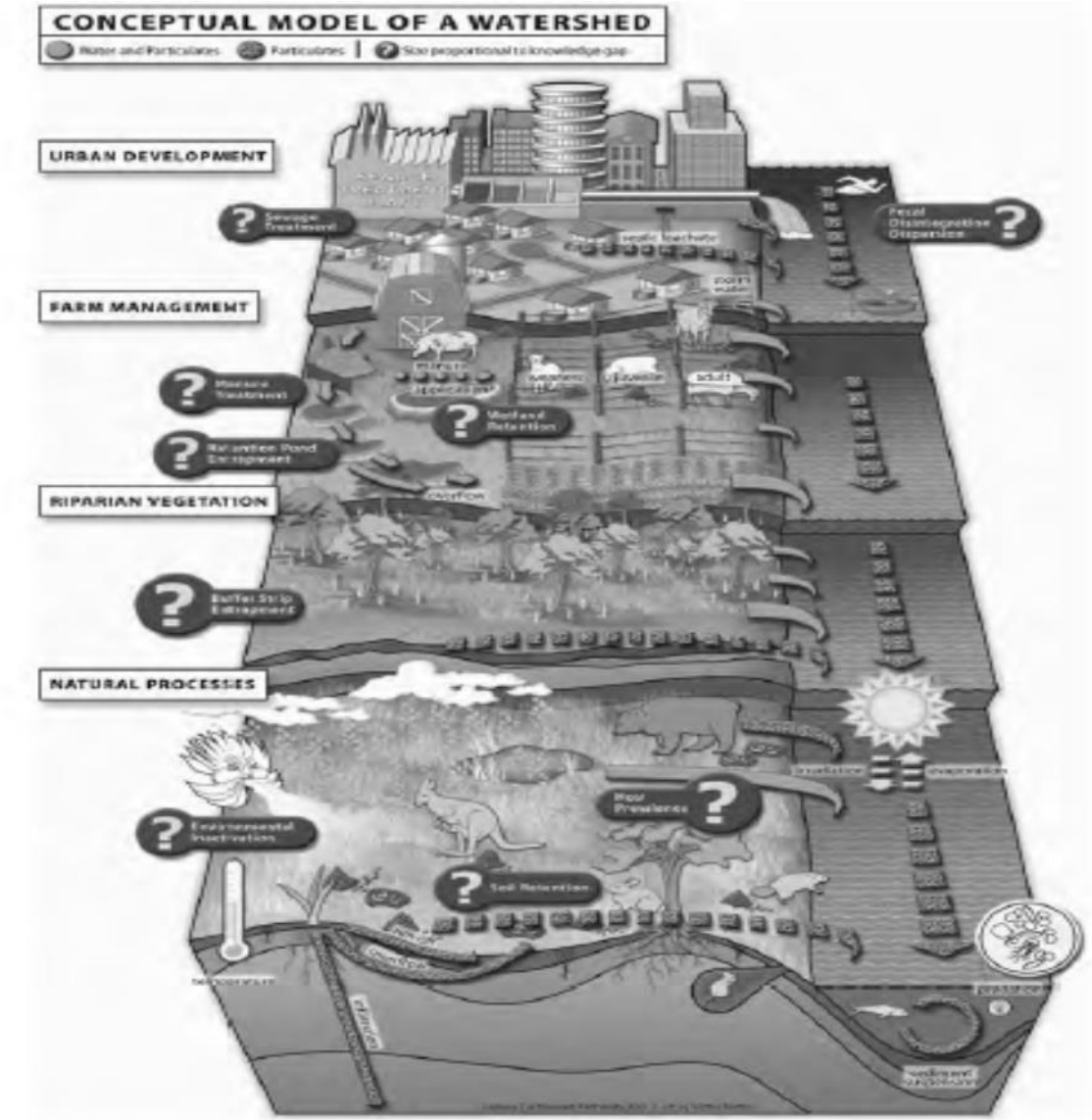


Figure 1 *Bored Well*

Alberta Agriculture and Forestry Design and Construction of Water wells 2016

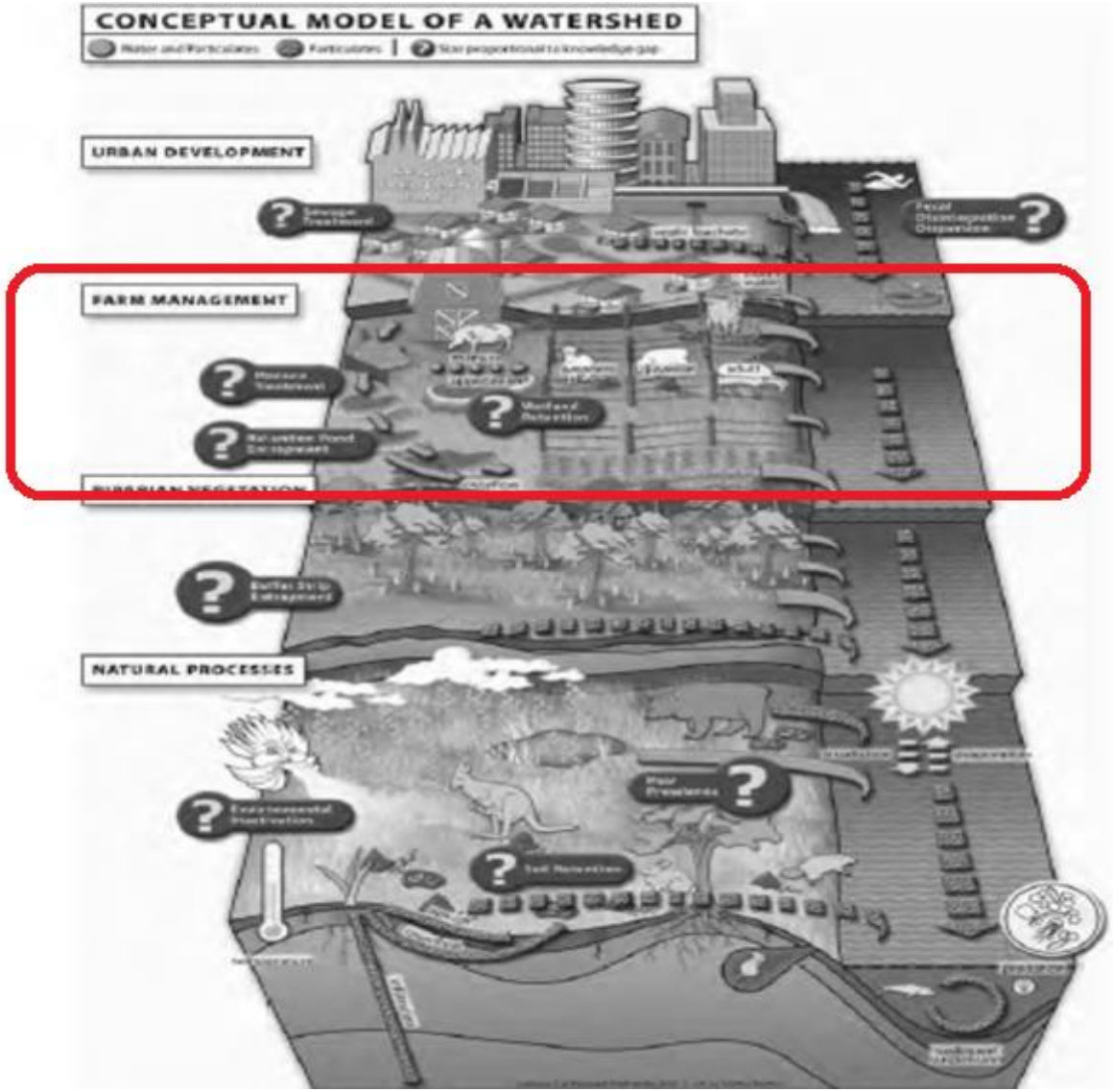
Risks within a Watershed



Dufour et al., 2012

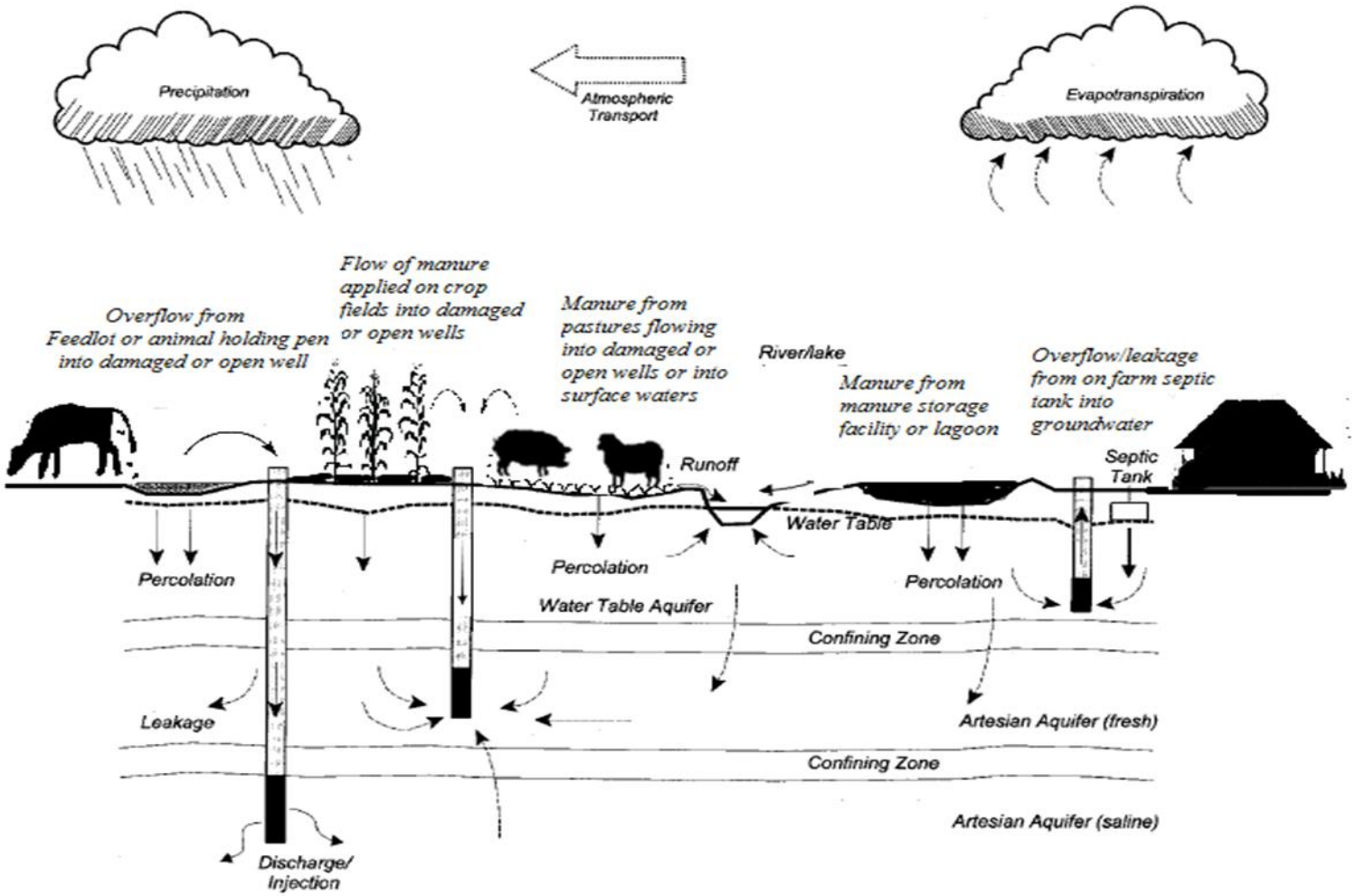
Figure 5.1 Conceptual model of pathogen sources, fate and transport in a drinking-water catchment (*with permission from JAWWA*).

