

Irrigation and Rain-fed Crop Production System in Ethiopia

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Abstract

Crop production is a function of water, nutrient, climate and soil environment. Provided that all other requirement are satisfactorily for proper growth and production, rainfall rarely meets the time with required amount of water application for plant growth. As a result average yield of agricultural crops under rain-fed agriculture is low compared to irrigated agriculture. This study assesses irrigation and rain-fed agriculture system in connection to its potential productivity under existing practice. While the rain-fed areas considered in this study are the aggregate at the national level, five systematically selected Medium and large scale irrigation schemes were selected based on cropping pattern, geographic and agro ecological representation. These are Fincha'a, MAAE, Metehara, Sille, and UAAIE which are located at three river basins, viz, Nile (Abbay), Awash and the Rift valley basins. Data were collected using pre-formulated checklists, through series of interviews and discussions; and from published and unpublished documents. The result indicated that crop production was undulating under rain-fed agriculture and as a result the performance of rain-fed productivity remained low and stable for most crops. Although crops grown by small-holder private farmers are different, cereals occupy about 74 per cent followed by pulses and oil seeds with small proportion. During the last one decade, the maximum and

minimum cultivated land by small-holder peasant farmers at the national level was 10.7 and 6.6 M ha, respectively. Increased cultivable area by private small-holder farmers could not seem to contribute to the increased production. Total irrigated land by private peasant farmers ranged between 66 and 147 thousand hectares for the last one decade. During the last decade the area under irrigation was steadily increasing for most of the large scale schemes. Particularly Fincha'a and Metehara farms are significantly increasing while MAAE farm has shown only a slight increase. At UAAIE farm, crop production shows a decreasing trend. Productivity of banana at Sille farm was decreasing despite its increasing in land area.

Key words: Irrigation, Rain-fed, crop production, productivity, large scale scheme, private small-holder

1. Introduction

Crop production is a function of water, nutrient, climate and soil environment. Complex relationship existed between these factors and the crop as a consequence of the involvement of biological, physiological, physical and chemical processes. However, efficient crop production and optimum yield can be achieved only when the water supply is precisely in fine tune with the biological needs provided that the crop is well supplied with the required nutrients and well adapted to the prevailing environment. On the other

hand, there is no crop without water, what so ever needs are in place. Therefore, timely supplied with an adequate amount of precipitation and/or irrigation could play a major role in increasing agricultural crop production.

Rainfall rarely meets the time with required amount of application for plant growth. As a result average yield of agricultural crops under rain-fed agriculture is low compared to irrigation, which is the application of controlled amount of water at specified time of application. In Ethiopia, traditional rain-fed agriculture is the dominant form of farming in which the peasant farm households contribute the largest proportion of the total agricultural production. Out of the total land area of 112.3 M ha, about 16.4 M ha are suitable for the production of annual and perennial crops. Of the estimated arable land, presently about 10 M ha is used annually for rain-fed crops (CSA, 2006).

The pattern and intensity of rainfall in the country is quite variable in which most of the highlands receive between 510 to 1530mm of rain annually and in typical arid and semi-arid areas generally receive less than 500mm to about 750mm rain, respectively. However, rainfall in most cases is unreliable and erratic and moreover, productivity is constrained by several interlinked factors such as unpredictable climate (flood, frost, pest etc.) small and fragmented land holding, land degradation, limited technological inputs, etc. About 80 percent of the population lives in the highlands. Over population in these area caused shortage of land and thereby pushing the farmers onto lands with fragile soils and steep slopes in which the land becomes exposed to erosion and eventually turns out to unproductive state. On the other hand there is a huge tract of arable land in the low lands which could be utilized for agricultural production. However, rainfall is either not sufficient or not dependable in amounts and timing. As a result, crops suffer from severe soil moisture stress and drought.

The dependence on rain has significantly affected the life of the people in particular and economic development of the country in general. Improving this sector contributes to improve the productivity of agriculture and thus the generation of higher incomes, promotion food self-sufficiency and improving health condition of the people. It also increases and diversifies production of raw materials for industries and promotion of export item.

