Ethiopia:
Agricultural Water Management Policy Brief

Issue 1, July 2007

Many analysts believe that future increases in food supplies and economic prosperity for the rural poor in Ethiopia will come mainly from improved agricultural water management combined with other interventions contributing to production and productivity growth.

Access to water will allow the intensification of agricultural production systems. In light of this, researchers, policymakers, NGOs and farmers are increasingly experimenting with and promoting various innovative agricultural water management technologies and practices. Making relatively low cost agricultural water management technologies more widely available is likely to make a major contribution.

Water pond constructed at high elevation in East Hararghe, Ethiopia

Improving agricultural water management and irrigation development in Ethiopia

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Ethiopia's agricultural system is not significantly benefiting from the technologies of water management and irrigation that could improve productivity and reduce vulnerability to climate variability. Most of the country's poorest people live in rural areas with limited access to agricultural technology and limited potential to diversify agricultural production. They must also cope with underdeveloped rural infrastructure and poor access to agricultural markets. These issues, combined with increasing degradation of the natural resource base, especially in the highlands, aggravate poverty and food insecurity in rural areas. Improved water management for agriculture, through improved productivity, can help people cope with climate variability and reduce vulnerability. Moreover, it provides an important entry point to break the cycle of poverty. However, despite significant efforts of government and other stakeholders to improve agricultural water management and enhance irrigation, a number of constraints related to policy, institutions, technology, capacity, infrastructure and markets still exist. Addressing these constraints is vital to achieving sustainable growth and accelerated development in Ethiopia's agriculture sector.

Agricultural water management and irrigation development are key to improving the Ethiopian economy

Agriculture is the mainstay of the Ethiopian economy, and it is highly reliant on rainfall. High rainfall variability and drought affect agricultural production in a significant area of the country, and directly affect the Ethiopian economy (Fig. 1). During good rainfall years, growth in the country's economy has been recorded as a result of good harvests, and when rain is erratic and short, the economy suffers. Thus the Ethiopian economy has registered encouraging but mixed results, with a negative real Gross Domestic Product (GDP) growth rate of 3.3% in 2002/03 as a result of drought, followed by a strong positive performance of 11.9% and 10.6% during the subsequent two years—2003/04 and 2004/05 respectively.

The effect of rainfall coupled with the degradation of the natural resource base, especially in densely populated and highly vulnerable areas of the highlands, has led to the very high incidence of poverty and food insecurity in the country. As a consequence, despite growth in good years, 15% of the country's annual food requirement is met through food aid.

In the period of 1980 – 2001, for example (Table 1), growth in agricultural productivity in Ethiopia was almost stagnant. The growth of cereal production attributed to agricultural land expansion was 0.54% per annum and the overall growth of cereal production was a mere

Figure 1. Relationship between rainfall variability and GDP (World Bank 2006)

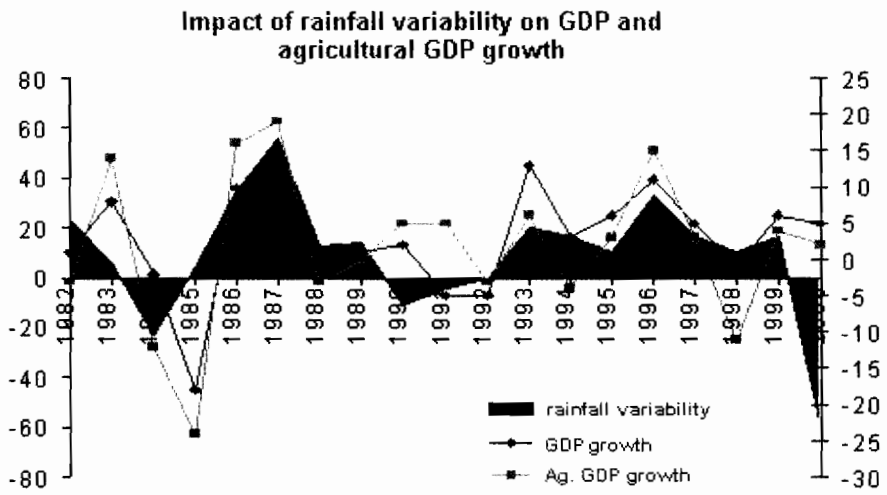


Table 1. Agriculture production in Ethiopia (1980-2001)

