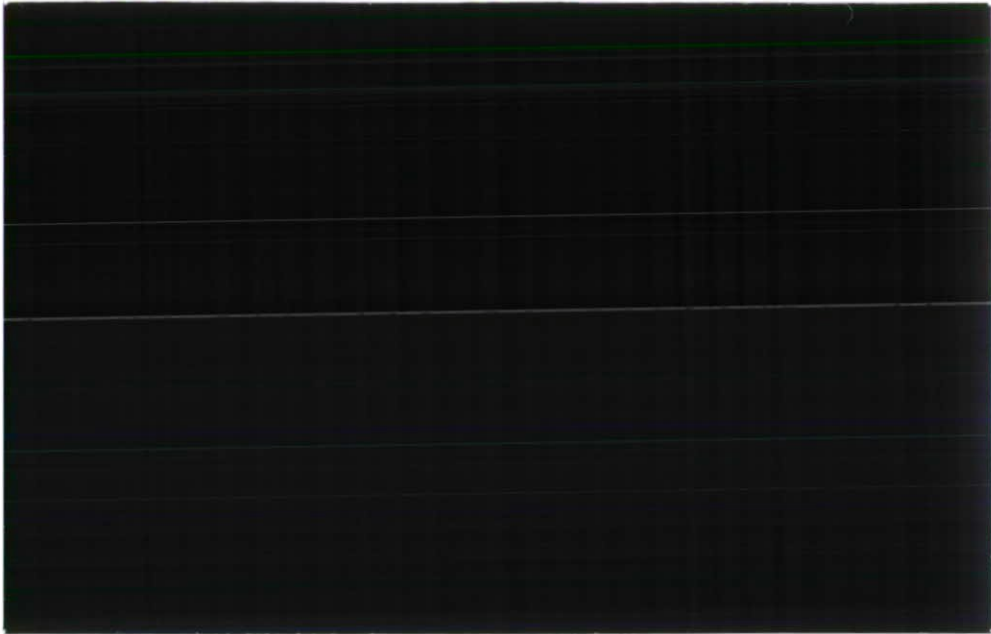




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***COMMENTS ON THE MALAWI GOVERNMENT  
WATER RESOURCES MANAGEMENT POLICY  
AND STRATEGIES***

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## **SUMMARY**

1. The Water Resources Management Policy and Strategies document provides sound and well argued reasons for developing a Water Resources Management Policy in Malawi.

2. These arguments could be strengthened with respect to consideration of the sensitivity of the Lake Malawi - Shire River system to both natural and man induced changes.

3. The issue of sensitivity is considered in relation to the following:

- \* FUTURE WATER RESOURCE ALLOCATION - A ROBUST OR FRAGILE RESOURCE?
- \* SENSITIVITY ANALYSIS
- \* MANAGEMENT OPTIONS



## **FUTURE WATER RESOURCE ALLOCATION - A ROBUST OR FRAGILE RESOURCE?**

It is well recognised that the economy and future development potential of Malawi is inextricably linked to the continued functioning, both in terms of water quality and quantity, of the Lake Malawi - Shire River system. It is also widely believed that "Malawi is endowed with abundant water resources"; with Africa's third largest freshwater lake within the country boundaries it is easy to understand this sanguine view.

The present functioning of the system does not necessarily imply it will continue into the future. For two decades this century there was no flow out of the Lake; a result almost certainly due primarily to natural climatic variability. If the climatic situation was to repeat today the impact would be severe; electric power production would cease, transport on the lake would be brought to a virtual halt through lack of port facilities, tourist developments on the lake shore would be badly affected as would water supplies to the major city and towns supplied by the Shire together with the irrigated production of sugar cane fed lower down the Shire. In the longer term there would be adverse impacts on fisheries and the environment.

### **SENSITIVITY ANALYSIS**

The sensitivity of the system to changes in land use with respect to the area of the land catchment under forestry and the area under irrigation has been investigated using a previously developed water balance model for Lake Malawi (Calder et al. 1994).

Figure 1 shows the observed lake levels since 1955 together with the predicted levels obtained using a model which takes into account a 13% reduction in natural forest cover during the years 1967-90. Figure 2 shows that if the 13% reduction in forest cover had not occurred the present lake levels be about 1 m lower than they are.

