

Technological Innovations in Data Collection of Family Income and Expenditure Survey: Data Quality, Timeliness, Costs and Acceptance

Wilma A. Guillen, Mechelle M. Viernes,
Vergel C. Antazo, Maynard Anthony T. Acosta, Mary Joy R. Castromayor

ABSTRACT

Timely, high-quality and consistent data are important in measuring the progress made towards the achievement of the targets embedded within the different development agenda, primarily the Ambisyon Natin 2040, Philippine Development Plan (PDP), Sectoral Plans, and the Sustainable Development Goals. Several indicators to measure the progress on these development agendas rely on the Family Income and Expenditure Survey (FIES).

The FIES is a very crucial household survey particularly during this unprecedented time because there is a need to assess the impacts of COVID-19 pandemic in the income, and expenditure patterns, particularly food and non-food consumption patterns of families due to the impacts of the COVID-19 pandemic.

In response to the need to be more responsive in the commitment for timely, accurate and relevant socio-economic statistics, the PSA has revolutionized field data collection methods in FIES using the CAPI, which replaced the traditional PAPI used in previous survey rounds to be more responsive in keeping to its commitment for timely, accurate and relevant statistics that are useful in the formulation of policies, implementation of targeted intervention programs, and in monitoring impacts to beneficiaries.

The 2021 FIES used for the first time, a technology-enabled platform to have a more efficient data collection system in line with the Fourth Industrial Revolution's rapid pace of change, scope, and broad impacts.

To further improve the CAPI system in preparation to the next FIES rounds and in CAPI-based transition of other household surveys, there is a need to quantify the benefits of the CAPI relative to the PAPI. Specifically, the study will look at the effects of adopting CAPI system on data quality, time efficiencies particularly on the time saved during the processing, data preparation and analysis, cost effectiveness as well as the acceptability of the users particularly the statistical researchers and FIES focal persons.

Keywords: CAPI, PAPI, FIES

I. INTRODUCTION

The Philippine Statistics Authority (PSA) conducts household surveys on a regular basis, by means of face-to-face interviews of members of households which have been selected in a nationwide sample. Information from surveys or interviews may include data on employment, income, expenditure, health, education, gender, children and poverty.

To optimize the usefulness of statistics, it has to be timely, reliable and of good quality. Thus, it is imperative to innovate statistical processes within the PSS to allow faster data collection, collect high-quality data and to generate electronic datasets that are instantaneously available for review and analysis.

A wide range of different potential data collection methods and sources have become available in the developing world as a result of the advancements in the technology. The Philippine Statistics Authority has made significant steps in increasing the use of technology in data collection, particularly in using the Computer Aided Personal Interview (CAPI) to improve data collection, starting with the Labor Force Survey (LFS) in 2017.

With the goal to integrate technological innovations in data collection processes, the PSA continued to explore the possibility of using handheld devices in conducting censuses and surveys, particularly on household surveys specifically on the Family Income and Expenditure Survey (FIES), recognizing the importance of FIES as data input in producing statistics on income, poverty and hunger, which are essential in measuring human development in a country. The first goal of the SDGs and the AmBisyon Natin 2040 are being adopted and implemented by the government to eradicate poverty and inequality, for which, several indicators to measure the progress on these development agenda rely on the FIES.

In response to the need to be more responsive in the commitment for timely, accurate and relevant socio-economic statistics, the PSA has revolutionized field data collection methods in FIES for the first time using a technology-enabled platform to have a more efficient data collection in line with the Fourth Industrial Revolution's rapid pace of change, scope, and broad impacts. The Computer-Aided Personal Interviewing (CAPI) system replaced the Paper and Pencil Interviewing (PAPI), which is a traditional field data collection method used in surveys and censuses.

The transition from paper-based personal interviews to computer-assisted interviews has been carried out on surveys for the past years. Several studies have been conducted to assess the advantages and disadvantages of CAPI as well as the effects of the transition from PAPI to CAPI. Nichols and De Leeuw (1996) reported a positive effect of CAPI wherein saving time was one of the cited reasons in the transition from PAPI to CAPI. Evidence from other CAPI studies mentioned that computer assisted interviewing improves data quality (De Leeuw and Nicholls, 1996; Beckenbach, 1995; and Thornberry et al., 1991). By reducing inconsistent or blank entries and by eliminating skipping errors, fewer instances of missing data were reported. Often anticipated benefits of the transition from PAPI to CAPI are cost saving and the availability of data for analysis (Thornberry et al., 1991; Leisher, 2014). On the other hand, some studies suggested that using CAPI for household surveys have disadvantages too. As mentioned by (Martin et al. 1993), it takes longer to administer a CAPI interview than a PAPI interview. There was also some concern that CAPI would further reduce the willingness to participate in surveys or that CAPI respondents would object to having their information stored on computers (Couper 2005).