Irrigation is one means for a good farm husbandry, better land utilization and stable and higher crop production. Sustained growth and dynamism in agriculture is a fundamental necessity to meet the increasing demand for food and other products in view of the growing population. Irrigated agriculture will play a major role in reaching the broader development vision of the country in achieving food security, poverty alleviation and improvement in the quality of life. The main objective of irrigated agriculture is to provide plants with sufficient water to prevent stress that may cause reduced yields or poor quality of harvest (Haise and Hagan, 1987; Tayler, 1965).

Ethiopia is one of the few African countries endowed with relatively abundant water resources, favorable climate and potentially huge irrigable land. The annual stream flow and groundwater resources are estimated around 122 and 2.6 billion m³, respectively. About 83 percent of the total runoff is found in the basins of large rivers such as the Abbay (Blue Nile), the Baro Akobo, the Omo Gibe and the Tekez (MoWR, 2002).

While the potential benefits of irrigation are great, the actual achievement in many irrigated areas of the country is substantially less than the potential. According to MoWR (2005), Ethiopia is estimated to have 3.7 M ha of potentially irrigable area with the available surface water resources and the land irrigated through the development of traditional and modern irrigation schemes are estimated to be about 386,603 hectares,

which is about 10 per cent of potentially irrigable land. According to the report, in the modern irrigation there were 466 small, 102 medium and 9 large irrigation schemes with the total area coverage of 28,939, 71,924 and 49,675 ha, respectively have been developed by Government, nongovernmental organizations and private investors. However, the major crops produced with irrigation are industrial and cash crops with small proportion of food crops. The major part of food crops produced in the country come from rain-fed agriculture.

This gross underdevelopment has spurred the Irrigation Development Program (IDP) to put additional hectares of land under irrigation within its 15-year plan period of 2002-2016 (MoFED, 2006). Therefore, a strategy that ensures economically profitable, ecologically sustainable and socially acceptable use of the available resources (land, water, climate, labor,

finance) is of paramount importance. This presumes that the limited resources are efficiently used so that the benefits per unit out puts are optimized. Therefore, this study was aimed to assess irrigation and rain-fed agriculture system in connection to its potential productivity under existing practice.

2. Study Area

The study area encompasses rain-fed areas in the country in general and five systematically selected Medium and large scale irrigation schemes based on cropping pattern, geographic and agro ecological representation. These are Fincha'a, MAAE, Metehara, Sille, and UAAIE which are located at three river basins, viz, Nile (Abbay), Awash and the Rift valley basins. The main features of the study sites are presented in Table 1.

Table 1 Main features of selected irrigation schemes

	Irrigation Schemes				
Features	Fincha	MAAI	MSF	UAAIE	Sille SF
River basin	Abbey	Awash	Awash	Awash	Rift valley
Latitude	9° 18'N	9° 46'N	8° 52'N	8° 37'N	6° 1'N
Longitude	37° 14'E	40° 38'E	39° 54'E	39° 43'E	37° 37'E
Altitude (m)	1450	750	950	1100-1200	1280
Tmax (°C)	24	34	33.1	32.6	32
Tmin (°C)	7.4	18	17.2	15.3	17
Rainfall (mm)	1300	500	550	500	729.6
Crops	Sugarcane	Cotton	Sugar (fruits)	vegetables and fruits	cotton, maize and banana
Source of water	Fincha'a River	Awash River	Awash River	Awash River	Sille River
Method of irrigation	Sprinkler	Surface (furrow)	Surface (furrow)	(furrow and basin)	Surface (furrow)

3. Methodology

In this study status of rain-fed and irrigated agriculture in terms of area, production and productivity will be assessed at national and River basin level. Primary data (crop production and productivity, irrigated and rain-fed area etc) were collected using pre-formulated checklists for time span of at least ten years. Series of interviews and discussions were held with different stakeholders including; representatives of water user associations and beneficiaries, subject matter specialists from zonal and district BoARD (agronomists, irrigation and natural resource experts, extension personnel etc) for the small scale irrigation schemes and the corresponding rain-fed agriculture system. Similarly interviews and discussions were also held with enterprise, farm and unit managers of the selected large

scale irrigation schemes. In addition, published and unpublished documents (series of agricultural sample survey reports (CSA) were reviewed and analyzed.

