

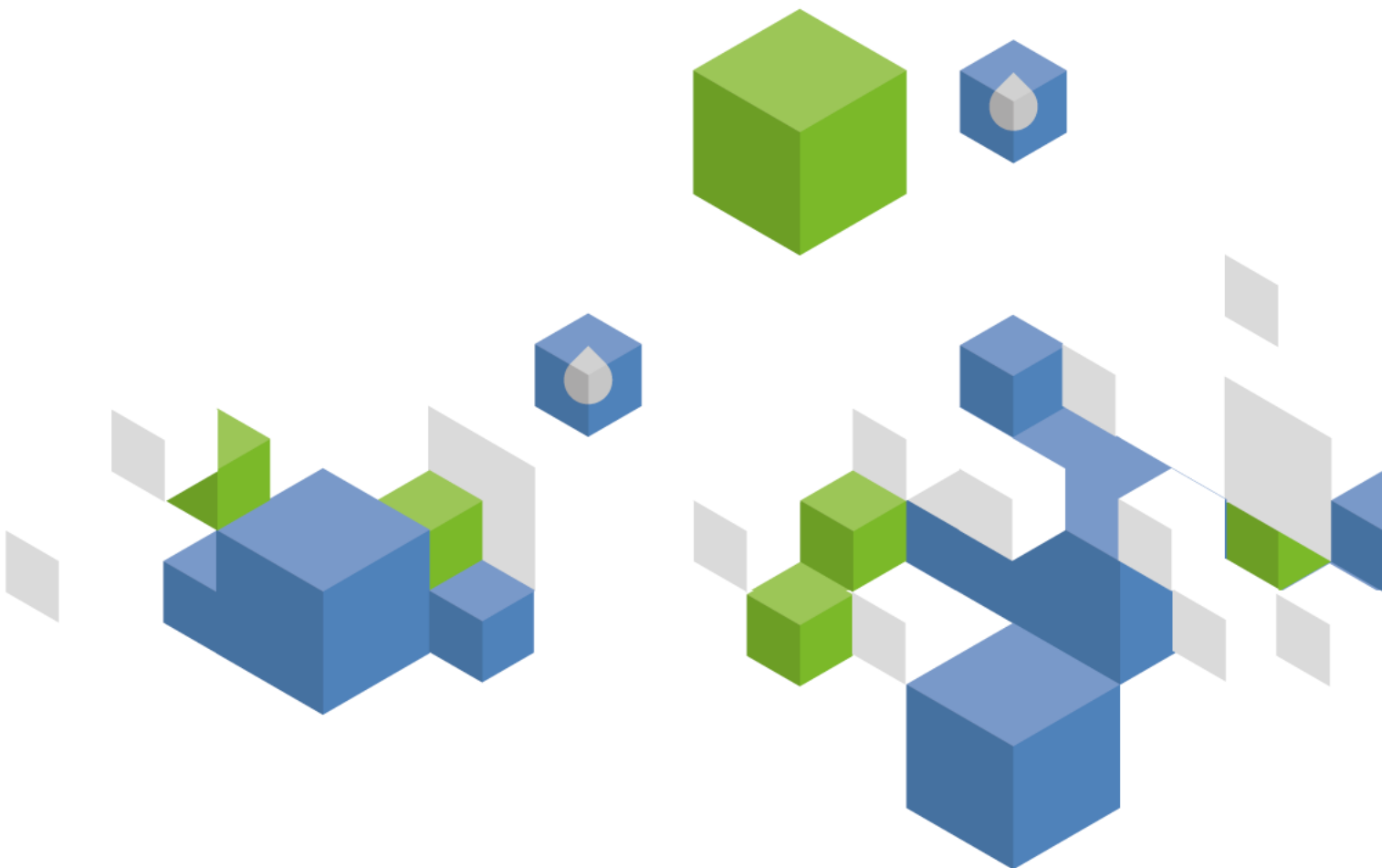


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Malawi

GEOGRAPHY, CLIMATE AND POPULATION

Geography

Malawi is a landlocked country, lying in Southern Africa between latitudes 9°22'S and 17°03'S and longitudes 33°40'E and 35°55'E. It is bordered by the United Republic of Tanzania to the north and northeast, Mozambique to the east, south and southwest, and Zambia to the west. The country has a total area of 118 480 km² with a total length of about 900 km and a maximum width of about 250 km. About 20 percent of its total area is covered by surface water bodies.

Malawi's topography is characterized by extremely diverse physical features. It is divided into four major physiographic zones:

- The highlands of Mulanje, Zomba and Dedza in the southern part of the country;
- The plateau of the central and northern regions;
- The rift valley escarpment;
- The rift valley plains along the lakeshores of Lake Malawi, the Upper Shire and Lower Shire Valleys.

The soils of Malawi have been grouped into 28 classes, predominated by three major soil types:

- The Eutric Leptosols, known as Lithosols, which occur in most areas of the country;
- The Chromic Luvisols, generally known as Latosols, which are the red-yellow soils of the Lilongwe plain and some parts of southern region;
- The Haplic Lixisols, which are the alluvial soils of lacustrine and river-line plains, the Vertisols of the lower shire valley and Phalombe plain and the Mopanosols in the Liwonde and Balaka areas.

Climate

The climate of Malawi is tropical continental and largely influenced by the huge water mass of Lake Malawi, which defines almost two-thirds of Malawi's eastern border. There are two distinct seasons: the rainy season from November to April and the dry season from May to October. The dry season may be divided into the cool dry period from May to July and the hot dry period from August to October.

