Systems Diagrams - Guidelines

1 Diagrams – general points

1.1 Why use diagrams?

Many people find images easier to understand and remember than text (i.e they are "visualizers" rather than "verbalizers"). Drawing a diagram shows the relationships or linkages between different concepts or variables more clearly and immediately than is possible with text. Establishing the relationship of new information to that already assimilated is considered to be one of the most important cognitive processes in learning. Drawing diagrams therefore stimulate thinking about a situation.

When diagrams are constructed as a group process, they aid brainstorming, analysis, communication and a common understanding of a situation.

Most communication is mediated by language. Often, concepts are difficult to explain or appreciate in another language, but can become clearer when visualised as an image or diagram. When working with people of different cultures or different languages, diagrams can therefore help overcome the language barrier. Also, people that are considered to be "illiterate" (because they cannot read or write) can often show considerable analytical capability when they can express themselves in diagrams in an environment and using materials with which they are familiar. Getting people to analyse the current situation as expressed in a diagram is a good way to initiate a discussion of what could be changed, the impact these changes would have, and hence what sort of future could be possible. Diagrams thus facilitate "*visioning"* of alternative futures by rural people.

In analysing systems – where an analysis of the *interrelationships* between different elements (stakeholders, entities, processes, etc.) is paramount, rather than the more reductionist analysis of the elements themselves – different types of diagrams are some of the main analytical tools used. Mostly, the diagrams are used to identify where a study needs to be focused: i.e. to identify which elements (stakeholders, processes, problems) of a complex situation form the *relevant system* for further analysis, with the ultimate aim of designing an improvements to that system that can be implemented by stakeholders involved.

1.2 General guidelines in drawing diagrams

In this learning resource, several diagram types are described. It is also possible to combine objectives and types, to make a hybrid diagram, but it is probably best to decide on the objective of a diagram and choose the best diagram type for this objective. Also, it is usually better to make several different diagrams to convey understanding of a situation, rather than try to include lots of different sorts of information in one complicated picture.

Simple diagrams (5-10 elements) are easier to understand, although complex situations often result in complex diagrams. Keep the clutter to a minimum. Avoid elements that are not strictly relevant. If words are necessary to explain the working of a diagram, try to use single words or short phrases rather than sentences; a more complete explanation can be given in accompanying text. Give every diagram a title, to show its purpose.

Before starting a diagram, decide on the main purpose and – more importantly – who will be involved in drawing and interpreting the diagram:

- If the main purpose of a diagram is to facilitate analysis by rural people, then diagrams that use materials that are more familiar (e.g. using a stick in the ground) will allow people to feel more comfortable and hence facilitate their participation (the diagram can always be photographed or redrawn later). In this situation, the use of drawings or symbols is usually preferable to words in the diagram.
- If the main purpose of the diagram is to convey information in a report to other development professionals or decision makers, it may be better to use symbols or text. If text is used, single words or very short phases should be used rather than long sentences. If using a computer to write a report, the excessive use of clip-art should be avoided, as this can clutter up and distract, rather than aid understanding.
- When diagrams are being used to facilitate team analysis and understanding, the value is mainly in the process of drawing itself rather than the finished drawing. It is therefore a mistake to wait for a complete understanding of a situation before starting to draw a diagram, as the act of drawing will identify areas where such understanding is incomplete. Few diagrams reach a "final" form without redrawing several times.

As with all teamwork or facilitation of group interviews or participatory activities, you should be aware of *process* issues as well as the content or output. In particular, you should be wary of forcing a consensus on a particular point – there is room in a diagram for different points of view. These differences of perspective are often highly significant.

Preparing a diagram is not a quick process, if the associated analysis is to do more than "scratch the surface". Managing discussion and disagreements takes a lot of time, but is necessary to build common understanding within a team, between rural people and development professionals, or between an analytical team and decision makers. Take your time, get feedback from others, and make sure the diagram is understandable. Ask others what they understand when they "read" the diagram. If your diagram is being used to convey meaning in a report, make sure that it only contains the information necessary to convey the meaning you intend.

2 Concept maps

2.1 What are concept maps?

"Concept mapping" is a way of representing and relating knowledge, by showing important elements (concepts) and the relationships between these, usually around a central theme. It was developed by Joseph Novak of Cornell University in the 1960s, based on the theory that new knowledge is more easily assimilated when it is related to existing ways of thinking. Concept maps are often advocated as way of conveying information in a form that is facilitates learning.

Other names for similar types of diagram are:

- "Mind maps" (a term copyrighted by Tony Buzan, and so called because the brain thinks in terms of associations). These are usually put forward as a way of personal "brainstorming", and organizing one's thoughts.
- "Spray diagrams" (as called by Peter Checkland and his school of soft systems analysis at Lancaster University, because the ideas spray out from a central point). These are mainly used as a way of structuring a situation or for taking notes.
- "Spider diagrams" as they can look like spiders webs, and so on.

As expressed by the terminology, the different developers have all had slightly different objectives, and the diagrams may look slightly different. Concept mapping usually emphasises inclusion of the relationship between elements, while spray diagramming and mindmapping emphasize the basic structure without elaborating on the nature of the connections or relationships. However, the different diagram types are sufficiently similar to treat them as one diagram type in these learning resources, and so will be referred to here as "concept maps".

These diagrams are not difficult draw manually. In recent years however, a number of software packages have been developed to structure information in this way, encourage thinking, and make "neater" results (see ICRA links to systems thinking).

2.2 When to use concept diagrams

As can be seen from the above introduction, concept maps (and the related diagram types) can have several uses. These include:

- Personal brainstorming (organizing and exploring one's thoughts).
- Group brainstorming. Exploring and recording many ideas.
- Making notes for personal use, Many people find it easier to retrace their thoughts, pick out important points, recognise what they know or have learned, if they record and present this information in the form of a concept map, rather than sequential text.
- Making notes in an interview. When conducting an informal interview (i.e. one where there is no formal, fixed "questionnaire"), the note taker will often find it quicker to take notes in the form of a concept map, rather than text (especially after a little practice). It also forces the note taker to make sense of what he/she is hearing and so encourages a more active listening. Interview notes recorded as a concept map on a large sheet are also a good way for both interviewer and interviewee to see what has been

discussed: i.e. to “map” the interview. Seeing what has been discussed, and what remains to be discussed (by identifying all the main issues first) helps keep the interview focussed and on track, avoiding the common problem of going of at a tangent and discussing something relatively inconsequential.

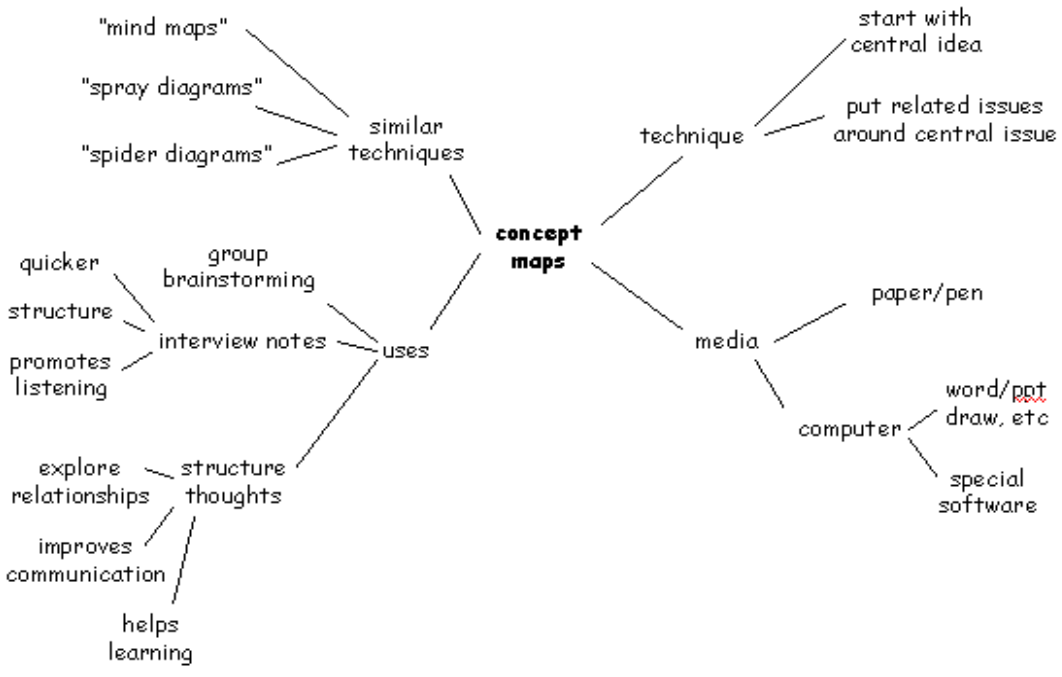
- Showing relationships between different concepts and ideas.
- Communicating complex situations to others.

