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The Stumbling Irrigation Sector of Ethiopia: Critical Review and Analysis

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Abstract

The middle 19th century irrigation development historyof the world,especially Green Revolution, taught us that intensive irrigation expansion has the power and is also the key to eradicate food shortages of some nations. At the same period, an attempt was made to improve irrigation sector of Ethiopia but not successful as Asian countries.The paper tried to present the pathways Ethiopian irrigated agriculture so far travelled based on comprehensive reviews substantiated by indepth analyses. From the irrigation policies and development plans up to organizational setups, diverse but critical platforms which troubled its development evolutions have been raised and criticised. Effects of these platforms or their aftermaths on targeted development plans; on data of irrigated areas and potentials as well as on performances of irrigation schemes have also been analytically quantified and thoroughly discussed. In general, development of the sector is still stumbling for half a century and unable to contribute for food selfsufficiency and economic growth. The country donot have clear irrigation policy; the sector is supported with low financial backups; organizational structure is shacky and misaligned; the institution are weak so that irrigated areas and potentials are unknown or the figures are inconsistent; scheme categorization is confusing; improperly planned developments are failed and stagnated; large scheme development are stagnated and too slow to change the economy. For the last 60 years less than 0.65 million ha is developed in the country. Irrigation efficiencies of the schemes is below 35%. Finally, overhauling the sector as a whole is recommended if real development is expected.

Keywords: Scheme categorization • Performance • Irrigation policy • Food selfsufficiency

Introduction

The concept of irrigated agriculture was emanated from losing of confidence on natural rainfall for sustainable production of food crops at the required volume [1]. Through time, the wider and diverse advantages started to be accepted as a driving force for economic growth of a nation. Otherwise, at any moment, stability or even existence of a nation will be in question if not consistently able to satisfy food demands and economic growth of its population [2]. Hence, local availability of both foodand industrial products are essentials.

Globally, irrigation is feeding the growing population and was a key component of the "Green Revolution" of the 1960s and 70s. The global Area Equipped for Irrigation (AEI) covered an area of 63 million ha in 1900, nearly doubled to 111 million ha in 1950 and approximately tripled to 306 million ha by year 2005mostly in arid and semi-arid environments for rice, wheat, maize and cotton productions.The sector provides about 40% of the worlds' food production from 18% of cultivated land [3]. According to Hussain and Hanjra, in some part of the world, cereal production was more than doubled between 1995 and 2001 due to irrigation expansion and use of varieties and fertilizers. Average crop yield per hectare was 2.3 times higher than rainfed agriculture [4].

Rationale for government support for irrigation has been of two types: investment in large scale irrigation schemes; and promotion of small scale schemes often as a component of rural development. Large schemes have several benefits that can be rationalized as; in response to rapid population growth and sluggish agricultural performance, they have the capacity to minimizing food shortages and food imports; for producing high yielding quality crops for food, industrial and foreign exchanges for the national economy and for employment in rural areas. On the other hand, rapid irrigation of smallscale irrigation contributes to poverty alleviation by enhancing productivity will contribute to the reliability of food supplies, enhancement of incomes and employmentfor the rural communities [5].

In order to gain the benefits, substantial area must be developed in short time, intensively cropped, should be strongly financed and implemented with strong commitments as US, China and other Asian countries did. In 2013 in US, although only 7.5% of cropland and pastureland was irrigated, it provided nearly 55% of total crop sales, suggesting an important role in overall agriculture productivity. During 1949 to 2009 for 60 years, population of China has increased from 0.5 to 1.3 billion;irrigated area has increased from 15.9 to 61.7 million ha (on average 0.82 million ha per year); and grain output has increased from 0.113 to 0.57 billion tons. Approximately half of the cropland was irrigated and produced 75% of the nation's food; 80% of cotton and oil crops; and 90% of vegetables and fruits.Untill 2009 government invested heavily on irrigation projects and then changed the direction towatersaving, irrigation managements, modernization and maintenances [6]. In 2015, out of 66.5 million ha irrigated area, 91.2% was only for food crops.

Despitehaving comparable ageswithdevelopment initiative of world countries, irrigation sector of Ethiopia lagged much behind and its contribution for national crop production and economy isalmost zero. The objectives of the paper were to assess development history of the irrigation sector;to identify major challenges hampering its progresses; andto suggest possible recommendations based on extensive reviews and indepth analyses.The paper begins with the need of irrigation for the country and comprisesthree major sections; the plateforms on which the sector has been functioning will be critically assessed with much emphasis on policies and strategic directions; organizational setups and institutional capacities of the current government. Then the aftermaths willfollow by illustrating implementationofdevelopment plans; figures on irrigated areasand potentials; scheme categorization system; and irrigation performances of the country. The final section of the paper will be conclusions and recommendations.

Irrigation for Ethiopia

Irrigated agriculture in the form of spate systems capturing the runoff from Ethiopian highlands along the Red Sea Coast has been a choice in the Horn of Africa for more than thousand years. These were the precursors to small scale, traditional irrigation schemes, including diversion, spate, spring, lift and very small storage systems now widely practiced by local communities. The

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first advice, which was considered as the beginning of state's interventions on irrigation, given to farmers to construct canals and to produce vegetables for mitigating the looming drought was in 1928 through issuing of a proclamation. But it was in 1956 that serious development was started by adopting modern irrigation in awash basin. Intensive water resource studies and irrigation developments have been carried out in the 1960s and 70s which were in the same period of rapid expansion of irrigation world wide; and the era of green revolution in Asian countries such as China [7].

Ethiopia coversaround 111 million ha in which 36% is highland and the remaining 64% is lowland. Preliminary studies indicated that the country has close to 123 and 36-40 billion m^3 annual run off from 12 major river basins, and groundwater, respectively. The runoff is unevenly distributed in time and place in which more than 80% is produced in the west and south-western parts where the five river basins (Abay, Tekeze, Mereb, BaroAkobo, and Omo Gibe) and only 30 to 40% of the 110 million people are found. Only 10 to 20% of the runoff occurs in the east and central basins where the population is over 60%. Almost 70% of the runoff from the five basins occurs between June and October.

Having potential for irrigation (water, land, climate etc.) which has hardly been developed to date, Ethiopian economy is still highly dependent on rainfed smallholders who are highly vulnerable to food insecurity. For the last five years, 80% the national foreign currency have been acquired from export of agricultrulal products. The numbers of population seeking food aids are alarmingly increasing. Food crops' prices are escalating. Considerable volumes of food and industrial crops such as wheat, sugar, food oil, and malt are still imported distorting foreign exchange balances. Close to 90% people and about 95% of the cultivated area is situated in the highlands under the prevalent rainfed production system, progressive degradation of natural resources coupled with climate variability aggravating incidences of poverty and food insecurity. According to Central Statisticis Authority, CSA, around 14.5 million ha was cultivated by 16.5 million small farm holders with an average land holding of 0.88 ha; 61.7% of the farmers had below 1.0 ha. In 2018/19 meher and belg rain seasons, 12.7 and 1.9 million ha were cultivated by 16.0 and 6.6 million rainfedsmall farmers, respectively whoproduced around 95% (29.52 million tons) of the country's cereal production. Only 0.62 and 1.36 million ha were cultivated by small irrigators and commercial farmers, respectively. In the same year, share of cereal crops was 25.70% and 9.50% of the total area and total production of small farm irrigators, and 1.4% and 2.4% of cereal producing rainfed small holders, respectively (own calculation from CSA 2018/19 data).

Of course, average per capita local cereal production has increased from below 150 kg in 2003/04 to 213 kg in 2007/08 and again to 268.4 kg in 2018/19 (110 million people being considered) so the country can be categorized as food selfsufficient but not stable. Because, the production is totally dependend on the unrelieablerainfall so that according to Elias still more than 25 million people become food unsecured. The country is struggling to be one of middle income countries by the end of 2030 and to liberate its rainfall dependent agriculture. But average per capita irrigated area of the country is 60 m^2 or 167 persons are dependent on one hectare of irrigated land (Section 4.1) which is by far lower than current global average i.e. 400 m^2 or 25 persons. Only 30% of onion and tomato and 12.7% of maize of small holders are marketed. In 2018/19, sugarcane and cotton were harvested from 0.081 and 0.188 million ha to produce 7.75 and 3.75 million tons, respectively (CSA 2018/19 data) for local factories and markets.

To attain at least the global average per capita irrigated area, currently it is expected to have at least 4.4 million ha irrigated area which is comparable with projected estimate ofIrrigation Development Program (IDP) of Water Resources Development Program (WRDP). The plan was prepared in 2001 (65.26 million people) by Ministry of Water Resources (MoWR) based on 2.72% population growths together with projected demands ofcereals, cotton and sugarcane crops by 2006, 2011 and 2016. According to MoWR (2001), even under 5% rainfed agriculture growths, the country could face up to 4.9 million tons cereals, 0.85 million tons cotton and 0.620 million tons sugar by 2011. The country required 6.25 million tons of cereals, 1.41 million tons of cotton and 1.42 million tons of sugar by the end of 2016. Hence, it was expected to irrigate an additional 1.33, 1.56 and 1.81 million ha (4.7 million ha in total) by the end of 2006, 2011 and 2016, respectively.

It is clear that the demand gaps are so huge that can never be narrowed by improving only productivities of fragmented and mixed rainfed production systems so that **irrigation** expansion is the only option [8].

Platforms of the Sector

Policies, strategies and mandates

Irrigation development is as much a social and political activity as a technical one (Bottrall, 1985) and policy implementation is not a linear process in which paper policy is transformed into real-world outcomes, but rather an interactive one, which can lead to a variety of outcomes as policy elites and implementers try to respond to societal reactions to policy implementation. It is transformed and reinterpreted during the implementation process but decades of disparity between paper irrigation policy and policy in practice illustrate that policy narratives and implementation cannot be equated [9].