Aside from the challenge of producing timely, high-quality and accurate data from FIES, there is also a clamor for more frequent data on income and expenditure, thus, starting 2023 the FIES will be conducted biennially from the triennial conduct in the previous years. To further improve the CAPI system in preparation to the next FIES rounds and in CAPI-based transition of other household surveys, there is a need to quantify the benefits of the CAPI relative to the PAPI.

This study aims to assess the effectiveness and efficiency of using the CSPro-based CAPI System in the Family Income and Expenditure Survey. Specifically, this study aims to:

1. To assess the data quality, time efficiencies particularly on the time saved during the processing, data preparation and analysis, cost effectiveness as well as acceptability of the users particularly the statistical researchers and FIES focal persons.
2. To quantify the benefits of the CSPro-based CAPI relative to the Paper and Pencil Interviewing (PAPI).

3. To further improve the CSPro-based CAPI system in preparation for the next FIES rounds and in CAPI-based transition of other household surveys.

II. TECHNOLOGICAL INNOVATIONS INTRODUCED TO THE 2021 FIES

1. Computer-Aided Personal Interviewing (CAPI) System using the CSPro.

CAPI refers to the collection of survey data using handheld digital devices, as opposed to the typical pen and paper interviewing (PAPI) method. With inbuilt data checks, navigation tools, easy data transfer options over the internet or via Bluetooth technology, and the ability to capture ancillary information such as global positioning system (GPS) coordinates, CAPI not only reduces the overall time to produce a clean dataset but is also expected to improve data quality.

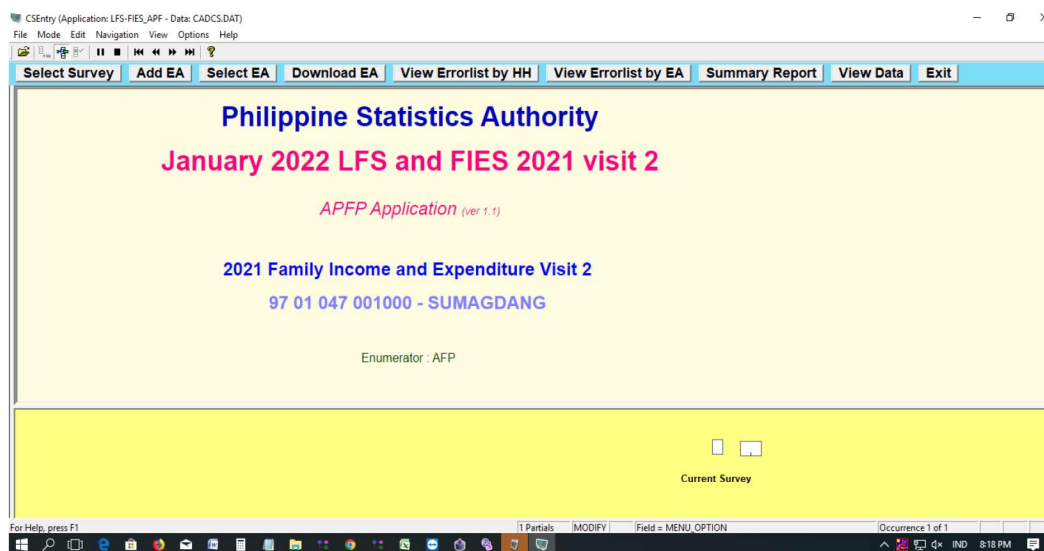
The screenshot shows the CADCSrunfies app interface. On the left is a navigation menu with sections like '(Id Items)', 'B - Particulars About the Family', and '01.1.1 - Bread and Cereals'. The main screen displays a question: '(b) How much is your consumption of the following? Please give me the consumption on a daily, weekly, every 15 days, monthly, once every 2 months, once every 3 months, or for the entire six (6) months.' Below the question is a list of options for 'Bread and Cereal Code' with radio buttons: Rice, well milled; Rice, regular milled; Rice, special; NFA rice; Rice, glutinous; Other rice, n.e.c.; Rice, over milled, broken rice; Rice, undermilled, brown; Rice, undermilled, red; Corn on the cob (includes yellow, white and glutinous); Whole corn, grain; and Corn grits, milled.