Figures 3 and 4 show how lake levels in the recent past would have been affected had they been operating under different irrigation scenarios. The Water Resources Management Policy gives a figure of 44,6000 ha as the present area under irrigation for sugar and rice with the potential of 100,000 ha for small scale self-help irrigation schemes. Figure 3 shows the effects on lake level of a worst case scenario in which it is assumed that (i) a similar area was developed for irrigation in Tanzania, giving a total area under irrigation of 300,000 ha, and that (ii) all these schemes fell within the lake catchment area and that (iii) the demand figure of 2.5 m depth of water is consumed per hectare (SADC conference 1994). Using the same area under irrigation but assuming what is thought to be a more realistic figure of 1 m as the extra annual evaporation from an irrigated area the effects on lake levels are less, Figure 4.

## MANAGEMENT OPTIONS

At present our ability to forecast climate variability and change is very limited, and the possibilities for controlling climate change virtually non-existent. There are however two options for reducing the impacts of such a repeat of climatic conditions, disaster preparedness and integrated water resource management.

### **Disaster preparedness.**

Disaster preparedness would involve having in place alternative plans for electrical generation, water supply and transport, should these systems be affected, and to use the zero cost option when considering alternatives for future developments which do not rely on continuous Shire flows.

### **Integrated water resource management.**

Integrated water resource management should ensure that, even if the climatic conditions did repeat, the effects on the Lake Malawi- Shire River system were not worsened by man induced changes and developments.

A central theme of Malawi's water resource planning should be directed, as far as is practical, towards maintaining outflows from the Lake.

It was recognised at the SADC conference on Integrated Water Resources Management for the Zambezi (SADC, 1994) that, for the Zambezi region as a whole, the three most important development activities which influence the water balance are, in order of importance: irrigation, hydropower and land use change (industrial use and domestic supply are insignificant and likely to remain insignificant into the foreseeable future compared with the effects of these major three developments). Within Malawi, although hydropower generation is a major industry it is not a consumptive user of water. There are no major impoundment reservoirs, in place or planned, which give rise to higher evaporative losses as is the situation, for example, for Cabora Bassa and Kariba. The developments which will most affect the water balance of the Lake Malawi-Shire River system are therefore irrigation and land use change. The regulation of irrigation schemes, and land use changes which reduce flows, particularly where these effect flows to the lake rather than the Shire River, requires a pricing policy for water which takes account of the value of water to stakeholders at different stages of its movement through the system.

**Pricing policy.** The value of water decreases as it moves through the system. Water which is at high altitude on the land catchment of the lake has the potential for generating electricity before it reaches the lake, sustaining lake levels which support the fisheries, and transport, and the tourist industry, can be used for hydroelectric generation after leaving the lake and for irrigation or supply purposes lower down the Shire. Water in the Shire before exiting to

Mozambique has environmental value for sustaining fisheries and wildlife but has few of the other economic benefits. Pricing policies will need to be developed such that where these uses reduce flows to the system the charge to the developer reflects the losses incurred by the other downstream stakeholders.

**Pricing policy - irrigation water.** In practice this should mean that the charge to the irrigator of water for irrigation purposes on the land catchment of the Lake should be substantially higher than that for water taken from the outfall of the Lake, which itself should be higher than that taken from the lower Shire below the hydropower schemes. Such a charging policy is likely to shift the balance of future major irrigation schemes to the Lower Shire except where the returns from cash crops or reduced transportation costs can offset the higher water charges.

**Regulatory (Pricing) policy - land use.** Land use has an influence on the water balance of the system. It is known from studies carried out worldwide that forests, whether man made or natural tend to evaporate more water than agricultural crops. Modelling studies of the water balance of Lake Malawi (Calder et al. 1994) confirm that Malawi is not an exception to this general rule. The conversion of the indigenous miomba woodland to annual agricultural crops such as maize will increase flows to the system, conversion of agricultural land to plantation forestry will have the opposite effect. A land use policy should take account the economic returns from forestry in relation to the extra consumptive use charged using the price of water at the position in the catchment where it is consumed.

