webAKT Tutorial 2
Creating a simple knowledge base
Part 1: Introduction and sample knowledge source

This tutorial guides you through the creation of a small knowledge base and then invites you to try out different ways of exploring it. This is the second webAKT Tutorial. Tutorial 1 - Viewing a Knowledge Base – takes you through the tools available for displaying the various components of an AKT knowledge base, such as statements and sources. **The present tutorial assumes you have familiarized yourself with these tools, and now wish to learn how to build a new knowledge base and/or edit an existing one.** So, if you have not already done so, please work through Tutorial 1 – it should take less than 30 mins.

The tutorial is only an introduction to AKT; please use chapters 7 – 12 to guide you when you require further information on AKT facilities.

The knowledge used in this tutorial is abstracted from:
Bandy, D.E., Garrity, D.P. and Sanchez, P.A. (1993) The worldwide problem of slash-and-burn agriculture. Agroforestry Today Vol. 5 (3), 2-6.

In this tutorial, we will first see (Part 1) how to:

- Analyse the information provided by some source (in this case, a published document);
- Extract the information into individual statements;
- Express these statements in AKTs formal language.

Then (Part 2), how to use webAKT to:

- Enter sources;
- Enter statements – the text-based method;
- Editing and entering formal terms;
- Creating and editing object hierarchies;
- Creating and editing topics;
- Creating and editing topic hierarchies;
- Entering statements – the template method;
- Entering statements – the diagramming method;
- Adding images [*working but not yet written up in the tutorial*].

Analysing the information provided by some source

For the purposes of this tutorial, we will make use of the following text as our source knowledge. It may be more usual however, for source knowledge to be a tape-recorded interview.

The following are extracts from the source text:

> *"...burning helps to control pests and diseases....the higher soil temperatures that follow clearing and burning also accelerate the decomposition of organic matter in the top layers of the soil.*
>
> *About half of the nitrogen and phosphorus in the burnt material and nearly all the remaining nutrients are released to the soil from the ash after burning. These nutrients are flushed from the ash by the rain and have the effect of raising the pH of the upper layers of soil as well as incorporating the nutrients. Nutrients in concentrated form are thus available for one or two years after clearing. The quantity and quality of these nutrients depends on the native fertility of the soil…*
>
> *Crops such as corn, rice, beans, cassava, yams and plantains are then planted.…*
>
> *As nutrients are removed by crop harvests or lost through leaching, soil fertility declines. At the same time, the relatively easily removed broad-leaved weeds are replaced by harder to manage grasses and increasing weed density quickly impedes further cropping. The fields are then abandoned for a period of fallow.*
>
> *The secondary forest grows rapidly during the fallow, using nutrients remaining in the soil...Essential minerals (phosphorus, potassium, calcium, etc.) are extracted from lower soil layers during regrowth and brought to the surface by trees..…*
>
> *Soil erosion... is seldom a problem in shifting cultivation because the cleared areas are small and are always covered by some sort of vegetation. When unsustainable slash-and-burn is practised by newcomers, however, the soil is sometimes left uncovered. This can lead to major erosion problems, particularly in hilly areas.....*
>
> *When the soil is bare and erosion a problem, the siltation rate of the waterways is increased and this often has a negative effect upon aquatic life forms and fish production.*
>
> *Neither are weeds a difficulty in the traditional method because the land is left to fallow as soon as they become a problem. In the*

subsequent fallow period, weeds soon die out as the crown of the secondary forest closes. Migrant farmers, however, will remove all vegetation and the roots and stumps of the felled trees from the areas they clear for intensive farming.

These practices mean that when the land is finally abandoned there are no rootstocks left from which the trees may grow and grasses are the most common invaders of the open areas. This means that clearing of land by migrant farmers generally results in the permanent destruction of the rain forest."

The intention behind creating a knowledge base in AKT is to represent knowledge that provides a description of the ecology of a particular agroforestry practice. This is achieved by abstracting a set of unitary statements from the source knowledge that, as a set, represent a coherent description of the ecology of the practice. This process of breaking down the source knowledge into a set of unitary statements may demand considerable interpretation. Relying too literally on the exact statements in the source knowledge will tend to result in many statements in the knowledge base that become very difficult to interpret.

Consider, for example:

"In the subsequent fallow period, weeds soon die out as the crown of the secondary forest closes."

A literal abstraction of information might result in the statements that:

"Weeds soon die out in the fallow period"

"Weeds die out when the crown of the secondary forest closes"

Both statements are fairly literal abstractions and superficially reasonable and useful. However, as statements in a knowledge base they are problematic as both contain implicit information. The term 'soon' is relative to the rate of weed mortality on land, which is not fallowed. This is clear enough in the source knowledge but not as an explicit statement of ecological knowledge. Furthermore, in the second statement there is an implicit causality – however the statement only really identifies the coincidence of weed die back and canopy closure.