4. Results and Discussion

Rain-fed Farming System

Ethiopian farming is mainly dependant on rain-fed smallholder agriculture system as a means of food and income for its population. Virtually all food crops come from rain-fed agriculture system. The farming societies are principally private peasant. Crops grown under rain-fed farming system were diverse and many within a cropping season. However, the agriculture system is dominated by cereal based productions since it was produced in large quantity as compared to other crops (Fig. 1). Pulses and oil seeds occupy small proportion in contrast to cereals. The major cereal crops grown were maize, sorghum, tef, wheat and barley.

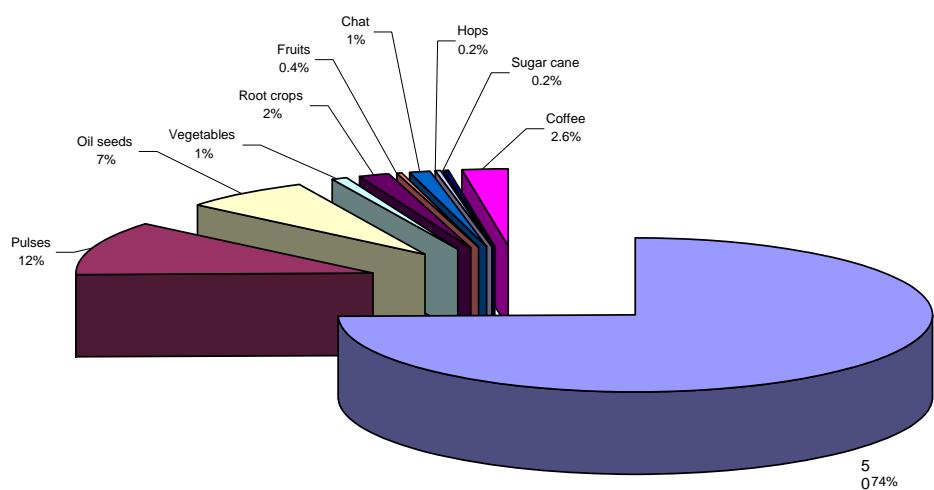
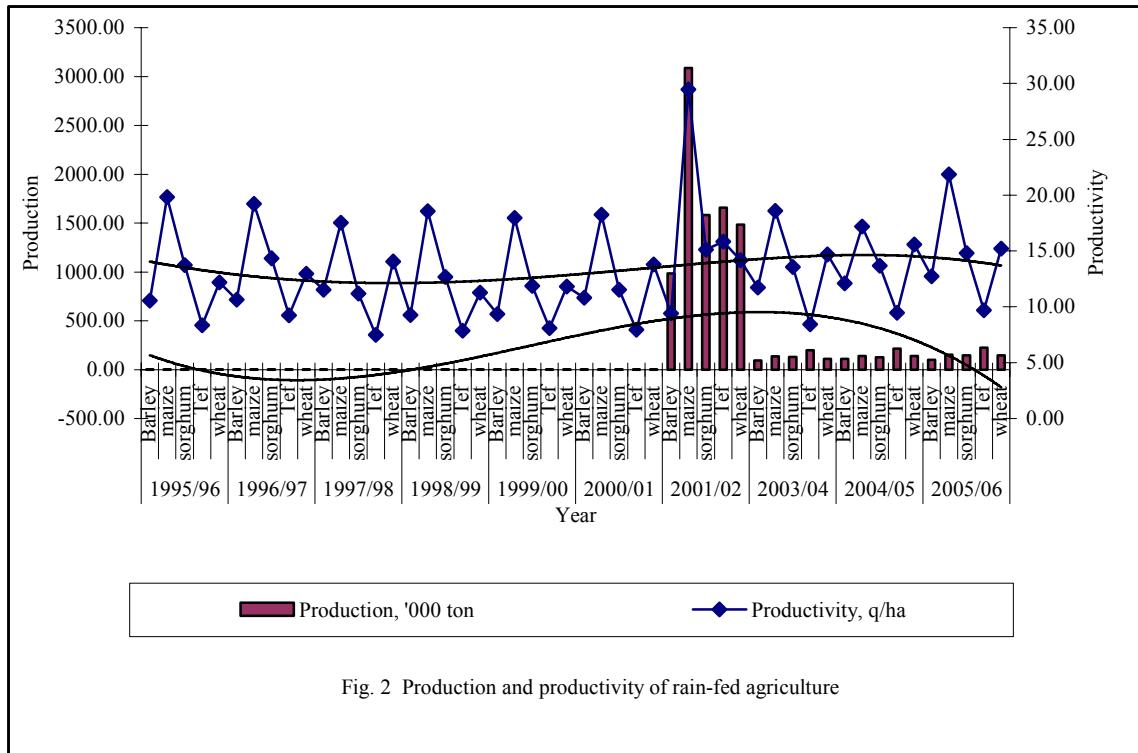


