

Guide to measuring farm input and output data

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WORLD AGROFORESTRY (ICRAF)

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Guide to measuring farm input and output data

This guide was written to help researchers understand some of the problems faced when collecting farm input and output data. It offers suggestions on how to reduce some of these problems and minimise errors in data collection.

What do we mean by farms, input and output?

By **farms** we are referring to smallholdings managed by farmers, typically mixed farms which are part of mixed livelihoods. By **inputs** we mean inputs to plots, fields or farms, such as labour (family and hired), recurrent purchases (seeds, fertilizers, chemicals), capital purchases (tools, equipment), advice (training, extension, veterinary), and land (owned, rented or borrowed). By **outputs** we mean products for sale or consumption (plus processing before sale, or social exchanges), such as main crops, other crops, animals, milk and other animal products, firewood or timber, fruits, and minor products such as medicinals and manure.

The common approach used for collecting such data is a survey, meaning that a sample of farms, farmers or fields is selected in some way and data collected from this sample. Data on inputs and outputs is commonly collected using methods that involve several factors.

- **Self-assessment:** farmers are asked for values (for example, for crop production) and their responses are recorded. There is no objective measurement (for example, by weighing actual crop production).
- **Recall:** farmers are asked the values for something that happened some time ago (for example, crop production last season; labour spent weeding 3 months ago).
- **Quantitative indicators:** farmers are asked for actual quantities (for example, for kilograms of crop produced) not a qualitative assessment (for example, 'good' or 'poor').

In what situations are data collected?

Input and output data are collected for many different purposes, including as part of the following.

- Routine compilation of official social and economic statistics by governments. Often repeated regularly, with national coverage and consistent methods across countries.
- Diagnosing farming systems in selected locations, often with a focus on a particular sector or problem.
- Research efforts to develop new technologies or practices, for example, doing cost-benefit analyses of alternatives.
- Assessment of the impact of a new practice or policy.

Overall, these fall into two groups summarised in Table 1.

Table 1. The two groups of farm input and output data collection activities.

Group	Description	Characteristic	Methods development and choice
A	Routine, large scale, carried out by national statistical agencies.	Repeated over time so that experience is gained. Repeated in different countries and supported by international organisations. Most interest in aggregate measures.	Investment in development and validation of methods; training of staff; continued learning and evolution.
B	Unique, often small scale, carried out by diverse research teams.	One-off investigation of a problem that is deliberately different from what has been done before. This can include multi-phase investigations. Limited scope for in-depth investigation of methods, hence, choices based on general principles. Limited time and budget for training. Often most interested in individual farms and variations between them.	Use general ideas and principles, based on literature and standard practice, to design a unique survey and 'hope for the best'.

This guide is about B — small-scale research — not A.

The core problem: limits to quantitative self-assessment and recall data

The basis of many methods is to ask farmers, 'How much input did you use and how much output did you get?'. The specific details vary depending on time period, units, style of interview or scale of focus.

- **Time:** the period referred to may be 'this season', 'last year', 'usually' etc.
- **Units:** the units of measurement ('kilograms', 'tonnes', 'bags' etc) may be defined by the data collector or the respondent.
- **Structure:** questions may be formally embedded in a conversation or not, depending on how structured an interview is.
- **Scale:** data collection may focus on one product, enterprise or field or refer to whole farms.

The core problem is the same: if an answer includes something like...

'I grew 0.5 hectare of hybrid maize with 50 kilograms of urea as fertilizer and harvested 22 bags of maize. I sold half of it for 1200 shillings per bag and stored the rest to eat.'

... can this data be relied on?

This is the sort of information that is used in many different calculations, **but is it correct?** No. Such data is never exactly correct and it is even hard to say what 'exactly correct' means. But, is it good enough for the purpose? That must depend on the purpose.

We do know that it is usually impossible to assess the quality or reliability of data in a single survey data set. We can check whether reported values are feasible. But, as an example, smallholders' maize yields can realistically be anything from near zero to 10 t ha⁻¹. Yield calculated from reported production and area could be outside that range because either production, area or both are erroneous. It could also be within the range but still wildly wrong, again owing to errors in production, area or both.

We also know that research studies and cases in which it is possible to check data (for example, because it includes triangulation) show that recall and self-reported data are often very poor.

And finally, there are plenty of studies which report that recall data is ‘good enough’ but these focus on aggregate values not individuals. For example, they show that the average yield in a study area is estimated acceptably well by recall. This is not the same as showing that individual values are estimated well.

Why does the problem arise?

Asking for data and relying on the responses rests on the assumptions outlined in Table 2.

