

Combining Multiple Questionnaire Testing Methods: The Bento Box Approach in the 2017 Census of Agriculture Testing

Jaki S. McCarthy¹

ABSTRACT

There are many methods that can be used to test questionnaires, each with its own strengths and weaknesses. The best approaches to questionnaire testing combine different methods to both broaden and strengthen the results. The US Census of Agriculture (COA) is conducted every five years and collects detailed information from agricultural operations on agricultural production, inventories, practices and operator demographics. Preceding each COA, evaluation and testing is done to test new items in the questionnaire and improve data quality for the subsequent COA. This paper will describe the multi-method approach, which we call our Bento Box Testing, used in questionnaire testing leading up to the 2017 Census of Agriculture. Testing includes solicitation of expert opinion, data review, cognitive testing, qualitative follow up interviews, and large scale field tests. The benefits of each of these testing methods and how their results are combined to improve the COA questionnaires is discussed.

1. INTRODUCTION

The Census of Agriculture (COA) is conducted by the USDA's National Agricultural Statistics Service every five years, collecting information for the reference years ending in 2 and 7. The COA collects data from all known and potential farm operations and is NASS's largest data collection. Information on agricultural land, production, inventories, production practices, economics, and farm and ranch operator demographics is collected in a lengthy 24 page form. The data are primarily collected via self-administered forms mailed to approximately 3 million addresses for known and potential agricultural operations. As with any large complex data collection, there are always potential improvements or changes possible both to improve data quality and to accommodate the changing agricultural sector and data needs. Thus, preceding each COA, NASS conducts activities to improve the questionnaire and data collection procedures for the next COA.

As in previous COAs, NASS chartered a team to design and carry out multiple tests to evaluate and propose improvements to the forms and data collection (McCarthy and Buysse, 2010). The intent of these tests is to improve the questionnaire and data

¹ Jaki S. McCarthy, US Department of Agriculture, National Agricultural Statistics Service, 1400 Independence Avenue, SW, Room 5300, Washington DC 20250, jaki_mccarthy@nass.usda.gov

Figure 1: Bento Boxes

A bento box is a traditional Japanese meal prepared according to 5 Buddhist principles (each with five elements):

* **Goho** (five methods): simmer; steam; grill; fry; raw.

* **Goshiki** (five colors): red; yellow; green; black; white.

* **Gomi** (five flavors): salty; sour; sweet; bitter; spicy.

* **Gokan** (five senses): sight; hearing; smell; taste; touch

* **Gokan no mon** (five viewpoints)

Any ingredients can be used, but if the box contains all of these elements it should be a well balanced and nutritious meal.

collection procedures to improve accuracy of the data collected, improve response rates, and reduce respondent burden. By combining multiple methods of testing, we can exploit the strengths of each method for a stronger overall redesign effort. While any individual questionnaire evaluation method may provide useful information, survey methodologists often prefer to combine results from multiple methods (OMB, 2016, Madans, Miller, Maitland, and Willis, 2011, Presser, Rothgeb, Couper, Lessler, Martin, Martin, and Singer, 2004). The results from each are used to complement the others, both supporting and expanding on the information obtained in each. In the Census of Agriculture we call this approach our “Bento Box” approach to questionnaire testing.

A traditional Japanese bento box is a meal prepared according to five principles with five elements each (see Figure 1). While any ingredients can be included, if the five principles are used, the resulting meal will be nutritious and well balanced and contain complementary elements in the overall meal. We strove to combine information from 5 different, yet complementary questionnaire testing methods in the development of the 2017 COA data collection. The five methods in our COA testing Bento Box included:

1. Evaluation of Historical Data,
2. Expert Review,
3. Cognitive Interviews,
4. Field Testing, and
5. Follow up Interviews

Each of these methods has its own strengths and weaknesses and complements the others. Paralleling bento meal preparation, using information from all of these methods together provides a well-balanced questionnaire evaluation. Each method will be briefly described below along with the strengths and weaknesses of the method. Examples of how the results were used together will follow.

2. The Questionnaire Bento Box

2.1 Evaluation of Historical Data

The team began by reviewing the data from the previous 2012 COA. For each item on the form, the original reported data were available and compared to the final edited and

imputed data. Edits and imputations can originate from automated editing and imputation procedures or analysts' manual reviews. The implicit assumption is that items that must be changed from (or imputed for) respondents' originally reported data contain measurement error. Questionnaire items can then be ranked both by number and frequency of edits. Items with higher levels of editing and imputation may be good candidates for improvement with changes in data collection. For a questionnaire as large as the COA, this can help focus efforts toward those areas that are the best candidates for redesign or improvement.

In addition, during every COA there is a toll free telephone hotline printed on the forms. Respondents can call NASS for assistance with any aspect of the census. For those that request help completing their forms, the section of the form for which help was needed was logged, along with a comment summarizing what was requested. The number of times respondents request help in particular areas is another way to target items for improvement.