Risks within a Watershed



Dufour et al., 2012

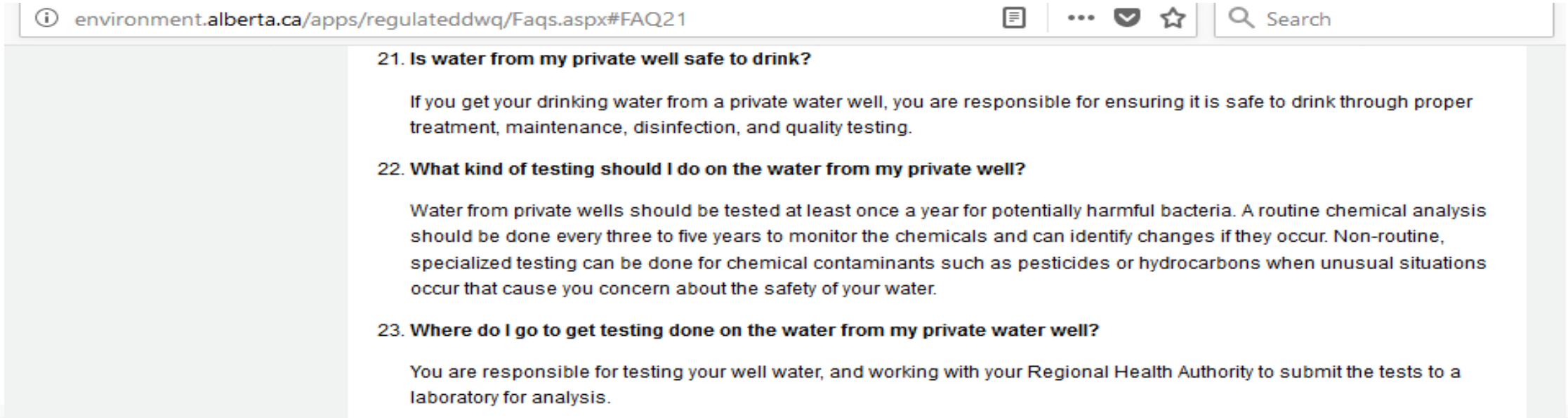
Livestock as a risk factor



Adopted from Ritter et al., 2002

Well stewardship

- The water well is your “baby” Ken Williamson WWP
- Less than 11% of well owners test their well water on an annual basis
- Well owners must decide when to test, what to test for and what treatments to use