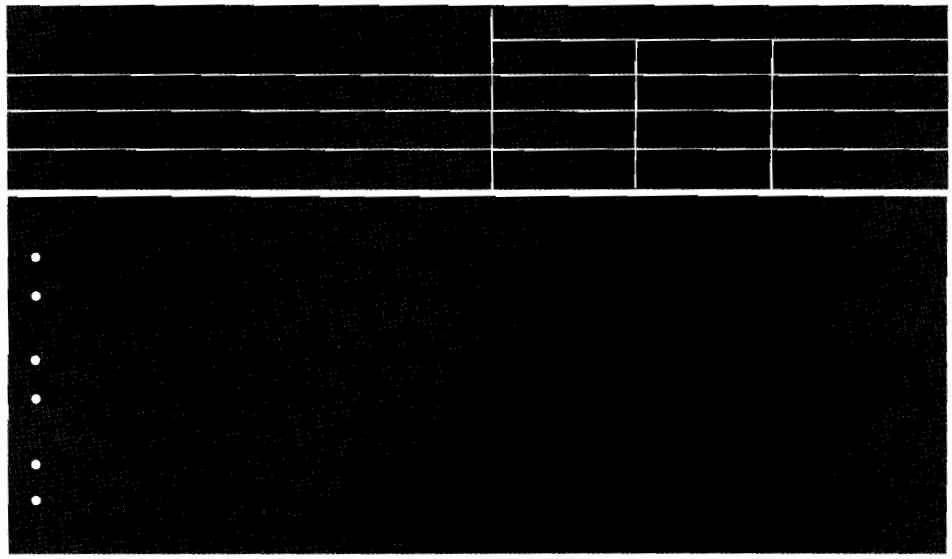
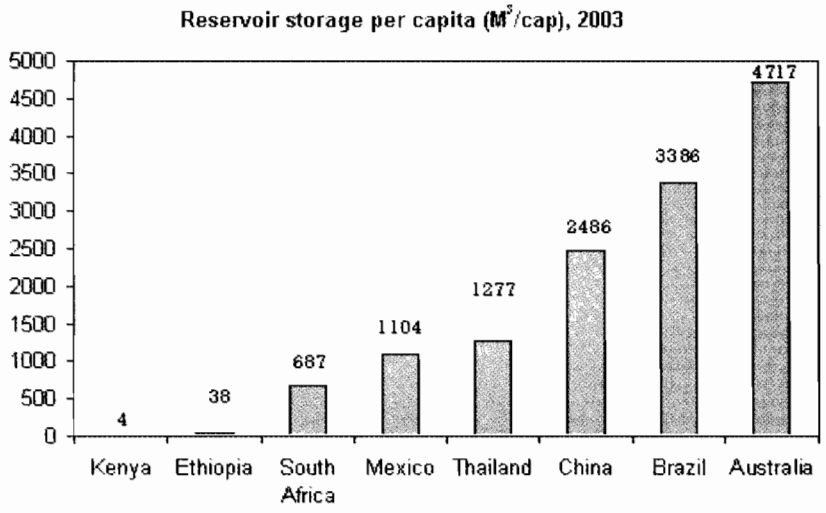


Figure 2. Per capita stored water availability of Ethiopia and selected countries of the world (World Bank 2006)



0.74%, demonstrating that almost all the increase in agricultural production is attributable to extensification rather than intensification. There was almost no progress in improving productivity of farming systems throughout the 20 year period.

Improving water management for various uses and particularly for agricultural water management is one of the key solutions to further increase agricultural productivity. It enables the improvement of productivity of rainfed agriculture and also, most importantly, enables the widespread use of irrigation to enhance the contribution of irrigated agriculture and expansion of the irrigated area, thereby improving land productivity. Ethiopia has 12 river basins with an annual runoff volume of 123 billion m^3 of water with an estimated 2.6 billion m^3 of groundwater potential, according to the Ethiopian water management policy. This amounts to 1530 m^3 of water per person per year—a relatively large volume. Lack of runoff storage structures, coupled with the unimodal nature of the rain, means that most parts of the country produce only one crop per year. Figure 2 shows the per capita stored water availability of Ethiopia as compared to other countries.