Evaluation of historical data from previous COAs provides empirical evidence of potential problems and fully represents the COA population and operational data collection procedures. However, it gives little direct information about the reason for problems.

2.2 Expert Review

Subject matter or other experts can provide useful information related to questionnaire design (Willis et al 1999, Presser and Blair, 1994). NASS uses numerous types of experts, both internal and external, to review the COA and provide input for improvements. For the 2017 COA, NASS commissioned an external panel of experts to address concerns that NASS and the COA do not adequately represent the role of women and beginning or younger farmers (Ridolfo et al, 2016). This panel was comprised of experts both from industry and survey methodology. The panel met several times and provided recommendations to add additional questions about specific decision making roles within the operation. They also recommended that NASS broaden the definition of an "operator" from those individuals *making* day-to-day decisions to all those individuals *involved* in decisions. They further recommended that NASS move away from using the term "operator". Finally, they recommended that these questions could be improved by incorporating the flexibility of an on-line instrument and that these new questions be adequately tested. Each of these recommendations was considered as changes were proposed to the questionnaire.

Additional external experts that NASS relies on to provide input for the COA include NASS's standing Advisory Committee on Agricultural Statistics, commodity organizations, and data users. While these external groups often do not provide specific input for changes to the questionnaires or data collection procedures, they often request new or expanded content for the COA, given evolving data needs. For example, requests were made for several new items for the 2017 COA, including the value of products marketed directly to retail and institutional establishments, the value of sales of value added products, and whether operators were veterans.

NASS also consults internal experts for input, including NASS field office staff and NASS subject matter experts. After all major data collections, NASS survey

administrators formally solicit feedback from NASS staff on all aspects of the survey operations, materials, and procedures. Staff are asked to provide comments and suggestions for improvements for future data collections. These comments are then reviewed by the survey teams and considered for incorporation into future survey administrations. Comments were solicited after the 2012 COA and these comments were part of the initial review in preparation for the 2017 testing.

The strength of external experts is their unique insight for NASS. They bring expertise that may not be available within NASS and a perspective from outside survey operations and data collection. They may also provide insight relative to the subject area beyond just the census. That is, their input may have broader impact than just the immediate administration of the COA. External experts are more likely to suggest fundamental changes to concepts, rather than incremental changes, but they are also least likely to understand operational constraints associated with proposed changes.

Internal experts also provide a valuable contribution. NASS solicits input from various operational units within the agency, each with a unique perspective. Field office staff can provide insight from processing and analyzing previous COA data. Subject matter experts can provide insight regarding common practices within an industry or from other related statistics outside the COA. However, a noteworthy limitation in each group of experts may be a narrow consideration of information only in their area of expertise. Indeed, while useful, expert reviews tend to provide idiosyncratic and inconsistent results (Olson, 2010).

2.3 Cognitive Interviews

Cognitive interviews are routinely used in survey questionnaire development (Willis, 2005 and Willis 2015). In cognitive interviews, respondents are asked to complete questionnaires and describe their reporting process. In addition, respondents are asked follow up probes to elaborate on their comprehension and interpretation of questions, assess the accuracy of their answers, and identify any additional problems they have reporting. Cognitive interviews are typically conducted in small sets of interviews, maybe a dozen or less. However, we conducted an unusually large number of cognitive interviews so that a wide variety of types of agricultural establishments and all proposed alternatives of the draft form could be tested. Several iterative rounds of cognitive interviews were conducted for the COA.

Because of the lengthy nature of the COA questionnaire, cognitive interviews were conducted to target subsets of sections of the form. Prior to the field test, several rounds of cognitive interviews began in August 2015 and were used to finalize the forms for field testing. Different types of operations were targeted and selected in multiple states to include a diversity of operation types and to account for regional variation in production of commodities. Over 40 interviews were completed by specially trained NASS field staff.

An additional round of cognitive interviews was conducted in early 2016 to test sections of the form that were not tested in the initial round, to test the short form version, and to test alternative versions with pre-printed commodities listed in those sections of the form. Although we would have preferred to conduct and incorporate the findings from these interviews prior to the field test, we were unable to schedule these until the field test was

already underway. Again, as in the initial rounds of cognitive interviews, these provided qualitative information about how respondents were interpreting questions and formulating their answers.

Although cognitive interviews use small samples compared to field tests and production data collection, cognitive interviews provide rich insight into the question response process beyond that which can be gained from quantitative data alone. The objective of cognitive interviewing is to understand how respondents interpret and answer survey questions and most importantly, to identify the source of problems. However, due to the limited number of these interviews, they do not provide empirical information to quantify the extent of any problems or the magnitude of their impact on survey estimates.