Properly designed and consistently improved policies and strategies are crucial for economic growth of a nation so deemed to assessthe frameworks influencing irrigation sector of Ethiopia. After highlighting aboutthe unstabilityof policies and strategies of the last half century, startegies and policies of the current government will be assessed little deeper.

The Imperial government took the first water resource development initiative in late 1950s. The regime was keen to estimate potentials of the river basins and to invite foreigners to invest in agro-industrial enterprises. Large scale agro-industrial projects were constructed in the Awash valley and subsequently spread to Rift Valley and WabeShebelli basins. In the 1960s and 1970s, comprehensive reconnaissance and feasibility studies were carried out on the Abay, Awash and Wabe Shebelle river basins. In 1962 and 1964, German and U.S. engineering teams respectively undertook extensive studies on water resource potential of Abay River basin. Awash and Wabe Shebelle River basins were surveyed and studied in the 1960s and 1970s. About the same time, a reconnaissance survey of Tekeze and Mereb in the north was made. On a smaller scale, pre-feasibilities and reconnaissances have been undertaken by the initiative of Water Resources Development Authority (WRDA) and Ethiopian Valley Studies Development Authority (EVSDA). The main objective all these had been to assess extents of water developments and potentials, and to prioritize development areas. Essentially, the government's interest was entirely on large-scale irrigation for supplying industrial crops to the growing agro-industries and to boost exports. Sugarcane, cotton, sesame, fruit and vegetables were the main crops. In the Rift Valley, some irrigation was used to grow food crops.

During the initial period of Dergregime which was started in 1974, irrigation was seen as a tool for modernizing and socializing agriculture of the country. It was also considered as an important sector for increasing rural incomes, and for utilizing unused agricultural lands. All large scale irrigation was nationalized in 1975 by the government which handed them over to the Ministry of State Farms. Small scale irrigation suffered a similar fate and most landlord based schemes were converted into Producers' Cooperatives or PCs [10]. The government pursued the development of medium and large irrigation schemes in various basins on top of expanding in the Awash Valley. Amibara in Awash, Alwero in Baro, Gode in Wabi Shebelle, Omorrate in Omo, Tana Beles in Abay, Finchain Abay, and etc are some. In late 1980s, the Indian firm Water and Power Consulting Services (WAPCOS) prepared a preliminary water development master plan of the country (WAPCOS, 1990). The emphasis was to promote large schemes owned by state controlled agro industries and enterprises. In parts of several highlands of the country, traditional systems dated back to a century but little attention was given. However, it was only after the 1984/85 devastating famine that Derg began to show interests in small and traditional schemes. The justifications expanded towards relieving of drought and food shortages. At the end of 1984, Irrigation Development Department (IDD) within Ministry of Agriculture (MoA) was established and mandated for the development of smallscale projects. Until

1991, IDD constructed around 35 small schemes of which nearly 33% were formerly traditional. They were taken over by the government and upgraded then transferred to PCs.

Following downfall of Derg in 1991, the current government withdrew from expansion of State farms and further construction of medium and largescale irrigation until the aftermath of 2002/3 drought. Not only the government hesitated to expand medium and large scales but also has interrupted major irrigation projects started in the Derg regime. MoWR was established in August 1995 by proclamation No. 4/1995 as a federal institution for the water sector. At regional level, the water sector was the responsibility of Water, Mines, and Energy Development Bureaus (WMEDB) or Water Resources Development Bureaus (WRDB).

The first Water Sector Policy was issued in 2001 by the MoWR with the following summarized justifications: absence of well-defined coherent policy and lack of the required huge investment for the development of the water sector which in turn significantly hampered the overall socioeconomic development of the country.

The document comprises Water supply and Sanitation Policy, Irrigation Policy and Hydropower Policy. Underthree pages 'Irrigation Policy" of thisdocumentinthe general policy part, the following statements have given much emphasis: the irrigation development should ensure integration particularly with ADLI (Agricultural Development Led Industrialization) strategy; develop a hierarchy of priority schemes based on food requirements, needs of national economy and requirements of raw materials and other needs; by promoting decentralization and users based irrigation management and also by supporting and enhancing traditional irrigation schemes and localized water harvesting techniques; enhance greater participation by the Regional and Federal Governments in the development of large scale irrigated farms in high water potential basins but with low population density.

Among others, the two main objectives of the irrigation policybeing stated are; development and enhancement of small scale irrigated agriculture and grazing lands for food self-sufficiency at the household level, and development and enhancement of small, medium and large scale irrigated agriculture for food security and food self sufficiency at national level including export and to satisfy local agro-industrial demands.

The irrigation policy was expected to enhance ADLI strategy with the above of attaining the two objectives, it is very necessary to highlight the ADLI strategy framework briefly first together with how irrigation scheme development responsibilities have been allotted amongministerial offices.

Ethiopian government has been implementing ADLI since 1991 that sees agriculture as engine of growth with emphasis to; (i) improve agricultural extension services; (ii) promote better use of land and water resources; (iii) enhance access to financial services; (iv) improve access to domestic and export markets; and (v) provide rural infrastructure which aimed to enhance agricultural productivities by; (i) improving agricultural practices through increased use of fertilizers and improved seeds and through trainings; (ii) developing agricultural infrastructures through small scale irrigation, improved rural banking and so on; and (iii) promoting large scale (private as well as state owned) commercial farmings.

EWRM (Ethiopian Water Resources Management) Proclamation No. 197/2000 legalized MoWRto administer and supervise all water resources and water related development activities by updating the 1994 Water Resources Utilization proclamation No. 92/1994 which categorically mandatedMoWR and MNRDEP for Transboundary Rivers and water that flows more than one National/Regional governments, and regional water resources, respectively. But it was after five years thatProclamation No.471/2005 (for Definition of Powers and Duties of Executive Organs of the Federal Democratic Republic of Ethiopia or FDRE) mandatedMoWRto causefor carrying out of study, design and construction of medium and large irrigation dams(Federal Negarit Gazeta No. 1 17th November, 20005, page 3295) without mentioning small scale schemes under both MoWR and MoARD mandates. Later, Proclamation No.1097/2010 passed the responsibilities to foster small scale irrigation developments toMoA.

It looks as ifemphasisfor irrigation in general and for small scale schemes in particular had been given byboth the 1991 ADLI and the 2001 irrigation policy. However, in the 1995 Proclamation No.4/1995,except manadatingMoWR to administer water resources, nothing was mentioned about irrigation while defining the power and responsibilities of government's excutive organs. MoWR and MoAhave beenmandated for medium and large scales in 2005; and for small scale scheme in 2010, respectively.

Medium and large schemes were not the focus of ADLI and it was after 15 and 20 years of ADLI that MoWR and MoA were mandated for irrigation developments. Hence, the sector wascompletely ignored, officially at least, by the current government for more than half of its ruling period. Of course, there is no any agricultural input supply services targeting even the small scale schemes and it was after 2016 that Amhara, Tigray, Oromiya and South Nations Nationalities People (SNNP) regions endorsedWUA proclamations revealing the fact that even small scales has given little attention for the last three decades. That is whymany scholars raised questions regarding ADLI's concerntowards small scale irrigation schemes of the country.

In the first place, despite its advocacy, the irrigation policy contradicts itself by giving equal weight for the development of all scheme categories that ensure ADLI's strategy which ignored medium and large scales. Second, other than suggesting immediate preparations of strategies, implementation methodologies and action plans by MoWR, the policy didn't even define scheme categories and their coverages; resources potentials; stakeholders; focus areas; and so on let aloneto be comprehensive.

Apart from its generic, redundant and vague ideas and principles; the irrigation policy turn out to be useless since 2005. Because ADLI was replacedby Plan for Accelerated and Sustainable Development to End Poverty (PASDEP) in 2005 which was replaced by GTP-I plan in 2010/11. The first Growth and Transformation Plan (GTP-I) was upgraded to GTP-II in 2015/16. Recently, new national irrigation development plan was launched (MoWIE, 2020; MoA, 2020). But, the irrigation policy still advocates ADLI but developments of medium and large scale schemes have been parts of these plans.

Legitimacies of the proclamations as well as the justifications for sharing responsibilities among government's offices are also critical issues of the sector. It seems that MoWR have been restricted for the constructions of headwork and main canals only. In the contrary, MoA have been involved on development and agricultural services of small schemes since 1991 though proclaimed just a decade before. Both offices are not responsible for agricultural services of medium and large irrigation schemes.

In Ethiopia, the notion of being large, medium or small scheme is totally linked with responsibility sharing among stakeholders. Whatever the costs and technologies are, constructing a scheme is a one time activity while providing agricultural services are continues and cyclic processes so each should be managed by separate institution because it is a key to realize the success of irrigation schemes. Neither MoA nor MoWR offices at federal and regional levels should involve on the development of irrigation schemes. As the names imply, their mandates ought to be on improving agricultural productivities of all schemes irrespective of their size and governing of water resources of the country, respectively. Constructions of irrigation schemes might be left for individual farmer, communitites, cooperatives, private investors, non governmental organizations, agro industries, corporations or companies, and so on with close supervision, technical and financial support and coordination of a separate strong government organ.

Policy, strategy and mandateinstabilities and flaws jeopardized the realization of enhancing irrigation sector of the country by upsetting every aspects of the sector which will be discussed in Section 4.Therefore, first revising of existing irrigation policy in response to development needs and potentials is highly important. Second mandates of both ministry offices' should also be restricted on coordinating agriculture services and water resources of the country. The recent establishment of Irrigation Development Commission at the federal level is a good start for coordinating developments of any irrigation scheme but it should be strengthened by forming representative offices at all levels in all regions.