Irrigation is not a well developed sector in Ethiopia

The irrigated area in Ethiopia is only about five percent of the country's irrigation potential. Due to this, the contribution of the irrigation sector to the national economy is minimal. In Ethiopia irrigation schemes can be broadly classified into large, medium and small scale, based on the size of land irrigated and the type of development.

Traditional small scale irrigation schemes have been in use for decades and are distributed across the country. The schemes are planned and implemented by the farmers themselves with minimal or no technical and financial support from external bodies like the government or NGOs. Most of these schemes are river diversions using surface irrigation methods such as furrow and flooding. Spring development, hand dug wells and rainwater harvesting are also other sources of water for traditional irrigation. Plot size under such a scheme could vary from 10s of m^2 for rainwater harvesting to 10s of ha for river diversions. Crops cultivated are usually high value crops like sugarcane, banana, chat and vegetables. Community-based traditional irrigation schemes are usually organized under water users' associations (WUAs). There is no actual record of the traditional irrigation schemes. However, the estimates of total development are assumed to be about 250,000ha.

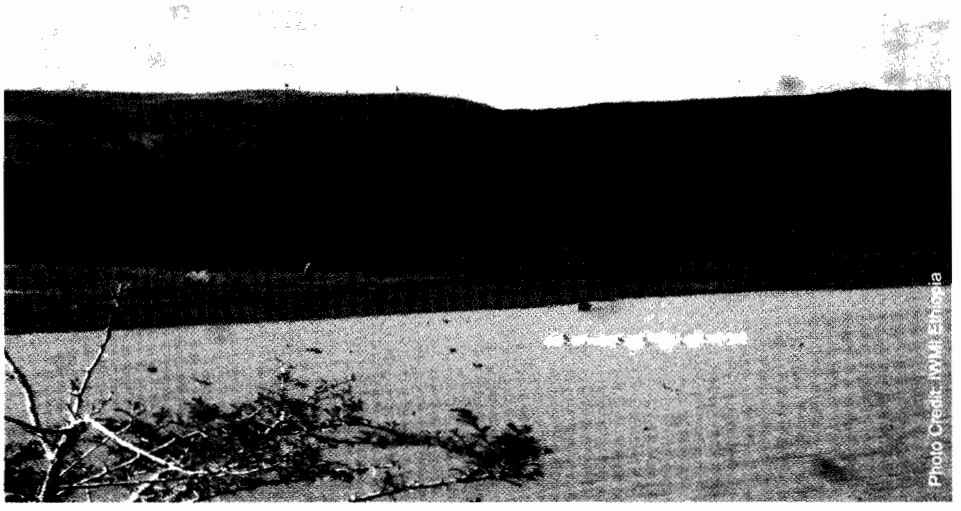
Modern small scale irrigation (MSSI) are those which are planned, designed and constructed by the government or other external bodies for the benefit of farmers. River diversion is the most commonly employed system in MSSI. There are also some micro earth dams and pump schemes developed in the 90s, but such developments were interrupted after the 90s. The total command area under MSSI is estimated to be 19% of the modern irrigation schemes at 20,735ha. More recently, micro irrigation systems using rainwater harvesting storage structures have been introduced through largely government programs, Their use is currently limited to supplementary irrigation of vegetables due to the small size of the storage structures.

Medium and large scale irrigation in Ethiopia is mainly concentrated in the Awash Valley but is gradually expanding to other areas such as the Rift Valley, Nile, Tekeze and Wabi Shebelle Basins. The first large scale irrigation scheme was introduced in the 1950s at Wonji to develop a sugar cane farm for the production of sugar using water from the Awash River controlled by the Koka Dam. Subsequently, other medium and large scale farms were developed in upper, middle and lower Awash. The total area under medium and large scale irrigation in the country at present is not significant and estimated at 97,000ha by 2004. In the 90s and the first few years of this century the size and number of medium and large scale irrigation schemes in the country also remained stagnant. Since 2004 there is substantial engagement of the government to develop large scale irrigation that would also include small scale users. The new medium and large scale projects that are at planning, design or implementation stages of developments are in the order of 510,603ha.