2.3 Steps

- Usually, the place to start is the central idea, or topic of interview, etc. This can be put in a circle (as a “blob”) on the page, or just written down as a single word or concise phrase (no long sentences!).
- Then place around this the (4-10) main elements or issues or questions that are related to the central issue, also as words or concise phrases. Connect the secondary issues with the central issue by a line. Explaining the line – putting in the nature of the relationship usually helps, but may not always be necessary.
- Once the main secondary issues or elements have been identified, the “tertiary” elements or issues can be similarly arranged around the secondary issues. In this way, the “map” is built up – usually from the centre outwards.
- Of course, it is sometimes difficult to know where to stop. But usually 3 or 4 “layers” are sufficient to explore or summarize a particular situation, or identify elements and/pr relationships that merit more detailed analysis.

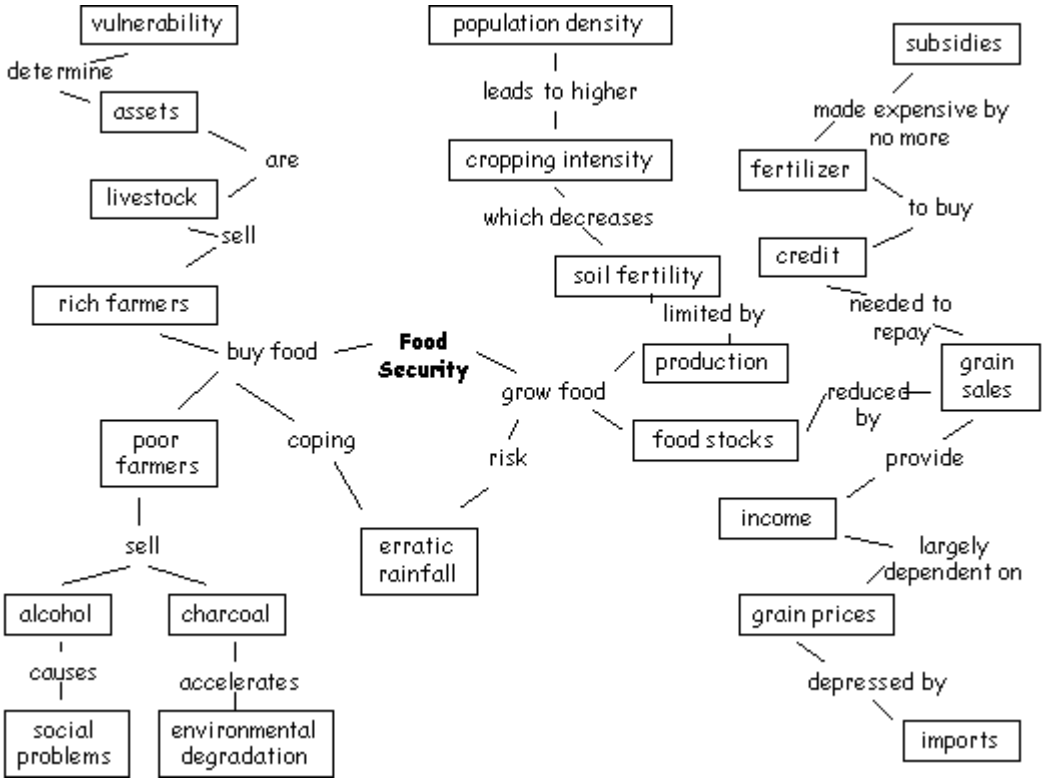
2.4 Examples

A Concept mapping



Which is the easier to follow – the text in the above sections, or the diagram?

B Food Security Situation in Ethiopian District



Look at the above diagram carefully. Is the logic understandable? How much text would be needed to convey the same understanding?

3 Stakeholder maps

3.1 What are stakeholder maps?

Stakeholder maps show the stakeholders that are part of a system, and their proximity. By definition, all systems that interest us in any practical sense are human activity systems and hence involve different stakeholders ("actors", or "interest groups). Stakeholder maps are essentially a number of circles or "blobs" that identify elements and overlap to show where there are areas of interaction. They do not include lines or between the elements.

Stakeholder maps as described here are related to Venn diagrams, which show a series of overlapping circles or ellipses to compare, contrast and analyse similarities between elements. Venn diagrams have a considerable amount of mathematical theory behind them. In guides to participatory methods, a similar technique if less rigorous technique used to show institutional relations to a particular community or issue is sometimes referred to as "chapatti diagrams".

3.2 When to use stakeholder maps

Stakeholder maps are useful at a preliminary stage of an investigation, when the different interests and perspectives related to a problem are being investigated, and where areas of common interest between stakeholders are being identified and can serve as a focus for further investigation.

Stakeholder diagrams are easily understood, easy to draw and thus are a good way for stakeholders to visualize, identify and analyse their relationships to others.

3.3 Steps

- Identify all the stakeholders that have an interest in problem situation being discussed. If done in a group or as a participatory exercise, this can be done using cards (preferably round or oval).
- Use the cards in pairs to discuss where different actors share a common interest, and where there are conflicts. The cards can then be arranged so that they overlap to represent where stakeholders interact significantly, or a diagram can be drawn with "blobs" to represent the different stakeholders and their interaction (the use of irregularly shaped blobs makes the overlapping easier to arrange).

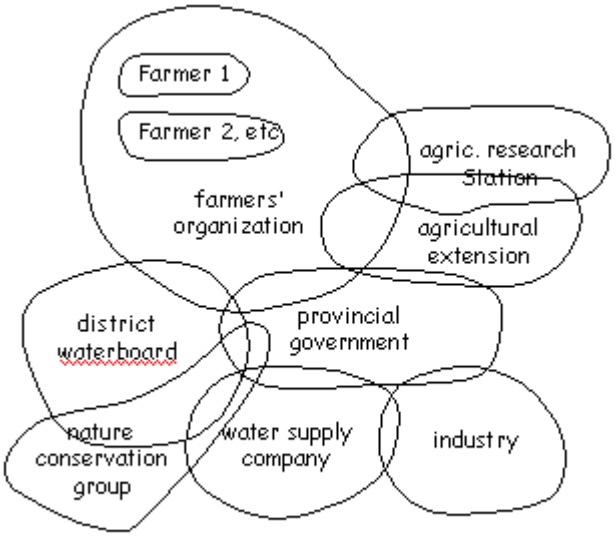
3.4 Example

The following example is a summary of the stakeholder interaction from an ICRA study in the Province of Noord Brabant, The Netherlands. This was a study organised in collaboration with the Livestock Research Station, who were being asked by dairy farmers (via their organizations) to develop ways of using water more efficiently.