Organizational Setups

Since 1991 Ethiopia has a decentralized federal system of regional states and administrative cities. Key government institutions comprise ministries and bureaus at federal and regional levels, respectively. Regions have constitutional right to form their own government officies. Conceptually, ministry offices are responsible for policies and strategic issues and supervising of projects while counterpart regional bureasusare responsible to implement them.In the irrigation sector,MoA and MoWR offices in cooperation with regional offices are thought to be responsible for small; and medium and large scheme developments, respectively. Responsibilities for agricultural services of small schemes have been mandated for MoA.

Actually a distinction in responsibilities for large and medium versus small scale has been in place in 1985 which continues to this day; WRDA of MoWR to take the lead in large and mediumscale irrigation development. IDD of the MoA was charged with development of small scale irrigation activities and providing assistance to farmers and communities. Their efforts were eventually decentralized to zonal level where Irrigation and Rural Water Supply Teams were established to foster and facilitate the expansion of small scales at local level. With the change in government and recognition of the continuing need for greater regional autonomy and decentralization, after 10 years of establishment IDD was dissolved in 1994. Government policy support for small scale irrigation, however, remains high; the importance of small scale to the government was best manifeste in creation of Regional Commission for Sustainable Agriculture and Environmental Rehabilitation (CO-SAERs) being promoted under the federalist structures of regions. These new organizations have embraced the promotion of small scale irrigation as primary mandate. The development strategy and its corresponding institutional model encompass three phases and a changing cast of institutional players. At the design phase, a combination of regional bodies; the Regional Bureau of Agriculture, Energy, Water and Mines (RBAEWM), and Health, together with the project proponent, whether one of the Sponsors or CO-SAERs work together on the design and siting requirements of a scheme. Once the project document is approved, CO-SAERs or the Sponsors take charge and work with the community and the concerned Woreda, in the construction of basic infrastructure (dam or weir and primary canals). Once civil works are completed, the scheme was handed over to the communities and RBAEWM, and Health for implementation. The community is expected to complete secondary and tertiary canals and begin to use the system, with the advice and assistance of Development Agents, DAs.

Several national and international organizations are also engaged in financing particularly study, design and implementation of small scale schemes across all regions at different degree of involvments. World Bank, CIDA (Canadian International Development Agency), EU (European Union), AfDB (African Development Bank), US, Japan, UNDP (United Nations Development Program), UNICEF; USAID (U.S. Agency for International Development), World Vision, Plan International, Menschen fur Menschen, Care Ethiopia, Concern Ethiopia, Water Action, Water Aid Ethiopia, Oxfam, Lutheran World Federation, FHI/E (Family Health International/Ethiopia), IFAD (International Fund for Agricultural Development), JICA, Irish Aid, CRS (Catholic Relief Services), GIZ, SOS Sahel, and local Non-Government Organisations (NGOs) like Ethiopian Orthodox church, Ethiopian Evangelical Church, OSHO, ORDA, Relief Society of Tigray (REST), and etc. can be listed as example.

The “blinding promise” of small scale irrigation is leading to political and organizational bias in which too many organizations want to get involved and get the credits for establishing schemes; usually and actually building only the headworks which does not seem to be accompanied by willingness to be “accountable” when there are difficulties. This lack of accountability, borne of irrational compartmentalization of responsibilities associated with the current institutional approach is leading to institutionalized mediocrity in the performance of the sector.

Although uniform organizational setupsand communications are expected among federal, regional and external aid officies, structural setups of the sector are too much diversified and complicated. It is difficult to find any two regions having similar organizational setup. For instance, planning, studying, designing and construction of small scale schemes in Amhara, Tigray and SNNP are carried out by regional water or irrigation bureaus then transferred to respective agricultural bureaus to manage and support the agricultural services of the schemes. In Oromiya and SNNP, development and administration of small schemes are neither of the water nor agriculture office of the regions rather that of Oromiya Irrigation Development Authority (OIDA) and South Irrigation Development Authority (SIDA), respectively. But only OIDA do have its own DA and Extension team. In SNNP, water harvesting projects are carried out in collaboration with water and rural development, and water bureaus of the region. Designs and constructions of water harvesting structures and small scale irrigation are carried out by SIDA while well drilling for irrigation is by the water bureau. Completed small scale schemes of SIDA will be transferred to agriculture office to administer agricultural services of the schemes but organizing the farmers as WUA is responsibility of the regional Cooperative Promotion Bureau, CPB.

In Oromiya region, OIDA is mandated to study and design of medium and large scale irrigation schemes but in Amhara region they are responsibilities of water bureau. Not only that CoSAERAR, BoA (Bureau of Agriculture), Bureau of Co-operatives, and ARARI (Amhara Region Agricultural Research Institute) of the region are also involved on development of water harvesting, small and large irrigation schemes.

As discussed earlier, neither federal offices nor regional bureaus are proclaimed to operate, manage medium and large scale schemes of the country (Section 3.1). Across many levels (from Kebele or Woreda to regional or zone and federal level), there are institutional challenges that prevent irrigation plans from being implemented; involvements of various actors, no standardized approach across agencies for monitoring projects; lack of ownership; lack of technical staff and etc.

Each of the regional bureaus defines its role in terms of its authority over the schemes in its area, and not in terms of the services it will provide which is part of the pains of federalism and decentralization. There is a predetermined separation between government offices those responsible for planning, building and operating a scheme. While external funding organizations are expected to interact with variety of regional bureaus during planning and design, the real role of these organizations comes into play once the infrastructure has been built and the scheme transferred to the communities. Koga and Fentale schemes are good examples for revealing these facts.

Koga which is found in Amhara regionis a dam based large scale irrigation scheme. Its study, design and construction activities were funded and monitored by the project owner MoWR with the involvements of local and foreign consultantsand contractors. After completion, this 7,000 ha scheme was transferred to water bureau of the region but currently several stakeholders are involved in the management and operations. Abay Basin Authority is responsible for the river water while Ethiopian Construction Corporation is owner of the dam and the dam water; water bureau of the region is mandated to manage the main and secondary canals while WUA of the scheme is responsible fortertiary canal and field irrigation water; the agriculture bureau is mandated to support and supervise crop production activities; and Woreda cooperative bureau to organize the farmers. The maximum area so far irrigated is 4,000 ha.

Fentale is a diversion weir large scale community scheme locatedin Awash basin of Oromiya region. Water bureau of the region was owner of the project and OIDA has involved on the study, design and construction of the scheme. Currently, however, the owner has limited roles on the scheme whereas WUAsare managing the scheme; various cooperatives established by the Woreda offices are responsible for water distribution while agriculture bureau arefor extension services. Out of the planned 18,000 ha, only 6,500 ha is operational with mean irrigation efficiency of 25%.

Apart from existences of diverse structural setups, hierarchical misalignments have also created communication gaps or barrrier between the federal and regional offices as well as among regional offices. For instance, both MoWR

and MoA don't have legal rights to supervise regional such as OIDA's activities regarding development of small or large scale schemes, respectively and their participations are almost limited on financial arrangements for projects to be implemented by regional offices.

The organizational setup of the irrigation sector is also very dynamic. These disconnected regional and federal offices have been frequently restructured. More importantly, complete absence of strong government institute to coordinate all stakeholders is the major problem for the development of the sector.

In general, non uniform organizational setups; structural instabilities; absence of coordinating organ; and involvement of too many stakeholders without having defined roles, responsibilities and accountabilities created mandate confusion (overlaps and/or gaps), ownership and commitment vacuum which resulted in low performances or total failure of schemes.

Institutional Capacities

Older irrigation schemes of Ethiopia being studied, designed, constructed, and then managed by foreign investors performed well for decades but after transferred togovernment organizations by Derg regime, they started to deteriorate. Currently, it is very difficult to see properly operating irrigation scheme. Several factors might contributed for the under development of the sector but among others absence of skilled manpower as well as research and training institutes in the required quantities and qualities are very crucial.

Most of the following section was summarized from the report of Mebruk. According to the report, in order to develop and properly manage around 4.5 million ha of irrigated land, not less than 50,000 pure irrigation and related professionals should be trained in at least 5 and 6 specialized universities and three collages. Moreover, the country demanded around 5,000 irrigation researchers. With these aspects, the statuses of the country are very upsetting.

There are around 51 Universities, 8 water related institutes, and 17 federal and 40 regional agricultural research centers in Ethiopia. Around 32 TVET collages train students in various fields of studies such as mechanical, civil, electricity and so on etc, while 6 ATVET (Agriculture Technical Vocational Training Education) colleges on agriculture such as agronomy, crop protection, natural resource management, and livestock production at diploma levels. The college graduates will be assigned as DA in each rural Kebele of the country. However, there is no university specialized in agriculture let alone in irrigation and also there is no agricultural research center excelling in pure irrigation. The numbers of researchers on irrigation is below one hundred. Yearly, less than 30 second or Masters Degree holders are graduating from local universities while around 50 from abroad but in most cases they leave the country due to different reasons. From 2002 to 2008, over 8,500 Farmer Training Centers (FTC) have been established and 63,000 DAs have been trained. However, it was two or three years back that a three years training on irrigation was started within six ATVET colleges.

Out of the total 1,899 agricultural researchers of federal and regional centers, only 387 (20.4%) were engaged on natural resources and agronomy researches which is assumed to be related with irrigation, otherwise figures for irrigation researchers were not reported separately. From the 387 researchers, only 29.2% and 4.1% were second and third (PhD) degree holders, respectively. Similarly, in all Universities, only 97 or 16.4% of the whole staff were engaged in natural resources related research activities from which 26.8% and 62.0% were third and second degree holders, respectively.Natural resource managemet research departments of both the research centers and universities are commonly comprise soil fertility and plant nutrition, problematic soils improvement, soil conservation, watershed management and irrigation water management fields sotime engagement of the researchers on irrigation might not be more than 20%. Hence, only 25 second and third degree researchers have been engaged in irrigation researchesof the country.