Table 2. List of assumptions that are often made when collecting farm input/output data

Assumption	When is it likely to be more of a problem	When it is likely to be less of a problem
1. Respondent is the right person.	Convention or etiquette requires answering by person who does not have the information. Information needed is held by multiple people.	One person is responsible for all aspects of production and is the one answering the questions. Multiple people involved in the farm answer jointly.
2. Question is understood in the way the researcher intended.	Researcher* uses standard concepts without checking local relevance. Translation to local languages not agreed or checked by researcher.	Researcher is very familiar with local context and the farming and land systems. Researcher knows local languages.
3. Quantity was known correctly at some time in the past.	Person answering is not actually involved or responsible for the inputs or outputs. Several people are involved in the inputs and outputs and no one person holds all the information. For outputs: products are harvested or collected irregularly on many occasions; products are for home consumption not sale; products are not packed or stored in standard containers or units. For inputs: inputs are made several times or irregularly; inputs such as labour from family and friends and community; inputs not purchased.	Person answering is the one involved in or responsible for production. For outputs: harvests are made at a single time; products are for sale; products are packed, stored or transported in standard units. For inputs: purchased inputs, including hired labour.
4. Quantity is still remembered.	The quantity is not recent, was nothing special at the time, did not involve money.	The quantity is recent, unusual, involved money.
5. Willingness to reveal quantity.	Researchers and those who introduce them to farmers are strangers. Farmers have reason to expect their answers will influence what happens next (for example, their experience that receiving benefits from projects was determined by their answers).	Good social capital between researchers and farmers, meaning trust and understanding. No perceived advantage from giving any particular answer.

* ‘Researcher’ here means the person or people who designed the study.

Note that the problem of who answers the questions is real. ‘The farmer’ is a concept used by researchers but in reality multiple people may be involved and hold relevant information. Cultural norms might require answers to be provided by the ‘the head of household’ even if this person does not hold the necessary information.

It is also important to note that understanding the question can be surprisingly hard, even for something as simple in principle as maize production. For example, ‘How much maize did you harvest from your farm last season?’ might be ambiguous because it is not clear whether to include harvests from rented land, green cobs that were harvested, or maize harvested from the respondent’s own land by someone else such as a family member. Elements of a question that are commonly used and seem clear to researchers but can be ambiguous include ‘household’, ‘farm’, ‘season’, ‘year’, ‘production’, ‘harvest’, ‘field’. A question such as, ‘What was the price [of the product you sold]?’ invites a single answer but the reality might be that prices vary throughout the season.

Neither of these potential problems are restricted to surveys collecting input and output data by recall but are important reasons for such data often being poor quality.

Planning to avoid the problem

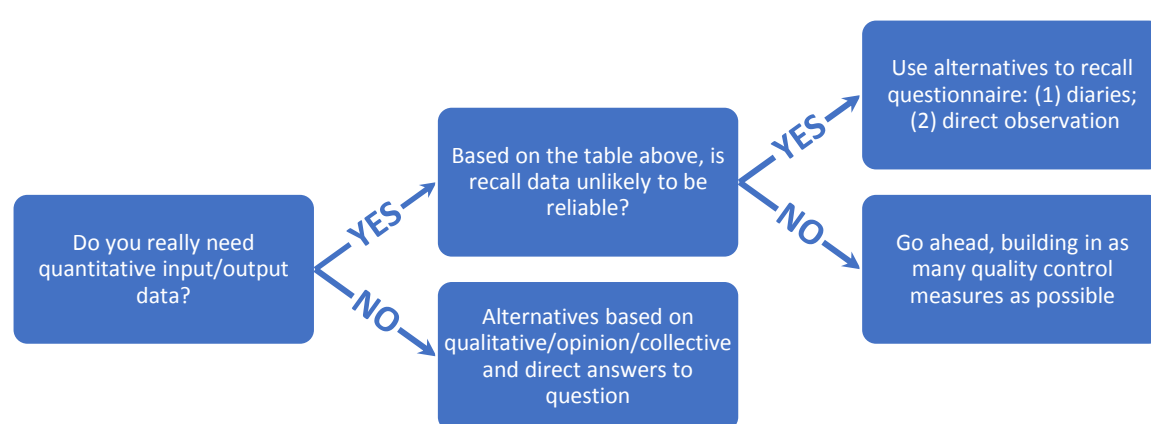


Figure 1. Decision tree showing pathways to help avoid collecting low-quality recall data

You can minimise problems caused by low-quality recall data by using the decision tree in Figure 1.

Note that the action boxes in Figure 1 will not automatically give you high-quality data. You will still need to pay careful attention to all aspects of design and implementation of the study.

Each question and response in Figure 1 is discussed below.

Q1. Do you really need quantitative input and output data?

Think carefully about the real objectives of the study. Are detailed quantities actually necessary? The three examples below show some of the alternative ways of meeting the objectives of a study without trying to collect and interpret quantities.