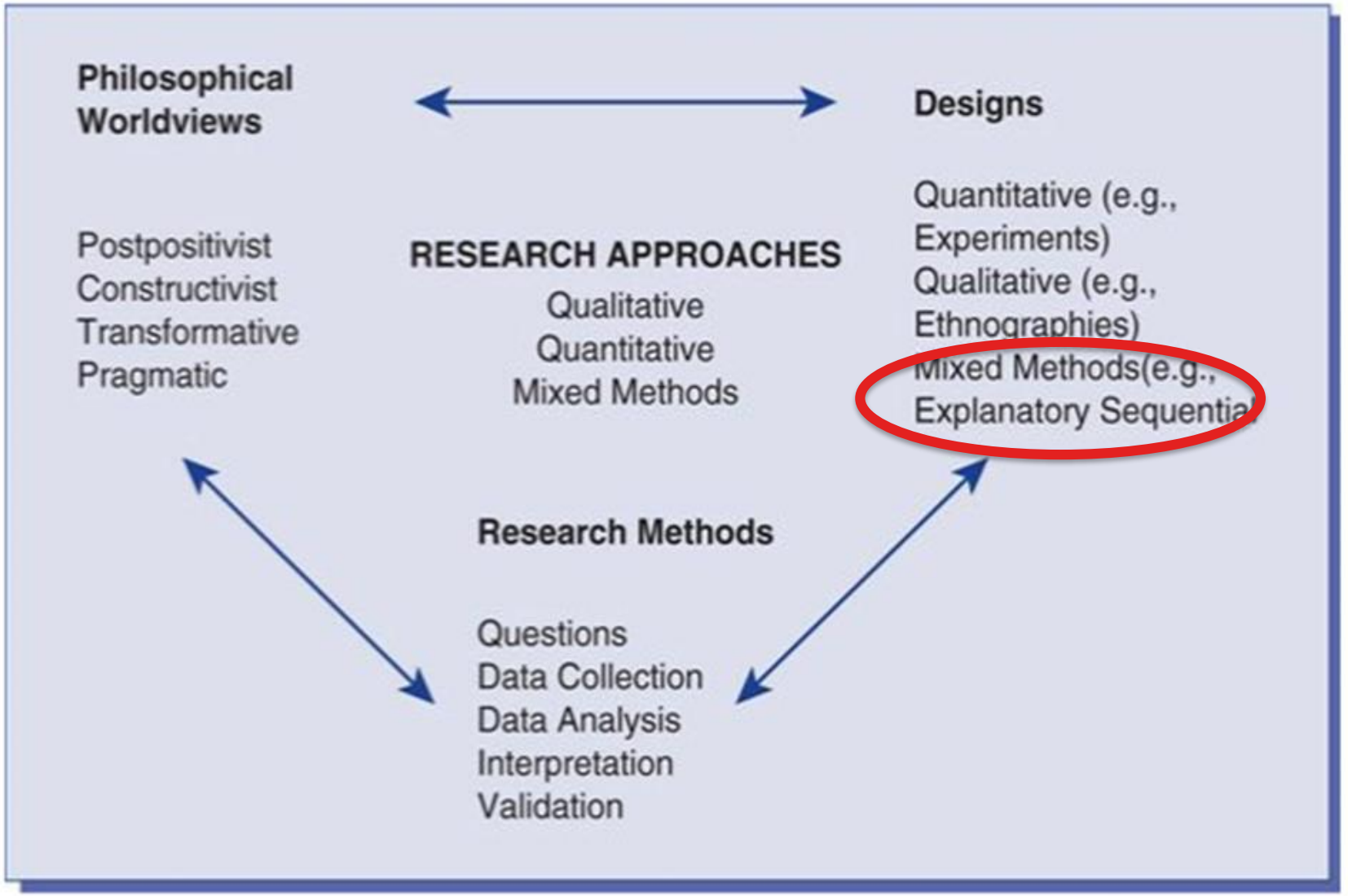
Study Key Objectives

- Describe the ***perceptions, knowledge, and beliefs*** rural Albertan residents have of well water quality, how, and whether they ***associate livestock*** with well water contamination

- Identify ***key barriers*** faced by well water owners with respect to using well water stewardship practices

- Identify **risk factors** that predict well water stewardship practices (i.e., testing treatment)

The mixed methods approach



Methods

A mixed methods study

- Quantitative approach
  - Descriptive stats and Regression analysis on questionnaire

- Qualitative approach
  - Thematic analysis on interviews with well owners

- Water quality report data (microbiological quality of domestic well water using *E.coli* as an indicator species)

Recruitment

- Recruitment though
  - AWWID, watershed management groups, county councils and well water management programs in the province
- Mail out questionnaires sent to well owner residences
- 250+ questionnaires returned (mail and online)

Methods

A mixed methods study

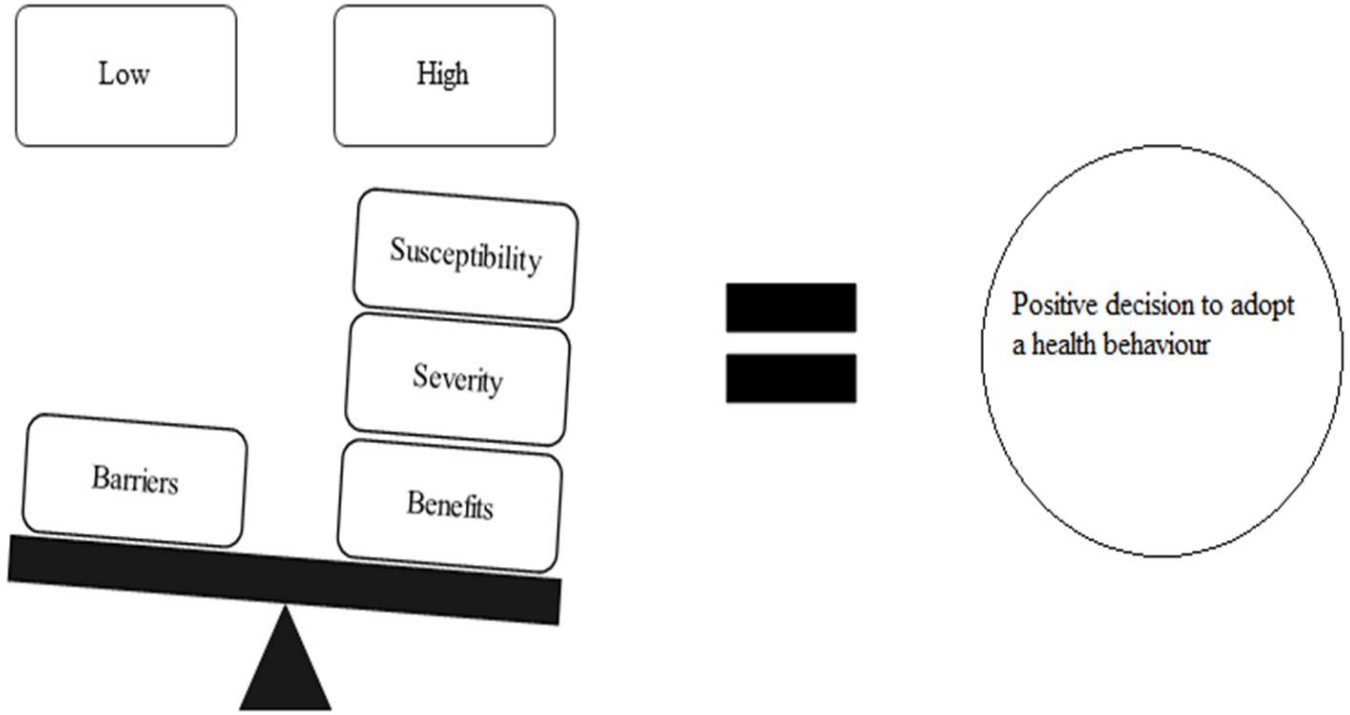
- Quantitative approach
  - Descriptive stats and Regression analysis on questionnaire

- Qualitative approach
  - Thematic analysis on interviews with well owners

- Water quality report data (microbiological quality of domestic well water using *E.coli* as an indicator species)*

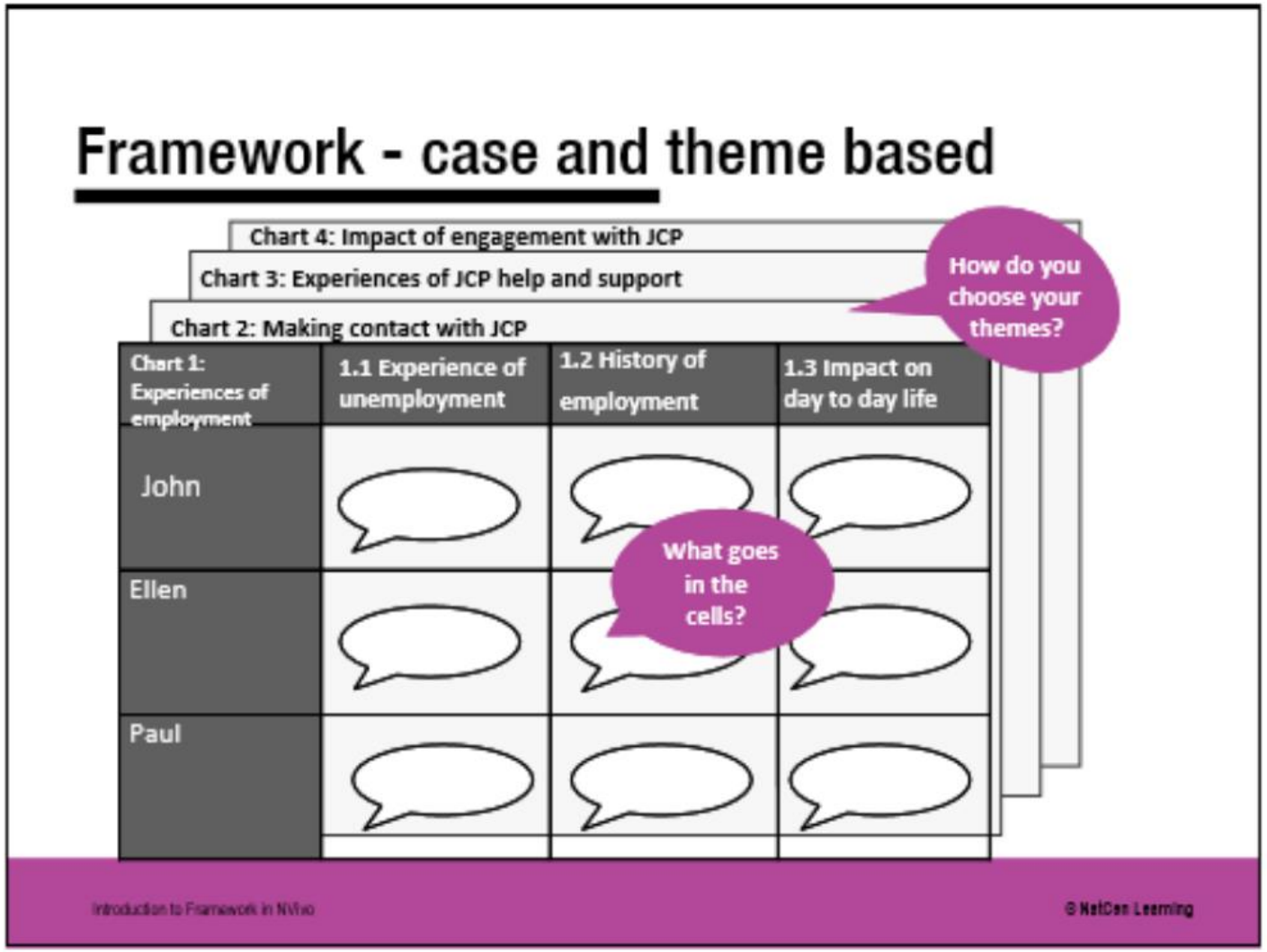
Qualitative approach: Health Belief Model