Annual rainfall in Malawi ranges from 700 to 2 400 mm with mean annual rainfall being 1 180 mm. Its distribution is mostly influenced by the topography and proximity to Lake Malawi. The highest rainfall is experienced in the high altitude and mountainous areas of Mulanje, Zomba, Dedza and the plateaus of Viphya and Nyika while the lowest rainfall is experienced in the low lying areas of the Lower Shire Valley and other rain shadow areas.

The main rain bearing system in Malawi is the Inter-Tropical Convergence Zone (ITCZ). This is a broad zone in the equatorial low-pressure belt, towards which the northeasterly and southeasterly trade winds converge. This system is responsible for most of the rain received in the country. Other rain bearing systems affecting Malawi are:

FIGURE 1
Map of Malawi



FAO - AQUASTAT, 2005

MALAWI

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- Tropical cyclones, which are essentially intense low-pressure cells that originate in the Indian Ocean and move from east to west, bringing widespread heavy rainfall mostly in southern Malawi, which can cause serious flooding.
- The Convergence Ahead of Pressure Surges (CAPS) system, which develops as high-pressure cells continue to move over the southern tip of the sub-continent. This leads to the convergence ahead of the pressure surges causing isolated but locally heavy rains that normally precede the onset of the rainy season.
- The easterly waves system, which is mostly active towards the end of the rainy season (March/April). The existence of easterly waves in the atmosphere causes isolated but locally heavy rains in some parts of the country.

Temperatures are greatly influenced by the topography and decreases with increasing altitude. The mean maximum and minimum temperatures are 28°C and 10°C respectively in the plateau areas, and 32°C and 14°C respectively in the rift valley plains. The highest temperatures occur in October/November while the lowest temperatures are experienced in June/July.

Population

In 2004, Malawi's population was about 12.3 million with an annual growth rate of 2.1 percent (Table 1). About 83 percent of the total population was rural. Malawi is the most densely populated country in the SADC region, with a population density of 104 inhabitants/km². The population is not evenly distributed throughout the country, and the Southern Region has some of the highest population densities in the country. In 2002, 96 percent of the urban population and 62 percent of the rural population were using improved drinking water sources (Table 1).

TABLE 1
Basic statistics and population

Physical areas:			
Area of the country	2002	11 848 000	ha
Cultivated area (arable land and area under permanent crops)	2002	2 440 000	ha
• As % of the total area of the country	2002	21	%
• Arable land (annual crops + temp fallow + temp. meadows)	2002	2 300 000	ha
• Area under permanent crops	2002	140 000	ha
Population:			
Total population	2004	12 337 000	inhabitants
- Of which rural	2004	83	%
Population density	2004	104	inhabitants/km ²
Economically active population	2004	5 876 000	inhabitants
- as % of total population	2004	48	%
- female	2004	49	%
- male	2004	51	%
Population economically active in agriculture	2004	4 777 000	inhabitants
- as % of total economically active population	2004	81	%
- female	2004	56	%
- male	2004	44	%
Economy and development:			
Gross Domestic Product (GDP) (current US\$)	2003	1 700	million US\$/year
• Value added in agriculture (% of GDP)	2003	37.6	%
• GDP per capita	2003	140	US\$/year
Human Development Index (highest = 1)	2002	0.388	
Access to improved drinking water sources:			
Total population	2002	67	%
Urban population	2002	96	%
Rural population	2002	62	%

Though Malawi's fertility rate of 6.7 births per woman in the period 1990-1992 has dropped to 6.3 births per woman in 1998-2000, it still remains one of the highest in the world. This high rate is attributed to several reasons such as early marriages, early-age pregnancies, relatively short birth intervals and still little knowledge of and access to modern contraceptive practices.

Malawi still remains one of the poorest countries in the world. Its Human Development Index (HDI) of 0.464 ranked the country 163rd out of 174 countries in 2000.

The rapid increase in population has resulted in great pressure on land. Fallow periods for restoring soil fertility have been reduced greatly in the smallholder farming systems, and cultivation is expanding to marginal and less fertile areas. This is leading to severe deforestation, soil erosion and a general degradation of the natural resource base. This problem is most serious in southern Malawi as compared to central and northern Malawi.

ECONOMY, AGRICULTURE AND FOOD SECURITY

Agriculture is by far the most important sector of Malawi's economy. In 2003, it contributed 37.6 percent to the country's GDP of 1 700 million US\$. Agriculture accounts for about 90 percent of the country's export earnings, with tobacco alone accounting for 60 percent, and provides employment for 81 percent of the economically active population.

Malawi's agricultural sector is characterized by a dualistic structure: a low input/low productivity smallholder sector and high input/high productivity estate sector. The smallholder sub-sector comprises a very large number of small-scale farmers growing mainly food crops for their own consumption but they also grow some cash crops such as coffee, tobacco, macadamia and cotton. The estate sector comprises a much smaller number of large-scale farmers, producing almost entirely for the export market. In 2001, the cultivated area was about 2.34 million ha (25 percent of the land area) with just over half occupied by agricultural estates.

The main food crop is maize, which accounts for nearly 90 percent of the cultivated land, supplemented by sorghum, millet, pulses, rice, root crops, vegetables and fruits. Industrial export crops grown by smallholders include cotton, rice, groundnuts, coffee, macadamia and tobacco. The main estate-grown crops are tobacco, coffee, tea and sugar. Malawi is the second largest producer of tobacco in Africa after Zimbabwe.