Example 1. Millet farming and livelihoods in East Uganda

The aim is to understand the importance of millet in the farming and livelihoods’ systems of East Uganda in order to decide whether to work on millet development. The original plan was to collect input and output data on millet. But the objective can be met by asking qualitative questions about the role of millet and its relative importance, bottlenecks to its development, specific problems and potential for improvement. An advantage of this approach, beyond not requiring recall data, is greater insight into the role and problems of millet production.

Example 2. Changing millet practices on farms

The aim is to understand how new millet agronomic practices are changing farms. The original plan was to collect input and output data using the recall method from before and after adoption of the new practices. But the objective can be met by asking farmers directly what is changing. An advantage of this approach, beyond not requiring recall data, is farmers also talking about changes that cannot easily be quantified.

Example 3. Assessing profitability of weed management systems for millet

The aim is to assess the profitability of new weed management practices for millet. The original plan was to collect input and output data from farmers who are trying both the old and new systems, and construct budgets with financial indicators. The objective can be met by using participatory cost–benefit analysis methods that elicit the relative costs and benefits of each practice and the balances between them. Advantages of this approach, beyond not requiring recall data, include the way farmers bring in costs and benefits that cannot be quantified in monetary terms and their assessment of balances that often do not correspond to economists’ indices.

Often the quantitative data is a step towards answering a further question and that question can be more directly answered without collecting the quantitative data at all. For example, the purpose of the quantitative data might be to do a cost–benefit analysis of a new practice in the expectation that it will tell you about its attractiveness to farmers. The alternative would be to have farmers try the new practice and assess attractiveness directly, by-passing the need for the cost–benefit data.

So, going back to the question, ‘Do you really need quantitative input and output data?’...

If the answer is ‘No’, meaning that you can achieve your objectives without the quantitative input and output data, then use an alternative approach that avoids quantitative recall data from individual farmers. The two most common are 1) asking questions directly (while remembering that open-ended questions and group discussions are alternatives to closed questions); and 2) doing ‘semi-quantitative comparisons’, such as ranking and rating.

If the answer is ‘Yes’, meaning that you need to have the quantitative input and output data... go to Q2.

Q2. Is recall data unlikely to be reliable?

Use Table 2 to decide if you are likely or unlikely to be able to get reliable data by recall. Look at the second column of Table 2 — ‘When is it likely to be more of a problem’ — and decide if those conditions apply to your situation.

Example 1. Measuring profit from growing cotton

You want to know who is able to make money from growing cotton and you planned to collect input and output data about cotton from a sample of farmers. In the area where you are working, there are several relevant factors.

- Cotton fields are ploughed by hired tractors.
- Seeds and fertilizers are supplied on credit by the company that buys the cotton.
- Harvested cotton is packed into 50 kg sacks and weighed.
- All production is bought by the one company at harvest.
- Planting, weeding and harvesting is mainly done with hired labour.

Referring to Table 2 shows that there is a good chance you can get reliable recall data on cotton inputs and outputs, for example, for the season that has just finished.

Example 2. Measuring the value of firewood production

You want to know how much firewood is produced on farms and what it is worth. In the area where you are working there are several relevant factors.

- Firewood is collected irregularly as needed, some from farms and some from common land.
- People collect as much as they find. Sometimes there are large piles of tree prunings available, sometimes only a few sticks.
- It is collected by children or others not otherwise busy.
- Firewood is rarely bought and sold.

Referring to Table 2 suggests that recall data is unlikely to be reliable owing to the irregularity of collection, multiple people involved and lack of sales.

Answering the question above requires you to have a good understanding of the local context and systems (cotton production and firewood use in the examples). **If you do not know enough of the local context** to use Table 2 to decide, **then you do not know enough to design the study**, whether or not it is a survey based on recall data. In that case, you need to start with an exploratory investigation to collect the necessary local background information.

If the answer to, 'Is recall data unlikely to be reliable', is 'No', then it is likely that the recall data will be good quality.

If this is the case, go ahead with your survey using the following hints to minimise errors.

- **Be reasonable.** Don't ask for too much data (for example, inputs and outputs for many different crops or for several previous years) and remember the points in Table 2 for every question asked.
- **Pilot** all aspects of the questionnaire. This will include checking the understanding of all questions.
- **Pay attention to units.** The units used to record quantities are as important as the numbers. Ensure researchers and respondents mean the same thing because confusion is common. In one example, local vegetables were sold in 'bunches' and so the number of bunches produced was recorded. But the bunch size varied with time of year.
- **Check** data in the field when possible. Include in the data collection protocol a process for checking that recorded values are realistic. For example, the data collector may need to estimate yields from area and production and seek confirmation if they seem wrong.
- **Triangulate** when possible. This means collecting the same information in two different ways so that agreement can be checked. For example, a commodity might be produced and either sold or consumed, so ask all respondents for three quantities (produced, sold, consumed) and confirm that 'production = sold + consumed'.
- **Local verification.** Use local experts to check that quantities reported are realistic.