Fig. 1 Area coverage of rain-fed crops

Cereal production and productivity under rain-fed agriculture is shown in figure 2. The crop production was undulating reaching low during 1995/96 and 2005/06; and pick during 2001/02. As shown in Fig. 3, area under rain-fed agriculture was highest during 2005/06 cropping season and where as production is low as compared to 200/01 cropping season.

During the last one decade, the maximum and minimum cultivated land by small-holder peasant farmers at the national level was 10.7 and 6.6 M ha, respectively (fig. 3). Agricultural production could be increased through increasing cultivable area or using improved seed and cultural practices (fertilizer, irrigation etc). The increased cultivable area during 2005/06 by private small-holder farmers could not seem to contribute to the increased production. The production rather seems to fall as the area increased. There can be several reasons for low production. Simple reason for increased crop production during 2001/02 could be

due to an increase in cultivable area along with the favorable conditions including adequate rainfall that might have occurred during the cropping season. Moreover, visual observation elucidated that the occurrence of sufficient rainfall (adequacy and reliability) through-out the growing season enables the private peasant farmers to get bumper harvest, indicating rain-fed agriculture to depend strongly on rainfall availability. In absence of sufficient rainfall, there is always low agricultural production thereby creating food shortage and food insecurity for its population and also dipping poverty. Consequently, the performance of rain-fed agricultural production and productivity remained low and stable for most of the years. The low level of performance of rain-fed agriculture could not only be attributed to erratic nature of rainfall but also deteriorating soil fertility and slow adoption and/or lack of appropriate technologies.



The above statements generally point out that those small-holder private farmers

survived with uncertainty of rainfall and low level of technology aggravating the

occurrence of poverty and food insecurity. With the existing rate of production and productivity, it is going to be a challenge and threat to the country to feed the ever rapidly growing population. Therefore, due attention should be given to improve the production system to alleviate poverty and secure food self-sufficiency.

Irrigation Farming System

Irrigation enables farmers to improve crop production and intensification thereby sustaining and improving livelihoods and food security. In Ethiopia, private peasant

farmers use irrigation at small scale level to enable them increase crop production and as a means of raising income. Small scale irrigation not only increase crop production, but also improves cropping intensity and reduces the effect of erratic rainfall. The practice of irrigation may not be possible for every farmer and could not be possible to expand the area. As shown in figure 3, during the last one decade, the total irrigated land by private peasant farmers ranged between 63 and 175 thousand hectares which is 0.8 to 1.8 per cent of the total area covered under rain-fed agriculture, respectively.