CAPI allows for the recording of interview responses on the tablet rather than on paper questionnaires. The salient features of the CAPI include embedded consistency check, skipping pattern and error detection. Editing was also done using the Computer Aided Field Editing (CAFE) program after every interviewed household to ensure completeness and consistency of encoded entries.

The CAPI system has also embedded a summary table presenting the total income and expenditure and details on the other critical data items of the family to instantly check for possible errors before moving to the next interview.

2. Supervisor's App (Tablet-based and Desktop-based System)

Supervisor's App was used by the team supervisors as well as the provincial and regional focal persons to review the errors on the uploaded data during the interview. The Supervisor's App cannot be used to edit entries captured by the Statistical Researcher (SRs). With this app, the supervisor can immediately communicate and correct to the SRs the errors committed during data collection. The Supervisor's App is available in tablet format and desktop format.



3. Data Processing System (DPS)

The Data Processing System can perform the following tasks during the machine processing:

A. Completeness check

- used to check the count of the expected sample households from the list of Secondary Sampling Units (SSUs) and compare it to the actual encoded data or cases. Actual encoded cases should be equal or greater than the expected sample households.

B. ID validation

- used to check and validate the geographic identification (ID) of all encoded data or cases against the reference file, which is the list of SSUs or sample households. Unmatched IDs should be corrected.

C. Data Consistency Check and Data cleaning

- used to perform consistency checks on data items and update/verify the data items with inconsistencies (e.g., the age of the household member should be consistent with his/her highest grade completed, etc.).

D. Data Matching (LFS vs. FIES) and (Visit 1 vs. Visit 2)

- a module used to check the demographic and housing characteristics for inconsistencies. Check also, for inconsistencies, the values entered in each expenditure and income indicator.

E. Data Summary Report

- a module used to examine values that are outliers and are not acceptable.

F. In-Kind Consistency

- a new module that checks the detailed expenditure from in-kind sources

vis-à-vis the detailed income

The screenshot shows a software interface for the Philippine Statistics Authority Cordillera Administrative Region. At the top, there is a navigation bar with several tabs: 'Duplicate Case-ID Check', 'Completeness Check', 'ID Validation', 'Data Consistency Check', 'Data Summary', 'Data Matching (LFS_FiesV1_FiesV2)', 'Inkind vs Sources', and '<<'. The main content area has a yellow background and displays the following text: 'REPUBLIC OF THE PHILIPPINES', 'Philippine Statistics Authority', 'Cordillera Administrative Region', '2021 FAMILY INCOME AND EXPENDITURE SURVEY', 'Second Visit', and 'version 1.4 (27/04/2022)'. At the bottom, there is a blue bar with the text 'For Help, press F1' on the left and 'No Partials ADD' on the right.

4. Data Verification System (DVS)

The screenshot shows a window titled 'FIES2021v2' with a yellow background. It features a header with the text 'FAMILY INCOME AND EXPENDITURE SURVEY' and 'DATA VERIFICATION SYSTEM'. Below the header, there is a white rectangular box with a dropdown arrow on the right side. At the bottom of the window, there is a button labeled 'Generate Excel'.

This is an additional quality assessment feature of the FIES system, which generates a summary of observations on the difference of the tablet data and the PO Processed data. This system checks the differences of the tablet data, or the raw data collected from the households to the processed data. In case the differences were above the set threshold for each item, these will be subjected to further verification with the SR and the processor.