Irrigation development necessitated involvement of diversified field of studies and professionals at different skill levels. Irrigation as a discipline was of course included within teaching curriculums of six ATVET collages (Alage, Agarfa, Kombolacha in Oromiya, Kombolcha in Amhara, Wukro and Wolaita Sodo) and nine universities (Haramaya, Jimma, Mekelle, Arba Minch, Adama, Hawassa, Addis Abeba Institute of Technology (AAiT), Wello, Wellega and Bahir Dar). Around 8 Universities are graduating students with first degree, 15 with second degree and only 4 universities with third degrees but not on pure irrigation rather on related fieldslike river basin management, water resource management or engineering, watershed management, and soil conservation. For instance, Bahir Dar University is graduating second degree students on Water Resources Engineering and Hydrology and third degree on Hydrology. These fields, other than supplementing, cannot fully replace or substitute the irrigation fields.

In order to study, design, construct, operate, manage and administer the water and irrigation infrastructures as well as to manage the irrigated crops, qualified professionals especially on irrigation engineering, irrigation water management and scheme operation, irrigation agronomy and etc. should locally be produced at the required numbers. However, only Haramaya and Adama Universities are graduating irrigation engineers with second degree while only Haramaya delivers irrigation agronomy with second degree. Recently, AAiT of Addis Abeba University (AAU) started third degree on irrigation engineering program.

Even previously started efforts to graduate students in irrigation have been terminated as if the sector is not that much important for the country. Some years back Dilla, Gonder, Mekelle, Welega, and Bahir Dar and the like Universities started to graduate first degree students on 'Water Resources and Irrigation Management'. However, the students were unable to find jobs or government and private organizations to hire them with the reason that the study field was not listed in civil service registry. As a result, the universities called the graduates back, changed titles of their certificates and terminated the field. Similarly, there was 'Water Resources and Irrigation Engineering' field in Adama Science and Technology institutes at first degree level but the title was changed to 'Water Resources Engineering' by removing 'irrigation' due to unknown reasons.

Figure 1 is course compositions for 'Water Resources and Irrigation Engineering' first degree program for Arba Minch, Hawassa, Wello, MedaWelabu and Haramaya universities.

Course coverage on irrigation engineering is only 8.33% while that of water and civil engineering are 61.67% and 24.33%, respectively. Hence, the study program is more ofWater Resources and Civil Engineeringthan Water Resources and Irrigation Engineering.

Absence of specialized fields graduating students on pure irrigation such as irrigation engineering, irrigation water management, scheme operations and administration and etc forced civil engineers, water resource, hydraulics, hydrology, plant sciences professionals including university lecturers to bethe front liners on the development of the irrigation sectors (Table 1). For instance, in most of Woreda offices, small scale irrigation scheme are fully designed by civil engineering graduates without involvements of irrigation agronomist and irrigation engineers.

Five years ago, twenty fives of Ethiopian universities had only two lecturers with second degree in irrigation engineering. There was no third degree

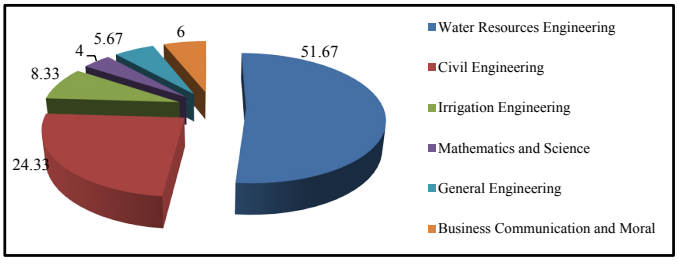

Figure 1. Course compositions and shares (%) of first degree Water Resources and Irrigation. Engineering

Table 1. Numbers of staff in 25 univerisities for the year 2015 (Mebruk et al., 2018).

Field of studies	Bachelors	Masters	PhD	Others	Total
Water resources engineering	35	34	6	0	75
Irrigation engineering	6	2	0	0	8
Water resources and irrigation management	15	28	1	3	47
Water resources and irrigation engineering	29	9	0	0	38
Soil and water engineering	21	5	0	0	28
Natural resources management	56	147	6	2	199
Civil engineering	32	43	23	12	110
Agriculture and Life Sciences	22	100	33	0	155

Table 2. Number of professionals working in regional water and agricultural offices (Mebruk et al., 2018).

Field of studies	Total numbers
Civil engineering	44,843
Water resources engineering	18,430
Agricultural science	87,905
Agricultural extension	17,643
Field crops production	2,816
Horticulture	5,570
Agricultural economics	12,633
Groundwater specialist	3,494
Hydrometric Monitoring	126

holder in irrigation engineering lecturing even in Adama and Haramaya univerisitieswhere irrigation engineering with second degree was delivered.

The following table shows the total numbers of professionals in federal and regional water and agricultural offices partlyworking on irrigation development activities (Table 2).

In agriculture and natural resources office of Gambela region, there were only three first degree irrigation engineers while there were around 28 in Afar and Somali regions. If time engagement of the prefessionals is considered as previously done for researchers, the number will be very disturbing.

The federal ministry offices are not immune from professional droughts and capacity limitations. Although mandated to coordinate the sector development across the county, until 2017 all activities related to small scale irrigation have been organized at team level under MoA with less than 5 irrigation specialists. Three years ago, it was promoted to directorate level and currentlyhas more than 15 irrigation specialists.

Generally, development plans of the irrigation sector were crafted without even recognizing the implementing capacities of the institutions and scarcity of skilled manpower in the country.

The Aftermaths

Irrigated area and the potential

Prior to setting targates and schedules of any strategies and programs, having precise data at hand about existing conditions, potentials, and capacities of stakeholders are crucial. Often availability of reliable and consistent data and information on surface and ground water is one of the basic requirements for development, use and management of water resources for water managers to make decisions, as well as for researchers to make proper analysis and arrive at reasonably accurate conclusions. Rahmeto wrote that;until recently even today, irrigation and water potential of the country was not accurately known. The problem still persists and even today it is a contentious area.

In order to assess the extent of the problem, comprehensivereviews have been made, compiled and summarized in Table 3. The table includes most relevant and indicative figures collected from available reports.

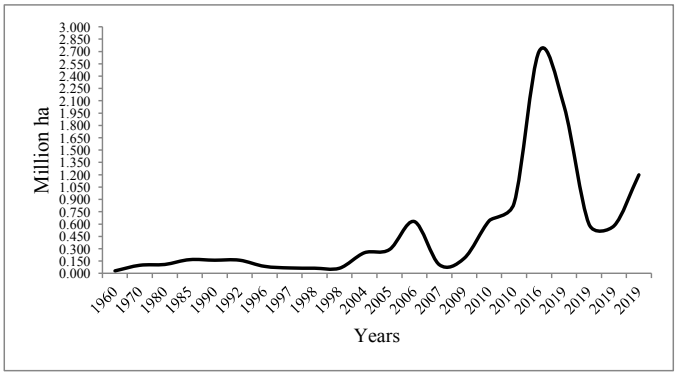

Figure 2. Trends of reported actually irrigated areas in million ha.

The data of EVDSA was quoted by Rahmato as an evidence for existence of variations among reported figures.

Still these days, the most mentioned figure is that of Awulachew followed by MoWRand Awulachew et al. . In some extent, the figure of MoANRD et alis also mentioned in recent documents. Other than referring old master plans, except few remote sensing and GIS based reports, original sources for the above figures were not clearly stated.Sometimes it was not clear whether the figures were reported for small scales only or for all types of irrigation schemes.The following graph will help to assess the trend of reported figures and interprate them more easily (Figure 2).

Rather than increasing or being constant, reported figures on actually irrigated areas of the country were highly oscillating. Starting from 1960, the graph was slowly increasing until 1992 then started to decrease upto 1998. After 1998, it was increased rapidly upto 2006 then remained low between 2007 and 2009. In 2010, it roseup again back to the 2006 figure and continued till 2016 to reach the highest peak. In 2019, it went down.There were variations even among reports of the same years.

Despite time gaps, reported figures collected from regional offices found to be comparable or much lower than that of surveyed figures. For instance, Gezahegn reported that a total of 0.61 million ha was irrigated by Oromiya; Amhara; SNNP; and Tigray regions. According to Mebruk et al, a total of 1.85 million ha was irrigated by these four regions. These figures vary with CSA (2018/19) survey data as wellas reports of MoWIE and MoA which are listed in the above table.

Regarding irrigation potential of the country, several estimations have been carried out for the last half century but still there is no consistent information that can be used with confidence. Mostof the estimations were made by international organizations and consultants such as FAO and WAPCOS. MoAhad also estimated using GIS technique. The following table summarized some of the most known and available figuresof different organizations and scholars so far reported (Table 4).

Similarly, extents of irrigation potential estimations for the country have increasing but oscillating trend ranged from 0.17 to 11.1 million ha. According to Rahmato most of previous reports were derived by adding potentials of eight river basins. FAO report can be mentioned as an example. Based on provisional data from ongoing studies, FAO reported very small potential

Table 3. Reported figures on total actual irrigated area of Ethiopia by different sources.