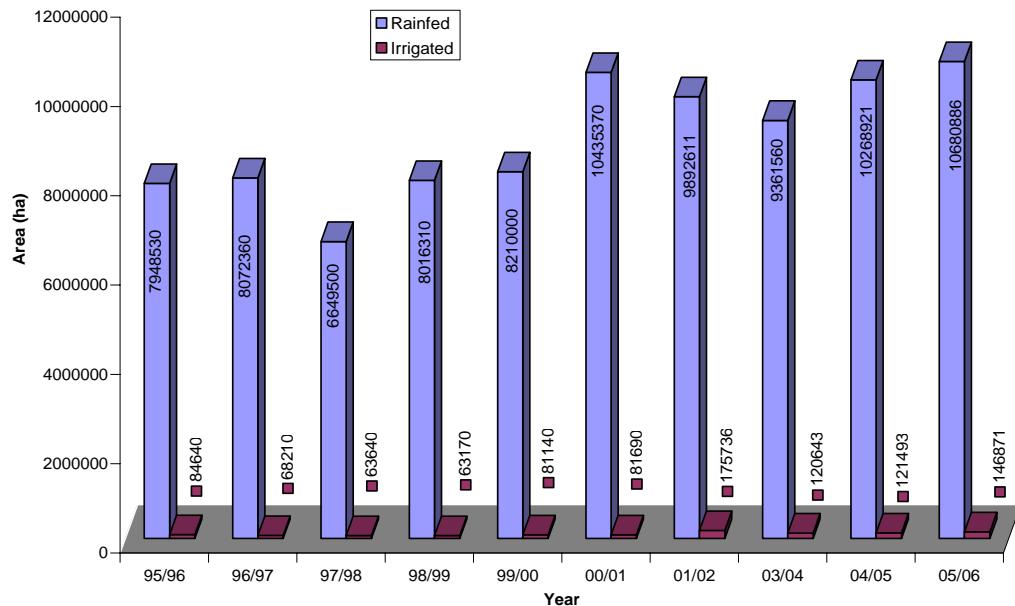


Fig. 3 Rain-fed and irrigated area under small-holders

The area under small scale irrigation has been appreciably expanding, particularly

after 2001/02 though apparently shown to decline during 2003/04.

Table 2. Irrigated area under small-holder private farmers (ha)

Year	Cereals						Pulses	Oil seeds	Others	Permanent crops
	Teff	Barley	Wheat	Maiz e	Sorghum	Total				
2005/06	7895	7441	6116	3558 6	15596	73509	3950	1740	30170	37502
2004/05	7756	7212	4614	2940 7	9756	59052	6832	1915	16143	34361
2003/04	7835	5647	3805	3257 3	11199	61406	5217	927	21578	31516
2001/02	1244 7	8016	4750	5383 8	12778	93615	9896	726	35855	33359
2000/01	5650	3680	1330	1896 0	15910	45770	3880	290	9240	22500
1999/00	5230	4630	1780	1856 0	11510	42850	2890	430	13390	21580
1998/99	2890	3580	2570	1365 0	7240	30110	2660	**	8830	21350
1997/98	1154 0	4230	2540	1214 0	3690	34560	1920	**	7350	18860
1996/97	4790	**	800	1369 0	18970	39220	**	**	3650	21470
1995/96	4490	1400	1890	2181 0	**	55050	5300	**	4890	1933

** not reported

The main agricultural produces under small scale irrigation includes cereals, pulses, oil seeds and permanent crops like fruits, chat, coffee, hopes and sugarcane. Permanent crops occupy the largest share next to cereals. Pulses and oil seeds occupy (5 %) insignificant part compared to permanent crops. The major irrigated pulse crops include field pea, horse bean, haricot bean and chick pea. Major irrigated oil seeds include neug, linseeds and sesame. Others like vegetables and root crops are produced in small proportion. Among cereals crops, maize covers the maximum area under small

scale irrigation followed by sorghum, tef, barley and wheat (Table 2).