On the sandy soils in this province, water tables have fallen dramatically during the last decade, due to fast discharge of surplus water in winter and spring though improved drainage, and because of increased water use by dairy farmers, industry and consumers. Dairy farmers have increased irrigation to improve pasture and fodder yields in a bid to remain competitive, as farming has become more intensive.

But the lowering of the water tables has had a negative impact on natural areas. After intense lobbying from the water supply company, the district water board and conservation groups, the provincial government proposed a ban on irrigation by farmers, which in turn caused protest from the farmers organization. A compromise solution was therefore needed, combining policy, technical improvements to water management and fodder production on the dairy farms.

The following diagram is an attempt to sum up this situation, showing stakeholder interaction and identify areas where the team could focus further investigation, with a view to developing changes in farming practice that could alleviate the problem of overuse of groundwater in N. Brabant.



Stakeholders involved in groundwater use, N.Brabant

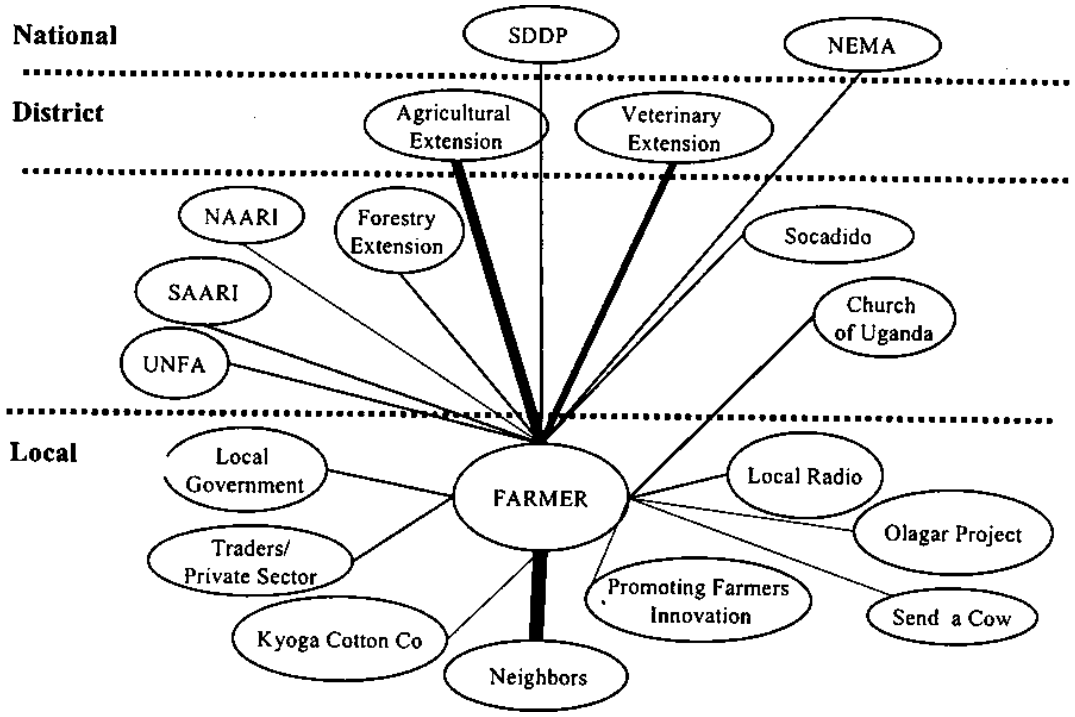
3.5 Variations

When using Venn diagrams as part of a participatory exercise to show the interrelationships between a village community and outside institutions or stakeholders, paper circles that have been already prepared (cut) are sometimes used, arranged around a large circle drawn to represent the community. Participants in the exercise select the ***size*** of the paper circles according to the importance that these institutions represent to the community, and the ***position*** of the circles to indicate participants perceptions of the communication between the institutions and the community:

- Separate – no contact
- Touching – information passes between institutions
- Small overlap – some cooperation in decision-making
- Large overlap – considerable cooperation in decision-making

However, the use of overlapping elements (circles) often makes for a crowded diagram, and some practitioners prefer to use connecting lines to indicate the degree of communication between a community (or farmer of particular type) and different institutions.

The following diagram, taken from an ICRA field study in Uganda, shows farmer's appreciation of their communication with different actors. In this diagram, the authors used the thickness of connecting lines to indicate the strength of linkages between actors (as indicated by the proportion of farmers that mentioned this link in interviews), rather than the distance between the elements in the diagram. Note that there are no arrows used in the diagram – an arrow would indicate flow (e.g. of information) and the direction of such a flow (flow diagrams are discussed in more detail below).



Farmer's appreciation of links with different actors (ICRA field study in Uganda)

However Venn diagrams and stakeholder maps are used, it is important that team members decide and agree beforehand on the conventions used in the diagramming (i.e. how the diagram will convey interaction between stakeholders, and the strength of this interaction), and clearly indicate this convention in the accompanying text, if such diagrams are to be useful for analysis and communication.

4 Rich pictures

4.1 What is a rich picture?

"Rich pictures" were developed as a tool for exploring a complex situation in soft systems analysis by Peter Checkland and colleagues at the University of Lancaster. He called them "rich" because the idea is too gain the "richest possible picture of the problem situation" (Checkland 1981). A rich picture should not try to impose too much structure too early in the process of exploration. A rich picture has few rules. It can show:

- Important actors and their relationships (but it is not just an actor or Venn diagram).
- Elements of structure and process, (but it is not just a system model or flow chart).
- Relationships between problems, (but it is not just a problem-causal diagram).
- Influences on the situation, (but it is not just an influence diagram).

The point is that all these other sorts of diagrams try to *clarify* the situation, and it precisely the lack of clarity that can be important at an early stage of exploring the situation. Anything that seems relevant can be included in a rich picture and it should include subjective information such as:

- Stakeholder perspectives, prejudices, concerns and conflicts (without trying to represent a "truth").
- Questions and uncertainties that seem relevant to the problem situation

Rich pictures usually use symbols, icons, cartoons and drawings and as few words as possible. This is because symbols and drawings allow a more intuitive impression and expression.

4.2 When to use rich pictures

Rich pictures can be useful to:

- Keep an open mind, broaden your thinking, and think creatively.
- Help understand and summarise a complex situation.
- Unearth the critical issues – unearth the "real" problem.
- Build a common understanding of the situation within the team.
- Help communicate your team's understanding of the situation to others.