Food demand in Malawi has been increasing steadily because of the absolute increase in population. In addition, droughts like the one of 1991/92, partially of 1996/97 and 2001/02 cause low yields and countrywide crop failures. The country is currently not able to meet its food requirements, particularly in cereals. The reasons for the food deficits are:

- The failure of food production to keep pace with increases in the human population;
- Lack of water (droughts) and inability to use it for agricultural production;
- Declining soil fertility, combined with shrinking average farm holdings;
- Inappropriate and outdated agricultural technologies;
- The perception by many that maize is the only food when other types of cereals that are more adapted to drought are available.

Past food production increases were achieved through expansion of the cultivated area. However, because of the increasing shortage of land and the small size of the family holding, this is no longer a viable option. Given the relatively low rainfall in parts of the country and its monomodal pattern, the potential for increased production through higher cropping intensities is severely limited without some form of irrigation. Increased irrigation, particularly in the smallholder sub-sector, is therefore essential for increased crop production.

It is estimated that by end-2001, 15 percent of adults (15-49 years old) in Malawi were living with HIV/AIDS. The high prevalence of HIV/AIDS has resulted in increased infant mortality and death rates and in changes in the distribution pattern of population in terms of age and sex. The 1998 population census revealed a noticeable drop in the population growth rate, as compared to the projections made on the basis of the 1987 population census.

WATER RESOURCES

Malawi is generally considered to be relatively rich in water resources, which are stored in the form of lakes, rivers and aquifers.

The country is divided into 17 Water Resources Areas (WRAs), which are subdivided into 78 Water Resources Units (WRUs). There are two major drainage systems:

- The Lake Malawi system, which is part of the Zambezi River basin. The Shire River is the only outlet of the lake with an average flow of 400 m³/s. About 91 percent of the country is located in the Zambezi River basin.
- The Lake Chilwa system, which is shared with Mozambique. Lake Chilwa is an endorheic basin draining rivers originating from the eastern slopes of the Shire Highlands, the Zomba Plateau and the northern slopes of the Mulanje Massif.

There are two main aquifers in Malawi:

- The Precambrian weathered basement complex, which is extensive but low yielding (up to 2 l/s);
- The quaternary alluvial aquifers of the lakeshore plains and the Lower Shire valley, which are high yielding (up to 20 l/s).

Malawi's total renewable water resources are estimated at 17.28 km³/yr (Table 2). From this, 16.14 km³/yr are produced internally, while about 1 km³/yr comes from Mozambique via the Ruo River and 0.14 km³/yr is from a lake shared with Mozambique along the course of the Shire River. Almost all of the internal groundwater resources of 1.4 km³/yr are thought to be drained by the rivers, as Malawi is a humid, enclosed country. Water resource distribution is highly variable both seasonally and geographically, as nearly 90 percent of the runoff in major rivers occurs between December and June.

TABLE 2
Water resources

Renewable water resources:			
Average precipitation		1 181	mm/yr
		140	10 ⁹ m ³ /yr
Internal renewable water resources		16.14	10 ⁹ m ³ /yr
Total actual renewable water resources		17.28	10 ⁹ m ³ /yr
Dependency ratio		6.6	%
Total actual renewable water resources per inhabitant	2004	1 401	m ³ /yr
Total dam capacity	2002	43	10 ⁶ m ³

Lakes are a main feature of Malawi's water resources and the main ones are:

- Lake Malawi, which is the third largest freshwater lake in Africa and the eleventh largest in the world, has a total surface area of 28 760 km² (including the part of the lake belonging to Mozambique). The lake is 570 km long, 16 to 80 km wide, and has a total storage of 1 000 km³. Its average depth is 426 m, while its maximum depth is 700 m. It is the most important single water resource and plays a vital role in the socio-economic development of the country.

- Lake Malombe covers 303 km², is about 30 km long, 15 km wide and has an average depth of 4 m.
- Lake Chilwa lies on the border between Malawi and Mozambique. Being the “sink” of an endorheic basin, its surface area is very variable but is on average 683 km², of which 721 km² lies in Malawi. It is a shallow, saline lake with an average depth of 2 m.
- Lake Chiuta, separated from Lake Chilwa by a sand bar of 20-25 m height, lies on the border between Malawi and Mozambique. It covers 200 km² of which 40 km² belong to Mozambique. Its depth is 5 m.

There are nine major dams with a height of more than 12 m and with a total storage of slightly over 43 million m³. They have been constructed mainly for municipal water supply, except for two that were constructed in the 1950s near Blantyre for hydroelectric purposes. In addition there are 700 750 small dams with a storage capacity of approximately 64 million m³, most of which were built during the colonial period and are in various states of disrepair. Due to lack of maintenance over a long period, most of these small dams require major rehabilitation. Currently the government has embarked on the rehabilitation of some of these small dams through various programmes as part of the national water conservation strategy. According to the Water Resources Board, any dam with a dam height of 4.5 m and above is classified as a large dam; for that reason, dam design reports and drawings have to be available for technical consideration when a water right application is processed.

Malawi is rich in wetlands, which include lakes, rivers, many reservoirs spread over the country and marshes. The most important marshes are the Elephant and Ndindi marshes in the Lower Shire Valley, the Vwaza Marsh in the Rumphi district, and the Chia Lagoon in Nkhotakota. The major wetlands of Lake Malawi and Lake Chilwa are closely monitored under the RAMSAR and UN biodiversity conventions.