In contrary to small scale irrigation, Medium and large scale irrigation schemes in the country has been found to produce mainly cash and industrial crops. The schemes considered this in study are government owned enterprises. Medium and large scale irrigation schemes are usually expected to contribute to the national economic growth and alleviation of poverty and food security. However, the contribution of these schemes to food crops production is almost none. The major crops grown under medium and large

scale irrigation include Sugarcane, cotton, fruits and vegetables. Figures 4 to 6 show area, production and productivity of Medium and large scale irrigated agriculture schemes. During the last one decade the area under irrigation was steadily increasing for most of medium and large scale schemes (Fig.4). Particularly Fincha'a and Metehara farms are significantly increasing while MAAE farm has shown only a slight increase. Mainly due to re-occupation of part of the lands by the local people, Sille farm has shown a decline in irrigated land area. . Similarly, crop production, has shown an increasing trend for most of the irrigation schemes (Fig. 5). Sugar cane production is increasing significantly at Fincha'a and Metehara while banana production is increasing significantly at Sille farm. However at UAAIE farm, crop production shows a decreasing trend. At Sille farm

cotton production shows a decreasing trend mainly the replacement of some of the cotton field by banana. This was attributed mainly to market problems since there are no competent purchasers of the products in the area, and transportation cost is too high to move to other areas. Consequently, the farm has become price recipient, instead of negotiating for a reasonable price.

Productivity is increasing better at MAAE farm only while at Metehara and sille farms the trend is stable. Productivity has been declining at UAAIE and Fincha farms, but attempts are made to compensate by increase in cultivated land area. While the productivity of banana at Sille farm was decreasing despite its increasing in land area, the overall productivity of Sille farm is unstable, which may be among the reasons for continuous change of crop types.