For a large and complex questionnaire like the COA, the small sample sizes may also mean that respondents with rare commodities or unique characteristics may not be included in the small ad hoc samples. If problems are specific to small subpopulations in the COA, these may not be uncovered in cognitive interviews but can be important in the overall COA. For example, if a problem occurs for operations with cattle in only a minority of cases or in limited geographic areas, we may gather little or no evidence of this problem, even if cattle operations are included in cognitive testing. But if even 1 or 2 percent of cattle operations in the COA exhibit significant problems this can have substantial impacts on data quality, processing resources, or output statistics.

Another limitation to cognitive interviewing is the unique nature of the cognitive interview. For most of the COA respondents, the information will be collected on a self-administered form completed at the respondent's convenience. In contrast, a cognitive interview features a trained interviewer observing respondents completing the form and may change the amount of time or effort expended by the respondent or their normal reporting process.

2.4 Field Testing

The next element in our testing bento box was a large field test using the forms drafted and revised based on the expert reviews and initial cognitive testing. There were several objectives for this test: to verify that respondents could complete the forms and provide data as expected in each section of the form, use embedded split samples to test alternative versions of the form that differed in format and layout (with respect to both data quality and response rates), evaluate the performance of a proposed short form, test the utility of a new experimental pre-census contact, and test a redesigned web version of the questionnaire. The test emulated the operational census procedures and schedule to the extent possible, with an initial mailing of a questionnaire and cover letter in January, a reminder postcard, a second questionnaire mailing, followed by telephone follow-ups for nonrespondents.

Approximately 30,000 operations were selected for this test, across ten treatment groups. Operations were selected from the NASS list of operations eligible for the census. In order to reduce overall respondent burden and because we did not intend to produce any population statistics from this test, we excluded operations that required special handling in data collection (e.g. institutions, complex partnership arrangements, long standing refusals, etc.), those that were included in any other NASS surveys during this time frame or operations that were selected for a large number of surveys earlier in 2015. In

addition, a minimum number of operations was selected with specific commodities or other characteristics so that respondents would report data in all sections of the form.

In addition to the traditional COA form, NASS also developed a “short form” for a subset of operations. This form was developed based on additional design and testing (Moore et al, 2016). The final version of the short form replaced several pages collecting information for specific types of commodities with Yes/No check questions. Any operations known to have these commodities were excluded from the short form universe eligible to receive the short form. The short form was tailored to them by removing several pages of the form that were not relevant to them. For example, a full page of questions asking for detail regarding the acreage and production of fruits was replaced by a question asking only if the operation had grown any fruit in 2015. Several other commodity pages were also removed from the form this way. Part of the field test was to assess the performance of this form and whether or not we could use existing list frame control data to reliably identify operations who should receive it. In addition, we sent the full long form to a sample from the short form universe to determine what information would be reported in the sections missing from the short form.

In addition to the short form, additional versions of the form included in the field test differed in several ways: the section of the form collecting information on the agricultural operators (personal characteristics section) was placed early in the form or near the end of the form; the commodity sections which collected acreage, inventory and production were formatted with commodities printed on the form using alternative formats (either with commodities pre-printed in tables collecting their information, in a listing on the page, or in a separate instruction sheet); and additional questions intended to assist in editing were added to the initial section of the form collecting information about the land in the operation (revised acreage section). A subset of large operations was selected to evaluate whether a presurvey mailing to collect contact information for the operation increased response rates or was useful for early identification of COA nonrespondents. Six versions of the form were drafted. The differences and treatment groups are shown below in Table 1.

Table 1. Field Test Experimental Groups

Treatment Group	Form Version	Sample Size	Personal Characteristics Placement	Commodity Table Pre-Prints	Acreage Section	Commodity Code Listings	Universe	Contact Card
1	1	6,500	Back	Some*	2012	Some**	Long	No
2	2	3,250	Front	None	Revised	None	Long	No
3	3	3,250	Back	None	2012	Field Crops	Short	No
4	4	3,150	Back	None	2012	None	Long ^{2/}	No
5	4	500	Back	None	2012	None	Long ^{3/}	No
6	4	500	Back	None	2012	None	Long ^{3/}	Yes
7	4	3,250	Back	None	2012	None	Short	No
8	5	3,250	Front	None	Revised	Field Crops	Short	No
9	6	3,250	Front	None	2012	None	Short	No
10	6	3,250	Front	None	2012	None	Long	No
Total		30,150						

Data collected in the field test were analyzed in a number of ways. Direct comparisons were made between the alternative forms to evaluate whether different forms produced different response rates. In addition, data quality was compared across alternative versions of the form by identifying unreasonable values (such as subitems not summing to a total, harvested commodities reported without associated sales, required items missing, etc.). Data quality checks were also run for common sections of the form to determine if there were any areas where data quality appeared unacceptable. Results of these checks were used to decide between the alternative versions of the forms and to indicate other common items where data quality was suspect due to high rates of unexpected or missing values.