5. Macros - Data Assessment/Evaluation

This module was used to assess the processed data by examining the summary statistics generated by the macros. In case there are outliers or unacceptable entries, this will be further subjected to verification if needed

Visit	FSIZE	REG_SAL	SEASON_SAL	WAGES	NETSHA_RE	CASH_A_BROAD	CASH_D_OMESTIC	RENTALS_REC	INTERES_T	PENSION	DIVIDEN_DS	OTHER_S_OURCE	NET_REC_EIPT	REGFT	NET_CFG	NET_LPR	NET_FIS_H	NET_FOR	NET_RE
Open Quest																			
v1	3	30960	0	30960	0	0	9750	0	0	0	0	0	250	314147	0	0	0	0	1200
v2	3	37460	0	37460	0	0	9750	0	0	0	0	0	1500	60	0	0	0	0	1500
v1	2	72000	0	72000	0	0	0	0	0	0	0	0	0	314127	0	0	0	0	0
v2	2	76000	0	76000	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
v1	5	55000	0	55000	0	0	12000	0	0	0	0	0	0	2526000	0	0	0	0	0

III. METHODOLOGY

To assess the efficiency and effectiveness of the CAPI system, the following will be examined:

a. Cost effectiveness

To gain a complete understanding of the potential cost efficiencies that might be achieved by implementing CAPI surveys, the budget requirements using the PAPI, and CAPI were analyzed on specific activities.

The assessment of the cost effectiveness is only limited however on the effects of the shift from PAPI to CAPI on specific activities and does not include the cost of the capital outlay for the tablets, servers and other hardware requirement because FIES made use of the available tablets in the field offices.

b. Time Efficiencies

Further, in assessing the time efficiencies of using the CAPI System, it is recommended to investigate the average time spent to complete the interview and detailed information on the time spent per section during the interview. However, this module was not currently integrated in the part of the system and was not noted by the SRs and focals.

Thus, to assess the time efficiencies, the days allotted from the training, enumeration, processing and until the dissemination of the results were compared to that of the PAPI. Further, the responses in the survey on the effectiveness and efficiency of the CAPI system will be used as reference.

c. Data Quality

Data quality was measured by examining the error list of the raw data from the tablet. In addition to this, the data quality of FIES, which is attributable to the skipping errors, consistency checks, and critical errors were also analyzed.

As part of the limitation of the study, parallel survey using the PAPI to compare the errors committed using the CAPI was not conducted considering the complexity of the

FIES, else, analysis focused on the number of skipping patterns, and consistency checks embedded in the CAPI System as well as the results of the survey from the SRs and focal persons.

d. Acceptability of the users

In order to assess the effectiveness and efficiency of using the CSPro-based CAPI System in the FIES, an online survey was conducted using a structured questionnaire. The questionnaire is composed of questions that directly ask respondents their experience on the ease of access; appearance or interface; comprehensibility and data quality; service quality and support; and overall satisfaction in using CAPI. The respondents were the statistical researchers or enumerators, team supervisors and focal person from the field offices. Google form was used in facilitating the survey.

Sampling Method

The researchers used purposive sampling to obtain the sample. Maxwell (1997) defined purposive sampling as a type of sampling in which, “particular settings, persons, or events are deliberately selected for the important information they can provide that cannot be gotten as well from other choices”.

Respondents Profile

A total of 718 qualified respondents answered the online questionnaire conducted by the researchers. The online survey was conducted from September 06 to 22, 2022.

IV. Results and Discussions

A. Assessment of the effectiveness and efficiency of the CSPro-based CAPI System

1. Cost Effectiveness

It is well-recognized that in adoption of any technological innovations, there is an associated sizeable fixed costs investments such as on the tablets and servers. However, the FIES made use of the existing tablets in the PSA used in other activities such as in the PhilSys registration among others.

This table presents a breakdown of cost for PAPI and CAPI for 2018 and 2021 FIES. As shown above, manual processing was excluded and cost for printing of questionnaires was minimized in the 2021 FIES. By using the CAPI system, no data-entry is needed and data-editing and cleaning cost less.

Looking at the distribution of each expenditure items to the total FIES budget, the printing of questionnaires and manuals, and the freight expense was 8.29% lower compared to 2018. Further, on the use of the CAPI system, there was no manual processing conducted, thus, this is a 8.72% savings on the 2021 FIES budget. It can be observed that the budget for the enumeration and supervision, trainings and machine processing increased due to the additional supplies requirement due to the COVID-19 protocol and increased in the

wages of the SRs. This is consistent with De Leeuw (2008), when he highlighted the significant cost savings from the back-end efficiencies achieved with CAPI, such as the printing costs of questionnaires and manuals, and in transporting paper questionnaires to and from the field.