If the answer is 'Yes', then it is unlikely that recall data will be good quality.

You have decided that 1) quantitative input and output data is needed; and 2) recall data is unlikely to be reliable. Hence, you need to find an alternative way of generating the data.

Refer to Table 2 and the five assumptions on which use of recall data is based. Finding alternative methods means finding methods that do not depend on these assumptions or methods in which the assumptions are directly confronted and dealt with.

In Table 2, assumptions 2 (understanding the question) and 5 (willingness to reveal quantity) require general [good survey practice](#) and are not discussed further here.

Table 3 gives suggestions for reducing the problems caused by the other two assumptions or ensuring the assumption is realistic.

Table 3. Suggestions for dealing with assumptions

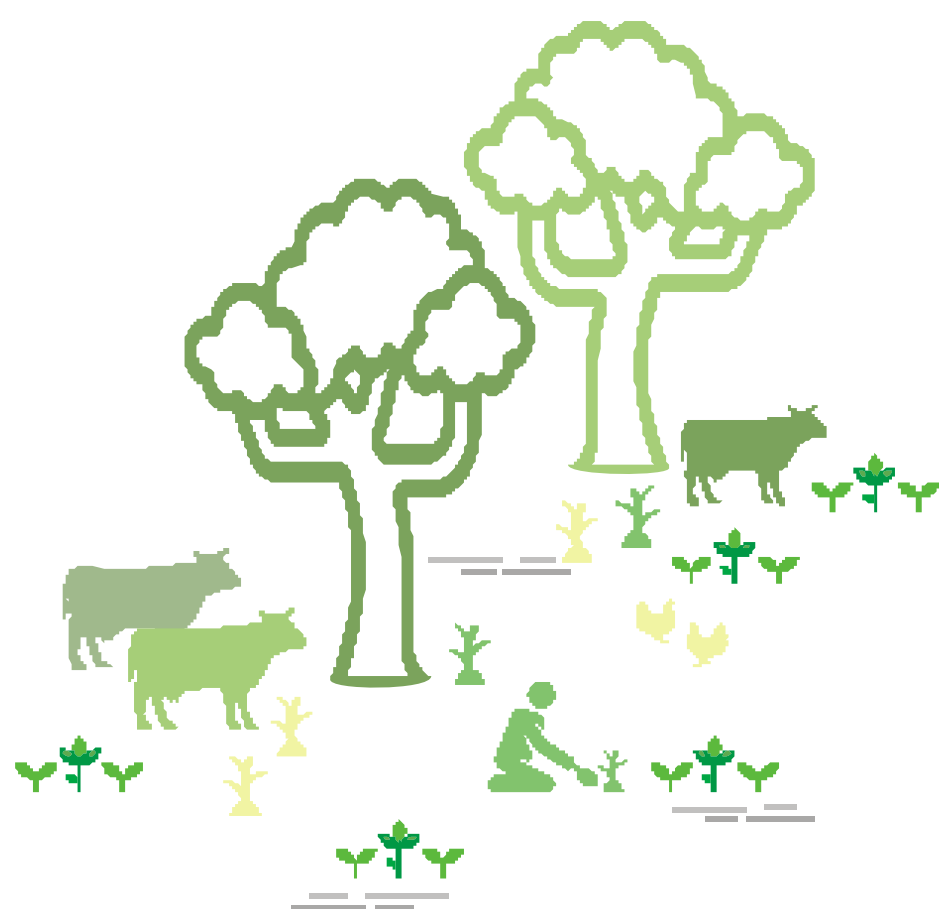
Assumption	Making it realistic
3. Quantity was known correctly at some time in the past.	Central idea: make sure each input or output quantity is known by the respondent. This means: <ul style="list-style-type: none"> - Providing a suitable measurement tool (1) - Defining a protocol for using it (2) - Ensuring respondents are willing and able to use these (3)
4. Quantity is still remembered.	Central idea: don't rely on recall but have data recorded at the time of taking the measurement. This means: <ul style="list-style-type: none"> - Providing suitable data collection forms or other technology (for example, SMS) (4) - Ensuring respondents are willing and able to use them (3)

In Table 3, the notes mean:

- (1) Might include a standard container to measure crop volume or a spring balance for weighing.
- (2) Includes procedures such as 'each time firewood is brought from the farm, tie it in a bundle and weigh it'.
- (3) Includes training and motivation to follow the protocol.
- (4) Includes forms designed to be farmer-friendly, including forms that can be used by non-literate people if necessary. They need to be made from durable material in a format that will stand field use.

If these procedures are too complex, expensive or slow for your research then go back to the original research objective and redefine it to something more achievable.

There is no point in going ahead with a data-collection exercise that you know has a high chance of producing poor-quality data.





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