Unlike cognitive interviews, which include interviewers and motivated respondents, the field test provided data which were collected with procedures similar to the COA and should more closely resemble COA data. In addition, unlike the relatively small number of respondents in the cognitive interviews, the field test included a much wider diversity of respondents. Indeed, much of our later round of cognitive interviews was targeted to include operations with commodities which were not represented in the initial cognitive interviews. Although not designed to make population estimates, the large size of the sample provided quantitative measures for evaluation and randomized split samples allow for direct comparisons of data quality. In addition, the size of the sample allowed us to identify issues that might arise in rare circumstances or only a small percentage of respondents.

2.5 Qualitative Follow Up Interviews

Following the field test, a limited number of follow up interviews were conducted with individually selected field test respondents. For example, methodologists re-contacted respondents who received the short form and unexpectedly indicated that they had commodities for which detail was not collected on the short form. These follow up contacts provided information on why respondents had reported unexpected data. For example, the field test showed that approximately 6% of respondents receiving a short form unexpectedly reported that they had vegetables. A small sample of these operations were recontacted and asked about their vegetables. A majority of those recontacted stated that they did not have commercial vegetable production but only had small home gardens for their personal use. These vegetables should have been excluded, but the short form omitted the instruction not to report home gardens.

In addition, a handful of other responses that had potentially problematic data were recontacted and asked to expand on their answers. These interviews provided important information for questionnaire changes or additional assurances that unusual data did not represent significant problems.

Similar to cognitive interviews, these qualitative interviews focused on understanding why respondents had reported the way they had and rich information on why respondents reported the way they had can be obtained. However, unlike cognitive interviews, these interviews asked about data that had been reported using similar data collection procedures to the COA and could be targeted to those respondents with unusual or suspect data.

3. Using Information from Multiple Sources

3.1 Example 1, Reformatting Land Items

The various methods in our testing bento box were combined in several ways to make improvements for the 2017 COA forms. In the initial review of historical data from the 2012 COA we were able to evaluate changes that had been made between the 2007 COA and the 2012 COA. The 2007 COA questionnaire collected acres owned, rented from others, and rented to others. Then respondents were instructed to add items 1 and 2 and subtract item 3 to arrive at the total acres operated. On the facing page, they were asked to report the total acres operated by land use and then instructed to add these items to again arrive at their total acres operated. See Figures 2 and 3 below.

Figure 2- 2007 COA acreage questions


	None	Number of Acres
1. All land owned. 0043	<input type="checkbox"/>	
2. All land rented or leased from others , including land worked by you on shares, used rent free, in exchange for services, payment of taxes, etc. Include Federal, State, and railroad land leased on a per-acre basis. Exclude land (i.e. private, Federal, State, railroad, etc.) used on a per-head or animal unit month (AUM) basis under a grazing permit. . . . 0044	<input type="checkbox"/>	
3. All land rented or leased to others , including land worked on shares by others and land subleased. 0045	<input type="checkbox"/>	
4. TOTAL ACRES in this operation for this census - Add items 1 and 2, then subtract item 3. If the entry is zero, please refer to the enclosed Instruction Sheet, section 1. These acres are referred to as THIS OPERATION for the remainder of this report.  0046		

Figure 3: 2007 COA land section

SECTION 2 LAND		None	Number of Acres
Report how the acres reported in SECTION 1, item 4 were used in 2007. Include land in CRP, WRP, and other State and Federal programs. Exclude land rented to others. Report land only once, in the first item that applies. For example: Land that was both pastured and had a crop harvested should be reported only in cropland harvested (item 1a).			
1. Cropland - Exclude cropland pasture.			
a. Cropland harvested - Include all land from which crops were harvested or hay was cut, all land in orchards, citrus groves, vineyards, berries, and nursery and greenhouse crops, Christmas trees, and short rotation woody crops. 0787	<input type="checkbox"/>		
b. Cropland on which all crops failed or were abandoned - Exclude land in orchards and vineyards. 0790	<input type="checkbox"/>		
c. Cropland in cultivated summer fallow. 0791	<input type="checkbox"/>		
d. Cropland idle or used for cover crops or soil-improvement but not harvested and not pastured or grazed. 1062	<input type="checkbox"/>		
2. Pasture			
a. Permanent pasture and rangeland - Exclude cropland pasture. 0796	<input type="checkbox"/>		
b. Woodland pastured. 0794	<input type="checkbox"/>		
c. Cropland used only for pasture or grazing - Include rotation pasture and grazing land that could have been used for crops without additional improvements. 0788	<input type="checkbox"/>		
3. Woodland not pastured - Include woodlots, timber tracts, and sugarbush. 0795	<input type="checkbox"/>		
4. All other land - Include land in farmsteads, buildings, livestock facilities, ponds, roads, wasteland, etc. 0797	<input type="checkbox"/>		
5. TOTAL ACRES - Add the acres reported in items 1 through 4 above. Should be the same acres as those reported in SECTION 1, Item 4. . . . 0798	<input type="checkbox"/>		

Because the total acres operated often do not equal the sum of the sub acreages or the 2 total acres operated amounts are not equal, these two sections were redesigned for the 2012 COA. The redesigned sections formatted the first section so that respondents entered the amounts by acreage category similar to a mathematical equation to arrive at the total acres operated. The following section was reformatted to more clearly indicate the subtypes of land and a check question was added to prompt respondents to explicitly verify that the 2 total acres amounts were the same. The revised 2012 sections are shown in Figures 4 and 5.