The history of groundwater development in Malawi dates back as far as the early 1930s. By 1994, there were about 9 600 boreholes and 5 600 protected shallow wells, the majority of which were constructed by the government. However, since then the increase in boreholes drilled by the government, non-governmental organizations and the private sector has been dramatic, and according to the Ministry of Water Development there were about 19 000 boreholes drilled in 2001. This trend is continuing and the number of boreholes is continually increasing as a result of the proliferation of drilling contractors in the country. Furthermore, due to the recent frequent occurrence of droughts, the number of hand-dug shallow wells has considerably decreased because they are highly vulnerable and prone to drying up, and therefore people have opted for boreholes instead of shallow wells.

INTERNATIONAL WATER ISSUES

A great part of Malawi's water resources, such as Lake Malawi, Lake Chilwa, Lake Chiuta, and Shire, Ruo and Songwe Rivers are shared with the neighbouring countries of Mozambique and the United Republic of Tanzania as transboundary and cross-boundary waters. So far, no major conflicts have arisen over the utilization of these resources. However, in order to avoid potential conflicts, Malawi is signatory to a number of international treaties and conventions, including the SADC Protocol on Shared Watercourses and the 1997 UN convention of non-navigational uses of international waters.

At a bilateral level, Malawi is implementing a project for the stabilization of the Songwe River course jointly with the United Republic of Tanzania, through the Malawi/the United Republic of Tanzania Joint Permanent Commission of Cooperation (JPCC). The agreement on the establishment of a Joint Water Commission between Malawi and Mozambique has been signed in November, 2003. With Lake Malawi and the Shire River system being a sub-basin of the Zambezi watercourse, Malawi actively participates in the Zambezi Watercourse Commission (ZAMCOM), which was signed by the eight riparian member states of the Zambezi River Basin in July 2004 in Kasanne, Botswana. Within the SADC region, Malawi is part of other initiatives such as the SIDA initiative and the FAO-supported Convention on the Management of Lake Malawi/Nyasa for Sustainable Development.

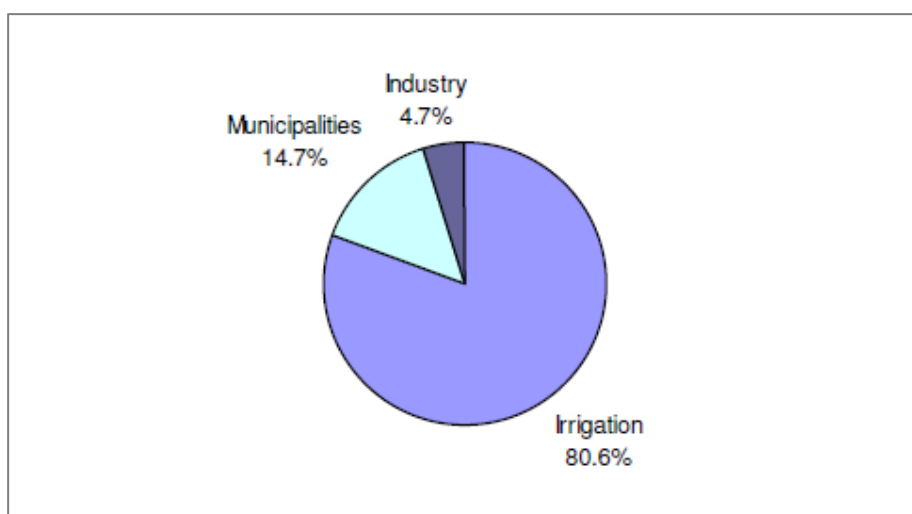
WATER USE

Major water users in the country are the municipal sector, irrigation, hydropower, industry, navigation, recreation and tourism, fisheries and biodiversity. Water withdrawal for agricultural and municipal purposes has increased over the last decade as a result of socio-economic development and population growth. Agriculture/irrigation is still by far the major water-withdrawing sector, followed by the municipal water supply and industry (Table 3 and Figure 2). However, an updated and comprehensive water resources and water use information database is not available in the country.

TABLE 3
Water uses

Water withdrawal:			
Total water withdrawal	2000	1 005	10 ⁶ m ³ /yr
- irrigation + livestock	2000	810	10 ⁶ m ³ /yr
- municipalities	2000	148	10 ⁶ m ³ /yr
- industry	2000	47	10 ⁶ m ³ /yr
• per inhabitant	2000	88	m ³ /yr
Surface water and groundwater withdrawal	2000	1 005	10 ⁶ m ³ /yr
• as % of total actual renewable water resources	2000	5.8	%
Non-conventional sources of water:			
Produced wastewater	-	-	10 ⁶ m ³ /yr
Treated wastewater	-	-	10 ⁶ m ³ /yr
Re-used treated wastewater	-	-	10 ⁶ m ³ /yr
Desalinated water produced	-	-	10 ⁶ m ³ /yr
Re-used agricultural drainage water	-	-	10 ⁶ m ³ /yr

FIGURE 2
Water withdrawal
Total 1.005 km³ in 2000



IRRIGATION AND DRAINAGE

The total potential for irrigation was estimated in the early 1990s to be 161 900 ha, including the existing dambos (Table 4). Other estimates range from 200 000 ha for formal irrigation up to 480 000 ha for informal irrigation. The potential for small-scale irrigation is estimated at 100 000 ha. Most of the potentially irrigable land lies in the plains along the shores of Lake Malawi in Karonga and Nkhotakota - Salima, the Lake Chilwa Plain, the Lower Shire Valley and the flood plain of the Limphasa River in Nkhata Bay. Of these, the Lower Shire Valley has the greatest potential for irrigation development in the country. These areas have fertile soils and adequate water resources for the development of irrigated agriculture.