Interpretation might suggest that we should state instead that:

Forest canopy closure causes weeds to die back

and

Forest canopy closure occurs during the fallow period

Clearly this interpretation may require validation through further reference to the source knowledge. However, the knowledge expressed here is more fundamental and more useful than the above statements.

Extracting the information into individual statements

As a result of the interpretation involved, different sets of statements will be abstracted from the same source knowledge by different people with different objectives. It is important to realise that any abstraction of knowledge for representation in the knowledge base is open to debate. There can be no single correct abstraction, although there can certainly be incorrect ones. The statements in Table 14.1 are an example of one set of statements abstracted from the text. These do not immediately and literally relate to the source knowledge but are designed to capture its ecological content. Some statements are speculative and demand validation while others can be expressed with more confidence.

Table 14.1 Example set of statements abstracted from the text

s1	Burning causes a decrease in numbers of pests.
s2	Burning causes a decrease in crop disease levels.
s3	Clearing causes an increase in soil temperature.
s4	An increase in soil temperature causes an increase in the rate of decomposition of organic matter.
s5	Nutrient availability is high for two years after burning.
s6	Harvesting causes a reduction in soil nutrient levels.
s7	Leaching causes a reduction in soil nutrient levels.
s8	A reduction in soil nutrient levels causes a reduction in soil fertility.
s9	An increase in weed density causes a decrease in crop yield.
s10	Soil erosion is not a problem IF the soil is always covered with some type of vegetation.
s11	Soil erosion is severe IF soil is not covered with vegetation.
s12	Soil erosion is very severe on hills.
s13	An increase in soil erosion causes an increase in the siltation of waterways.
s14	An increase in the siltation of waterways reduces fish production.
s15	Weeds are not a problem IF land is regularly fallowed.
s16	Canopy closure causes the death of weeds.

Expressing the statements in AKT's formal language

Although statements entered through the diagram interface are formalised automatically, any statements entered through the statement card must be formalised manually. The process of formal representation requires some practice. Read through Chapter 4 (part 4.2), which takes you through formal representation step by step, then try to formalise the extracted statements given in Table 1. (Table 2 gives a formal version for each of the statements in Table 1.)There are no definitive, correct answers in formal representation, although there are ertainly incorrect ones.

NOTE: Remember to use the underscore (_), not a hyphen (-) when writing formalised statements, e.g. att_value.

Table 2. Formal versions for each of the extracted statements in Table 14.1

	Extracted Statements	Formalised Statements
s1	Burning causes a decrease in numbers of pests	action(burning,site) causes1way att_value(pests,numbers,decrease)
s2	Burning causes a decrease in crop disease level	action(burning,site) causes1way att_value(crops_disease, level, decrease)
s3	Clearing causes an increase in soil temperature	action(clearing, site) causes1way att_value(soil,temperature,increase)
s4	An increase in soil temperature causes an increase in the rate of decomposition of organic matter	att_value(soil,temperature,increase) causes2way att_value(process(organic_matter,decomposition),rate, increase)
s5	Nutrient availability is high for att_value(site, nutrient_availability, high) IF two years after burning	att_value(site, time_since_burning,range('0 years', '2 years'))
s6	Harvesting causes a reduction in soil nutrient levels	action(harvesting, crops) causes1way att_value(part(soil, nutrients),level,decrease)
s7	Leaching causes a reduction in soil nutrient levels	process(leaching) causes1way att_value(part(soil,nutrients),level, decrease)
s8	A reduction in soil nutrient levels causes a reduction in soil fertility	att_value(part(soil, nutrients),level, decrease) causes2way att_value(soil, fertility, decrease)
s9	An increase in weed density causes a decrease in crop yield	att_value(weeds, density, increase) causes2way att_value(crops, yield, decrease)
s10	Soil erosion is minimal IF the rate,minimal) IF soil is always covered with some type of vegetation	att_value(process(soil, erosion), link(covers, vegetation, soil)
s11	Soil erosion is severe IF soil is not covered with vegetation	att_value(process(soil, erosion), rate, high) IF link(not_covers, vegetation, soil)
s12	Soil erosion is very severe on hills	att_value(process(soil, erosion),rate, severe) IF att_value(process(soil, erosion), location, hillside) and att_valu
s13	An increase in soil erosion causes an increase in the siltation of waterways	att_value(process(soil, erosion), rate, increase) causes2way att_value(process(waterways,

		siltation),rate, increase)
s14	An increase in the siltation of waterways reduces fish production	att_value(process(waterways, siltation),rate, increase) causes2way att_value(action(production,fish), rate,decrease)
s15	The weed population does not become a problem when land is regularly left to fallow.	att_value(action(fallowing,land),frequency,regular) causes1way att_value(weeds, population,decrease)
s16	Canopy closure causes the death of weeds	process(canopy,closure) causes1way process(weeds,death)

You are now ready to create a knowledge base containing this information, in Part 2 of this tutorial.