- Six tenets of the HBM (Janz & Becker 1974)
- Perceived Susceptibility
- Perceived Severity
- Perceived Benefits
- Perceived Barriers



- Cues to action
- Self efficacy

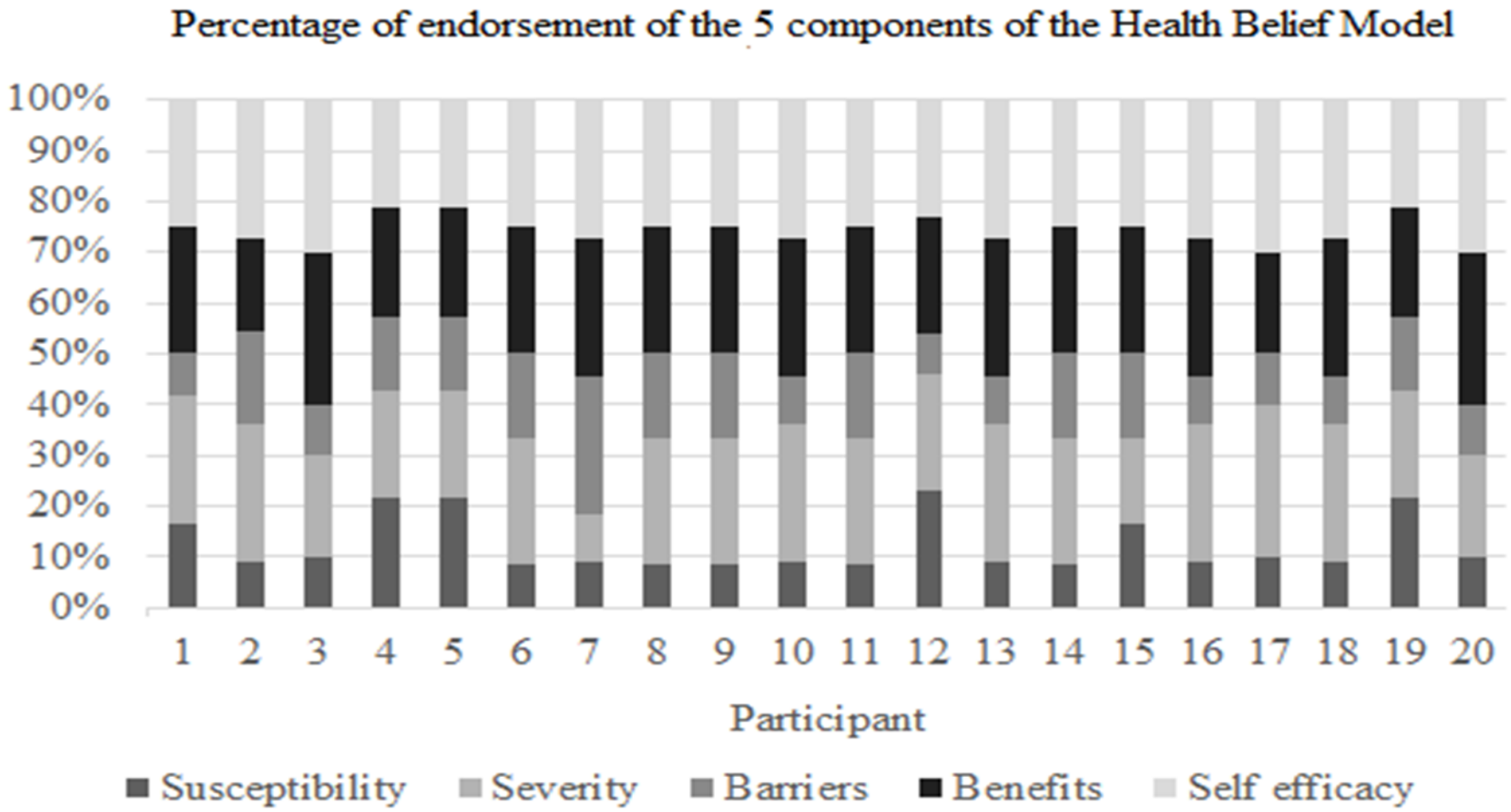
Framework analysis



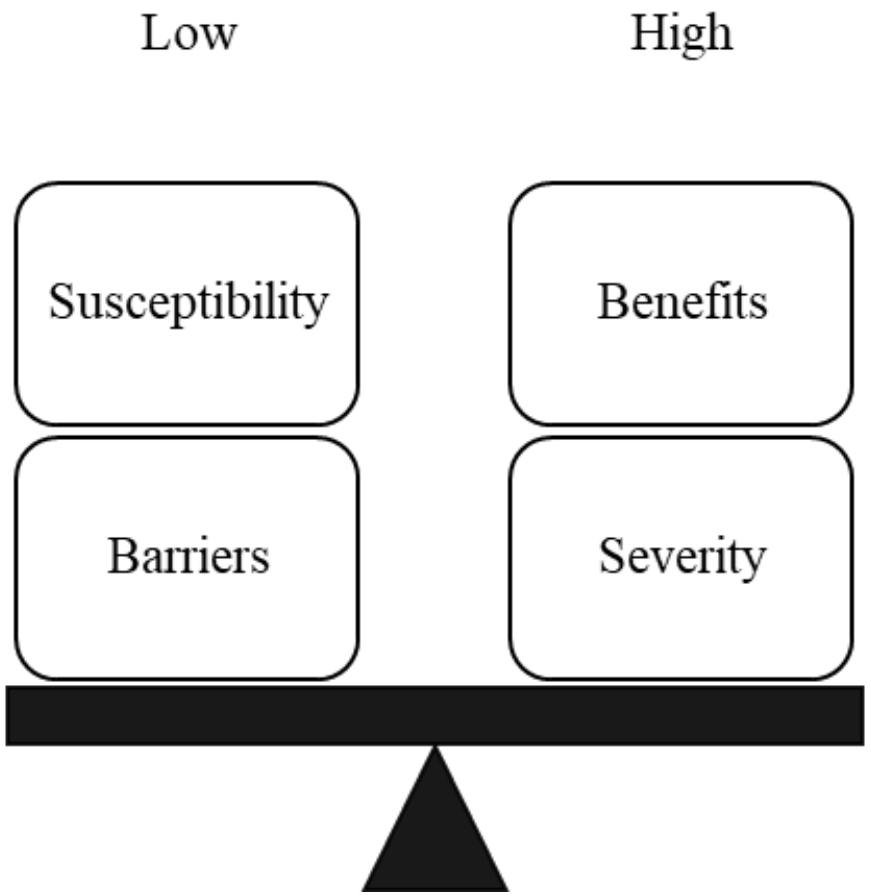
Framework analysis

Susceptibility	Severity	Barriers	Benefits	Cues to action	Self efficacy
"Oh (sigh) I do not feel it's a risk in like… Personally, I do not feel we are at risk (of well water contamination)."	"Um I guess if you look at Walkerton it can kill people."	"No other than the fact that it is really inconvenient the times to test the well, if it would make it easier for people to just drop their…and I am not sure, you know the chemical analysis, whether it has to be within a time frame, but its really…its really awkward to get that done."	"Well I think its absolutely imperative, I don't think its an option at all. I think its just a health and safety issue." Inter	"They could come pick it up at my door. No that's just a smart@#$ answer."	"Well again, Abraham, I have had zero problem, the 3…like I said the 3 times that I can remember... I have had zero problems."