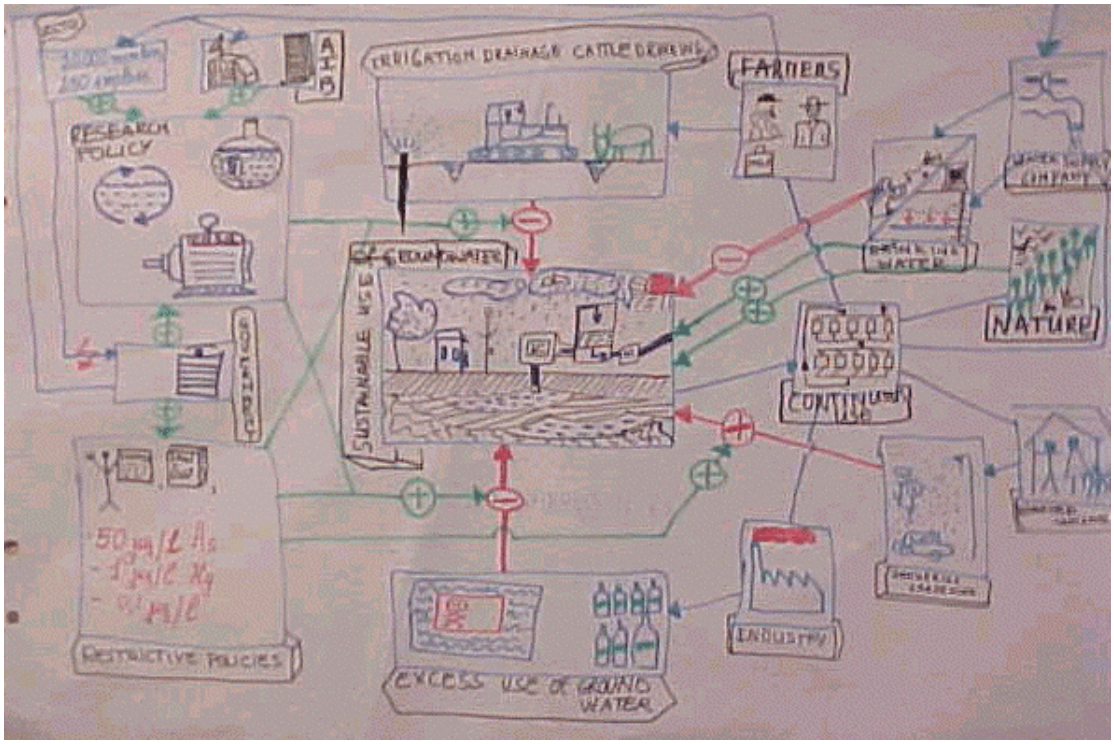
4.3 Steps

Again, there are few rules to a rich picture.

- Discuss with your team colleagues the main purpose of the diagram, and who is going to draw it, and with what information. How will you make sure the picture is as "rich" as possible?

- You can start by visualising the central theme or issue (as identified by the client) in the middle of a large sheet of paper. Try to express this as a simple picture or cartoon.
- Add elements of structure (e.g. important stakeholders) that seem most relevant to the problem situation. Don't worry about the layout or shape of your diagram at this stage (you can always redraw it later). You are a stakeholder (or you represent one or more stakeholders): so include yourself or your team in the diagram - What is your role, view of the situation?
- Add any activities or processes that seem to be an important part of the situation.
- As you add the elements to your picture, try to express any interrelationships between these items of structure and process. Or the absence of such a relationship where you might think there should be one.
- If you have conducted interviews with stakeholders, try to include the main issues as seen be the different groups (i.e. don't just stick to "factual" information, but include the different perspectives). A common way of doing this is to use speech bubbles.
- Look for areas that are confusing, or are not clear – try to express these.

4.4 Example



This example of a rich picture is based on the problem of groundwater use in N.Brabant described in the previous section (stakeholder maps). It was drawn by the ICRA group to express the different aspects of the problem: water use and stakeholder conflict. The diagram was then used to focus the study to specific aspects of groundwater use.

5 Flow diagrams

5.1 What are flow diagrams?

Flow diagrams emphasise the flow of something within or between systems. In agricultural or rural livelihood analyses, these flows are usually of materials, nutrients, labour, cash or information. When a particular system is depicted with boundaries, this type of diagram can also be referred to as an "input-output" model.

This type of diagram is sometimes also referred to as a "flow chart", although flow charts are often used to depict a *process* with a defined starting and end point, and showing the activities and decisions at different points within this process.

5.2 When to use flow diagrams

Flow diagrams show how scarce resources are deployed within a system. When the boundaries to the system are shown, they can also show clearly the inputs and outputs of a particular system (e.g. a "farm system") and how interrelated this system is with other systems (e.g. other farms within the same are, with communal resource systems, with marketing systems, etc.).

Making explicit the flows between components of a system facilitates discussion about potential changes to those components and the likely impact on the system (for example, what would happen if this farm type stops growing sorghum and instead grows tomatoes?).

Flow diagrams can be stylised or pictorial. Pictorial diagrams are easily visualised and can hence promote communication between development professionals and rural people. Use of such diagrams facilitates "visioning" where farmers can explore or model ideas that involve exploiting new agroecological niches, adding new elements (crops, livestock) to their activities, changing resource flows, etc.

5.3 Steps

First, decide on the purpose of the diagram: is it to facilitate analysis and visioning with farmers what sort of flow is to be modelled, according to the need for analysis. Diagrams that try to combine different sorts of flow (eg materials, labour and cash) can turn out to be too cluttered – it is often better to draw separate diagrams to show these different aspects.

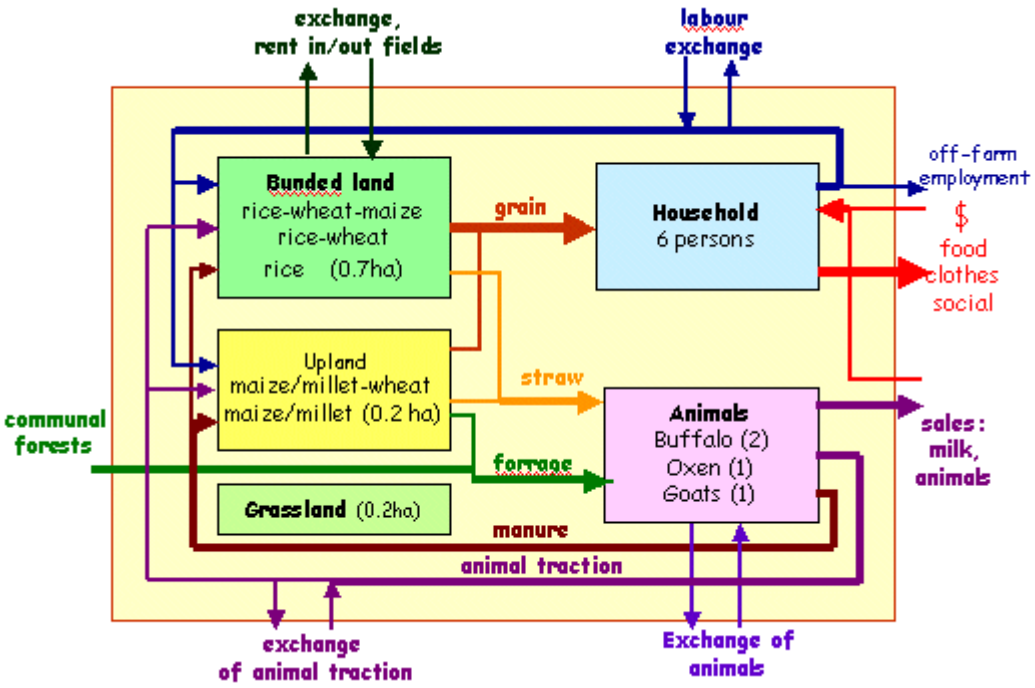
Next, use boxes, icons or drawings (depending on who will be involved in drawing or reading the diagram) to depict the main elements of the system being modelled. Be sparing of "clip-art", (this usually clutters diagrams for little additional gain in understanding). Show the main flows with arrows between these components, labelling the arrows for clarity if needed. Do not use double-headed arrows to depict flows (e.g. information) in both directions between two elements, as the flows are not identical (use two separate arrows and distinguish what *type* of information is being transferred).

It is usually helpful to distinguish the boundaries of the system that is being considered (e.g. farm, village), so that inputs and outputs are more clearly identifiable (e.g. communal resources such as grazing lands, forests, rivers, wells, etc.)

5.4 Examples

The following 4 examples show flow diagrams with different perspectives and emphases:

A Stylized input-output flow diagram of a Nepali hill farm.