Table 1. Percent Distribution of Expenditure Items for the FIES Conduct

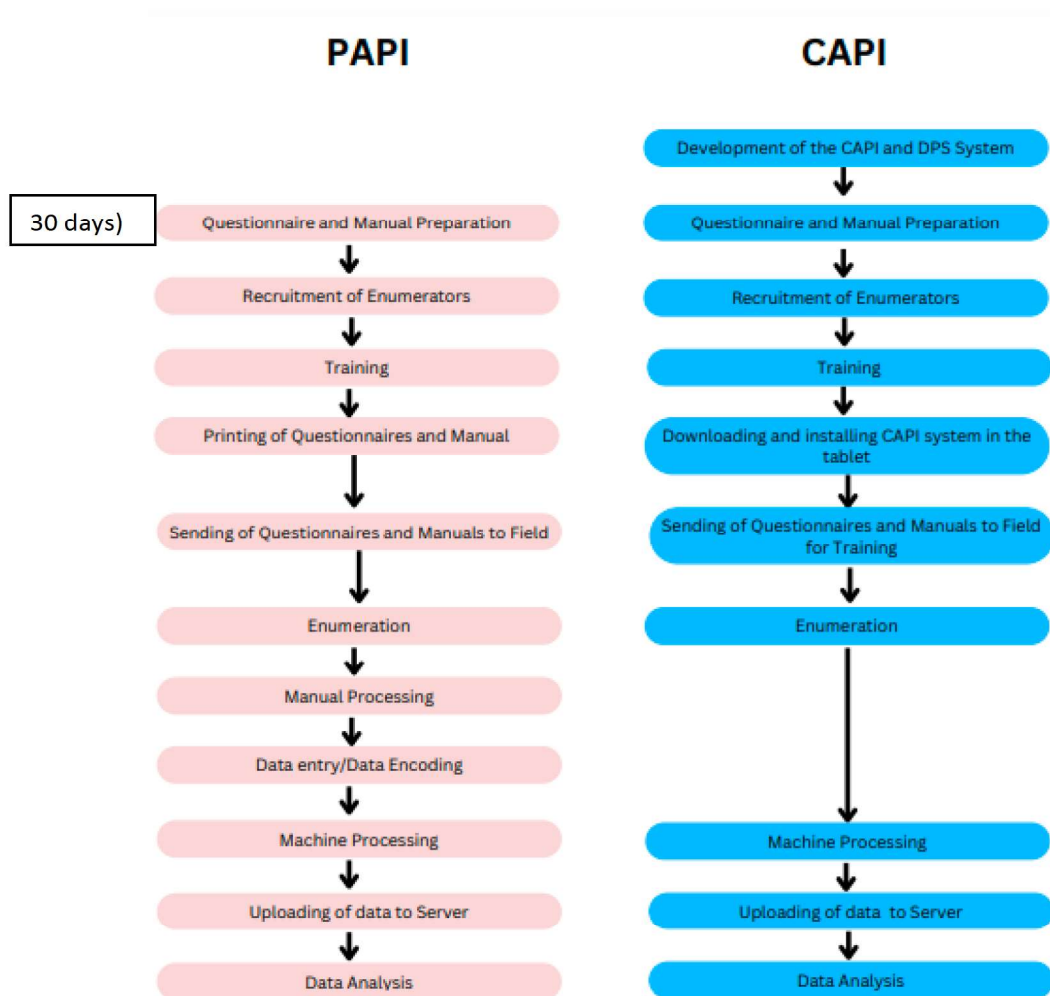
ACTIVITIES	2018 FIES (PAPI)	2021 FIES (CAPI)	Percentage Points Difference
Printing of Questionnaires and Manuals and Courier	13.42	5.13	-8.29
Trainings	35.07	41.43	6.36
Enumeration and Supervision	35.99	44.53	8.54
Manual Processing	8.72	0.00	-8.72
Machine Processing	6.80	8.91	2.10
Total FIES Budget	100.00	100.00	

Meanwhile, one of the challenges in implementing the CAPI system was the large amount of investments needed to acquire a sufficient number of tablets to successfully complete the entire survey. The expenses related to hardware purchase and maintenance are larger compared to the expenses of the traditional PAPI data collection method.