Endorsement of the health belief model



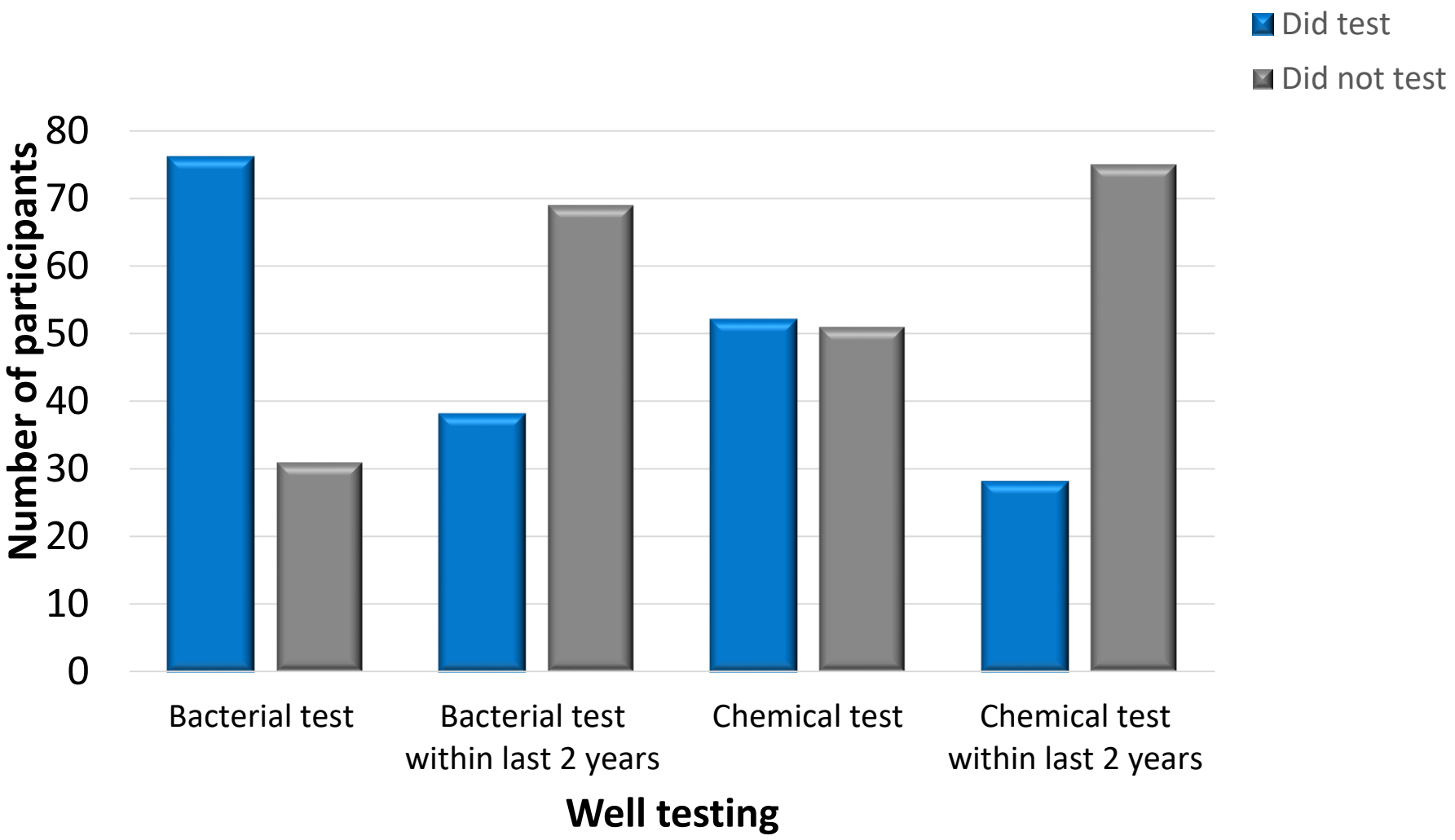
What we think is happening with water testing behaviour



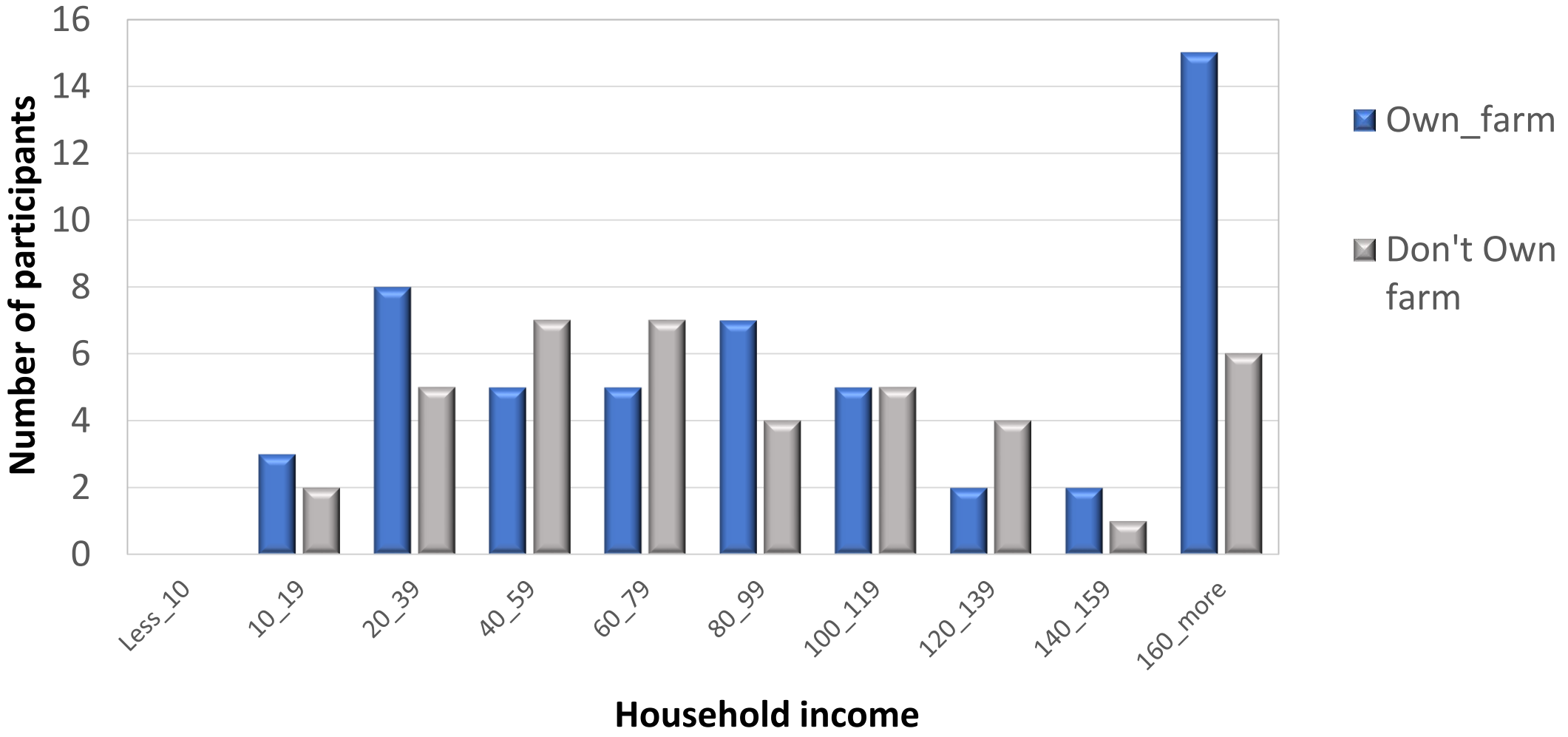
Participant demographics (overview)

- Received 111 usable paper questionnaires from the first mail and 51 usable paper questionnaires from the second mail out
- Mean age of participants was 57 years
- About 74% of our respondents were male