A methodology which should assist the development of a pricing policy is the combination of water balance modelling and sensitivity analysis. By altering the proportions of land under different land uses or under irrigation within a water balance model the effect on lake levels and outflows can be calculated and eventually translated into economic costs to the downstream stakeholders.

## REFERENCES

Calder, I.R., Hall, R.L., Bastable, H.G., Gunston, H.M., Shela, O, Chirwa, A. (1994). The impact of land use change on water resources in sub-Saharan Africa: A modelling study of Lake Malawi. To be submitted to J. Hydrol.

SADC (1994). Report on the Livingstone workshop. In preparation.

# Lake Malawi - predicted and observed lake levels assuming declining forest cover between 1967-90

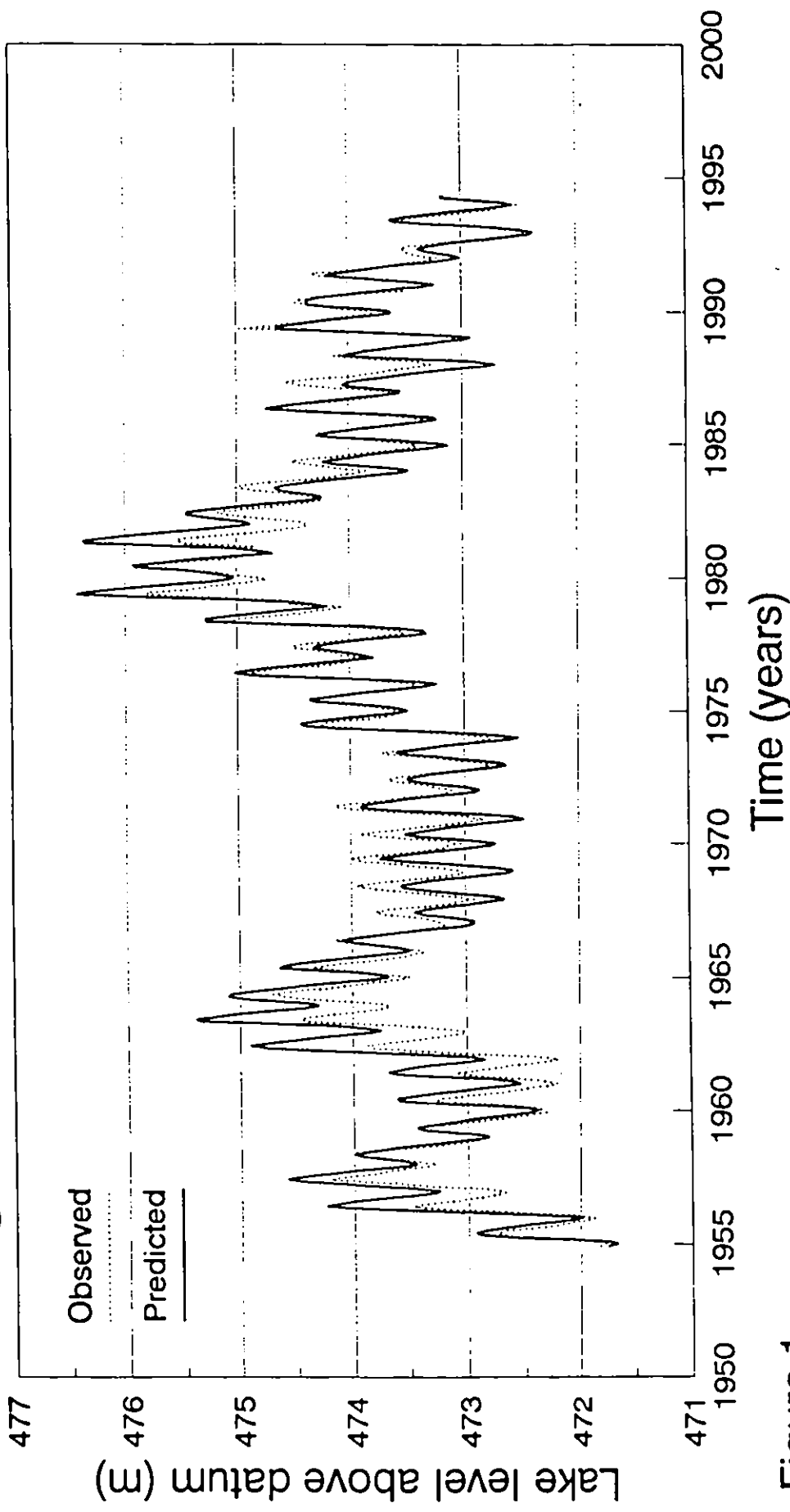


Figure 1