Figure 4: 2012 COA acreage questions

1. Enter the number of acres owned 0043	BOX A	<input type="text"/>
2. Enter the number of acres RENTED or LEASED FROM OTHERS 0044	BOX B	<input type="text"/>
<p>INCLUDE</p> <ul style="list-style-type: none"> land worked by you on shares land used rent free in exchange for services, payment of taxes, etc. Federal, State, and railroad land leased on a per acre basis 	<p>EXCLUDE</p> <ul style="list-style-type: none"> land used on a per-head or animal unit month (AUM) basis under a grazing permit. 	
3. Enter the number of acres RENTED OR LEASED TO OTHERS 0045	BOX C	<input type="text"/>
<p>INCLUDE LAND</p> <ul style="list-style-type: none"> worked on shares by others subleased 	<p>EXCLUDE acres enrolled in:</p> <ul style="list-style-type: none"> Conservation Reserve Program (CRP) Wetlands Reserve Program (WRP) Farmable Wetlands Program (FWP) Conservation Reserve Enhancement Program (CREP) 	
4. Enter the figures from the boxes above to determine your total acres operated:		
<input type="text"/>	+	<input type="text"/>
	-	<input type="text"/>
	=	<input type="text"/>
		0046

Figure 5: 2012 COA land section

SECTION 2 LAND

Of the acres reported in **Box D**, report acres in the first item that applies. **REPORT LAND ONLY ONCE.**

1. **Cropland** - Exclude cropland pasture.

a. Cropland harvested

INCLUDE	EXCLUDE	
land from which crops were harvested or hay was cut	Christmas trees	
orchards and vineyards	citrus groves	
nursery and green house crops	berries	
	short rotation woody crops 0787	<input type="checkbox"/>

b. Cropland on which all crops failed or were abandoned - Exclude land in orchards and vineyards. 0790

c. Cropland in cultivated summer fallow 0791

d. Cropland idle or used for cover crops or soil-improvement but not harvested and not pastured or grazed. 1002

2. **Pasture**

a. Permanent pasture and rangeland - Exclude cropland pasture 0796

b. Woodland pastured 0794

c. Cropland used **only** for pasture or grazing - Include rotation pasture and grazing land that could have been used for crops without additional improvements 0788

3. **Woodland not pastured**

INCLUDE

- woodlots
- timber tracts
- sugarbush 0795

4. **All other land**

INCLUDE LAND

- in farmsteads and buildings
- livestock facilities
- ponds
- roads
- wasteland, etc. 0797

5. **TOTAL ACRES** - Add items 1-4 to determine your total acres operated. 0798

BOX E

Does the total in **Box E** = the total in **Box D**?

Yes - Continue

No - Please go back and correct your figures. These numbers should be the same.



We have evidence from multiple sources to evaluate the impact of these changes. Our review of historical data compared unedited data reported by respondents in 2007 to unedited data reported in 2012. This showed that in 2012, using the revised format, there were fewer cases with the total acres missing and a greater number of cases where the 2 total acre numbers were equal in the 2012 COA, as shown in Table 3.

Table 3: Number and percentage of missing values for land and acreage sections for 2007 and 2012 COA

	2007 Census of Agriculture		2012 Census of Agriculture	
	Count	%	Count	%
Either Total Acres Missing	174,642	13.8	89,654	8.5
K46<>K798	197,949	15.6	77,034	7.4
Total Acres Correct	894,893	70.6	882,837	84.1
Total	1,267,484	100.0	1,049,525	100.0

$$X^2 = (2, N=2,317,009) = 60,612.48, p < 0.0001$$

In addition to the error rates, information from the toll free telephone helpline also provides evidence of improvements to the form. For each COA, respondents can call a toll free telephone helpline for assistance. For anyone asking for help completing their forms the section they request help on is also logged. The percent of respondents requesting help on the Land Sections of the form also declined in 2012 (Table 4).

Table 4: Calls to the help line by section for 2007 and 2012 COA

	2007 COA (n)	%	2012 COA (n)	%
Land	23780.	23.78	14340.	13.32
Crops	4927.	4.93	2920.	2.71
Livestock	8205.	8.21	4750.	4.41
Production Contracts	543.	0.54	437.	0.41
Economic Data	7299.	7.30	3498.	3.25
Operator Characteristics	7027	7.03	4296.	3.99
Address Label	1265.	1.27	1754.	1.63
Conclusion	4025.	4.03	2254.	2.09
EDR	679.	0.68	4778.	4.44
Other	70778.	70.78	83780.	77.81
Total Calls	99993.		107675.	