The existence of large quantities of land and water suitable for irrigation development and renewed political will to do so means that currently there is a significant opportunity to develop the irrigation sector in Ethiopia.

About 73.6 million hectares of the country's land area is estimated to be potentially suitable for agricultural production. The surface and groundwater resources are in the order of 122 and 2.6 billion m^3 respectively. In addition, in the last three years, there is a strong interest and commitment by the government of Ethiopia, donors and NGOs for the development and management of the irrigation sector. Indeed, the importance of water management and irrigation is strongly stipulated in PASDEP (Plan for Accelerated and Sustained Development to End Poverty) and the government is engaged in significant investment. PASDEP recognizes the importance of the development of small and medium scale irrigation among other interventions and takes water as an important entry point in all the three

Figure 3. Ethiopia has untapped water and land resources for agricultural production



agro-ecologies defined by rainfall and moisture. There are also opportunities to implement and effectively utilize scheme infrastructure for multiple uses of water to meet domestic, irrigation, livestock, energy and hygiene needs.

Irrigation development itself promotes growth of a dynamic economy and offers other important opportunities for:

- improving the knowledge of policy-makers, planners, consultants, contractors and development agencies through education, training, dialogues and participation;
- more gender-equitable investments targeting poor women through, for example, multiple-use systems and micro irrigation;
- private sector to be engaged in high value crops;
- work, employment and business opportunities that may be created through forward and backward linkages of irrigation development and chains of value addition.

Constraints to the development of the irrigation sector are still numerous. They include: lack or inadequacy of baseline studies and data and information on the potentials of different areas for water resource development; lack of infrastructure; lack of skilled capacity; absence of irrigation extension services; poor linkage between research and extension in the area of water management; limited technologies on agricultural water management; lack of start-up capital or access to credit to initiate irrigation ventures; lack of private sector participation; conflict in water use and use rights; frequent restructuring of responsible institutions; limited marketing and market access; small and irregular land holdings; and the reluctance of farmers to be involved in irrigation due to the dependency syndrome created by food aid.

Options to improve agricultural water management and irrigation development

Important issues and recommendations to be considered when improving agricultural water management (AWM) and developing irrigation include: a) Scaling up of best technologies for water management (water control, water lifting, conveyance and field application); b) Favorable policies, strategies and institutional support for irrigation development; c) Water rights and conflict resolution; d) Enhancing private sector involvement; and e) Research to improve AWM and irrigation.

Even with its limited capital for investment, Ethiopia needs to consider the opportunities that large and medium scale schemes provide to smallholders, creating wealth and economic development. Many countries have developed irrigation schemes as public investment (e.g., India, China, Egypt, USA) and some are still developing irrigation through the allocation of public and government resources (e.g., Turkey, Brazil) (Awulachew 2005). Though not always designed as pro-poor interventions, large-scale irrigation schemes in Asia have been shown to have positive poverty impacts (Hussian, 2005). The Government could also consider other models found in, for example China and build large public schemes at its expense, and then contract out the operation and maintenance (O&M) and even agricultural services to private firms. Smallholders and farmer-based WUAs or cooperatives could carry out O&M at the secondary and tertiary canal levels.

a) Scaling up of best bet technologies

Many analysts believe that future increases in food supplies and economic prosperity for the rural poor in Ethiopia will come mainly from improved agricultural water management combined with other interventions contributing to production and productivity growth such as soil fertility management, improved crop varieties, livestock management and reversal of watershed degradation. Access to water will allow the intensification of agricultural production systems. In light of this, researchers, policymakers, NGOs and farmers are increasingly experimenting with and promoting various innovative agricultural water management technologies and practices. Making relatively low cost AWM technologies more widely available is likely to make a major contribution.

The main challenges of today's irrigated agriculture are how to boost irrigation water productivity, reduce the cost of irrigation development technologies, formulate sound design criteria, promote multiple-use concepts and generate cost effective technologies for household water harvesting. Technological solutions can provide certain choices over the ever increasing demand for irrigation water. These can be started with interventions like monitoring existing cost effectiveness; affordability; sustainability; efficiency of water use; ease of O & M, etc., as well as evaluation of suitability, adoptability, availability and dissemination of newly adopted or developed technologies before eventual dissemination of the best technologies.