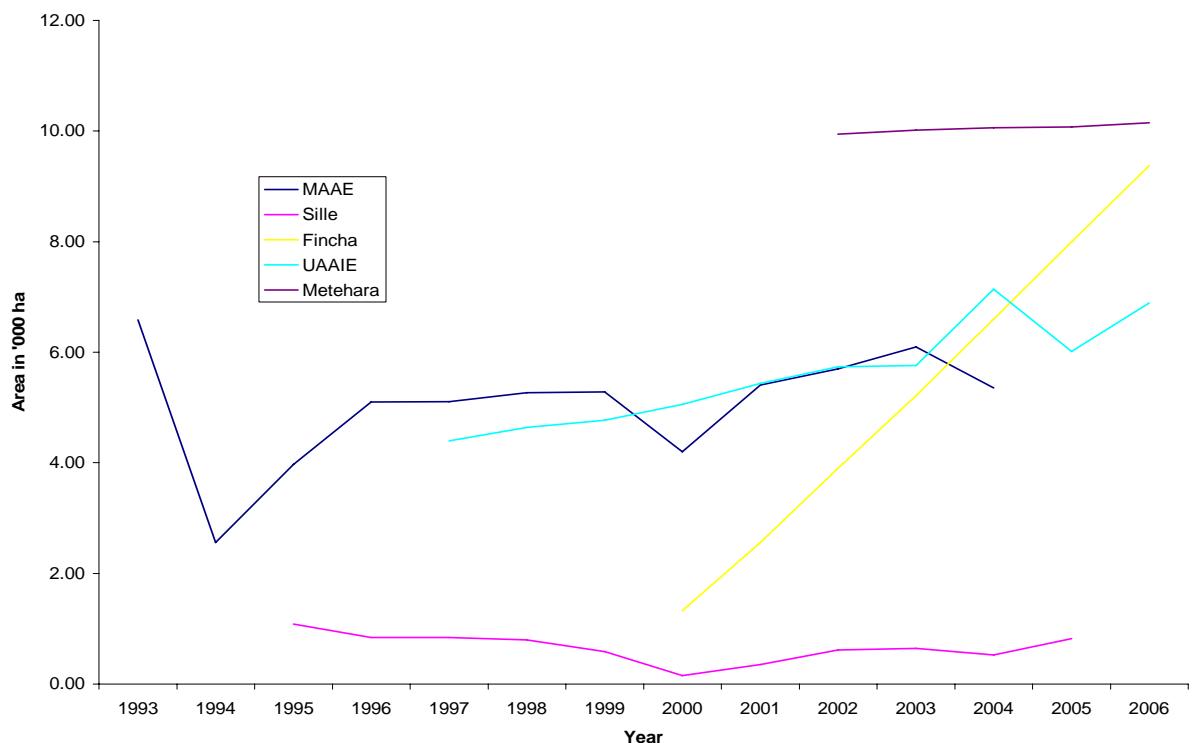


Fig. 4 Trend of irrigated area under medium and large-scale irrigation schemes

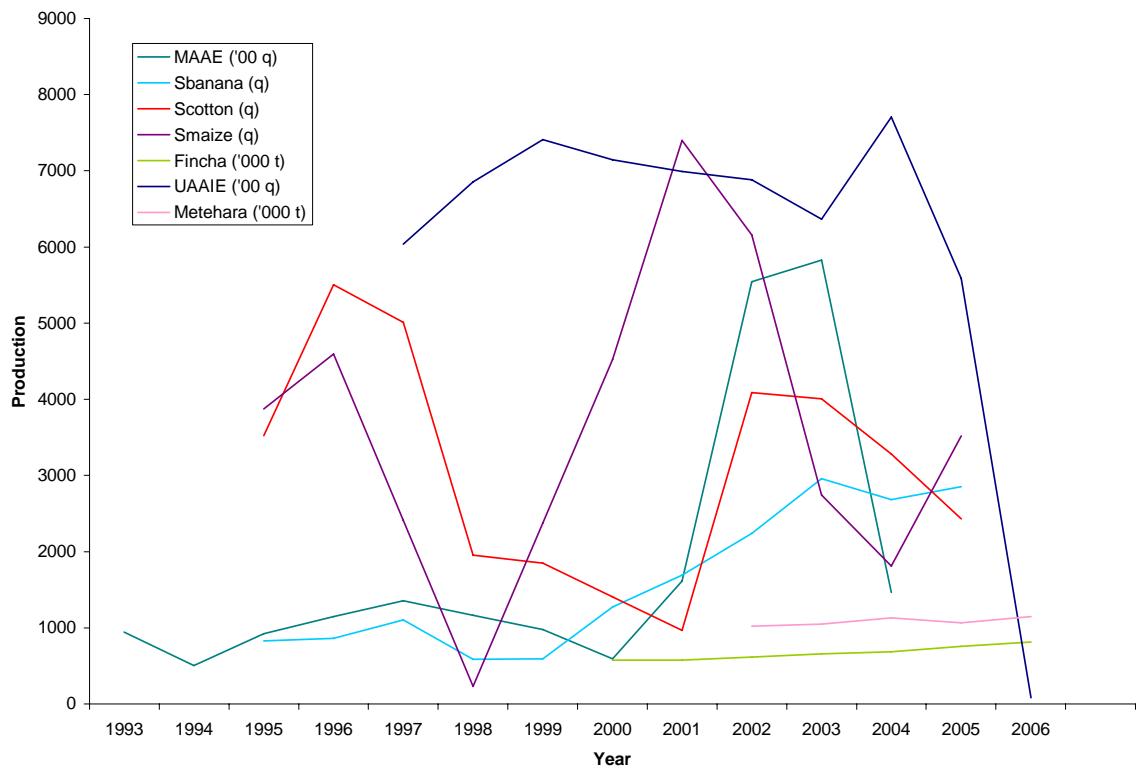


Fig. 5 Trend of agricultural production under medium and large-scale irrigation schemes