Finally, respondents in the cognitive interviews were observed answering the new check question at the end of the second section and going back and correcting their acres when unequal. Together these three sources of information were used to recommend retaining the 2012 format (even though this required more space on the questionnaire).

3.2 Example 2 – Use of pre-printed items in tables and listings

In several sections of the COA form, information about acreage, production and value of sales for different types of commodities is collected in tables with each commodity listed on a separate line. Separate sections for field crops, fruit, vegetables, and other categories of crops are included. In previous COAs, the most common crops have been prelisted within the table with a list of remaining crops (and their associated codes) listed on the same page beneath the table. An example of this format is shown in Figure 6. Because new content was requested for the 2012 COA but the number of pages available in the form is limited, alternatives to this format that would require less space in the form were drafted.

Figure 6: Version A-- preprinted crops in a commodity table

SECTION 6 FIELD CROPS					
1. Were any field crops, such as corn, soybeans, wheat, etc., harvested from this operation in 2012?					
INCLUDE • your landlord's share and crops grown under contract			EXCLUDE • crops grown on land rented to others		
1011 1 <input type="checkbox"/> Yes - Complete this section 3 <input type="checkbox"/> No - Go to SECTION 7					
2. Report quantity harvested in the unit specified with the crop name. For those crops not printed in the following table, enter the field crop name and code from the list below for any other field crop harvested in 2012. Report gross value of agricultural products sold from this operation in 2012. Include the value of your landlord's share, marketing charges, taxes, hauling, etc. Exclude value of items produced under production contracts.					
Field Crop	Code	Acres Harvested	Total Quantity Harvested	Acres Irrigated	Value of Sales (Dollars)
Tobacco - all types (tenth acres)	0094		Lbs.		\$.00
Field Crop	Code	Acres Harvested	Total Quantity Harvested	Acres Irrigated	Value of Sales (Dollars)
Barley for grain or seed	0079		Bu.		\$.00
Corn for grain or seed	0067		Bu.		\$.00
Corn for silage or greenchop	0070		Tons		\$.00
Dry edible beans - kidney, black, etc. - Exclude Limas	0554		Cwt.		\$.00
Oats for grain or seed	0076		Bu.		\$.00
Popcorn - pounds shelled	0662		Lbs.		\$.00
Rye for grain or seed - Exclude Tye-grass	0686		Bu.		\$.00
Sorghum for grain or seed - Include milo	0082		Bu.		\$.00
Sorghum for silage or greenchop - Report Sorghum-Sudan crosses in Section 7	0085		Tons		\$.00
Soybeans for beans	0088		Bu.		\$.00
Wheat, Spring for grain or seed, other than Durum	0728		Bu.		\$.00
Wheat, Winter for grain or seed harvested in 2012	0572		Bu.		\$.00
					\$.00
					\$.00
					\$.00
					\$.00
If more space is needed, use a separate sheet of paper.					
FIELD CROPS CODE FIELD CROPS CODE FIELD CROPS CODE					
Alfalfa hay - Report in SECTION 7. Alfalfa seed (pounds) 0542 Birdfoot trefoil seed (pounds) 0566 Bromegrass seed (pounds) 0569 Buckwheat (bushels) 0575 Camellina (pounds) 0608 Canola, edible (pounds) 0614 Clover, red clover seed (pounds) 0671 Cotton, Upland (bales) - Include cottonseed in value of sales only 0581 Emmer and spelt (bushels) 0599 Fescue seed (pounds) 0602 Flaxseed (bushels) 0605 Hay - Report in SECTION 7. Herbs, dried (pounds) 0620 Kentucky bluegrass seed (pounds) 0629 Lespedeza seed (pounds) 0638 Mint, peppermint (pounds of oil) 0047 Mint, spearmint (pounds of oil) 0060 Mint, tea leaves (pounds) 0767 Miscanthus (tons) 0641 Orchardgrass seed (pounds) 0653 Peas, dry edible (hundredweight) 0659 Potatoes - Report in SECTION 10. Proso millet for grain or seed (bushels) 0665 Ryegrass seed (pounds) 0689 Sorghum for syrup (gallons) 0704 Sorghum-Sudan crosses - Report in SECTION 7. Sudangrass seed (pounds) 0713 Sugarbeets for seed (pounds) 0716 Sugarbeets for sugar (tons) 0719 Sunflower seed, non-oil variety (pounds) 0776 Sunflower seed, oil variety (pounds) 0773 Sweet potatoes - Report in SECTION 10 Switchgrass (tons) 0647 Timothy seed (pounds) 0746 Triticale for grain (bushels) 0749 Vetch seed (pounds) 0755 Wheatgrass seed (pounds) 0758 Wild rice (hundredweight) 0764 Other field crop, specify above 0752					

Figure 7: Version B -- prelisted commodities removed from table commodities and codes only listed below the table

SECTION 7 FIELD CROPS

1. Were any field crops, such as corn, tobacco, wheat, etc., harvested from this operation in 2015?
INCLUDE • your landlord's share and crops grown under contract EXCLUDE • crops grown on land rented to others
 1011 1 Yes - Complete this section 3 No - Go to SECTION 8

Acres Harvested		Acres Irrigated	
Acres	Tenths	Acres	Tenths

2. Acres on which field crops were grown in 2015.
 Report multiple cropped acreage only once 1780

3. Fill in the columns below for all field crops harvested on this operation in 2015. For those commodities not listed, enter the crop name and code from the table below or the commodity listing and codes in the instruction booklet.
 • Include the value of your landlord's share, marketing charges, taxes, hauling, etc.
 • Exclude from sales the value of items produced under production contracts.