In-situ soil and water conservation technologies

Water and soil nutrient management are critical to successful agriculture. Soil nutrients are being mined in Ethiopia, leading to declining yields; but with the high cost and sometimes non-availability of fertilizers, Ethiopia has one of the lowest per ha use of fertilizer in the world. Yet there are a large number of both

indigenous and introduced technologies and practices that can help maintain and enhance soil nutrients and moisture conservation. These include techniques like terracing, ditches, stone and vegetative bunds, mulching, conservation tillage and more broadly "conservation agriculture." What specific techniques or combination of techniques is appropriate depends on local climate, soil, social and economic conditions and other factors.

As an example, semi circular terraces are a special kind of terrace built from stone and soil. Results from a GTZ financed study in Tigray identified them as effective soil conservation and water harvesting structures that can bring short-term benefits to landless farmers and can render unproductive hillsides into intensively cultivated units with supplemental irrigation.

Ex-situ water harvesting and storage

There are a variety of technologies for harvesting rainwater from roads, footpaths and household compounds. Water is harvested and directed either directly onto cropped fields, or into various types of natural or manmade storage structures. Examples include small storage dams, shallow wells and boreholes, rooftop water harvesting and surface and underground storage tanks.

Ethiopia's abundant water resources in its large rivers and basins are not yet tapped for beneficial uses. Provision of small to large dams and large diversion weirs are options to improve the control and management of water. Particularly since temporal variation of the rivers is high, considerable irrigation development requires an increase in water control and storage infrastructure.

Figure 4. Different kinds of treadle pumps

Technologies for water lifting

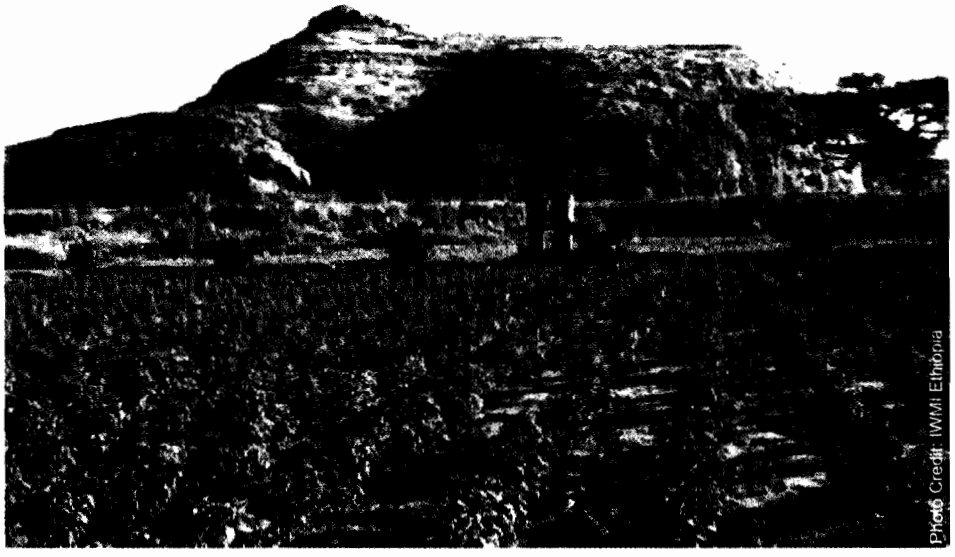
Treadle pumps and low cost motorized pumps are among the most popular technologies for water lifting and conveyance. Treadle pumps are potentially high-return, high-impact AWM interventions. They are especially appropriate where there is a water source close to the surface (less than 6m) and close to the field to be irrigated (less than 200m), and they will be especially profitable when farmers have access to markets where they can sell high-value fruits and vegetables. Low cost motorized pumps have had a big impact in Asia, but in Africa there is far less experience except in West Africa, especially Nigeria. The experience in Ethiopia is encouraging, particularly in the Rift Valley area, where farmers organize themselves to buy a communal pump or partner with capital investors who contribute with pumps and improved high value seed varieties for irrigation fields.

In addition to the use of shallow wells, utilization of groundwater from deep wells also provides ample opportunities in deep aquifer areas. The typical example is the Kobo-Girana Valley development, which resulted in successful interventions to improve the livelihoods of poor farmers.