Sources	Base years	Actually irrigated areas, million ha				Remarks
		Total	Small	Medium and large	Traditional	
Rahmeto (1999)	Early 1970	0.1				All were modern and 50% was in the Awash Valley
	Mid 1980	0.168	0.01	0.089	0.069	Warned presences of variations among reports
ONCCP (1990)			0.064	0.097		Figure for small scale might includtraditionals
EVDSA (Ethiopian Valleys Development Studies Authority)	1992	0.16				Almost 74% of irrigated area served by large and medium schemes is located in Awash valley, Reported by Rahmato (1999)
CSA (1998)	95/96	0.085				Meher (main rainy) season; Reported by Rahmato (1999)
	96/97	0.068				
AQUASTAT (1998)		0.064				An online data base supported by FAO. Reported by Rahmato (1999)
MoWR (1998)		0.064				Some schemes were not functioning; Reported by Rahmato (1999)
Tahal (1998)					0.040	Traditional Schemes only; Reported by Rahmato (1999)
IDD/MoA (1993)					0.07	Estimate of traditional irrigation ; Reported by Rahmato (1999)
Tilahun and Paulos (2004)		0.25	0.048	0.061	0.14	Frequently cited
Awulachew et al. (2005)	1990	0.161	0.064	0.097		Quoting French Consultants BCEOM (1998)
Awulachew et al. (2007)		0.107	0.028			
MoWR (2009)		0.184	0.02	0.164		
Hagos et al. (2009)	2005/6	0.63	0.056	0.087	0.48	Citing MoWR (2002)
Awulachew (2010)		0.64	0.383	0.13	0.128	Citing Awulachew et al. (2007), MoWR and MoA; 0.128 is for water harvesting: Information on water harvesting and small scales were crude. Otherwise, the figure for rain water harvesting ranged from 0.04 to 0.8 million ha.
MoA (2011)	2010	0.853				
NPC (2016)	2010		0.13			NPC (2016) reported in 2015, 0.41 million ha developed area which increased from 0.13 million ha of 2010.
	2015		0.41			
Yohannes (2019)		2.03	1.7	0.32		Quoting GIRD (2018) which used satellite imagery and overlay extraction
Seibert et al. (2015)	1960	0.03				Estimated based on The global Historical Irrigation Data (HID) set
	1980	0.11				
	2005	0.29				
MoANRD et al. (2016)		2.7	2.4	0.3		Small scales includes both modern and traditional
CSA (2018/19)	2019	0.6				Survey data
MoA (2020)	2019	0.58				
MoWIE (2020)	2019	1.2		0.49		

Table 4. Summary of Reported Potential Irrigation Areas of Ethiopia in million ha.

Sources	Potential area	Remarks
World Bank (1973)	1.0 to 1.5	Reported by Rahmato (1999)
FAO (1986)	0.64	Based on provisional data from FAO's ongoing studies
MoA for 1986	2.3	Reported by Rahmato (1999)
IFAD (1987)	2.8	Reported by Rahmato (1999)
ONCCP's (1990)	2.7	
WAPCOS (1995) for 1990	3.5	Only desk study without significant field investigation
IDD/MoA (1993)	0.352	Reported by Rahmato (1999)
FAO (1997)	3.61	By combining reviews of existed information with GIS
AQUASTAT (1998)	0.17 to 0.40	Online database as reported by Rahmato (1999)
MoWR (1998)	0.18	Reported by Rahmato (1999)
Tilahun and Paulos (2004)	4.26	
Awulachew et al. (2007)	3.7	Quoting master plan studies and WAPCOS (1995)
Awulachew, (2010)	5.4	3.7 million ha for surface water; 0.5 million ha for water harvesting and 1.2 million ha for groundwater
MoANRD et al. (2016)	11.1	4.3 million ha for surface water; 4.7 million ha for groundwater and 4.4 million ha for water harvesting
NPC (2016)	5.3	Based on MoWR data for medium and large schemes; 3.13 million ha (179 sites) for surface and 2.03 million ha (16 sites) for groundwater
MoWIE (2020)	5.8 to 7.5	

figure of Ethiopia. But after ten years, by combining existed information with GIS technique, FAO assessed availabilities of land and water in Africa for irrigation on the basis of river basins. According to the report, soil suitable for surface irrigation in Ethiopia is 30.34 million ha or 28% of the total landmasses from which 20.92 million ha is for rice while 9.42 million ha is for upland crops. The same report grouped the country into three major basins, Abbay, Rift Valley, and Shebelle Juba, and estimated their irrigation potentials. The potential of Abay basin of Ethiopia (BaroAkobo, Tekeze and Abay) is 2.2 million ha while that of the Ethiopian Rift Valley is 0.79 million ha (Awash basin 0.205 million ha, Omo Gibe 0.45 million ha and Central Lakes 0.14 million ha) and that of Shebelle and Juba (Genale Dawa) of Ethiopia were estimated as 0.204 and 0.42 million ha, respectively. Total of the three major basins is around 3.61 million ha. However, an equivalent estimation was already reported by WAPCOS as shown in the table.

The most known and quoted report is 3.7 million ha of Awulachew et al. followed by 4.26 million ha of by Tilahun and Paulos. These figures are recently replaced by that of Awulachew. According to them, the figures were collected from MoWRdata and master plan studies of the river basin. MoWR identified 560 potential sites on the major river basins with a total of 5.3 million ha for medium and large schemesa figure quoted by GTP-II plan document.In 2016, Ministry of Agriculture and Natural Resources Development (MoANRD) doubled the potential but recentlyMoWIEreported a figure in between as indicated in the table.

In some cases again, estimated national and river basin potentials were not only inconsistent but also lower than actually irrigated areas and somregional potentials. For instance, potentials of Omo Gibe and Awash basins were 0.068 and 0.134 million ha, respectively. Keflemariam estimated the potential of Awash to be around 0.15 million ha. Despite these figures, the designed areas of Kuraz sugar project of Omo basin which is currently under construction is 0.175 million ha while the existing irrigated areas of Awash basin is close to 0.2 million ha. Moreover, OWWDSE assessed potentials of Oromiya region in 2019. Considering surface water, the region has 3.92 million ha suitable for irrigation which is higher than the known 3.7 million ha potential of the country.

Accuracy of the estimations might be affected by methodologies followed, technologies used, criteriabeing selected, data availabilities, interests and capabilities of the organization and etc. As an example, potential assessment of OWWDSE for Oromiya region did not consider areas below 25 ha (OWWDSE, 2019) and also irrigated area inventory of FAO and Ministry of Water Irrigation and Energy (MoWIE) for Awash basin did not consider areas below 2.5 ha. As stated by Awulachew, most of the master plan studies of the river basins did not fully captured small scale irrigations which tend to underestimate their potentials.

More importantly, these old master plan reports have never been updated. Regional GIS based estimations so far made were also limited to the regions only.Regions and CSA offices are involved on estimating irrigated areas by small scale schemes but never synchronized each other. Unlike the regions which are inconsistent, CSA carry out field survey every year but both compile regional data without segregettingthem for the respective basins (except the recent attempts of Oromiya and SNNP regions).

Up to date and logical estimate of the maximum potential and inventory data of developed areas will help to set benchmarks and early decisions of policy makers. Otherwise, using non-validated, old and inconsistent data have several implications. According to Awulachew, it has implication on coordinating capability of the countryas well as absence of responsible institution neither to verify reported figures nor to generate original data. The other implication isjeopardizing of strategicand development plans (Section 4.3). Without having accurate figures, it might notbe possible to estimate contributions of the sector for the national economy and to device sound development plans as well. As an example, which figure should be used for estimating per capita irrigated area of the country? The final but the key implication of this review is focusing onthe significance of establishing platform for generating consistent and up to date informationaboutextents of irrigated and potential areas of regions and river basins.

Current irrigated area

Realizing the platform, indeed, will take time. Hence, the following summarized data can be usedfor the time being regarding irrigated areas of the country which was developedfrom raw data of SNNP, Amhara, Tigray and Oromiya regions' recent inventories. Excel spreadsheetbased raw data of the regions wererelatively realistic because: (i) the inventories were carried out in 2017/18 hence, very recent; (ii) names, x-y coordinates, sizes and etc. of each irrigation schemeof each regions were listed; (iii) almost 90% irrigation schemes of the country is found in these regions where significant expansions were carried out for the last two decades. However, adjustments have been madefor other regions. For Somali and Dire Dawa regions, 25% increment was assumed on reported data Awulachew while for Afar region, on the report of Yibeltal which was 0.045 million ha. For Gambella, the data was taken from Mebruk et al.The percentage was fixed based on expansion extent of Afar region basin. Figure 3 presents summaryof the data.

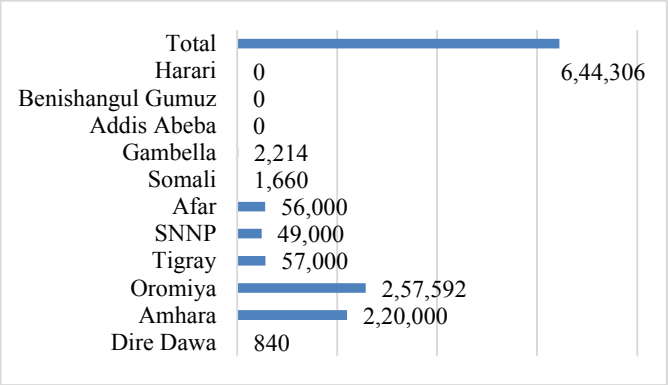

Figure 3. Currently irrigated areas of the regions in the country in ha.

Therefore, the total area currently irrigated in the country is around 0.64million ha. For Oromiya region, area covered by traditional and water harvesting are 0.12 and 0.048 million ha, respectively which will be almost 66% of the total irrigated area of the region.

Moreover, based on information collected from various federal and regional offices which were checkedbased on field observations, the following figures on existing technologies have been generated. Out of the total area in the country, more than 95% is irrigated using surface methods. Area coverages of sprinkler and drip systems are 3.50% and 0.33%, respectively (by excluding Wolkayit sugarcane 7,000 ha drip system which is under construction). Dragline sprinkler schemes are found at Finchaa (19,568 ha) and Wonji (2,430 ha) sugar factories. Around 850 ha center pivot sprinklers are found on Meki and Awassa areas owned by private investors while 538.7 ha at Wonji sugar factory. Drip systems of flower and vegetable producing farms are found in Koka, Mojo, Holleta, and Raya areas.