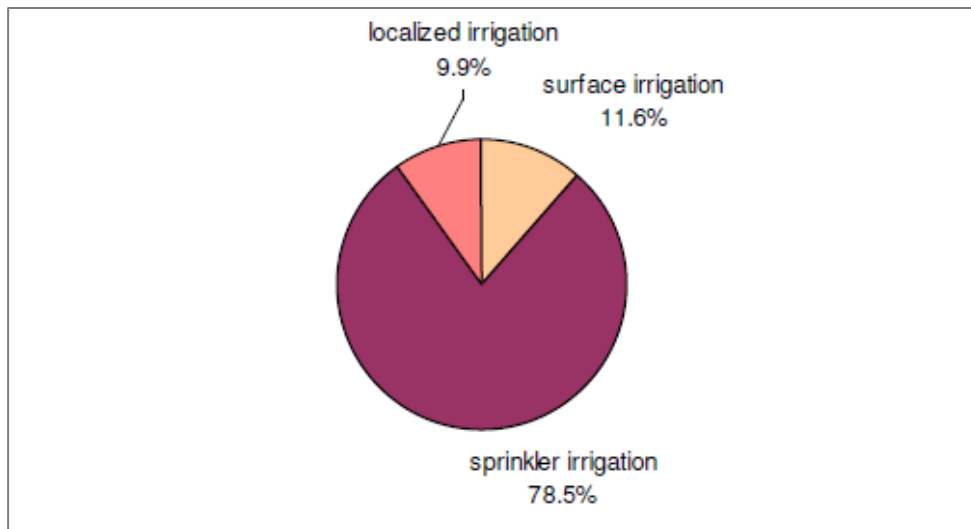
TABLE 4
Irrigation and drainage

Irrigation potential		161 900	ha
Water management			
1. Full or partial control irrigation: equipped area	2002	56 390	ha
- surface irrigation	2002	6 357	ha
- sprinkler irrigation	2002	43 193	ha
- localized irrigation	2002	5 450	ha
• % of area irrigated from groundwater	1992	0.05	%
• % of area irrigated from surface water	1992	99.95	%
2. Equipped lowlands (wetland, ivb, flood plains, mangroves)		-	ha
3. Spate irrigation		-	ha
Total area equipped for irrigation (1+2+3)	2002	56 390	ha
- as % of cultivated area	2002	2.3	%
- average increase per year over the last 10 years	1992-2002	7.3	%
- power irrigated area as % of total area equipped		-	%
- % of total area equipped actually irrigated	1992	96	%
4. Non-equipped cultivated wetlands and inland valley bottoms	1992	61 900	ha
5. Non-equipped flood recession cropping area		-	ha
Total water-managed area (1+2+3+4+5)	2002	118 290	ha
• as % of cultivated area	2002	4.8	%
Full or partial control irrigation schemes: Criteria:			
Small-scale schemes	< ha	-	ha
Medium-scale schemes		-	ha
large-scale schemes	> ha	-	ha
Total number of households in irrigation		-	
Irrigated crops in full or partial control irrigation schemes:			
Total irrigated grain production	1992	32 750	tonnes
• as % of total grain production	1992	2	%
Total harvested irrigated cropped area		-	ha
• Annual crops: total		-	ha
- sugar cane	2000	21 685	ha
- rice and vegetables	2002	8 380	ha
- other annual crops		-	ha
• Permanent crops: total	2000	26 450	ha
- tea	2000	21 000	ha
- coffee	2000	5 450	ha
Irrigated cropping intensity		-	%
Drainage - Environment:			
Total drained area		-	ha
- part of the area equipped for irrigation drained		-	ha
- other drained area (non-irrigated)		-	ha
• drained area as % of cultivated area		-	%
Flood-protected areas		-	ha
Area salinized by irrigation		-	ha
Population affected by water-related diseases		-	inhabitants

Irrigated agriculture in Malawi started in the late 1940s with the development of the Limphasa Irrigation Scheme in the Nkhata Bay District. In the mid-1950s, two more schemes were established in the Chilwa Phalombe Plain and an irrigated crop research station was developed at Makhanga. In 1965 the Sugar Corporation of Malawi (SUCOMA) started the production of sugar cane under irrigation. Further irrigation development took place between 1968 and 1979 when 16 schemes with a total irrigable area of 3 600 ha were constructed by the government, with a view to increasing rice production and, amongst other objectives, to serve as training grounds for farmers in irrigation skills. These government schemes are located in Karonga, Mzuzu, Salima, Machinga and Ngabu Agricultural Development Divisions (ADDs).

In 2000, the total area equipped for full or partial control irrigation was 55 000 ha, with almost 80 percent being under sprinkler irrigation (Figure 3). Almost all irrigation is from surface water. Some small lakeshore areas are irrigated by groundwater.

FIGURE 3
Irrigation techniques
Total 55 000 ha in 2000



In 2002, an estimated 56 390 ha were equipped (Table 4). Of these, 48 135 ha belonged to estates cultivating sugar cane, tea and coffee under irrigation.

Irrigation schemes in Malawi can be categorized into four main groups:

- Private large commercial schemes (> 100 ha), such as the Nchalo and Dwangwa sugar estates and Kawalazi coffee estates, are mostly owned by foreign investors, such as Illovo, Commonwealth Development Corporation (CDC), etc.
- Private small commercial schemes owned by individuals (< 100 ha).
- Government-operated smallholder schemes established by the government to give irrigation opportunities to local small-scale farmers at almost no cost. The farmers pay no water charges.
- Self-help smallholder schemes run by the farmers themselves on a self-help basis or in certain cases by non-governmental organizations (NGOs).

