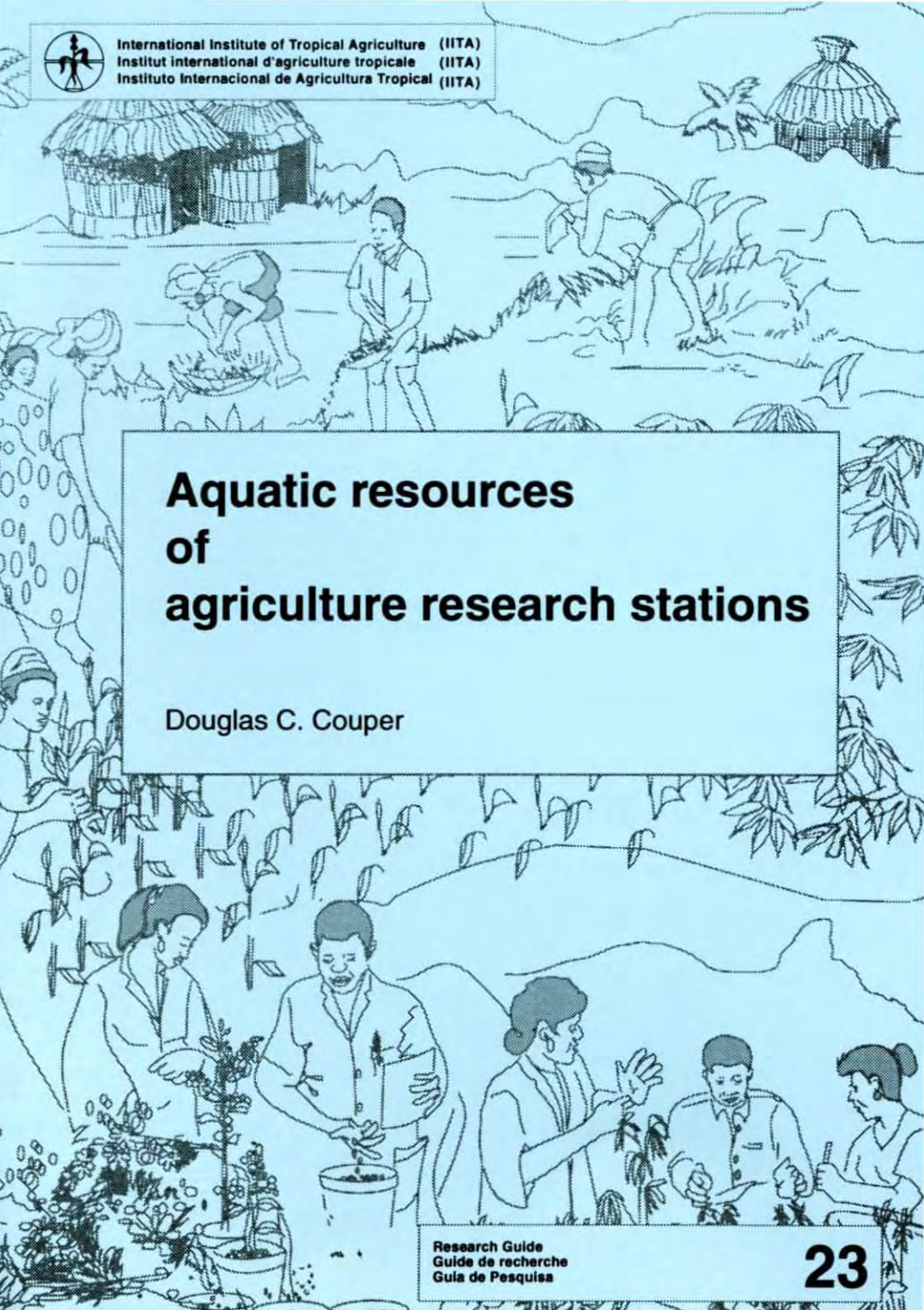

International Institute of Tropical Agriculture (IITA)
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Aquatic resources of agriculture research stations

Douglas C. Couper

Research Guide
Guide de recherche
Guia de Pesquisa
23

IITA Research Guide 23

Aquatic resources of agricultural research stations

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IITA Research Guides

IITA Research Guides provide information and guidance to scientists and technicians conducting research essential to agricultural development. Research Guides can be used in both research and training activities. They are periodically updated to meet advances in scientific knowledge.

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Aquatic resources of agricultural research stations

Objectives. This guide is intended to enable you to:

- describe alternatives of water supply,
- explain the principles of earth dam construction,
- manage lakes.