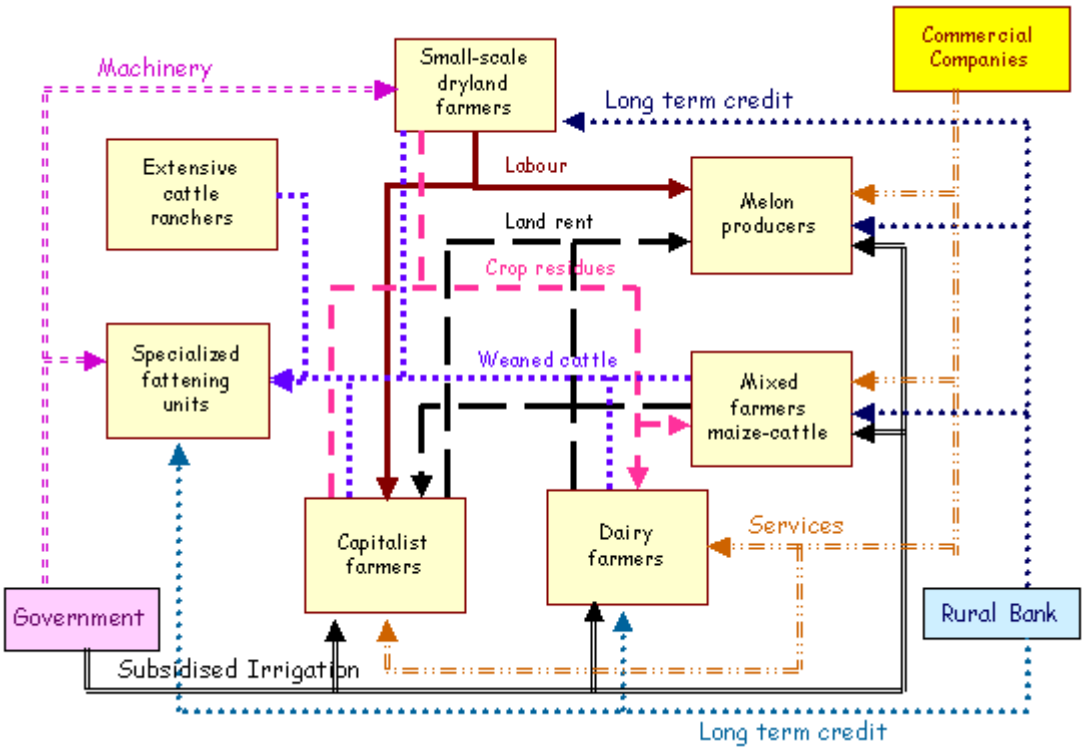


The model of the Nepali hill farm shows flows of labour, animal power, and crop-livestock products.

It shows the importance of communal forests as a source of fodder for the livestock, which are, in-turn, important as a source of power, manure and the main source of income. Cropping patterns are already very intensive (with double or even triple cropping within one year – although crop calendars would be a better way to show this information). In spite of this intensity, no fertilizers are imported into the farm, showing highly closed nutrient cycles (the only source of nutrients from outside is the fodder from communal forests).

This example was drawn by the author in 1986, and shows the perspective of researchers at that time. It shows clearly the boundary of the farm, and the inputs and outputs. Drawing the diagram in this way emphasises the surprising amount of exchange with other farms (labour and animal power sharing agreements, livestock exchange, etc.); the farms are not as independent as had been thought by the researchers, and indicates that a communal approach to the research and development might have been more effective than the emphasis at that time on the individual farm as the main unit for analysis.

B Stylized flow diagram of Mexican region

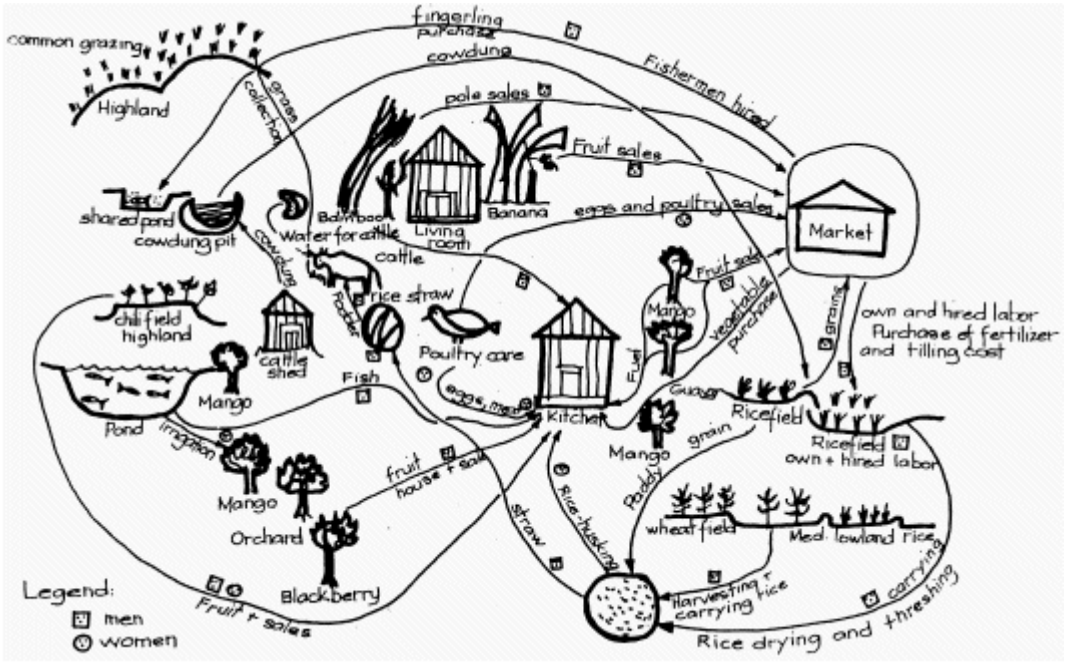


This flow chart represents a model of agro-ecosystems at a higher hierarchical level – the micro-region – rather than the farm level model in the previous example.

An ICRA field group drew this model of a Mexican rural region in 1989. It shows the flows of labour, land and materials (weaned cattle, crop residues) between 7 types of farm, and flows of credit and services from 3 types of regional agency to these different farm types.

The diagram indicates how the different farm types are interrelated. Changes in any one of these farm types are likely to affect not only that type of farm, but also will affect the other types as well.