# Lake Malawi - predicted and observed lake levels assuming a catchment forest cover of 64%

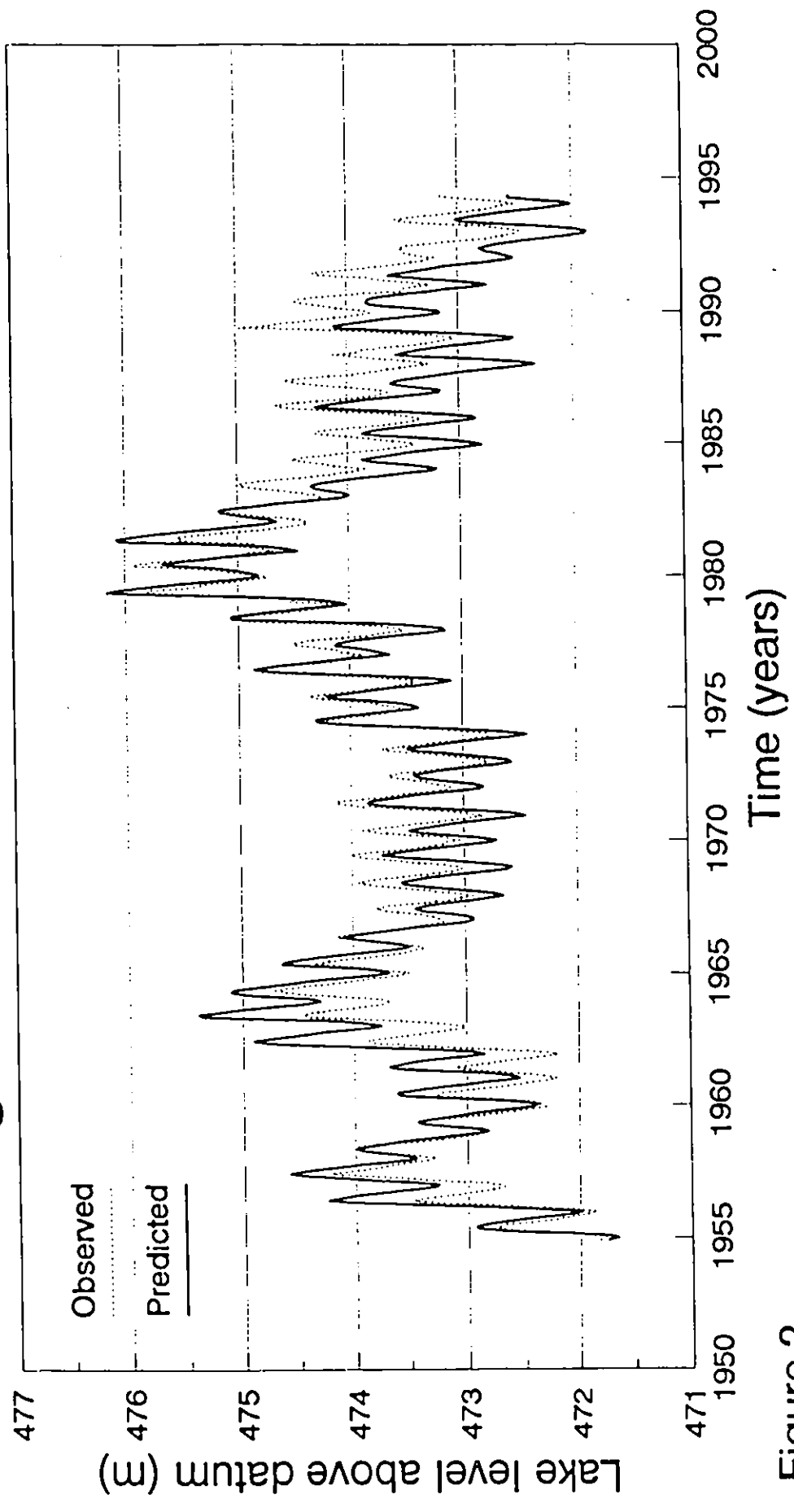


Figure 2

# Lake Malawi - predicted and observed lake levels assuming annual abstraction of $7.5 \times 10^9 \text{ m}^3$

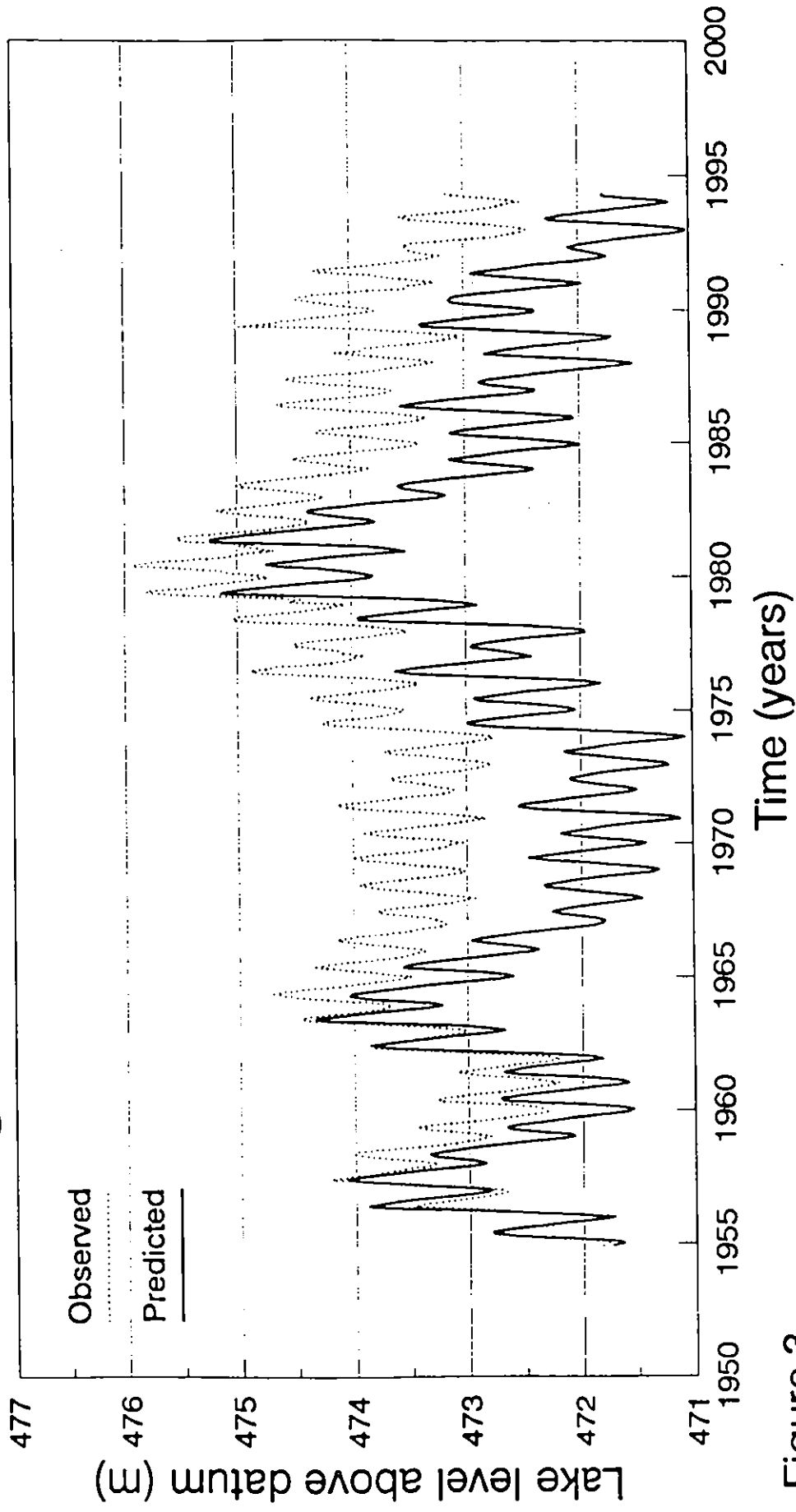


Figure 3

Lake Malawi - predicted and observed lake levels  
assuming annual abstraction of  $3.0 \times 10^9 \text{ m}^3$