Study materials

- Farm plans for designing water supply.
- Slides on dam construction and management.
- Samples of water weeds.
- Samples of fish types.

Practicals

- Evaluate alternatives for water supply under your present local situation.
- Practice the design of earth dams.
- Describe the construction and use of earth dams.
- Practice weed control in lakes.
- Demonstrate fish harvesting methods.

Questionnaire

1 For what purposes does an agricultural research station require water?
2 What are the limitations of public water systems?
3 How can you ensure water supply in the event of temporary failure?
4 Why should you seek expert advice for bore-holes?
5 On what factors does the size of a reservoir depend?
6 Where should you locate a dam?
7 How deep should you dig the trench for a dam?
8 What are the correct slopes of a dam?
9 How can you stabilize the slopes?
10 How should you construct an emergency spillway?
11 What are three aspects of lake management?
12 How can you prevent sedimentation in lakes?
13 What are the two main types of weeds in lakes?
14 Why should you use mechanical rather than chemical weed control?
15 What should you consider when stocking *Tilapia* species in lakes?

Aquatic resources of agricultural research stations

1 Water supply
2 Construction of small earth dams
3 Lake management
4 Bibliography
5 Suggestions for trainers

Abstract. Every research station requires water. Local urban water supplies may be unreliable. Land storage tanks may be required. A research station may need to develop its own water supply by constructing wells or dams.

1 Water supply

Every agricultural research station requires water supply for:

- laboratories, offices, toilets, washrooms, and canteens;
- staff houses;
- livestock;
- irrigation.

Water may be obtained from several sources:

- public systems,
- shallow and deep wells,
- earth dams.

Public systems. Make sure that public systems can be used for all the station's needs. Sometimes a town supply is only allowed for domestic purposes, and an alternative source must be found for irrigation.

Find out whether the town supply is presently stretched to keep up with the demand, or whether it has capacity for future needs. If the town or city is growing at a rapid rate, ascertain that the existing supply can keep up with the projected increasing demand.

If water is taken from an existing public supply, build a good water storage tank, so that water is assured in the event of a temporary failure in the public supply.

Shallow and deep wells. If a water supply is not available, develop a supply on the station. The type of water system depends on the quantity of water required. A domestic supply requires a relatively low capacity, possibly only a shallow well or a single, small borehole.

Seek expert advice if a bore-hole is required, as the geology of an area will determine whether or not drilling a borehole is feasible. In some areas, a relatively shallow well may provide plentiful water throughout the year, whereas only a few hundred meters away, one may drill hundreds of meters deep without ever obtaining water. For example, there are borehole water supplies at IITA's Ikenne and Onne Stations and IITA's Ikeja Guest house, but it is impractical to drill boreholes in the granite rock base of the Ibadan farm.

Earth dams. Storing water in lakes or reservoirs formed by the building of dams is an alternative to wells and bore-holes. For research stations, generally, build earth dams using outside contractors or the research station's support services. Good examples of earth dams exist on the IITA Ibadan farm where 5 different sizes of dam have been built. One dam impounds water covering an area of 70 ha, two dams each create lakes of 2-3 ha, and two others create lakes of 1-2 ha.

The size of the reservoir depends on:

- kind of water usage envisaged (small for domestic use, larger for livestock and irrigation);
- duration of dry season.

Whenever contemplating a water supply using either bore-holes or dams, seek the advice of companies or government departments with expertise in water supply.

2 Construction of small earth dams

Construct dams in the following way:

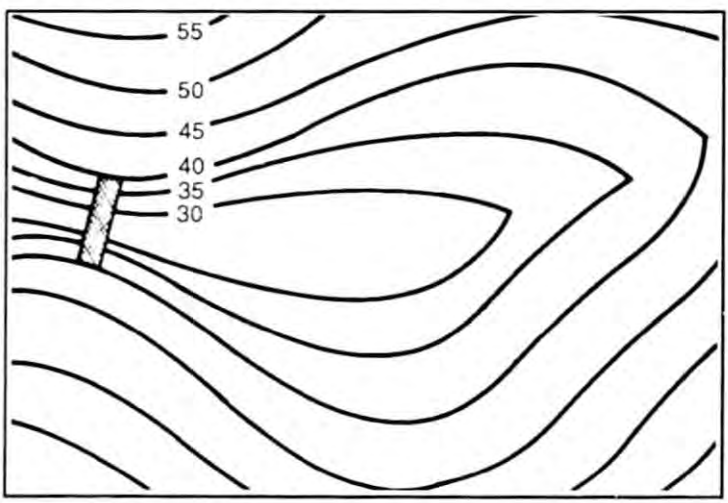
- Determine a suitable site for the dam from survey maps. Locate the dam where contour lines indicate a narrowing valley and steep slopes (Figure 1).