The Department of Irrigation (DoI) uses the following, informal classification for its work: small schemes have a gross area of less than 50 ha, medium schemes are between 50 and 500 ha and large schemes are over 500 ha. Within each of these size classes there are differences depending on how the scheme is farmed and managed. Therefore, DoI subdivides the schemes as follows:

- Informal schemes: developed by farmers themselves, with limited or no technical input to design;
- Semi-formal schemes: received some kind of technical support and are usually farmer-initiated self-help schemes;
- Formal schemes: planned, designed and built according to technical standards and by professionally trained staff; they include both smallholder and estate schemes and many schemes that were in the public domain in the past.

In 1997, the construction of the Bwanje Valley Irrigation Development Project commenced with grant aid from Japan. The 800 ha scheme was developed by the JICA and aimed at enabling 2 240 smallholder farmers to produce rice and other crops for food security and economic development at household level among others. It included works in the basin of the Namikokwe River, which were the largest scale

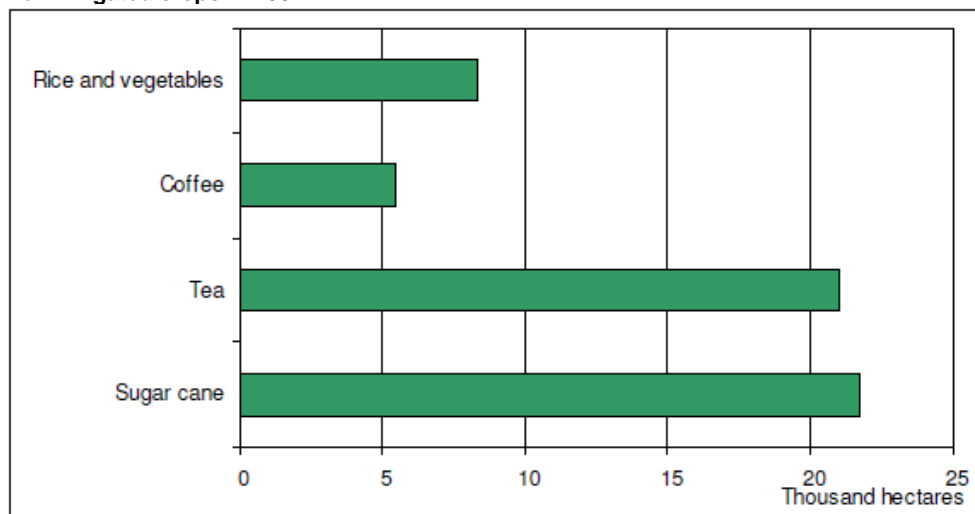
construction works on irrigation facilities in Malawi so far. There are however critical voices saying that instead of the implemented diversion that leads river water into the canal, a dam would have been far more efficient, since during the dry period large parts of the scheme cannot be irrigated because of the reduced river flow.

The oldest traditional irrigation method used in the country is the watering can. It is probably the cheapest and simplest technology and hence most widely used by smallholder farmers in self-help schemes. Since about 1998, the DoI has introduced several irrigation technologies targeting smallholder farmers, including motorized pumps, river diversions and manual pumps (treadle pumps). The demand for the latter is reported to be high: by 2001 Malawi had imported 10 000 treadle pumps. The Ministry of Agriculture introduced motorized and treadle pump schemes for employees to purchase the pumps on loan. The use of motorized pumps is widely common, especially by the estates and private commercial farmers. In 2001 the Malawi Project Inc., with support from Healing Hands International, purchased 3 000 drip irrigation systems and organized the training of Malawians as instructors. As a result, two and in some cases three crop harvests were brought in from the drip program farms. The area of non-equipped wetlands (*dambos*) was estimated at 61 900 ha in 1992 (Table 4).

Role of irrigation in agricultural production, the economy and society

Sugar cane is the main irrigated crop, followed by tea (Figure 4). Other irrigated crops include rice and vegetables in smallholder schemes. Currently the yields for rice in the government-owned irrigation schemes are as low as 1 tonne/ha, and improving irrigation efficiency should be a priority concern for the government.

FIGURE 4
Main irrigated crops in 2002



Large-scale commercial estate production of sugar cane under irrigation is well established in the Chikwawa and Nkhatakota Districts. Supplementary irrigation of tea and coffee is used on estates in Thyolo, Mulanje and Nkhata Bay. Smallholder schemes are mainly used for growing rice, vegetables, and maize (Table 4). In the wetlands (*dambos*), simple irrigation is used for vegetable and rice production.

Over the last 15 years, irrigation has had a low priority in agricultural production. The main constraints have been:

- Focusing of the agricultural economy on rainfed agriculture and existing irrigation schemes, where emphasis was on funding extension activities;
- Reluctance of donors to fund irrigation development;

- Replacement of irrigation services under the Ministry of Agriculture, which has focused on rainfed agriculture;
- Price setting for crops not viable for irrigation;
- Almost no irrigation technology training facilities within the country;
- A poorly funded and understaffed Department of Irrigation;
- Lack of farmer ownership of plots on government schemes.

Over a considerably long period, informal irrigation in the country has been growing steadily to supplement all other efforts by the government, as well as the private sector, to improve the food availability and security situation. At the same time individuals have benefited as a source of regular income for their households comes from the sale of their produce.