2. Time Efficiencies

The FIES questionnaire was complex in nature and lengthy in design as it contained several sections and subsections. Skipping patterns and logic embedded in the CAPI system helps the enumerator navigate easily through the questionnaire and reduces the duration of interview.

It is worth mentioning that with the exclusion of the manual processing in the process of the conduct of FIES, the entire process was reduced to 2 months. Thus, in 2021, the FIES results was released a year after the data collection compared to the previous schedule of releases.



It is worth mentioning that from the results of the online survey result wherein most of the respondents, 282 out of 718 (39.3%) strongly agree that interviews using the CAPI consumed less time compared to PAPI.

3. Data Quality

It was also found out that skipping patterns and logic embedded in the CAPI system increases the data quality and decreases processing time. The study shows that consistency checking has the largest share in the logic embedded in the CAPI system. There were also 141 skipping patterns included in the CAPI system that increased the data quality of the FIES, as these were already automatically skipped in the CAPI compared to the PAPI.

Table 2. Number of Skipping Patterns, Consistency Checks, Critical errors and Consistency with other Sections

Section	Skipping Pattern	Consistency Check	Critical Errors	Consistency With Other Sections
1. Identification and Other Information	1	6	0	1
2. Particulars about the Family	1	13	0	2
3. Expenditure Items	77	502	6	39
4. Income items	54	314	3	31
5. Matching with LFS				
6. Housing characteristics	8	13	0	8

Further, based on the results of the survey, computer aided data collection generally has a positive impact on data quality. According to the survey with the focal persons and statistical researchers that were involved in the survey operation of FIES, there was a gradual improvement in the quality of data with the introduction of CAPI. Most of the inconsistencies previously found in data collected using PAPI were eliminated because they were addressed in the programming of consistency checks and skipping patterns. Furthermore, CAPI allowed linking different modules making data collected at the same household easier to merge.

Further, the feature to integrate the FIES and the LFS, simplified the data collection because there was no need to re-enter the name and other information of the household head as this was collected in the LFS.

Meanwhile, with the PAPI, entire information of the household head had to be rewritten in FIES which resulted in mistakes and lower quality data.

4. Acceptability

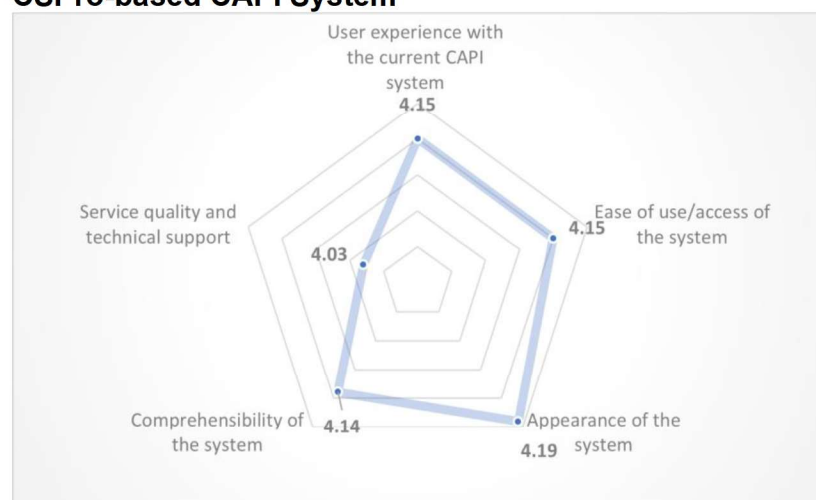
Table 3 shows the demographic breakdown of respondents. Regarding the sex, 77% of the respondents are female and 22.3% are male. In terms of age group, the majority (50.7%) are aged 26-40, (34.3%) are aged 41-60, (14.6%) are aged 18-25, and the remaining 0.4% are aged 61 years old and above. Most of the respondents are from Visayas (33.3%) and South Luzon (30.2%) area. Statistical researchers accounted for 81.2% of the total respondents who answered the online questionnaire.