Well Water testing

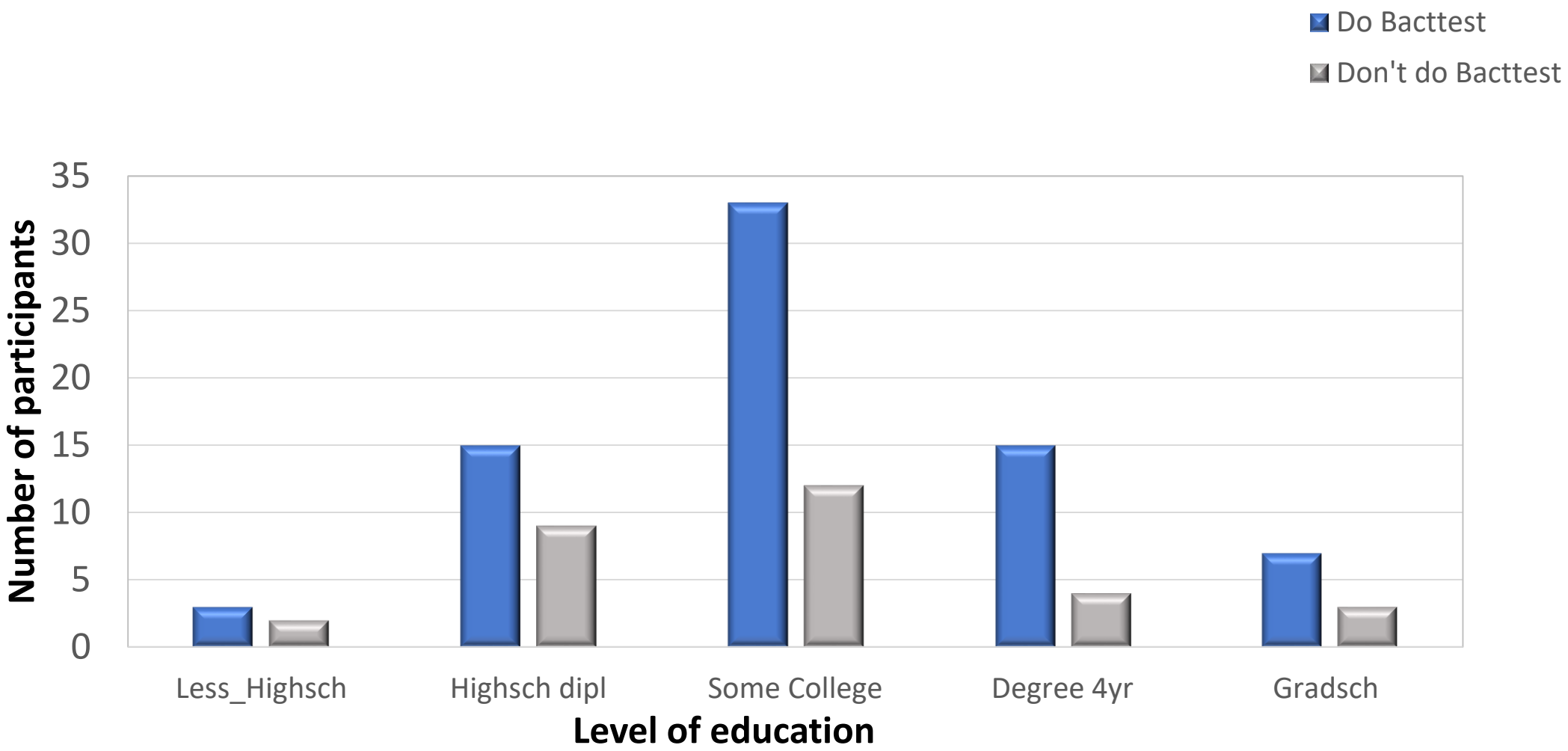


Demographics (Income) and well testing



$\chi^2 = 0.04$ $p > 0.05$

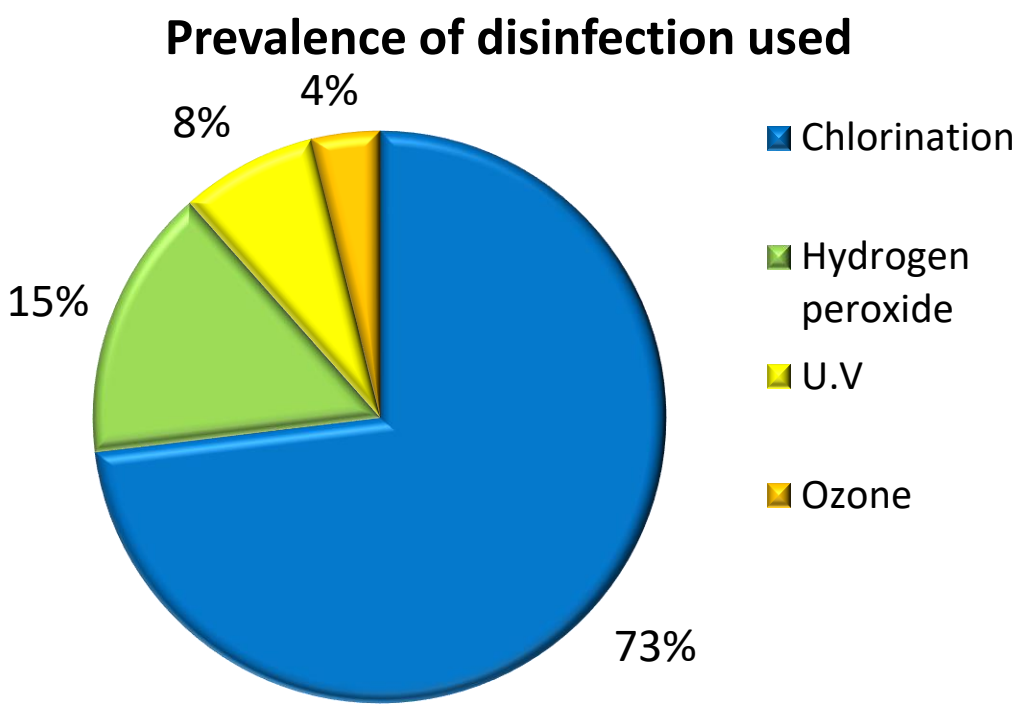
Demographics (education) and well testing