- Dig a trench over the length of the proposed dam, preferably down to bedrock. If this is impossible, try to dig the trench down to a clay layer.

- Back-fill the trench with clay from the area above the dam, deepening the area of the new reservoir.

- Excavate soil for the dam wall from the area immediately up-stream of the proposed dam and compact as construction progresses.

Figure 1. Suitable site for dam.



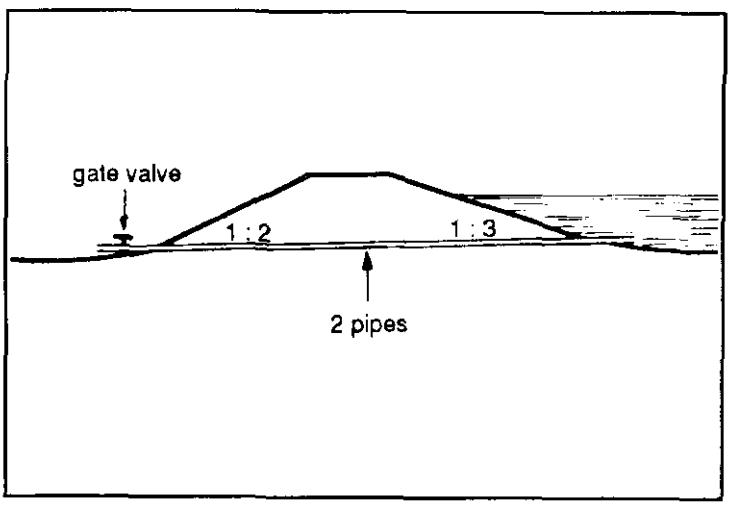
- Place two water pipes of suitable size under the dam wall on the downstream end. The pipes should have gate valves so that the lake may be drained during fish harvesting, dam repairs etc.

- Maintain correct slopes during construction. The slope on the downstream side of the dam wall should be 1 in 2 while the slope on the upstream side should be at least 1 in 3 (Figure 2).

- When the dam wall has been completed, stabilize the slopes by sprigging in a low growing but tough grass, such as *Paspalum notatum*.

- Water these grass sprigs, where possible, to ensure that the grass is established before the rains start.

Figure 2. Dam construction (side view).

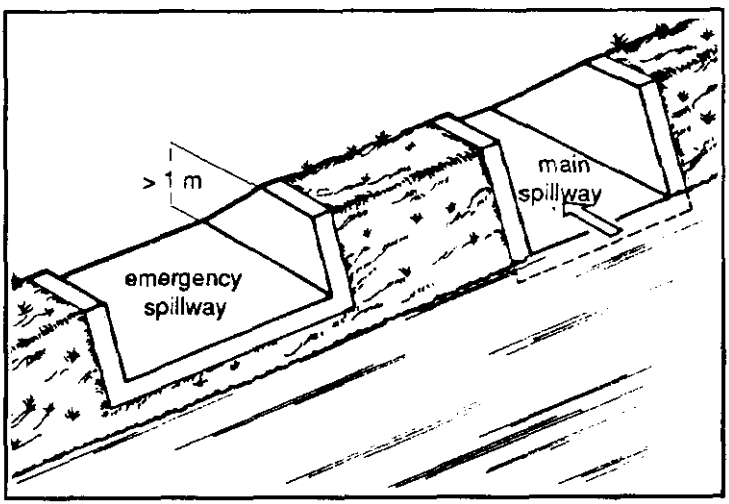


- Where windy conditions exist, line the lake-side slope of the dam with stone to prevent erosion (rip-rap).

- Construct a spillway, over, or through which excess water may flow, without eroding any part of the dam wall, when the lake is full. The spillway determines the level of the reservoir formed by the dam. Use concrete sill or culvert rings, for spillway construction. Calculate spillway size carefully, as too small a spillway results in destruction of the dam.

- If possible, install an emergency spillway at a slightly higher level than the main spillway in case the main spillway cannot cope during an emergency. The emergency spillway should be > 1 m below the level of the top of the dam wall in a small earth dam (Figure 3).

Figure 3. Main spillway and emergency spillway.