Awulachew et al listed large scale schemes of the country with total extent of 0.057 million ha. If the new Omokuraz project with total area of 16,537 ha (Omo Kuraz-1 with 8,560 ha; Omo Kuraz 2 with 4,058 ha and Omo Kuraz 3 with 3,919 ha); Koga (7,000 ha); Kessem (3,500 ha); Tendaho (3,000 ha); Seffae in SNNP (6,800 ha); FentaleQawa (6,500 ha); FentaleAbadir (5,150 ha) and etc. as well as expansions of Wonji (6,319 ha) and Finchaa (11,540 ha) large scale schemes covering a total of 0.066 million ha constructed during the last 13 years were added, the total area covered by large schemes will be 0.123 million ha which is 19.0% of the total area currently irrigated at national level.

Scheme Categorization

Irrigation schemes can be categorized into several groups based on several criteria because; there is no universally accepted standard by all parties. Scholars, nations, federal and regional offices, international organizations,

academic and research institutions, doners and so on might have and use different criteria that might fit with their ultimate goals so it should have purposes. Among the criteria or parameters, water and energy sources, water abstraction, distribution and application methods, organizational setups, size of irrigation schemes, management styles, and so are the most common. Categorizing irrigation schemes is very important for setting up national policies, strategies and development programs so as to prioritize allocations of limited resources. To be effective, however, the categorization should be based on understanding of the sector, the criteria used, and the intended objectives.

According to Rahmeto and Zewdie, during the Derg government, irrigation schemes were divided into three categories depending on their size, operation and management. Based on size; (i) large scale schemes (> 3,000 ha designed by National Water Resources Commission (NWRC) and WRDA and constructed by Ethiopian Water Works Construction Authority (EWWCA) mainly for the benefit of state farms); (ii) medium scale schemes (200 to 3,000 ha and their head works, main and secondary canals constructed by WRDA, and tertiary and farm canals by IDD. They are managed by state farms and other enterprises); and (iii) small scale schemes (upto 200 ha and constructed by IDD mainly for the benefit of peasants organised in cooperatives).

The 2001 Water Sector Program (WSP) document (MoWR, 2001) mentioned only the names of the three scheme categories. Water Sector Development Program (WSDP) document (MoWR, 2002) on page 14 stated that there are four categories of irrigation schemes countrywide. They include *traditional, modern communal, public, and private commercial* schemes. The same document, on page 50, further elaborated these categories as *traditional small scale of up to 100 ha built and operated by farmers in local communities; modern communal schemes up to 200 ha built by government agencies with farmer participation; modern private schemes of up to 2,000 ha owned and operated by private investors individually, in partnership or as corporations and public schemes of over 3,000 ha, owned and operated by public enterprises, as state farms*.

On the contrary, regional offices follow different classifications as shown in the following table which is adapted (Table 5).

Almost all international and national articles and reports published after 2002 even government documents might categorize based on either scheme sizes or their management systems. Based on sizes, their classifications were, however, exactly that of the Derg classifications than the MoWR system. They further classify the small scales as *traditional* (with temporary headwork built by farmers using local materials) and *modern* (built by governments and NGOs with permanent headwork and water controlling structures). The classifications by management system are*traditional, modern, public and private schemes*.However, they cited MoWR as a source while classifying based on sizesas well as while classifying the small scales as traditional and modern. Werfring is the other repeatedly cited paper as a source while classifying as *traditional, modern, public* and *private schemes*. The regional classifications, on the other hand, are rarely mentioned.

Actually, the classification of MoWR is not clear and quite differs from others. The criteria are mixed, not properly defined and for that matter, it is a description not a rule officially declared. Regional offices and scholars even the ministry office itself never used it. Moreover, internationally recognized system which is based on the technologies being used to apply irrigation water such as surface, sprinkler and drip systems are restricted for the classifications small scale schemes as modern and tradition schemes. Such classifications suitable for decision makers while choosing the best perfoming systems but ignored in Ethiopian conditions except or academic purposes.

Table 5. Scheme classification of some regions of Ethiopia.

Regions	Small, ha	Medium, ha	Large, ha
Amhara (Co-SAERAR)	<250	250-700	>700
Amhara (BoA)	<300	>300	No bottom limit
Oromiya	<300	300-3,000	>3,000
SNNP	50-200	200-1,000	>1,000
Federal	<200	200-3,000	>3,000

Many questions can be raised on the issue such as; what was the purpose of classifying irrigation schemes of the country? Why earlier authors preferredthe Derg classification but cited the 2002 water development document? Why regions prefer to use different size ranges? How can it be possible to summarize national data from inventories of regions if they have different criteria? What is the lower limit for small scale schemes; 2.5 ha or just 0.0 ha? Which one is really the official classification norm for the country? What are and should be the justifications for classifying irrigation schemes and by whom?

In Ethiopia, classifying the schemes solely used for allocation of responsibilities among stakeholders involved in the sector (Section 3.1 and 3.2) which has nothing to do with operational performance improvements for instance. Till today, this confusing and traditional system which was started during Derg regime is in use without further adjustment. The problem seems insignificant but has implications towards policy and organizational setups of the sector. Hence, first the objectives and purposes of classifying the schemes must be clearly defined and then standardized criteria that can help to attain the purposes and that can be uniformly used by all stakeholders should be set.

Irrigation Development Plans

The 1991 ADLI strategy gave more emphasis for enhancing productivities of small holders with justification of high poverty and food insecurity concentrations in rural areas and due to presence of large potentials for improvement which was also reverberated by Rahmeto. After decades of trial and errors, questions started to emerge to challenge the ADLI and its offspring strategies. First, productivity enhancement alone might help to achieve food security, but will not necessarily enable the rural poor to escape poverty. Second, the rural agriculture is challenged by complex issues such as mixed farming and land tenure. Third, development strategies were focused on rural areas of Amhara, Oromiya, SNNP and Tigray regions only. Fourth, despite the given attentions, extents and development rates being planned even for the small scale schemes were very small. Fifth, other than lately reciting the depth of the problems, the plans were not properly implemented.

Pluralist approaches or expanding of small, medium and large scale schemes and productivity enhancement were expected and have been implemented but not successful. Why? This section will assess the development plans so far implemented against the projected crop productions and irrigated land development demands of IDP.

In order to meet crop demands by 2016, starting from 2002 onwards it was expected to add on average 0.313 million ha new small, and medium and large irrigated lands every year. With the justification of capacity limitations, in 2001 IDP of WSDP planned to add only 0.128 and 0.147 million ha on existed 0.099 and 0.099 small, and medium and large scale schemes, respectively and making the total 0.47 million ha. After five years, PASDEP's revised plan was to expand 0.529 million ha in between 2005/2006 and 2009/2010 out of this 0.128 million ha was for medium and large scales while 0.389 million ha was small scales. After ten years or by the end of 2010, MoWR and Ministry of Agriculture and Rural Development (MoARD) constructed only 0.043 and 0.285 million ha, respectively. The total added irrigated land was 0.328 million ha which is a little higher than projected mean annual development rate or 0.313 million ha.

Between 2010/11 and 2015, PASDEP-II planned to increase the irrigated area from 0.64 to 1.8 million ha; two third of this through small scale and water harvesting. Similarly, during the GTP-I period (2010/11 to 2014/15), out of the planned 0.15, 0.20, 0.20 and 0.115 million ha of medium and large scale irrigation lands to be developed by MoWIE, regional governments, Sugar Corporation and private investors (MoANRD et al., 2016), 0.05, 0.09, 0.11 and 0.04 million ha were implemented by each respectivestakeholders i.e. 0.28 million ha or 43% was constructed. Accordingly, the coverage increased from 0.13 million ha in 2010 to 0.41 million ha in 2015.

In the GTP-II period (2015/15 to 2019/20), 73 medium and large schemes having 0.954 million ha were identified and targeted to develop 0.28, 0.34, and 0.32 million ha by MoWIE, Sugar Corporation and regional bureaus, respectively. MoA targeted to add 1.74 million ha small schemes on the already attained 2.4 million ha (MoANRD et al., 2016) but their accomplishments were not reported yet.

The above were major plans of the last 30 years being selected as example otherwise Agricultural Growth Program (AGP), Participatory Small Scale Irrigation Development Project (PASIDP)-I and II, Policy of Investmant Framework (PIF), Five-Year Growth and Transformation Plan (FYGTP), Rural Development Policy and Strategies (RDPS) and etc. targeting small holder farmers were also implemented.

When these development plans are evaluated, several issues will emerge especially on their genuineness. First, the original IDP of WSDP plan considered only sugarcane and cotton as industrial crops while all cereals as consumable food crops. Wheat and maize can also be raw materials for the food industries. The other point is that reducing the area to be developed with the justification of capacity limitations is not acceptable which might be true for the first three years of plannig period. Because planning is meant to identify factors affecting the accomplishments of intended targes by devicing mechanisms to overcome these factors. Otherwise, demands of any society will never be met. Second, reported accomplishments of the plans were exaggerated that contradicted with existing realities (Section 4.1). Third, all the plans were not only small in extents compared to the needs to bring meaningful changes on the economy but also poorly implemented. For the last 30 years, less than 0.50 million ha new irrigated land was added which is by far lower than China's single year accomplishment. Forth, targeted area of PASDEP for small scale schemes was three folds of large schemes. That is why PASDEP was considered as a lip service for the criticisms of ADLI by many commentators while it was the same with previous small holder approaches.

The other problem is government budgets for the sector. Asian countries such as Sri Lanka, Philippines and Thailand spend on average up to 30% of government budget for agriculture and 40% of the agricultural budget on irrigation during the initial development period i.e. in the 1970s and 80s, and sustainably rehabilitated their schemes. Later they reduced the allocations (Mekonnen et al., 2016). Ethiopia did not have such a big-push investment for irrigation as shown in Table 6.