Importation of certain small water lifting technologies for rural household use may require policy support in the form of import duty waivers. Otherwise, when there is in-country capability, production of the same technologies could be encouraged by incentive mechanisms.

Figure 5. Semi-circular terraces on steep slopes

Figure 6. Low cost, low pressure drip irrigation system



Technologies for irrigation water application

Low cost drip irrigation kits enable the farmer to make use of limited amounts of water and fertilizer to grow high value crops. It allows the precise application of small amounts of water directly to the root zone. It reduces losses from evaporation, weeds, runoff and percolation. Simple drip irrigation systems are now available which would cost a farmer US$15 to cover 15m^2, or US$ 200-400 for a bigger system covering 500m^2. The technology is potentially very beneficial and profitable to poor farmers provided that there is a reliable water source close to the garden to be irrigated; an effective program for promotion, training, technical support and provision of spare parts; access to output markets for higher value fruits and vegetables; and suitable types of soils.

Pitcher irrigation (Fig. 7) is another indigenous low cost irrigation system, which uses unglazed fire clay pots that have micro-pores and is molded by hand by rural women. Pitchers have much potential for backyard vegetable and flower production even in urban areas.

It has been well established that irrigation intervals between 7-14 days and water savings between 50% and 70% are achievable, resulting in yield increases between 30% and 45% over conventional flood, furrow and basin irrigation systems. This indicates a high potential for labor saving. Crops that prosper under this system include tomatoes, grapes, leaf vegetables, cauliflower, maize, beans and fruit trees.

b) Favorable policies, strategies and institutional support

The Rural Development Policy and the Water Resources Development and Management Policy are the two important policy documents which deal with the use and management of agricultural water in Ethiopia. The sub sector policy of irrigation aims "to develop the huge irrigation potential for the production of food crops and raw materials needed for agro-industries, on an efficient and sustainable basis and without degrading the fertility of the production fields and water resource base". The irrigation strategy deals with expansion of irrigated agriculture, water use and production efficiency, sustainable irrigation development and addresses problems related to irrigation such as water logging and salinity. Appropriate strategies of the sector have been recommended in the Water Sector Strategy 2002, and the revised strategy in PASDEP 2006.

Irrigation development needs to be institutionalized in river basins, at federal and regional levels. There is also a need for more defined and coherent institutional arrangements in irrigation development, irrigation scheme transfer after completion of civil work, WUAs and support services. There are no irrigation extension systems which can serve irrigation development.

The current integrated sector-based water policy is an overarching framework that was developed based on the national demand and supply concept of sectoral uses such as irrigation, hydroelectric power, industry and domestic consumption. It does not fully take into account regional differences in water demand coverage, availability of water sources; and regional development targets and approaches. Therefore, the two levels of planning should be harmonized as far as possible.

The various regions have also different sources of water, which are found under different contexts and settings. For instance, rainwater harvesting supply options may be viable for moisture stressed areas where there are limited permanent water sources and crops are affected due to dry spells and supplementary irrigation

Figure 7. Buried clay pots employed for irrigation water application

based small household level production is useful to supplement income and food production. In areas that have good rainfall and abundant water resources, the strategy should focus more on the wide use of water resources instead of focusing on small scale water harvesting types of AWM. The policy and strategy should reflect such variations in water and land resources endowment and implementation of the strategy should be clearly linked to the regional contexts.

Policy options to strengthen WUAs through proper legalization for ownership of irrigation facilities need to be considered. These legal entities can control the operation, repair and maintenance of the irrigation systems.

Although farmers in most schemes are aware of the importance of water to their crops, they are generally unaware of water requirements, correct intervals, efficient methods of application and suitable crop selection. As a result, expected yields are not obtained. On the other hand, yields can be improved significantly simply by improved extension which can inform and show farmers better crop types and varieties, correct irrigation practices and improved agro-techniques. What's necessary then are adequate irrigated agriculture support services and functions that include the private sector.

c) Water Rights, Water User Conflicts and Prices

Natural catastrophes and major political changes have disrupted indigenous water use arrangements and attempts to formalize water rights. In recent years, with the devolution of authority to the regions, the institutional challenges to rationalizing access to water have further evolved. Despite prioritizing domestic water supply in national policies, at the individual and family levels, many Ethiopians have limited access to adequate water resources to meet their basic needs and improve productivity through improved AWM. It is appropriate that the current water use rights at the community level are better understood. In addition, these rights need to be integrated into both the administrative and hydrological (basin) institutional arrangements before they emerge as a source of conflict. This is especially true as the level of water resources development increases and is likely to impact the community based systems, and even replication of community based systems, increasing the overall impact on a given basin.