WATER MANAGEMENT, POLICIES AND LEGISLATION RELATED TO WATER USE IN AGRICULTURE

Institutions

The development of irrigated agriculture is supported by several institutions including the Ministry of Agriculture and Irrigation (MAI), the Ministry of Water Development (MWD), the Department of Environmental Affairs, the Water Resources Board, the Department of National Parks and Wildlife, the Department of Forestry and training institutions.

The Department of Irrigation (DoI), which is part of the MAI, has in the past been responsible for the actual implementation of irrigation activities. Now, the responsibility for developing irrigation projects rests with the beneficiary community, and the DoI plays the role of a facilitator. It is the duty of the Department to provide advisory services in the development of irrigation programmes in the country. The Department consists of a Head Office and eight Agricultural Development Divisions (ADDs). One task of the ADDs is to manage irrigation schemes directly. The problems of the DoI are that it is heavily understaffed and that most of the present staff require training in irrigation technology.

The central function of the MWD is to facilitate the development and management of water resources in the country. Among its responsibilities are ensuring access to safe water and related sanitation services, the provision of safe drinking water to rural communities the collection of hydrological data and catchment protection. It has been noted that the link between the DoI and the MWD is very weak and needs to be strengthened.

The Water Resources Board is an institution within the MWD and is responsible for the granting of water rights for abstractions and discharge of effluents, as well as for monitoring the adherence to the water rights. For the development of irrigation schemes, water rights for abstraction and discharge of wastewater drained from irrigation schemes have to be granted by the Board.

The primary function of the Department of Environmental Affairs is to ensure that the implementation of projects does not result in the degradation of the environment. For all irrigation schemes of more than 10 ha, environmental impact assessments are conducted.

The Department of National Parks and Wildlife and the Department of Forestry are responsible for the protection of catchment areas that fall within their jurisdiction. Some of the rivers that are diverted for irrigation purposes arise from areas designated as national parks/game reserves or forest reserves and therefore, there is a need for collaboration between these departments and the Department of Irrigation.

Water management

Both the Irrigation Act 2001 and the Water Resources Act 1969 provide for the formation of water user associations or irrigation management authorities to promote local community or farmers' participation

in the development and management of irrigation and drainage, and proper utilization of the available water resources.

By 1999, the ADDs directly managed over 40 irrigation schemes. These are mainly smallholder irrigation schemes for rice production developed in the 1960s and 1970s. However, the level of farmers' involvement in the operation and maintenance of the irrigation schemes has been limited and their experience in scheme and water management is thus very low. This has been attributed to the top-down approaches used in the development and management of these schemes, which were initiated, designed, constructed and managed by the Government, without farmers' participation in the development process. To improve the situation, the DoI is currently transferring responsibility to the local smallholder farmers and empowers them to manage the schemes by themselves. To this effect, the DoI initiated the formation of water user associations or other farmer organizations, such as Trusts and Cooperatives, for a number of irrigation schemes.

The Government considers that extension services, especially those targeted at smallholder farmers, should remain part of its core functions. There is, however, a strong argument for partially commercializing extension and research services, in particular those delivered to the medium and large farmers who have the capacity to pay. The approach has in fact been tried with the irrigation and coffee trust, but it is too early to gauge its success.

Finances

Government policy on financing irrigation developments in the country is that such developments are only minimally subsidized. The government aims to optimize its investment in irrigation development through the application of the principles of cost sharing and cost recovery.

Policies and legislation

Policy issues are addressed by the National Irrigation Policy and Development Strategy (2000) developed by the DoI, the Water Policy (1996), the Water Resources Management Policy and Strategy (2000) developed by the MWD, and the Environmental Management Policy (1996). Main legislation concerned with issues of water resources and irrigation are the Water Resources Act of 1969 and the Irrigation Act of 2001.

According to the Irrigation Policy and Development Strategy, the mission of the DoI is to manage and develop water and land resources for diversified, economically sound and sustainable irrigation and drainage systems under organized smallholder and estate management institutions and to maintain an effective advisory service. Following this policy, an Irrigation Act (No. 16 of 2001) was passed by Parliament in November 2001. The Act makes provision for the sustainable development and management of irrigation, protection of the environment from irrigation related degradations, establishment of a National Irrigation Board and for matters connected therewith or incidental thereto.

The overall policy goal of the Water Resources Management Policy and Strategy is sustainable management and utilization of water resources in order to provide water of acceptable quality in sufficient quantities, and ensure availability of efficient and effective water and sanitation services that satisfy the basic requirements of every Malawian. The Policy is currently being revised to include a number of issues that were not clearly addressed in the previous policy documents.

Under the Water Resources Act of 1969 all water abstractions must be licensed, except for general household municipal use, as well as all industrial effluent discharges into public water bodies, including human sewage. Annual permits are required for abstractions greater than 1 000 l/day, except for municipal use. The charging system is based on the water source and type of usage; however, the collection of revenue is severely limited by lack of staff. Together with the efforts to revise the above policy there are attempts to revise and amend the Water Resources Act of 1969. The process of the

revision of the Act has been very slow. In fact, efforts to revise the Act started in the mid-1980s but they never materialized due to a number of factors. However, following recent revision of the policy, efforts are underway to finally amend the Act. The existing Act makes provision for the control, apportionment and use of the country's water resources.