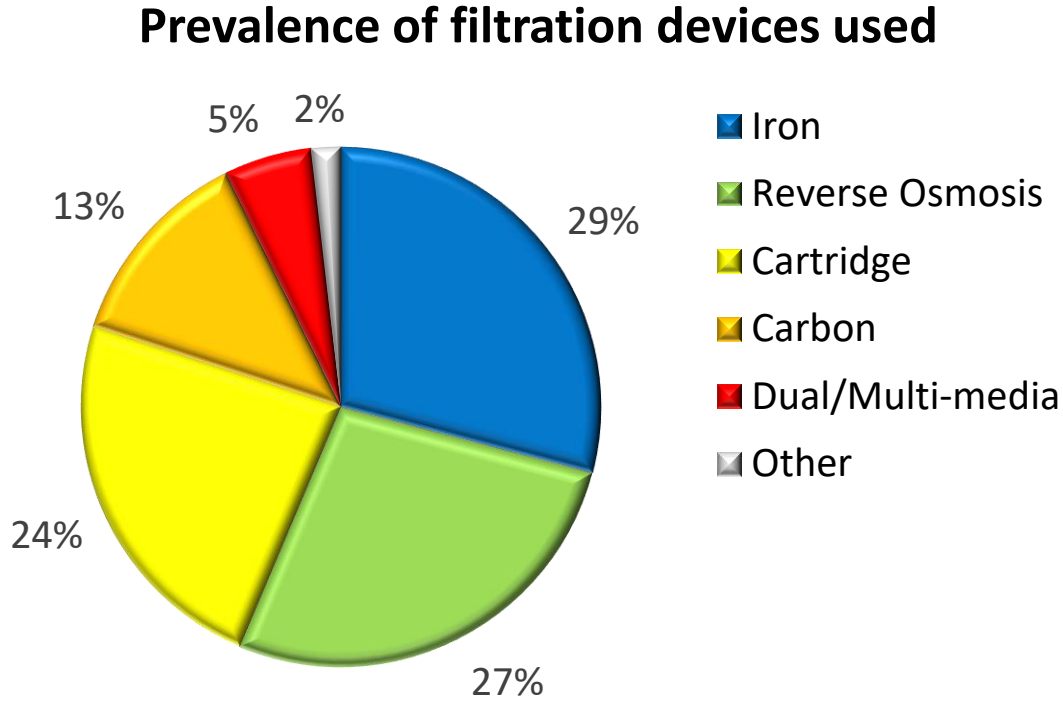


$\chi^2 = 1.24$ $p > 0.05$

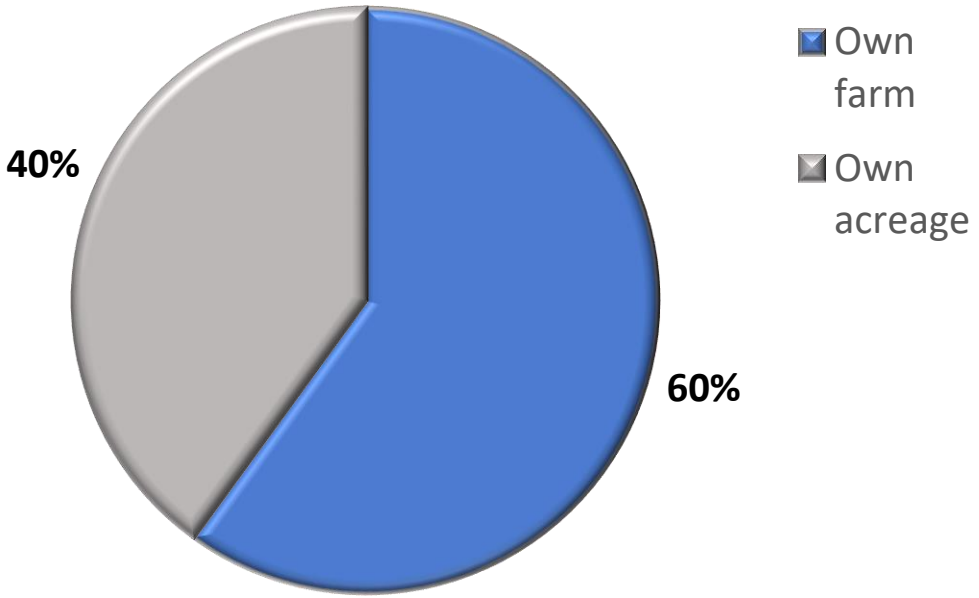
Well Water treatment

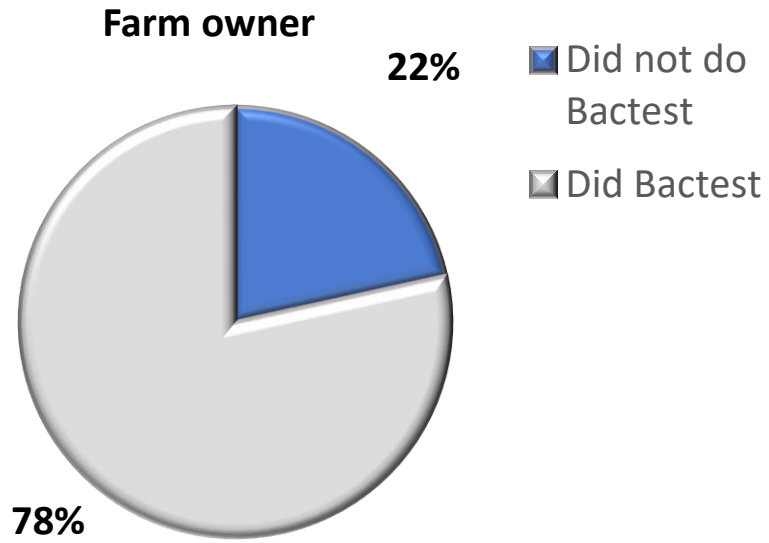
About 40% of well owners reported using some form of well treatment