C Pictorial flow diagram of a Bangladeshi Farm

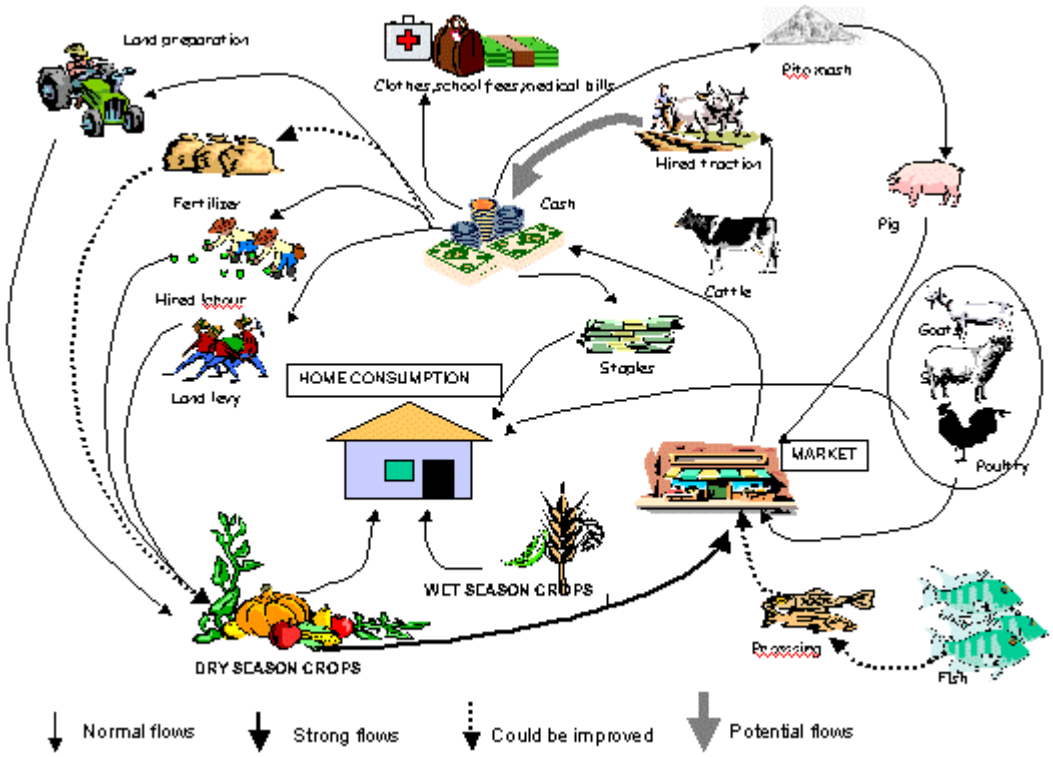


This diagram of a Bangladesh farm was drawn by the farmers themselves, after prompting and discussions with researchers (Lightfoot, Feldman and Abedin, 1991: *Households, agroecosystems and rural resources management*; published by Bangladesh Agricultural Research Institute and The International Centre for Living Aquatic Resources Management, The Philippines).

The diagram shows mainly flows of materials between different productive activities in the farm, but it also indicates the important communal grazing areas in the highland. Although the boundaries of the farm are not clearly demarcated in this diagram, it clearly shows inputs (labour, fertilizer, vegetables) and outputs (fruit, fish, eggs, poultry grain), as well as crucial flows within the farm (e.g. cow dung as manure to the crop fields, rice straw as fodder for the livestock).

The diagram also uses symbols associated with the different flows to disaggregate labour activities by gender, showing whether the man or women are responsible for certain activities. This distinction enables the researchers to focus more in-depth investigation of certain activities to the right person, as well as giving an indication of the potential impact of changes to the system on both men and women.

D Economic flows in irrigated systems, Ghana



The above diagram is from an ICRA study in Upper East Ghana. It formed shows the economic flows in irrigated systems and was used to contrast the cash inflow-outflow situation with rain-fed farming systems. These diagrams were used in conjunction with bio-resource flows.

In this diagram the thickness of the arrow depicted was varied to show the magnitude of the cash flow. Other types of arrow were also used to show potential improvements to the cash flow situation (e.g. potential earnings from hiring out livestock for traction).

6 Sign graphs

6.1 What is a sign graph?

A sign graph shows the relationships between processes or variables within a system, and whether this relationship is positive or negative.

6.2 When to use graphs

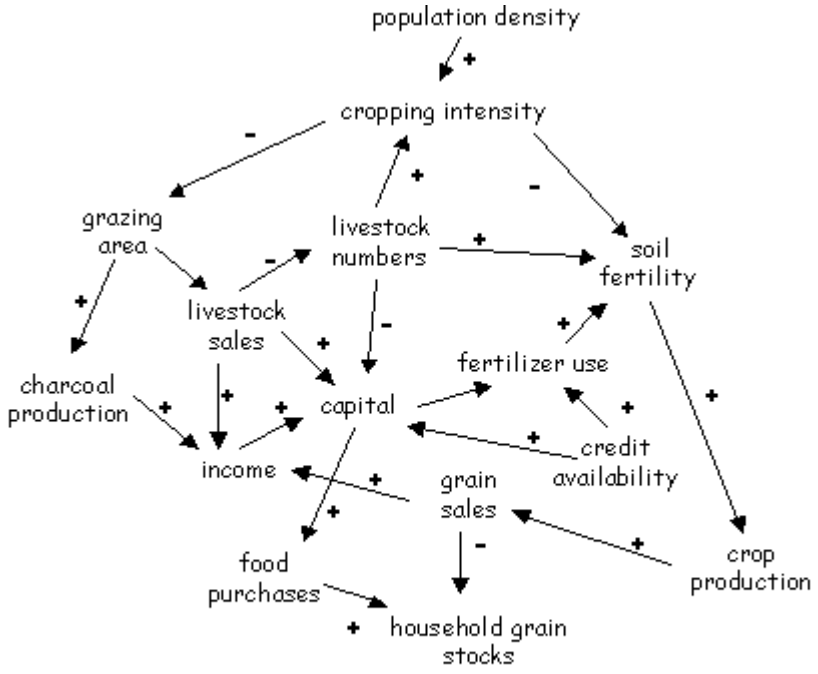
A sign graph is useful for understanding the dynamics of a complex situation. It can show the likely consequences of an intervention.

6.3 Steps

Start with the variable (activity, process) of interest and identify what other variables are causing an increase or decrease in magnitude of the first factor. Mark this relationship with an arrow. If an increase in the second variable (e.g. income) causes a increase in the first (e.g. capital level) mark the arrow with a positive (+) sign. Or, if an increase of the second variable leads to a decrease in the first, mark the relationship with a negative (-) sign (for example, a decrease in livestock numbers leads to lower level of available capital).

Build up the diagram by tracing the related variables that influence the magnitude of those already identified. If the relationship between the two variables is not clear, this should be explained in the accompanying text (e.g. why an increase in livestock numbers leads to an increase in cropping intensity).

6.4 Example



The complex interrelationship between livestock, crop production, capital and food security in an Ethiopian district

7 Problem - causal diagrams

7.1 What is a problem-causal diagram?

A problem-causal diagram shows the progressive breakdown of problems into contributing or related causes. Another name for this type of diagram is a “multiple cause diagram”, or, because of a common shape of the diagram, “problem trees” or “problem-causal trees”. Similarly, the analysis that this type of diagram facilitates is called a “problem causal analysis” or “constraints” analysis.

When expressed in causal diagrams, there is little distinction between “problems”, “causes” and “effects”. The difference depends on the level at which the problem is identified. “Many people use cars to travel” is a cause of the problem identified as “roads are congested”, but it can also be considered as a “problem” in its own right. That “roads are congested” may lead to “effects” such as “air is polluted”, which may in turn mean that “people’s health is affected”; but these can also be considered “problems” or “causes” which lead to further “effects”, etc.

7.2 When to use problem causal diagrams

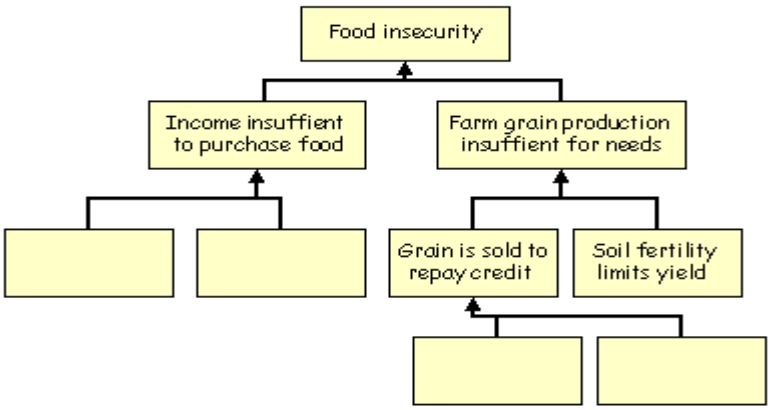
Problem-causal diagrams are another way of summing up a complex situation and integrating the perspectives of different disciplines and stakeholders. Also, it is often a waste of time tackling a problem directly (e.g. by constructing more roads), if the causes of that problem (ineffective public transport, need to travel) are not addressed.