During GTP-I period (2006 to 2010), government allocated 60% of the budget for poverty reduction. However, for irrigation the finance was insufficient to bring substantial change to the irrigated land. As indicated in the table above, for instance, during the period it was planned to develop a total of 0.275 million ha new area but the total allocated budget was 4.65 billion birr (591 million dollars). For one hectare of irrigated land, on average 17,000 birr (2,150 dollars) was allocated which was equivalent to 15 to 25% of the required during the time. On the contrary, according to Mekonnen et al, globally 90% of financing irrigation projects is from domestic sources whereas the remaining 10% is from foreign sources.

The development plans in general: were not inline with the policy; were nonobjective oriented; were divorced from actual existing conditions and institutional capacities; had uncertainties and ambiguities on planning; delayed; nonsustainable; were bogged down by poor operation and maintenance practices; had ad hoc practices lacking coherent objectives and continuity; were not progressively planned; were prepared based on inconsistent data; were not centrally coordinated; were not financially supported and etc. However, they might be taken as PILOT EXERCISES for future development endeavors.

The recent National Strategy of Irrigation Development Commision (IDC) being established under MoWIE aimed to increase food production and wealth creations, raw material supplies for agro industry, import substitutions, and job creations for graduate youth by expanding medium and large scale schemes (MoWIE, 2020). Improving crop productivities and irrigation efficiencies; organizing graduated youth; addressing gender issues; provision of trainings; market linkages and so on are also part of the plan (Table 7).

In the coming ten years (2021 to 2030), a total of 0.71 million ha medium and large scale irrigation schemes have been planned be be developed and to engage around 30,000 graduates. A 0.05 million ha pilot projects have already been started on selected large schemes such as Tendaho, Gidabo, Kuraz, ArjoDedessa, Gode, Alwero, Beles, Raya valley and so on. Sugar Corporation and MoA are also responsible for the development of the irrigation schemes. The major actors on expanding the irrigated area are IDC, MoA and Sugar Corporation.

MoA has planned to increase total grain and horticulture productions of rainfed (small holders and commercial) farms from 36.2 to 66.2, and from 18.1 to 26.1 million tons within the same period. The plans for small irrigators were from 0.8 to 3.8 and from 6.5 to 9.5 million tons, respectively which will increase the share irrigation around 21%. Increasing the irrigated area from 0.58 to 1.4 million ha during the first five years, rehabilitating exisiting schemes, expanding extents of water saving technologies, improving water use efficiencies, water harvesting and so on were among the strategies. At the end of the 10 years, it was also planned to balance coverage of surface, underground and harvested water sources i.e. around 33% each.

Pressures on the sector have been accumulated year after year and it is expected to intensify development rates. Unfortunately, both new plans of MoWIE and MoA did not recognize these realities. The extents of development plans are very small; both offices are out of focus; the budget is small; and so on. So they must revise their plans as soon as possible.

Stagnant Large Scale Irrigation Developments

Government offices, contraryto the realities on the ground, repeatedly advocatedthat emphasis was given for rapid expansions of both large and small scale schemes.

Most of construction of medium and large schemes started during the imperial regime were completed and are still functional while most of large schemes started during the Derg and current regimes are either terminated or under construction with very low paces. Otherwise, fully or semi functional public schemes of Derg regime, except sugarcane producing Wonji, Metehara and

Table 6. Government budget allocated for irrigation sector development (Michael, 2019).

Years	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019
Billion birr	0.8	0.9	1.0	1.15	1.8	2.15	3.05	3.65	2.95	3.0	6.1	5.0	4.9	8.3
Million dollars	91	103	110	120	167	169	175	199	155	153	288	221	179	292

Table 7. Medium and large scheme development Plan of IDC and budgets (MoWIE, 2020).

	Unit	2019/20	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	Total
Construction of medium and large schemes	1,000 ha	1,200	40	40	50	60	60	60	100	100	100	100	710.00
Finance needed	Billion birr		13.68	13.68	17.10	20.52	20.52	20.52	20.52	20.52	20.52	20.52	188.10

Finchaa estates, were transferred to the communities or private investors, and privatized for investors by the current government with the justifications of compensations, due to conflicts between neighboring community clans, and due to low regional capacities to manage the schemes. The reasons were unpalatable with the fact that all the stated problems which are common worldwide and might be handled at least by engaging the communities on the development. Moreover, the capcities of the communities never be better than the regional governments.

Construction of around 18 medium and large irrigation schemes covering 0.566 million ha were started during the Derg and current regimes but 14 of them were terminated while the other 4 are under constructions. The following table was summarized from '*Thereporter*' which is Amharic newspaper ofAugust 2 and 9, 2020 editionsand Awulachew et al.and listed suspended and ongoing large schemes of Ethiopia (Table 8).

The four large sugarcane schemes constituting 80% of the 0.566 million ha might be considered as an ongoing projects but they have serious problems. Only 8.2% of the total area is informally irrigated by the communities to produce cereal and vegetable crops or by project owners such as Sugar Corporation. Field water distribution especially secondary canals and associated structures and field preparation works of some of these schemes are not started yet or totally abandoned. Currently, there are movements to use some of the schemes for wheat production.

Considering the 0.041 million ha sugarcane farms of Wonji-Shoa, Metehara and Finchaa factories supplying almost 0.58 million tons of sugar per year for the country. On the other hand total area of the sugar projects is more than 11 times (0.453 million ha) of the three existing factories. The other 0.112 million ha was intended to produce other crops. Apart from their financial burdens, the country loses approximately 6.5 million tons of sugar and 0.56 million

Table 8. Suspended and ongoing large scale irrigation schemes.

No	Dams and diversion weirs	Basins/Regions	Areas, 1,000 ha	Started in	Purposes	Current statuses	Areas used, 1,000 ha	Remarks
1	Gode	Shebelle/Somali	27.0	Previous government	Cereals and vegetables	Diversion and main canal constructed then terminated	2.0	Suspended
2	Alwero	Baro/Gambella	10.0	Previous government	Cereals and vegetables	Dam and main canal constructed then terminated	1.2	Suspended
3	TanaBeles	Abay/Benishangul Gumuz and Amhara	75.0	Previous and current governments	Sugar industry	Around 50,000 ha development started previously but completely abandoned. Currently, under construction with new design	13	Under construction
4	Tendaho	Awash/Afar	60.0	Current government	Sugar industry	Dam and main for 60,000 ha and some secondary canals constructed for 25,000 ha then terminated. The factory is also completely abandoned.	0.0	Sugarcane was planted on 15,000 ha but terminated
5	Kessem	Awash/Afar	20.0	Current government	Sugar industry	Dam, weir and main canals for 20,000 ha, and some secondary canals for 2,786 ha were constructed then terminated.	3.5	Suspended
6	FentalBoset	Awash/Oromiya	18.0	Current government	Community cereals and vegetables	Diversion, main and secondary canal constructed for 6,000 ha then terminated;	5.6	Suspended
7	WelenchitiBofa	Awash/Oromiya	15.0	Current government	Sugar industry	Diversion, main and secondary canal constructed for 1,500 ha then terminated	1.5	Suspended
8	Megech	Abay/Amhara	17.0	Current government	Cereals and vegetables	Only the dam completed	0.0	Suspended
9	Ribb	Abay/Amhara	20.0	Current government	Cereals and vegetables	Only the dam completed	0.0	Suspended
10	ArjoDeddesa	Abay/Oromiya	50.0	Current government	Sugar industry	Only dam is under construction but main canal and land development not started	0.0	Under construction
11	Gidabo	Omo/SNNP	13.5	Current government	Cereals and vegetables	Only the dam completed	1.5	Suspended
12	Kuraz	Omo/SNNP	175.0	Current government	Sugar industry	Only left bank main canal constructed, and dam & right bank main canal are under construction.	16.0	Under construction
13	Welkayit	Tekeze/Tigray	50.0	Current government	Sugar industry	Dam completed and portion of fields are under construction but main canal not started	0.0	Under construction
14	MekiZiway	Rift valley/Oromiya	3.0	Previous government	Cereals and vegetables	Pumping station, main canal and housing designed	1.0	Suspended
15	AlabaKulito	Rift valley/Oromiya	3.7	Previous government	Cereals and vegetables	Dam started then terminated	0.0	Suspended
16	Borkena	Awash/Amhara	3.0	Previous government	Cereals and vegetables	Dam started then terminated	0.15	Suspended
17	El-bahay (Jijiga)	Shebelle/Somali	3.0	Previous government	Cereals and vegetables	Only the dam constructed	0.0	Suspended
18	Angelele	Awash/Afar	3.0	Previous government	Pasture	Designed	1.0	Suspended
	Total		566.2				46.45	

tons of cereals that can be harvested every year due to the terminations and slow construction progresses of these mega projects.

Performances of Irrigation Schemes

Well-managed irrigation development is a key for Ethiopia to overcome major challenges. Developing infrastructure has been the major concern while managing the schemes is largely overlooked implying unfair distribution, overirrigation or water shortage, deteriorating infrastructure, low Water User Associations (WUE), productivity and sustainability.

Due to poor policy and strategy setups, weak institutional capacitites, absences of skilled manpower, weak organizational setup and linkages etc. development and performances of irrigation schemes of the country found to be very poor.

In 2004 and 2005, out of 477 small scale modern schemes irrigating 0.052 million ha, 13% schemes were completely out of use while 12% were serving less areas than the developed (Mebruk et al., 2018). The same report, based on data from Oromiya, Amhara, SNNP, Gambela and Tigray regional offices, revealed that on average 28% of schemes were completely damaged and not functional while 32.2% were irrigating less area than the developed. Only 39.2% were operational. According to Awulachew et al. (2010), most of the schemes were irrigating 70% of their areas which means out of the total 0.64 million ha irrigated area of the country, 0.2 milion ha was not productive. Yibeltal, for instances, based on field survey found that out of 2,166 schemes of Awash Basin, 741 were irrigating 79% of the developed areas due to; (i) damages on structures (42.5%); (ii) reduction of river flow and excess use of upstream users (24%); (iii) combinations of (i) and (ii) (28%); and (v) unknown reasons (13%).