ENVIRONMENT AND HEALTH

The quality of the water resources in Malawi is dependent on three major factors:

- Chemical composition of the parent rocks existing in the area;
- Extent of agricultural activities (application of agrochemicals, farming practices, land husbandry);
- Disposal of industrial waste products as well as human sewage, particularly in urban areas.

Generally both surface water and groundwater are acceptable for human consumption. However, due to recently increased agricultural activities, there has been considerable degradation of water resources as a result of increased siltation in rivers and reservoirs. This is most severe in areas that are under immense population pressure, resulting in serious deforestation and cultivation of marginal and other fragile areas. Groundwater is more mineralized in alluvial aquifers than in the weathered basement aquifers. Areas such as the lower Shire Valley, eastern Bwanje valley and around Lake Chilwa have saline waters. As such the utilization of groundwater in such areas is limited due to high contents of iron, fluoride, sulphates, nitrates and Total Dissolved Solids (TDS).

Irrigation development in Malawi has not had any very serious negative environmental impacts. Most of the areas that have been developed for irrigation have for as long as people can remember been considered waterlogged areas for most of the year. As a result the impact of irrigation development in terms of waterlogging is minimal.

Water-related vector-borne diseases such as malaria, typhoid, cholera and bilharzia have infected most people around the irrigation schemes in Malawi. In order to reduce the spread and intensification of such diseases, most of the schemes, and particularly those operated by the government, include a water supply and sanitation component to provide for potable water through sinking of boreholes, and proper sanitation facilities. In addition, health clinic facilities are provided to provide treatment for the affected population as well as health hygiene and education. However, there are quite a number of schemes, and especially self-help schemes, where such facilities are lacking.

PROSPECTS FOR AGRICULTURAL WATER MANAGEMENT

Since 1994 the new Government has realized the importance of irrigation as a means of ensuring food security at both household and national levels. This has been demonstrated by raising the status of irrigation to Ministry level and recent Government pronouncements suggest that irrigation will be the cornerstone of the country's agricultural development strategy. The new Ministry has put forward a 23-point irrigation development strategy plan for poverty alleviation. Its main features are to:

- Give highest priority to the development of irrigation and water resources and strengthen the MAI with sufficient funds and staffing to undertake studies on pumping sites, boreholes and dam development;
- Establish a National Committee on Irrigation and Drainage and promote irrigation research;
- Recommend power lines be installed along rivers and the lake shore to encourage irrigation development and agro-industries;
- Facilitate arrangements for the provision of input support to small farmers, including credit facilities;
- Increase the development of self-help farmer schemes, and hand over operation and management of existing government-run schemes following completion of rehabilitation;

- Support irrigation development in the private sector, and support smallholder farms with irrigation technology and diversified cropping systems;
- Provide training at field and management levels and assist farmers in the organization of water user associations to ensure that future irrigation development is socially and economically viable;
- Ensure women's participation at all levels and ensure adequate health standards on schemes;
- In close collaboration with other relevant Ministries and organizations, ensure the enforcement of legislation on water conservation and catchment protection;
- Strengthen monitoring activities to ensure projects are executed as planned.

The MAI (1999) had identified unreliable water supplies as a main restriction to developing irrigation and presented the following strategies to overcome the problem:

- More small earth-dams will be constructed over rivers to create reservoirs for use in irrigation farming. The dams will not only guarantee availability of water for crops during the dry season and drought periods, but they will also control floods by retaining excess runoff during heavy storms thereby protecting crops from flood damage.
- Catchment areas of rivers supplying water to irrigation schemes and fragile areas such as riverbanks and wetlands will be protected. This is necessary because, due to the encroachment upon catchment areas by human activities, such as agricultural production and settlements, most of the land has been devoid of vegetation cover thus preventing adequate amounts of rainwater from infiltrating into the ground to recharge aquifers and causing soil erosion leading to serious siltation problems and choked canals.
- Environmental impact assessments will be conducted on all irrigation schemes of more than 10 ha.
- Alternative sources of water supply will be exploited. In this respect, groundwater resources should be developed for irrigation. This also applies to water from Lake Malawi, which will be tapped using canals or pumps to irrigate areas along the lakeshore. Areas between Liwonde and Mangochi and between Karonga Boma and Songwe would benefit from such irrigation projects.
- Imported "orphan" pumps, i.e. pumps for which spare parts are not locally available and which farmers cannot repair, will not be used for irrigation.

In 2002/03, the MAI revised its irrigation development programme for the next five years. This development programme prioritizes irrigation development aimed at increasing agricultural productivity and at the same time at promoting the use of appropriate and simple irrigation technologies. The programme focuses largely on the use of treadle pump technology by smallholder farmers, with the objective of considerably increasing the coverage of irrigation development in the country. It is planned that an estimated 300 000 treadle pumps will be installed for smallholder farmers until 2008, and that an estimated 495 km of canals will be built over the same period. Other technologies, such as river impoundments and the use of small motorized pumps, will be exploited further. It is planned that by the end of 2008 at least 100 800 ha of irrigation development will be added to the current status. To achieve this development goal, a total of almost US\$ 78 million would be required to cover the procurement of 300 000 treadle pumps, the construction of 495 km canals, the procurement of 2 000 small motorized pumps and other equipment (bulldozers, excavators) and the provision of extension services.

The country is blessed with large water bodies, rivers, lakes and dambo wetlands, and there is large scope for sustainable production expansion under irrigation. There is considerable scope for expanding rice production in Malawi under irrigation, but there is also a high potential for the production of high value crops, other than rice, for the export and municipal markets under irrigated agriculture.

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