Enter Field Crop Name	Enter Code	Acres Harvested	Total Quantity Harvested	Acres Irrigated	Gross Value of Sales (Dollars)	Amount used or to be used on this operation for feed, seed, etc.
					\$.00	
					\$.00	
					\$.00	
					\$.00	

If more space is needed, use a separate sheet of paper.

FIELD CROPS	CODE	FIELD CROPS	CODE	FIELD CROPS	CODE
Alfalfa seed (pounds)	0542	Emmer and spelt (bushels)	0599	Rice (hundredweight)	0677
Bahia grass seed (pounds)	0551	Fescue seed (pounds)	0602	Ryegrass seed (pounds)	0689
Beans, dry edible (hundredweight)	0554	Flaxseed (bushels)	0605	Sorghum for syrup (gallons)	0704
Beans, Lima (hundredweight)	0557	Herbs, dried (pounds)	0620	Sugarbeets for sugar (tons)	0719
Buckwheat (bushels)	0575	Kentucky bluegrass seed (pounds)	0629	Sugarcane for seed (tons)	0725
Canola, edible (pounds)	0614	Lentils (hundredweight)	0635	Sugarcane for sugar (tons)	0722
Clover, crimson clover seed (pounds)	0593	Peas, dry edible (hundredweight)	0659	Triticale for grain (bushels)	0749
Clover, red clover seed (pounds)	0671	Peas, dry Southern/cowpeas (bushels)	0584	Wheat, Durum for grain or seed (bushels)	0578
Cotton, Pima (bales) - Include		Popcorn (pounds shelled)	0662	Other field crop, specify above	0752
cottonseed in gross value of sales only	0644	Proso millet for grain or seed (bushels)	0665		

Figure 8: Version C--Alternate version without commodities prelisted in the table or page. Commodity list and codes listed only in a separate instruction sheet.

SECTION 7 FIELD CROPS

1. Were any field crops, such as corn, tobacco, wheat, etc., harvested from this operation in 2015?
INCLUDE • your landlord's share and crops grown under contract EXCLUDE • crops grown on land rented to others
 1011 1 Yes - Complete this section 3 No - Go to SECTION 8

Acres Harvested		Acres Irrigated	
Acres	Tenths	Acres	Tenths

2. Acres on which field crops were grown in 2015.
 Report multiple cropped acreage only once 1780

3. Fill in the columns below for all field crops harvested on this operation in 2015. For those commodities not listed, enter the crop name and code from the table below or the commodity listing and codes in the instruction booklet.
 • Include the value of your landlord's share, marketing charges, taxes, hauling, etc.
 • Exclude from sales the value of items produced under production contracts.

Enter Field Crop Name	Enter Code	Acres Harvested	Total Quantity Harvested	Acres Irrigated	Gross Value of Sales (Dollars)	Amount used or to be used on this operation for feed, seed, etc.
					\$.00	
					\$.00	
					\$.00	
					\$.00	

If more space is needed, use a separate sheet of paper.

One alternative format removed the prelisted commodities from the page and had only a list of commodities and codes below the table, shown in Figure 7. Another version was drafted with no commodities prelisted in the table or within the questionnaire but with the commodity list and codes listed only in a separate instruction sheet, shown in Figure 8.

Cognitive interviews showed that few, if any, respondents referred to the separate instruction sheet to see the commodity listings when they did not appear on the form. Commodities were sometimes written in correctly, but many respondents wrote in entries that could not be coded or entered commodities in the wrong sections of the form. Cognitive interviews indicated that the format with a separate instruction sheet negatively impacted data quality, but did not provide a measure of the extent of this problem.

In the field test, versions of the form with each of the alternative commodity section formats were mailed to large samples of respondents. Comparisons of the commodities reported in the Field Crops Section of the form showed that 18% of respondents in a group who received a form with commodities listed reported at least one crop in the section (Version A) while only 13% of respondents in a comparable group who received a form without commodities listed (Version C) reported any field crops. In addition, when crops were reported in the field crop section, respondents also reported more crops when the commodities were listed on the page rather than in the separate instruction sheet. The field test provided measurable results that placing commodity listings in a separate instruction sheet negatively impacted data quality.