3 Lake management

Lake management may be divided into three aspects:

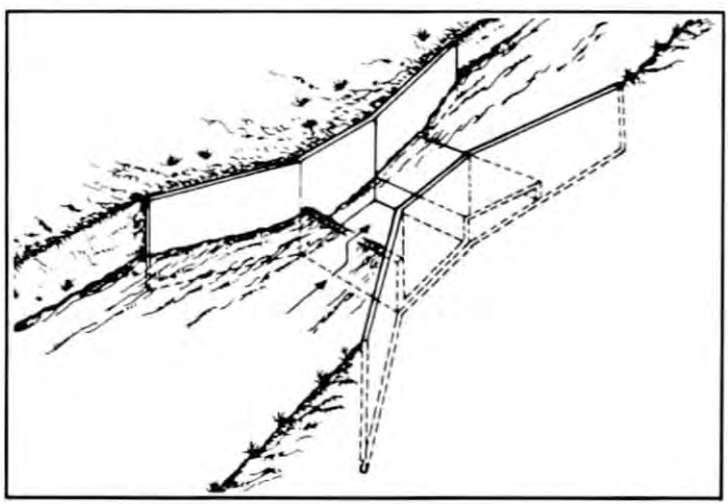
- sedimentation prevention,
- weed control,
- fish production.

Sedimentation prevention. Sedimentation control is often impossible, but two methods of prevention are:

- Drop boxes in in-flow valleys reduce the scouring effect of water run-off in the valley bottom, thereby reducing the amount of sediment carried into a lake (Figure 4).

- Water weeds growing in valleys or drainage ways slow down the run-off water so that sediment settles and deposits among the weeds before the water enters the lake.

Figure 4. Drop box to control sedimentation.



Weed control. In warm climates, such as in tropical Africa, water in lakes is always warm. Weed therefore grows in the water throughout the year and if not checked, may cover the whole surface of a lake resulting in:

- poor quality of water supply;
- prevention of fish harvesting and recreational activities.

Examine the vegetation in a lake frequently to avoid a problem weed becoming dominant.

Two main types of weeds are:

- floating weeds such as water lettuce and water hyacinth;
- bottom rooted weeds such as water lilies and *Polygonum*.

Floating weeds pose a severe problem as their rate of multiplication is fast. Once introduced, they can completely cover the water surface of a small lake in a few weeks. Examine the lake frequently. If any floating weed is seen, remove it by hand immediately.

Should the floating weed become a problem, use mechanical rather than chemical control methods. Chemical weed control can completely ruin quality of the water and cause the death of living organisms in the water. Several companies manufacture machines called water weed harvesters (Figure 5), which can rake up floating weeds and lift them onto dry land.

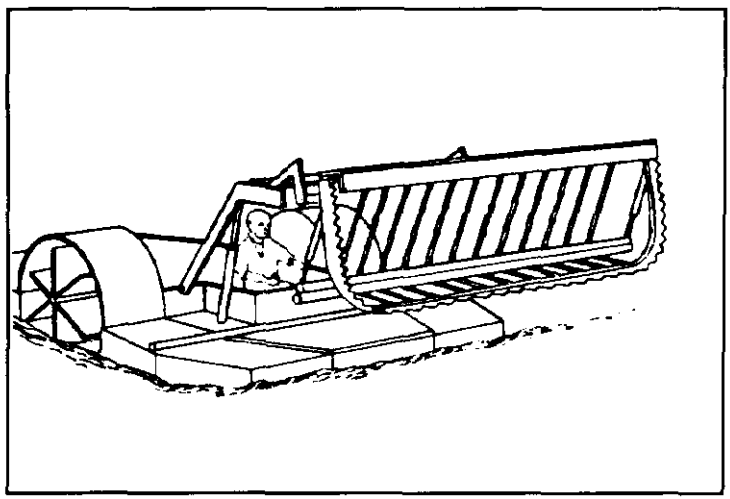
Generally, non-floating weeds are easier to control. If cut off under the water, the cut vegetation floats to the

surface where it can be blown to the sides of the lake, to rot or be removed either manually or mechanically.

Spray a small area of a potentially troublesome non-floating weed with a suitable herbicide such as glyphosate, which translocates into roots, rhizomes and stolons, killing off the weed completely.

Fish production. Stock fish into any lake on a research farm. Different fish have different foods. For example, within the *Tilapia* family, some species eat plankton, others eat plants, and others eat organisms in bottom mud. Plankton feeding fish help to prevent plankton build-up which can block water pumps in lakes. Similarly, plant-eating fish help to prevent weed build up.