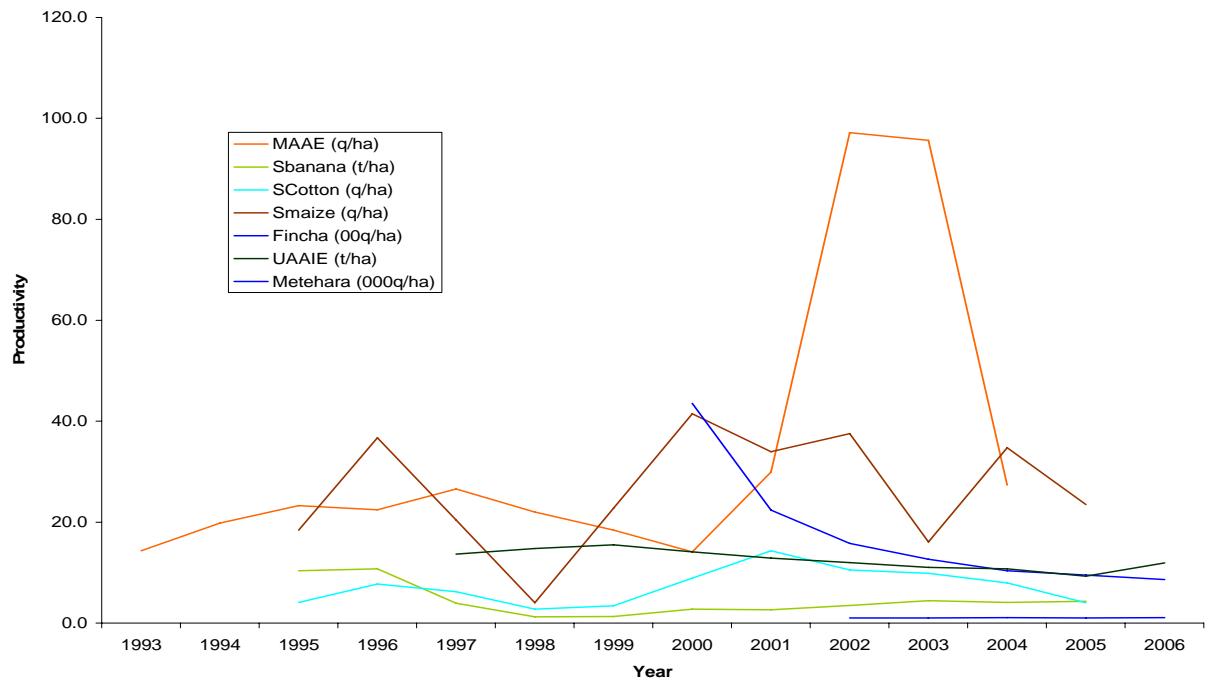


Fig. 6 Trend of productivity of irrigated agriculture under medium and large-scale schemes

5. Conclusion

In Ethiopia, crop production is dominated by traditional rain-fed agriculture. However, rainfall is unreliable and erratic in nature. As a result, production and productivity is low and stable. During the last one decade, the maximum and minimum cultivated land by small-holder peasant farmers at the national level was 10.7 and 6.6 M ha, respectively. Crops grown are mainly cereals occupying about 74 per cent followed by pulses and oil seeds in small proportion. The major cereal crops grown were maize, sorghum, tef, wheat and barley. However, rain-fed agriculture does not seem to meet the ever rising demand for food as population increased. Hence, requires special focus on ways of increasing production and productivity.

Private peasant farmers use irrigation at small scale level to enable them increase crop production and as a means of raising income. Area under small scale irrigation has been appreciably expanding, particularly after 2001/02. During the last one decade, the total irrigated land by private peasant farmers ranged between 63 and 175 thousand hectares which is 0.8 to 1.8 per cent of the total area covered under rain-fed agriculture, respectively. Cereals and permanent crops occupy the major part followed by vegetables and root crops.

The contribution of medium and large scale irrigation to food crops is almost negligible. The schemes produce mainly industrial, exportable and cash crops of which sugarcane, cotton, fruits and vegetables are the major ones. In most cases, the area under medium and large scale irrigation schemes was steadily increasing except at MAAE and Sille farm. At UAAIE production and productivity were declining while Sille farm production is generally declining and productivity was unstable. Crop productivity was declining at Fincha'a farm, better at MAAE farm and stable at Metehara.

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