Once a diagram has been constructed that shows a hierarchy of problems (i.e. a negative state), it is relatively simple to “convert” this into a positive hierarchy of objectives or “objectives tree” which forms the basis of most planning procedures and “logical frameworks”. Some planning procedures (e.g. the “ZOPP” or “objectives oriented project planning” approach) require the construction of a problem and objectives tree by all stakeholders involved (see ICRA handout on “objectives”)

7.3 Steps

A - using vertical logic

In the “tree” form, a central problem is identified and then the main “causes” of this



problem then described in a second “layer” underneath. The causes of this second layer of related problems are then identified and described in a third layer, and so on. In this way, the tree is constructed vertically downwards.

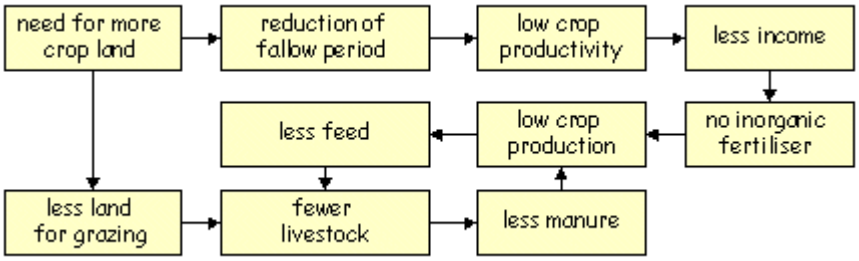
Alternatively, a set of problems that have been identified by brainstorming, or through interviews etc. can be summarized on cards and then ordered hierarchically beginning with any card, and then placing the cards that represent “causes” below the first card, and those that represent “effects” above.

In a diagram that uses a “vertical logic” such as this, it is important to continually ask: “does problem A cause problem B, or does problem B cause problem A”? The hierarchical structure of the diagram is then built up until the “problems” or causes identified fall outside the possibilities of action by the involved stakeholders or clients (e.g. “grain prices reduced by imports”). Of course, it is not always easy to decide whether stakeholders should treat a problem as beyond their scope for action (e.g. they could form a lobby group to change trade policies). It is important to remember that problem-objective trees are just an aid to thinking and planning.

The advantage of a hierarchical diagram using vertical logic is that makes conversion to an objectives tree and logical framework easier. The difficulty is that many problems are more inter-related than can be shown easily in such a vertical structure (although problems – cards, boxes - can be repeated at different points of the diagram).

B – showing interrelated causes

Many problems are inter-related in such a way that they form a “vicious circle”. It is not easy to emphasise such relationship using the strong vertical logic described above. In this case, it may be easier to place the problems and causes in a less rigid way:



In building these sorts of diagrams, it is usually easiest to use cards that can be easily re-arranged. If pin boards are unavailable, cards can be stuck to poster paper on walls with glue or masking tape.

7.4 Precautions

These diagrams are easy to understand. Building a good problem-causal diagram is not easy, however, for several reasons:

Facilitating group work. Group sessions to construct problem/objective trees can be long and difficult to facilitate (it took 3 days for the ICRA group to fully construct the example from Brazil partially represented below). The facilitator should not be involved with the content of the discussion (e.g. whether seed quality is really an

important issue causing poor plant populations) - only with clarifying the nature of the problem and the logic of the causal linkage to the satisfaction of all the other participants. If several people try move cards at the same time (as often happens in heated exchanges!), the process has become unmanageable. If the facilitator does have a technical opinion on the causal linkages being discussed, he/she should hand over the facilitator's role to someone who is less interested in the technical points being discussed.

Vagueness. It is tempting to put vague ideas down (e.g. "soil fertility", or "inappropriate technology"). Such cards allow several different interpretations by different observers. ("inappropriate" in what way?). Similarly, cards may express several ideas at once ("soil fertility" may imply a combination of, for example, low N content, low P content, even low moisture holding capacity - all of which may have distinct causes and lead to different solutions). It is therefore important to phrase and clarify carefully each card; to do this it is often useful to identify or discuss a measure or indicator for each card (e.g. ask the writer of the card how he/she would measure "soil fertility"), and perhaps express this indicator on the card.

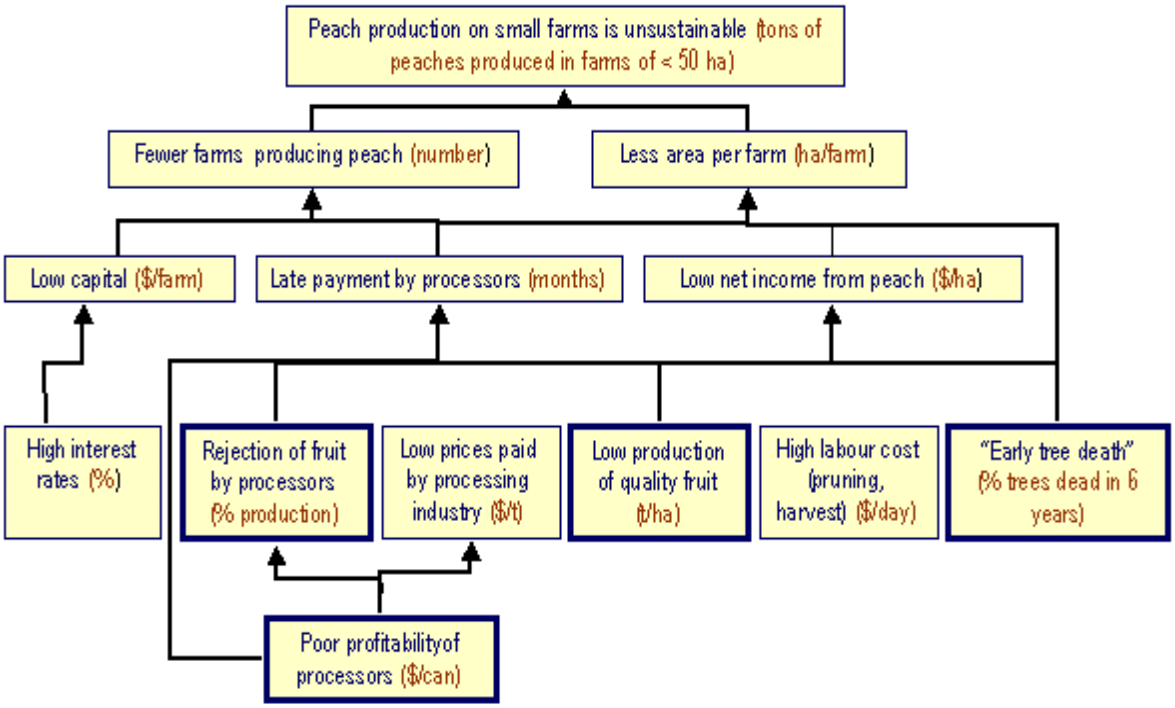
Absent solutions. It is also tempting to put absent solutions as problems (e.g. "lack of herbicides"), but these ideas should be rephrased where possible (e.g. "high incidence of broad leaf weeds"). The danger here is that if the problem is expressed as an absent solution, it may preclude thinking about other ways to solve the problem (e.g. crop rotations, or tillage, as ways to reduce weeds).

Uncertainties. Often, there may be a suspected problem or causal linkage. These should not be discounted, but it can be useful to clearly mark the card or linkage as a "hypothesis", and perhaps make a separate note to collect more data to verify or reject this hypothesis later.