Table 3. Demographic Profile of the Respondents

Area	North Luzon	17.3%
	Metro Manila	1.7%
	South Luzon	30.2%
	Visayas	33.3%
	Mindanao	17.5%
Position	Focal Person	7.9%
	Team Supervisor	10.9%
	Statistical Researcher	81.2%
Sex	Male	22.3%
	Female	77.7%
Age Group	18-25	14.6%
	26-40	50.7%
	41-60	34.3%
	61 and above	0.4%

Figure 1 shows the overall satisfaction of users in using the CPro-based CAPI system for FIES. Among categories, the appearance or interface of the system got the highest average score of 4.19, followed by the user experience on the current CAPI system at 4.15, comprehensibility of the system at 4.14. On the contrary, service quality and support posted the lowest average score of 4.03.

Figure 1. Average Score on the Overall Satisfaction of Users in using CPro-based CAPI System



Rating Scale (1-Strongly Dissatisfied 5-Strongly Satisfied)

Figure 2 shows the summary statistics of the assessment of users in using the CAPI system. Below are the score for the detailed items:

On the ease of use/access

- Most of the respondents strongly agree that FIES CPro-based CAPI menu was clear and accessible to the user with a score of 4.25. Respondents also provided and strongly agree with the ease of use of the CAPI System. Calculator feature was also found usable and writing of side notes or remarks in the FIES CPro-based CAPI System is convenient and helpful, although, these have the lowest average score of below 4.

On the appearance or interface of the system,

- Most of the respondents strongly agree that the style, size and color of the fonts used were visually pleasing and appropriate and the units of measure were clearly presented.

On the comprehensibility and data quality,

- Majority of the users strongly agree that interview using the CAPI compared to PAPI was less time consuming, automatic skipping patterns and data consistency present in the current CAPI system were helpful, error listing and summary report presented in the current CAPI system were useful and instruction and error messages were easy to understand. Based on the result of the survey, the overwhelming positive experience with CAPI reveals an enumerator and focal person preference for electronic surveys.

On the service quality and technical assistance,

- Most of the respondents agree that technical support was responsive if systems had technical problems. The solutions and next actions were also found to be clear and helpful.

Figure 2. Summary Statistics on the Assessment of Users in Using CSPro-based CAPI System

	MEAN	MEDIAN	MODE
Ease of Use/Access (1-Strongly Disagree 5-Strongly Agree)			
FIES CSPro-based CAPI System was easy to use	4.09	4	4
FIES CSPro-based CAPI menu were clear and accessible to the user (e.g. selecting survey, EA selection, CAPI or CAFE selection)	4.25	4	5
The FIES CSPro-based CAPI System loaded quickly	3.95	4	4
Calculator feature was usable	3.86	4	5
Buttons and menus were arranged consistently	4.06	4	4
Writing of side notes or remarks in the FIES CSPro-based CAPI System is convenient and helpful	4.24	4	5
Appearance/Interface (1-Strongly Disagree 5-Strongly Agree)			
The User interface were visually pleasing and professional	4.18	4	4
The color choices were visually pleasing, consistent and appropriate with regards to the content	4.20	4	4
The style, size and color of the fonts used were visually pleasing and appropriate	4.25	4	5
The units of measure were clearly presented (e.g. quantity measure such as kilograms, grams, liters, etc)	4.14	4	5
Comprehensibility and Data Quality (1-Strongly Disagree 5-Strongly Agree)			
Higher quality of data gathered using current FIES CSPro-based CAPI system compared to PAPI (e.g. CAPI eliminates the manual encoding errors, specific data validation on answers based on each questions)	4.10	4	4
Less time consumed in interviewing using the CAPI compared to PAPI	3.95	4	5
Automatic skipping patterns and data consistency present in the current CAPI system were helpful	4.37	5	5
Error listing present in the current CAPI system were useful	4.31	5	5
Instruction and error messages were easy to understand	4.20	4	5
Summary report presented by the CAPI were useful (e.g. total income, total expenditure)	4.42	5	5
Service Quality and Support (1-Strongly Disagree 5-Strongly Agree)			
Technical support was responsive if the system has technical problem or crashes	3.97	4	4
If a technical issue was encountered, the solutions or next actions were clear and helpful	4.0	4	4

V. CONCLUSION/RECOMMENDATIONS

As countries begin developing a strategy for collecting data demanded by the SDGs framework, additional pressure will be placed on the agency to produce timely, high-quality and accurate data by minimizing data collection and management cost without jeopardizing the quality of data. In response to this, the PSA has revolutionized field data collection methods in FIES using the CAPI. Several studies provide evidence of the advantages and disadvantages of using CAPI vs PAPI.