There are no clear guidelines and regulations on water rights and water pricing in existing irrigation infrastructures. Water rights policies should be clearly developed to avoid conflicts before they arise. Conflicts may arise from competing different users and upstream and downstream users for irrigation and other sectors. A water rights policy should also consider resource capabilities in the watershed or aquifer system.

d) Enhancing private sector involvement

Ethiopia's rural economy is heavily reliant on crop/crop-livestock and pastoral production systems. These kinds of systems are also deeply rooted in the traditional ways of life of Ethiopian people. It was further worsened by a strong policy implemented by the previous regime, prior to 1991, which inhibited rural entrepreneurship and diversification of production systems. The rural economy needs diversified economic activities that support agriculture such as trade, services and rural industry. The introduction of irrigation yields the opportunity for diversified business activities. As income increases due to surplus production of irrigation, there will be increased demand for non-farm products and services. Hence, the private sector will be involved to handle these business activities. As these activities require financial and institutional support, the role of the government will be to enhance the rural business areas, facilitate or avail of capital in the form of credit or incentives and guide the running of the businesses and in general develop rural entrepreneurship and private sector participation.

e) Research for improved AWM

Currently, no national institution in Ethiopia is undertaking coherent and effective water and agricultural water management research, and there is a huge gap in terms of focus, capacity, ownership and institutionalization. The following points highlight the broad research needs in AWM in Ethiopia:

These research needs in AWM can be grouped into the following broad categories:

Policy research – strategic policy research to enhance the improvement of national level policies and processes, and to enhance the realization of broader poverty and food security impacts of smallholder to large scale irrigation interventions at national, regional and local (community and household) levels. Policy research should also look at the impact of these interventions towards building the economy of the country and regions.

Socio-economic and market research – research on marketing and market information so that farmers can produce targeted crops using irrigation is a general issue in all regions; market surveys and analysis so that farmers can produce according to market requirements; input supply arrangements during the irrigation period; research on how to successfully upgrade traditional schemes into modern ones, including organizational issues related to WUA formation; benefit-cost analysis for alternative irrigation technologies taking into account affordability, accessibility, maintenance and sustainability.

Institutional research – research to establish clear and effective policies to minimize conflicts between upstream and downstream water users; problems of irrigation institutional arrangements in regional structures; research on property rights regarding access to land and water, a particularly clear definition of rights to water to minimize conflicts between traditional irrigator and those on modern small scale scales. The link, complementarities and optional institutional arrangements between regions and federal institutions require strong research.

Technological research - there is a need to make an inventory of the available technologies for various stages of AWM and irrigation development. Research focusing on technologies available in the world or locally for piloting, up scaling and out scaling can provide reliable confidence in use and application.

Agricultural productivity – improving water productivity, technologies for achieving water use efficiency; agro-ecological based irrigation crop water requirements for Ethiopia; the cropping patterns for high economic returns; optimal irrigation scheduling for salinity and groundwater control; and techniques for reducing distribution and conveyance losses, are some of the examples and key issues that can be addressed through research.

Vegetable cultivation in Golgota, Ethiopia

References

This policy brief is based on selected papers presented, discussions and conclusions derived during a three-day symposium and exhibition conducted on "Best Practices and Technologies for Small Scale Agricultural Water Management in Ethiopia". The event was organized in March 2006 by the Federal Ministry of Agriculture and Rural Development (MoARD) of Ethiopia, Federal Ministry of Water Resource (MoWR) of Ethiopia, the US Agency for International Development (USAID) and the International Water Management Institute (IWMI).

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Acknowledgement:

This brief was prepared through financial assistance from USAID. The brief has been reviewed by members of the Ethiopian National Irrigation Steering Committee.

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