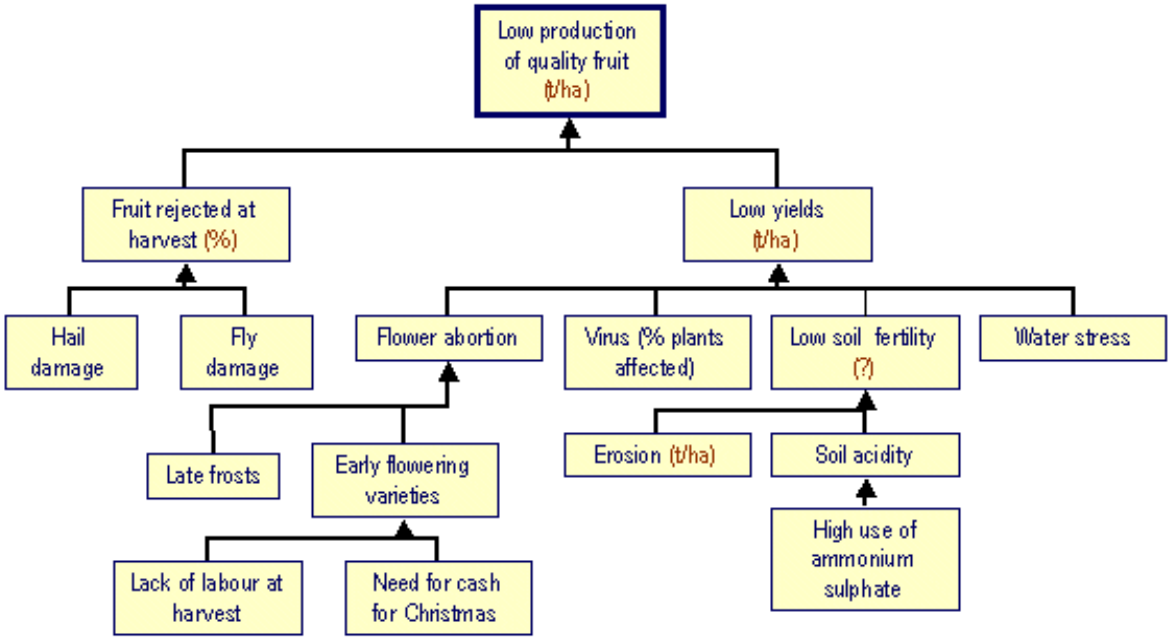
Ignoring opportunities. It should be remembered that a problem-causal analysis is a means to identifying future opportunities and objectives. Overemphasizing current problems can sometimes cause a team to loose focus on future opportunities.

7.5 Example

The following problem causal analysis was drawn by an ICRA group studying the sustainability of peach production in Southern Brazil, on behalf of a regional research station with mandate for family farms and a long-established peach research programme. The team used the problem causal analysis to integrate the information they had gained from stakeholder interviews. For ease of presentation and comprehension, the complete analysis is presented in 5 related diagrams.

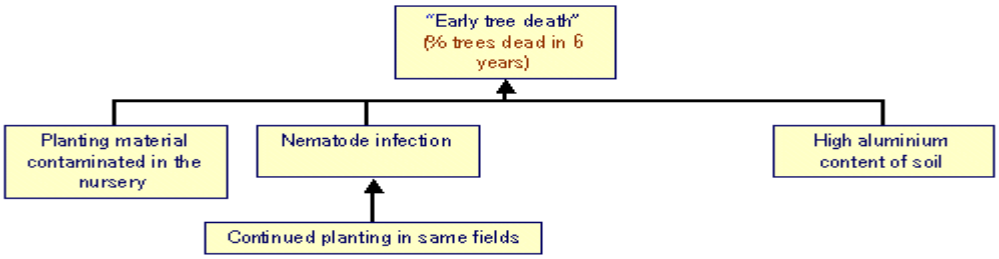


The above diagram shows the main areas that were analysed in more detail.

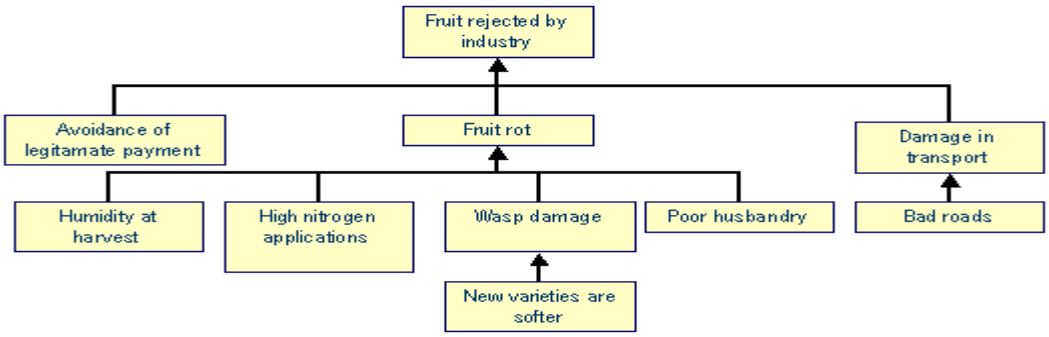


First, the team analysed the on-farm production problems. This included both reasons for low production, as well as the reasons that the farmers rejected fruit for shipping to the processing industry.

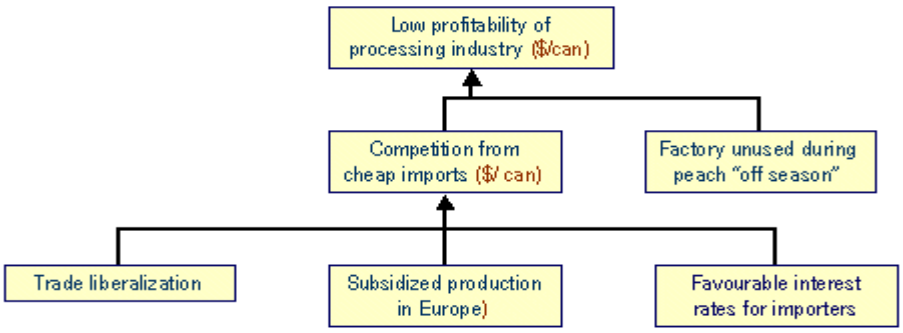
Secondly, the team looked at the reasons for the premature dying off of young trees, which worried farmers. Different reasons were given for the problem of early tree death by researchers, extensionists and farmers, respectively. The ICRA team concluded that more research was needed to clarify the issue.



Another major concern of farmers was that the canning industry rejected fruit after it received it at the factory (and for which no payment was then made to farmers). Farmers said that this was simply a trick to avoid payment for good fruit. The industry said the fruit was of poor quality and easily damaged. The team suggested that this problem could be resolved by an independent grading at the factory.



Then the team looked at the profitability of the processing (canning) industry. The processing industry was unable to raise prices to make cultivation more attractive to farmers because they were facing increasing competition from imports – unfair competition according to them. Most of the stakeholders agreed that if these favourable conditions continued for imports, they could not compete with the local production, even with improvements.



From the overall analysis, the team proposed a number of research activities for the major client (the a research centre), including proposals for collaboration with local NGOs and the canning industry, directed towards improving the sustainability of peach production on family farms in S. Brazil.

8 Acknowledgements

This learning resource was prepared for ICRA (www.icra-edu.org) by Richard Hawkins. It forms part of the ICRA learning resources, written for use in capacity building in “Agricultural Research for Development”. You are welcome to use these materials for non-profit purposes; we only ask you to send us a short email at Secretariat.ICRA@wur.nl, or leave a comment on our webpage telling us how you have used them and how you think they could be improved – Thank you!