It was found from the study that the CAPI system was respondents well-received by the statistical researchers, team supervisors and focal person who were involved in the 2021 FIES, although there were some adjustments on the use of tablet. In terms of data quality and time efficiency, salient features embedded in the system like consistency check, skipping pattern and error detection reduced the survey errors and the duration of the interview. Comparing the cost of the CAPI with the PAPI, evidence showed that CAPI requires sizeable investments in hardware and development work than PAPI. However, since FIES is a large and a regular survey, the adoption of this technology-enabled platform will eliminate the costs associated with PAPI like the printing of questionnaires, manual processing, and data entry.

To further improve the CAPI system in preparation for the next FIES rounds and in CAPI-based transition of other household surveys, the following recommendations have been made:

- To further ensure high quality data, additional module on the paradata should be considered. Paradata identifies the total survey duration by getting time stamps at the beginning and end of each module and for each section. This gives information on the length of time spent on each section, which can be a basis to assess quality.
- Preparation of dashboard to monitor the progress of the enumeration and the processing. CAPI system has the capability to be linked to a web-based monitoring dashboard that will be greatly beneficial as the fieldwork can be supervised effectively with the use of easily accessible and real-time summary status reports, tables and geographic visualizations of fieldwork which are additional ways to monitor progress and foresee potential problems.
- the system can embed automatic calculation of unit conversions with comprehensive units of measurement, arithmetic operations and other mathematical requirements of the survey to eliminate miscalculations.
- Additional reference files can be also incorporated to the system (information on local retail price or quantity measurement) which can help in filling out questions efficiently.
- Linking map in locating the target household can be also useful.
- additional features such as the GPS, pictures and video will be more useful in capturing data during survey operation;
- additional features on audio recording can be considered to record the responses of the respondents for easier reference during the processing; and
- lack of technical capacity to develop and implement CAPI surveys were seen as the contributors to the slow adoption of CAPI, thus investment to improve the skills of the developers and users should be given priority.

In general, CAPI system provides endless opportunities in survey implementation because it is a functional infrastructure designed to flexibly adapt to future technology. With the increasing recognition of formulating evidence-based policies and programs, there is a

need to better communicate the advantages as well as the challenges in using the innovative tools and techniques that minimize data collection and management costs without compromising on data quality. With the embedded skipping patterns, missing critical responses, consistency checks in the CAPI system, there is a higher likelihood of collecting more accurate data. Further, CAPI eliminates the need to encode data after the survey has ended, which significantly reduces the time and costs associated with producing a final clean dataset.

VI. REFERENCES

Beckenbach (1995). COMPUTER-ASSISTED QUESTIONING: THE NEW SURVEY METHODS IN THE PERCEPTION OF THE RESPONDENTS .Bulletin of Sociological Methodology / Bulletin de Méthodologie Sociologique , September, 1995, No. 48 (September, 1995), pp. 82-100

Couper, M.P. (2005). Technology Trends in Survey Data Collection. Social Science Computer Review, 23, 486–501.

C. Leisher. 2014. A Comparison of Tablet-Based and Paper-Based Survey Data Collection in Conservation Projects. Social Sciences. 3(2). pp. 264–271

Edith de Leeuw and William Nicholls II (1996) 'Technological Innovations in Data Collection: Acceptance, Data Quality and Costs' Sociological Research Online, vol. 1, no. 4,

E. De Leeuw. 2008. The Effect of Computer-Assisted Interviewing on Data Quality: A Review of the Evidence. Methodika: Utrecht University.
<https://dspace.library.uu.nl/handle/1874/44502>

Martin et al., 1993. The Use of CAPI for Attitude Surveys: An Experimental Comparison with Traditional Methods. Journal of Official Statistics.Vol. 9, No. 3, pp. 641-661

Maxwell, J. (1997). Designing a qualitative study. In L. Bickman & D. J. Rog (Eds.) Handbook of applied social research methods (pp. 69-100). Thousand Oaks, CA: Sage.

Thornberry et al., 1991. USE OF CAPI WITH THE U.S. NATIONAL HEALTH INTERVIEW SURVEY. Bulletin of Sociological Methodology / Bulletin de Méthodologie Sociologique , MARCH 1991, No. 30 (MARCH 1991), pp. 27-43