Another indicator of data quality is the rate of items that cannot be coded. If respondents report something in the section that cannot be coded or must be interpreted before it can be coded, it will be summarized in a general category of “other” crops. These “other” crop entries would include crops reported in the wrong section, unknown crops, illegible entries, entries that do not correspond to valid crops and other misreporting. In the COA, these would have to be reviewed individually by an analyst. Given the volume of records in the COA, “other” crop entries that have to be reviewed should be minimized to contain staff time and costs.

In the field test, we compared the number of “other” crops reported for the different formats. For the field crops section, 7.8% of respondents in a group with no commodity codes listed (Version C) (reported something coded in the “other” category, compared to only 1.2% for a comparable group of respondents who had commodity codes listed on the form (Version B). Based on these results, the recommendation was made to retain the commodity and code listings on the form near the table where they are needed. While this recommendation was suggested by the initial cognitive interview results, the empirical evidence provided by the field test strengthened support for this recommendation. (See Ott, McGovern and Sirkis, 2016 for additional details.)

4. Conclusion

For any large and complex data collection, a multi-method approach to questionnaire testing can provide huge dividends. The 2 examples discussed above illustrate how information from multiple kinds of questionnaire evaluations can be combined to provide a fuller picture of potential data quality problems. Some methods will provide information across a broader swath of respondents and can be supported by other

methods that provide less breadth but a deeper look with richer information. Each method's strengths can be complemented by those of the others.

Expert reviews can provide a more expansive view than the operational survey managers. However, they may have little input on how questions should be designed or how respondents may answer. Cognitive interviews can be used to provide rich qualitative information on how respondents interpret questions, their reporting strategies, etc. However, these interviews do not provide a quantitative measure of any issues identified. A large scale field test using operational survey procedures can allow direct comparisons of response rates, reported data, and edit rates and provide a measure of the size of potential errors. However, the field tests do not allow direct examination of why errors are occurring. Follow up qualitative interviews can be targeted at respondents reporting unusual data and can probe for why their data was unexpected, but can only be conducted with small samples.

In our testing, each evaluation method provided evidence of potential problems and areas for improvement. However, using evidence from multiple sources provided us with more confidence that we had correctly identified their source and scope. In addition, using multiple sources of information provided stronger justification for proposed changes. For such a large and complex data collection as the census of agriculture, the resources spent to test and retest our questionnaires will be paid back in better data quality from our respondents and less staff time needed in data editing, processing, and analysis. Taken together the multiple questionnaire evaluation elements of our bento box provide a much more satisfying meal than any of the evaluations consumed alone.

References

- Madans, J., Miller, K., Maitland, A., and Willis, G. *Question Evaluation Methods: Contributing to the Science of Data Quality*. (2011)
- McCarthy, J. and Buysse, D. (2010). Bento Box Questionnaire Testing: Multi-Method Questionnaire Testing for the 2012 Census of Agriculture. Proceedings of the American Association for Public Opinion Research Annual Conference.
- Moore, D., Ott, K. and Gertseva, A. (2016) Developing and Evaluating a Short Form: Results and Recommendations from Tests of a Form Designed to Reduce Questionnaire Length. Proceedings of the Fifth International Conference of Establishment Surveys, June 20-23, 2016, Geneva, Switzerland: American Statistical Association.
- Olson, K. (2010). An Examination of Questionnaire Evaluation by Expert Reviewers. *Field Methods*, 22(4), 295-318.
- Office of Management and Budget (2016). Statistical Policy Working Paper 47: Evaluating Survey Questions: An Inventory of Methods. Washington, DC.
- Ott, K., McGovern, P., and Sirkis, R. (2016) Using Analysis of Field Test Results to Evaluate Questionnaire Performance. Proceedings of the Fifth International Conference of Establishment Surveys, June 20-23, 2016, Geneva, Switzerland: American Statistical Association.

Presser, S. and Blair, J. (1994). Survey pretesting: Do different methods produce different results? *Sociological Methodology*, 24, 73-104.

Presser, S., Rothgeb, J., Couper, M., Lessler, J. Martin, E., Martin, J., and Singer, E. (Eds.) 2004. *Methods for Testing and Evaluating Survey Questionnaires*. New York: Wiley and Sons.

Ridolfo, H., Harris, V., McCarthy, J., Miller, D., Sedransk, N. and Young, L. (2016) Developing and Testing New Survey Questions: The Example of New Question on the Role of Women and New/Beginning Farm Operators. Proceedings of the Fifth International Conference of Establishment Surveys, June 20-23, 2016, Geneva, Switzerland: American Statistical Association.

Willis, Gordon B. *Cognitive interviewing: A tool for improving questionnaire design*. Sage Publications, 2004.

Willis, Gordon B. *Analysis of the cognitive interview in questionnaire design*. Oxford University Press, 2015.

Willis, Gordon B. "Questionnaire Pretesting." *The SAGE Handbook of Survey Methodology* (2016): 359.