From the 2018/19 inventory data of Oromiay and SNNP regions, it was found that out of 0.131 million ha being developed in SNNP, only 37% was actually irrigated. In Oromiya, actual irrigated area was 70% of the 0.301 million ha developed area. An assessment report in Amhara region on irrigated areas below 2.5 ha found that, out of 283 schemes only 20% were serving at full design capacities.Out of 158 thousands of small fuel driven small irrigation pumps in Amhara, Oromiya, Tigray and SNNP regions, 28% were not functional. In Oromiya, out of 24,552 small fuel pumps, more than 1,000 pumps were not functional.

Regarding irrigation efficiencies, many scheme based studies have been reported and published. But the most comprehensive and recent one is the work of Yusuf et al. This unpublished paper has categorically summarized efficiencies of 24 schemes ofAwash basin. According to the report, around 60% of the schems had efficiencies below 37%with area weighted mean of 33.7%. Mean efficiency of surface schemes was 33%; for sprinkler schemes it was 44%. Water shortages and abundances were the major driving factors and some sprinklers were performing even below some surface schemes.

There is no any organized and institutionalized scheme operations and water management support activity in the country. Irrigators are fully responsible. During a study survey on idenfying how farmers acquired the knowledge and how they manage, 90% of the farmers responded that they irrigate till furrows are full; 90% of the farmers irrigate if they feel the crop is thirsty; 3.2% farmers followed predefined programs; and only 9.9% acquired the knowledge from DAs. All the farmers have never attended any irrigation management training program. Contribution of researchers was as low as 10%.

In general, out of the developed irrigated area almost 40% which is equivalent to 0.44 million ha is not functional or not irrigated and at the same time it is common to use three and four times more water than demaded for a hectare of vegetable crops per season.

Conclusions and the Way Forward

Sustainable food availability and economic growth are primary demands of Ethiopia due to population growth and global economy pressures. However, the rainfed agriculture which is operating under multiple challenges is unable to satisfy these needs.The unpredictablerainfall and mixed farming systems of small farm holders in combination are prominentfactors impedingproductivity increment at the required levels. In order to produce quality crops in large quantity, both rainfall dependency and mixed production system of the rainfed agriculture should be simultaneously solved. Such transformation can only be achieved through the use of irrigationbecuasethe country has land and water resources as well as climates and crop types suitable for irrigation. Hence, expanding of monocropping irrigated agriculture is vital.

These realities should principally dictate any irrigation policies and developed strategies of the country.

With these perspectives, the last 50 years irrigation development effortsof the country were assessed and the following general conclusions were drawn. The country does not have clear irrigation policy. Organizational structures of the sector arediverse, complex and unstable too.At the same time, the sector has been segmented and mandated for different stakeholders who are involved without having defined roles, boundaries, accountabilities and centrally coordinating organ. Capacities of higher academic and research institutes have been weakened and disoriented so that they are unable to produce even handful qualified experts for the sector. Technical, financial and legal support for the sector is completely or almost absent.

Due to flaws of these frameworks, the sector was unable to support economic growth of the nation as expected. It is still not possible to identify the current needs and potentials so that all development plans so far implementedwere abortedwithout fulfilling the targets. Irrigation potentials and extents of irrigatedareas are not still properly estimated. Existing irrigation schemes are not clearly classified. Constructions of some medium and large scale schemes being started in the last four decades are not yet finalized. Operational performances of the existing irrigation schemes are also very poor.

In general, frequent restructuring of sector with massive migration of professionals; loss of documentation and information; discontinuity of projects and operations; fragmented management; and so on have proved to be heavily shaking the sector to stumble without significant progresses. Hence, the following summarized recommendations are forwarded which are rough indicators intended to supportefforts of MoWR and MoA for the attainment of food security and economic growth within the coming twenty years.

MoWRought to focus on coordinating and supporting of all water related development activities through preparations of policies and strategies; resource mobilizations such as finance sources and linking with financial institutions; identifying field of studies, higher institutes, collages, training and research centers, course curriculums and related capacity development activities; estimating land and water resource potentials of basins and regions together with extents of developed areas; mapping of existing irrigation technologies and scheme types; classifying of irrigation schemes; importing and local production of irrigation equipment; developing standards, guidelines, directives, codes, water use legal frameworks, maps and etc.; establishing of national database and dissemination systems and so on.

All irrigation constructionrelated activities should be under the responsibilities and supervision of the new IDC office which is currently under MoWR. Planning, studying, designing, constructing, rehabilitating and so on of irrigation schemesshould be carried out either under the coordination, monitoring and supervision of IDC or by itself if possible.All the constructions can not be done by IDC and involvement of external actors is critical. Once financial sources are arranged by MoWR, private investors, cooperatives, government development organizations, corporations, individual farmers and so on will develop their own irrigation schemes but it must be under the supervision of IDC.

Once the infrastructures are constructed, monitoring and supervising of the agricultural services will be full responsibilities of MoA. Improving crop productivities and irrigation efficiencies of all schemesirrespective of ownerships, types and sizes should be under the supervision of MoA.Only

IDC and MoA should have decision powers on the development of irrigation schemes but should be aligned with representative offices at all levels of the federal and regional structures.

Forlong term development strategies ofthe sector, formulating comprehensive irrigation policy that encompasses the current development demands of the country in relation to the global contexts which envisaged future scenarios should be the first measure a responsible government offices particularly MoWRmusttake. Identifying, aligning and defining responsibilities and roles of stakeholders involved in irrigation should be the next step of the office. Updating irrigation potentials and actually areas currently irrigated in each basin and region should also be carried out within short period of time. Next, demand gaps of the country by crop types and extents of irrigated area together with institutional capacities should properly be quantitatively and qualitatively projected. Then refined but highly intensive development plan for the irrigation sector must be crafted and consistently implemented with strong commitment and coordination.

Regarding the 2020 new plans of MoWIE and MoA, the following issues need due attentions which are forwarded based on the premises that; by considering 2.72% average annual growth rate, Ethiopian population will reach around 190 million by the year 2040. Hence, to be food selfsufficient, at least 50 million tons cereal crops should be annually produced which is almost 70% more than current production. So the existingproductivity of rainfedagriculture is expected to increase proportionally which seem very challenging. Otherwise, the country must develop new irrigated land within within the range of 4.25 to 7.3 million ha. The first fugure is to satisfy cereal production of local consumptiononly (0.75 million additional lands might be considered for industrial crops) while the second one is to meet at least the current global average irrigated area by the year 2040.

First of all, in the next ten years, the focus should be on rapid expansions of irrigated lands like other countries such as China did. Fortunately, headworks of 18 large schemes covering around 0.57 million ha; main canals and farm lands of some of these schemes have already been almost completed. Hence, entire efforts of IDC must be on completion of these schemes and rehabilitating of existing schemes within the coming five years. The total will reach around 1.67 million ha (Figure 4). Simultaneously, capacities will be enhanced to intensify the speed. For the second five years, planning to add a minimum of 1.5 million ha (0.3 million ha per year) new irrigated land will not be ambitious plan. The rest 4.0 million ha will be part of the second ten years.

Second, development of all types of irrigation schemes (small, medium and large) should be nationally supervised by IDC only. Individual farmers, private investors, government organizations such as Sugar Corporation and so on might construct irrigation schemes but should be strongly monitored by IDC. MoA should be out of irrigation development activities and should focus on improving agricultural services of the irrigation schemes. Experiences of Asian countries demonstrated that cropping strategies, improving productivities and irrigation efficiencies might be implemented after expanding the irrigated areas with significant proportions. Otherwise, the tasks might be fully transferred to MoA. Responsibilities such as organizing graduated youth, job creation, training provisions, and market linkages can also be transferred to appropriate government institutes. Third, intensive expansion of irrigation schemes will not be realized unless supported by strong and massive participations of every responsible citizen, private investor, local and international institution. Rather than relied on government budget and hired individual, thinking of mobilizing available resources as much as possible deemed necessary. Fourth, regarding financing the rapid expansion at the stated scales, the annual budgets requirement will be three times higher than that of the allocated. Hence, any possible options should be used to secure the finance such as; encouraging private commercial banks to lend for local farmers with lower interest rates; establishing agricultural banks to long-term investment; establishing an irrigation fund; grants from donors; implementing costrecovery system; subsidies; bonds and so on. Of course, it will be the responsibility of MoWR.

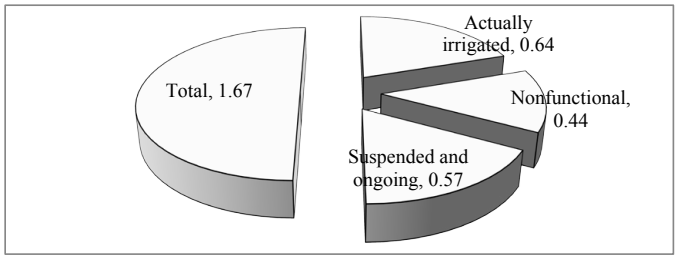

Figure 4. Proportions of irrigated and non-irrigated areas in million ha.

Although in depth analysis is needed, in order to boost crop production and economic growth of the country within the coming twenty years, area proportion or the ratio between irrigated and rainfedareas should roughly reach a minimum of 0.5 (5:10 million ha). This might be done by completing suspended schemes, rehabilitating existing schemes and specifically by expanding new irrigated lands so that the IDC targets must be increased by three folds. This has implication on the financial requirements which is expected to be increased proportionally. Hence, mobilizing external sources and devicing proper mechanizms is very crucial. The other important points are; more than 75% of the the developed irrigated area should be allocated for cereal crops and whatever irrigation scheme's management, operation or ownership modalities are set;ifmonocropping production system is widely practiced, economic growth of the country will be realized.

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