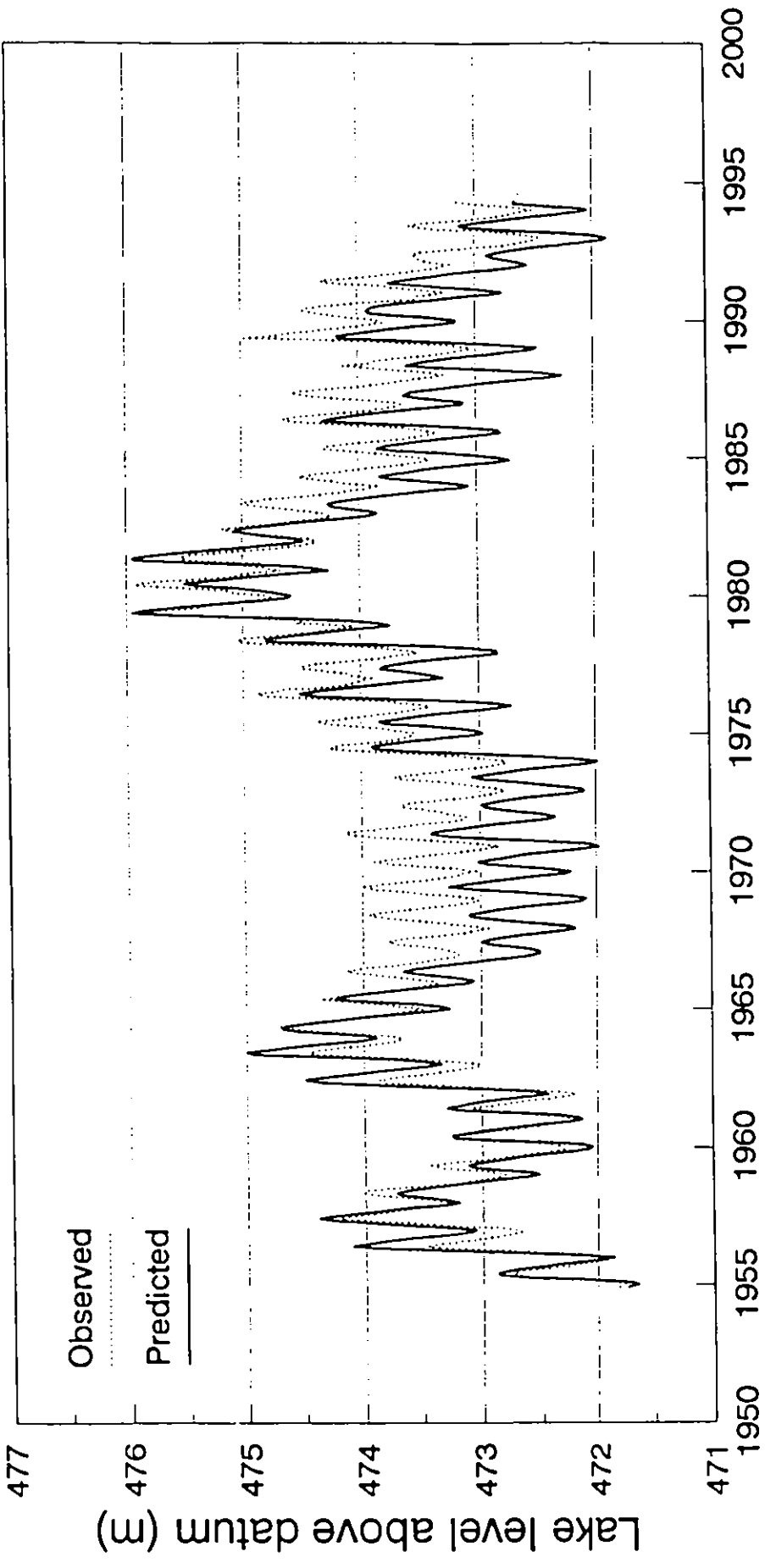


Figure 4