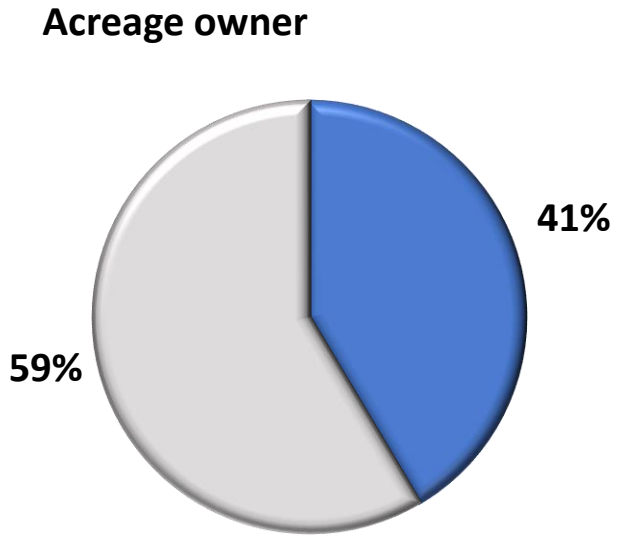




Farm ownership and well water testing

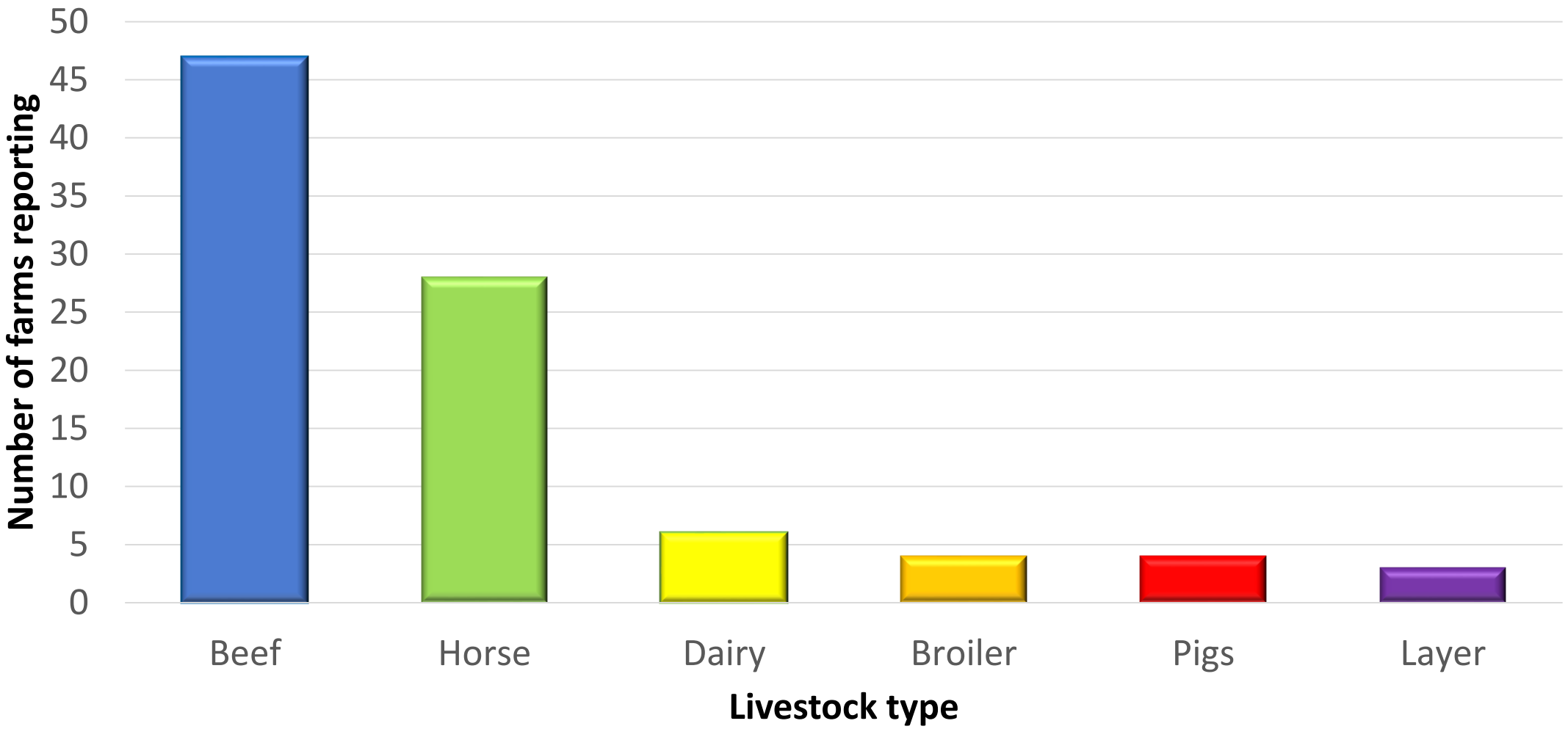




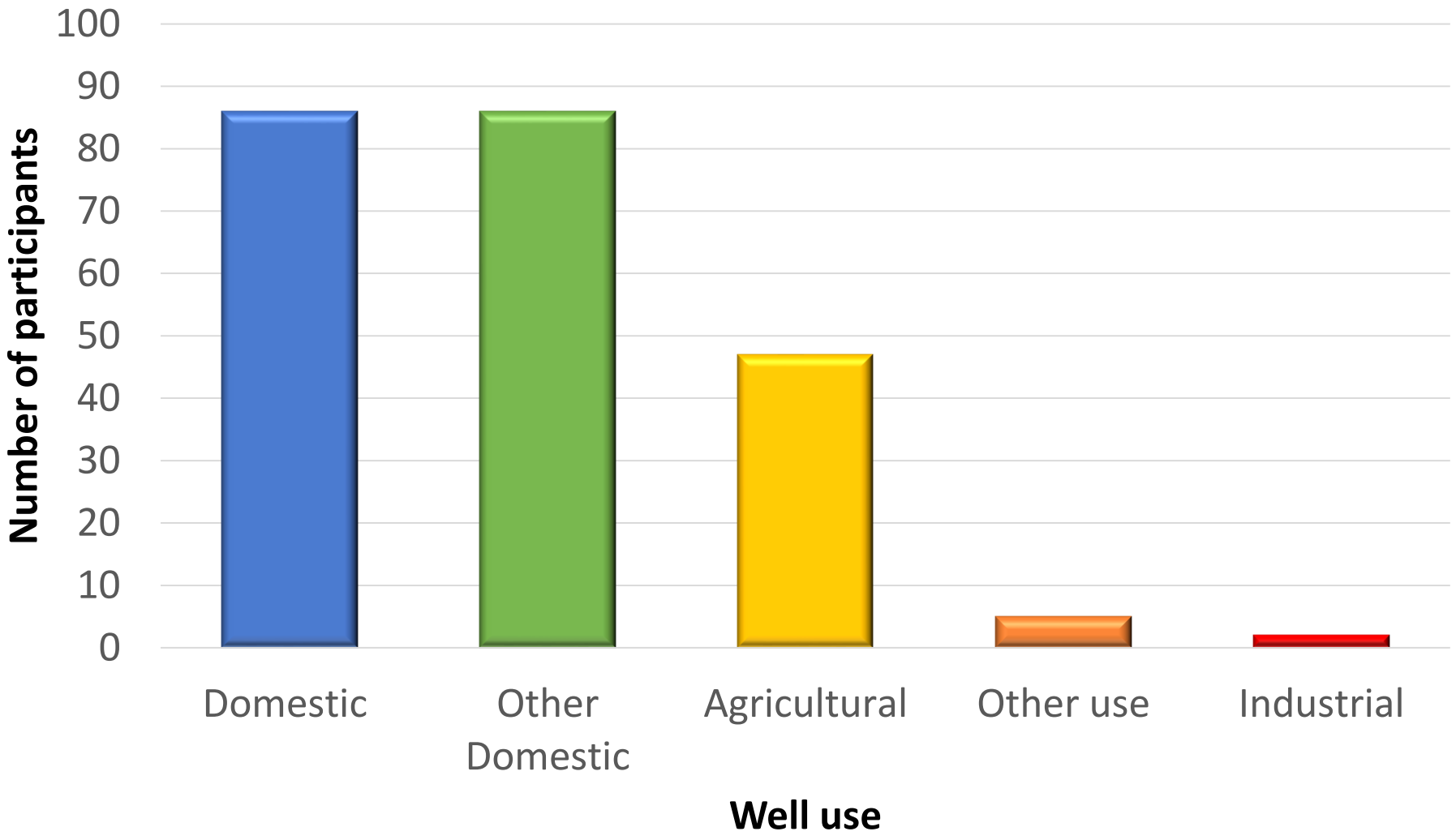


$\chi^2 = 4.44$ $p < 0.05$

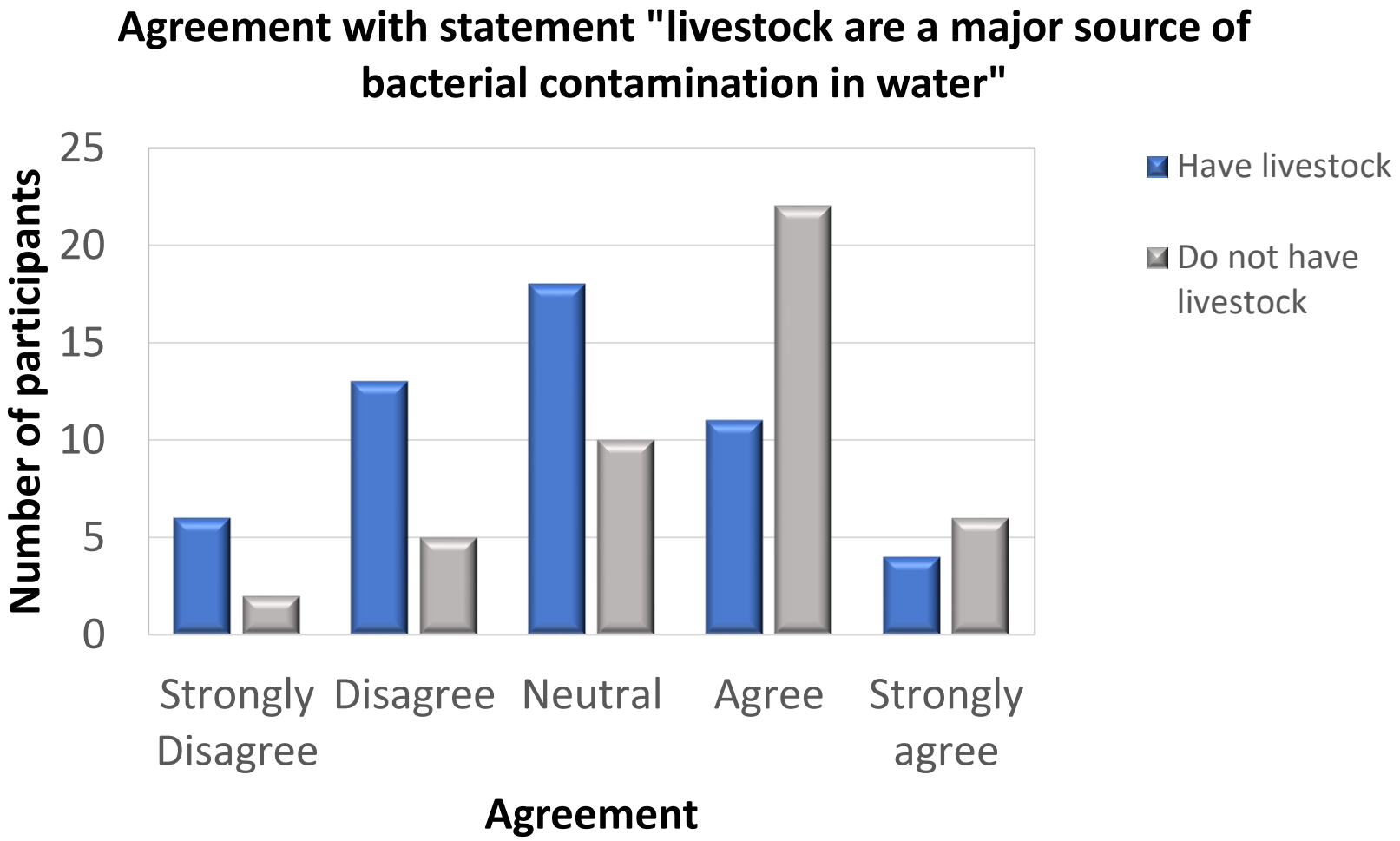
Number of farms reporting different types of livestock



Quantitative approach: Well use



Quantitative approach: Differences in perception of livestock as a risk factor



$\chi^2 = 10.8$ $p < 0.05$

What's next?

- Finish multivariable analysis on variables that are showing up as significant predictors of well water testing on univariate statistics
- Continue with write up
- Provide feedback to the working well program

Next steps and significance of study

By incorporating the perspectives multiple players including well water owners, livestock farm operators, watershed management groups, and involving environmental public health officials involved in well water quality testing, I hope to achieve the “transdisciplinary” aspect of the one health approach to develop a holistic understanding of the issues faced by well water owners with respect to water quality in Alberta.

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My supervisor (Dr. David Hall) and supervisory committee (Drs. Sylvia Checkley, Jocelyn Lockyer and Alessandro Massolo)

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Questions