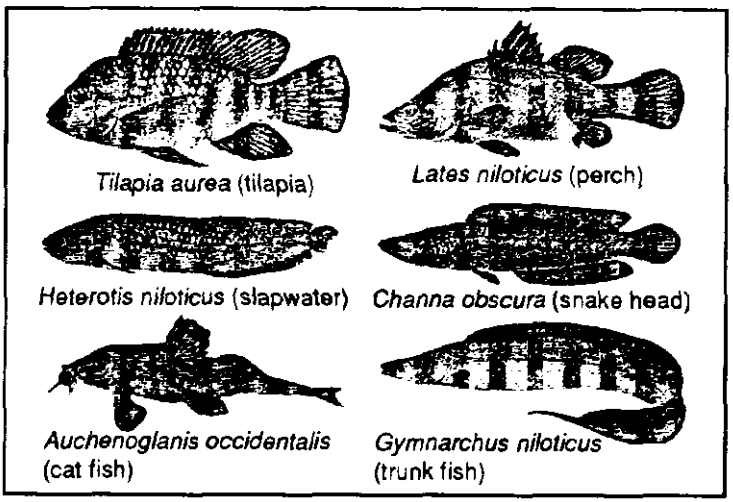
Figure 5. Water weed harvester.



If intending to stock a lake with fish, seek advice on the most suitable species for your situation. Generally, try to stock different species of fish (Figure 6) which do not compete with each other. However, *Tilapia* species tend to breed rapidly and overpopulate the lake. This results in the production of a great many, very small unmarketable fish. Introduce predatory fish into the lake so that the small fish are eaten leaving fewer fish which can grow to larger, marketable sizes.

Fish may be harvested from time to time using gill nets, seine nests or long lines. Alternatively, a small dam may be emptied during the rains and all the fish harvested.

Figure 6. Different species of fish stocked in a lake.



4 Bibliography

Couper, D.C. 1995. Use of maps for planning research farms. IITA Research Guide 7. Training Program, International Institute of Tropical Agriculture (IITA), Ibadan, Nigeria. 29 p. Third edition.

5 Suggestions for trainers

If you use this Research Guide in training ...

Generally:

- Distribute handouts (including this Research Guide) to trainees one or several days before your presentation, or distribute them at the end of the presentation.
- Do not distribute handouts at the beginning of a presentation, otherwise trainees will read instead of listen to you
- Ask trainees not to take notes, but to pay full attention to the training activity. Assure them that your handouts (and this Research Guide) contain all relevant information.
- Keep your training activities practical. Reduce theory to the minimum that is necessary to understand the practical exercises.
- Use the questions on page 4 (or a selection of questions) for examinations (quizzes, periodical tests, etc.). Allow consultation of handouts and books during examinations.
- Promote interaction of trainees. Allow questions, but do not deviate from the subject.
- Respect the time allotted.

Specifically:

- Ask trainees about experiences with water supply on their research stations (10 minutes).

- Present your subject, using the study materials suggested on page 3 (45 minutes).

  Have real samples of different species of fish available.

  You may photocopy the illustrations of the Research Guide on transparencies for projection with an overhead projector.

- Carry out the practicals suggested on page 3 (2 hours). When practicing a particular technique, make sure that each trainee has opportunity to practice. You may have to conduct the practicals in simultaneous group exercises.

  Organize your practicals/demonstrations well. Keep trainees busy. Prevent trainees from scattering around the lake.

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The International Institute of Tropical Agriculture (IITA) is an international agricultural research center in the Consultative Group on International Agricultural Research (CGIAR), which is an association of about 50 countries, international and regional organizations, and private foundations. IITA seeks to increase agricultural production in a sustainable way, in order to improve the nutritional status and well-being of people in tropical sub-Saharan Africa. To achieve this goal, IITA conducts research and training, provides information, collects and exchanges germplasm, and encourages transfer of technology, in partnership with African national agricultural research and development programs.

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O Instituto Internacional de Agricultura Tropical (IITA) é um centro internacional de investigação agrícola pertencendo ao Grupo Consultivo para Investigação Agrícola Internacional (GCIAI), uma associação de cerca de 50 países, organizações internacionais e regionais e fundações privadas. O IITA procura aumentar duravelmente a produção agrícola para melhorar a alimentação e o bem-estar das populações da Africa tropical ao sul do Sahara. Para alcançar esse objetivo, o IITA conduz actividades de investigação e treinamento, fornece informações, reúne e troca material genético e favorece a transferência de tecnologias en colaboração com os programas nacionais africanos de investigação e desenvolvimiento.