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Contributions of Tendaho Irrigation Project to the Improvement of Livelihoods of Agropastoralists in the Lower Awash Basin, Northeastern Ethiopia

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Abstract: *The study was conducted in Asaita and Dubti districts in northeastern Ethiopia to assess the contribution of Tendaho Irrigation Project to the improvement of the livelihoods of agropastoralists. Various data collection methods, including questionnaire surveys, semi-structured interviews, focus group discussion and field observations were used. A total of 70 respondents were taken for questionnaire survey (35 from each districts). It has been found that irrigation agriculture, animal rearing and selling of fuel wood are the major sources of livelihood for the study population. According to the key informants, 14, 532 hectare of land has been currently irrigated by the state and 12, 714 peoples are employed as permanent and temporary workers in the ongoing TIP. The livelihoods of the majority of respondents (74.3%) has improved due to the contributions of TIP with a significant difference at α 0.05 level. The difference in access and ownership of agropastoralists to the five livelihood assets before and after their involvement in TIP was found to be significant at α 0.01 level of significance. The TIP has facilitated the diversification of agropastoralists' livelihoods in which 48.6%, 25.7% and 25.7% of respondents have invested in rural trade, urban trade and other source of livelihood, respectively. Generally collaborative irrigation resource management of TIP has enabled agropastoralists to improve and diversify their livelihood. To make the contribution of TIP to the livelihood improvement of the local communities more and sustainable, their participation at all decision making that directly or indirectly affect their lives has to be assured.*

Keywords: ***Tendaho irrigation project, livelihood assets, collaborative natural resource management, livelihood diversification, Ethiopia***

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1. Introduction

In recent years, pastoralists have faced increased competition for dryland natural resources, especially water, land and pastures, in the context of decreased rangeland access (Gomes, 2006). Faustine et al (2002), stated that due to drought, livestock diseases, land encroachment, government development policies and increasing human population, many agro-pastorals are facing difficulties of pursing their traditional agropastoral livelihood system. Instead they have now engaged themselves in additional sources of income to cope up with the above bottlenecks to sustain their life and diversify their livelihood.

Among many other options governments of East Africa have designed policies and programs that facilitate permanent settlement of agropastoralist based on subsistence farming and irrigation (Faustine et al, 2002). As part of such policy direction, governments are currently implementing large-scale irrigation projects, which claimed the transfer of huge hectares of grazing range lands of pastoralists into state-managed irrigation lands.

According to Sandford (2011), the reason why irrigation is being adopted as a solution to the problems of pastoralists in the arid and semiarid areas of East Africa is that there is much land in pastoralist areas of the Horn of Africa (HOA) that could be converted to irrigated agriculture and thus, provide an alternative or additional livelihood for agropastoralists.

In HOA, the total estimated area of irrigable land, including the already irrigated land, in or immediately adjacent to pastoralist areas is 2.2 million ha. Ethiopia has the highest number of pastoralists (8 million) and largest irrigable land in pastoralist areas (1,673,000 ha) in the horn of Africa. The ratio of irrigable land to agropastoralist households in pastoralist areas is estimated at 1.25 (Sandford, 2011). This indicates the enormous potential of the Ethiopia for achieving better irrigation development. Hence, tremendous efforts are underway to promote large-, medium- and small-scale irrigation schemes through huge financial and labor investments. In the last few years, heavy investments have been made to harness the water resources of the country towards irrigation development. Tendaho Large-Scale Irrigation Project (TIP[3]), which is found within the lower Awash River Basin in Ethiopia, is one of the ongoing irrigation projects that demonstrate commitment of the Ethiopian Government to irrigation development (Gashaye and Tena, 2008).

[3] TIP stands for Tendaho Irrigation Project

Employment opportunity, supply of raw materials for industries, especially to sugar and bio-fuel factories, and facilitated permanent settlement of nearby pastoralists are some of the expected contributions of the irrigation project.

The lower Awash basin, where the TIP is currently located, has been an area of natural resource-based conflicts between the local communities and the State, mainly over the control of irrigable land and water resources since the middle of the 20th Century (Rettberg, 2010, Bondestam, 1974, Said, 1997 and Dejene, 1999). There was a development initiative such as the establishment of large-scale cotton and sugarcane farms by successive Ethiopian Governments since the 1960s. However, such development initiatives have marginalized the local communities from participation in the projects and any benefit (Getachew, 2001). Consequently, the livelihoods of the local communities were not improved for a long period of time.

In the last few decades, there has been a growing awareness of the importance of Collaborative Natural Resource Management (CNRM) practices and institutions, and recognition of the ways that historic forces have disrupted local people's ability to manage the lands and resources they depend upon (Rose et al, 2009). In this context of institutional reform, the increasingly popular community-based natural resource managementnarrative was widely promoted and adopted in Ethiopia. The Government of Ethiopia has introduced participatory irrigation resource management, in which agropastoralists in and around TIP are directly involved in the management and utilization of the land resources of the project. Moreover, there are no scientific studies carried out regarding the role of TIP on the improvement of livelihoods of agropastoralists. Being located in the agropastoral desert area, TIP has very distinctive nature that makes it unique from other projects. Thus, it requires scientific investigation to determine its contribution to improve the livelihoods of the local communities.
The specific objectives of the study were to: (i) examine the improvement of livelihoods of agropastoralists as a result of their involvement in TIP as perceived by themselves; (ii) assess the change in the livelihood assets of agropastoralists as a result of the cooperative management of TIP; and (iii) identify the role of cooperative irrigation resource management in the diversification of livelihoods of agro pastoralists.

2. Conceptual Framework

The sustainable livelihoods framework or approach (SLA) developed by DFID and others is a commonly accepted basis for analyzing livelihoods in the context of long-term development initiatives such as irrigation. The framework illustrates how the capital assets, namely financial, physical, human, natural and social assets, are the bases of households for their livelihood strategies. These strategies are impacted by the 'vulnerability context' in which people operate, and are also shaped by the policies, institutions and processes, which form the external context. After all of the influences and access created by the above factors, successful communities or individuals will have better livelihood outcomes (Virtanen, P., et al (2011), Catley, 2008).

This study focuses on the impact of collaborative natural resource management of TIP (long-term development initiative) on the improvement of livelihoods of agropastoralists (local communities) living under a vulnerability context (market irregularity, climate change and conflicts). Hence, the SLA is adopted as a framework for our study. The major part of this study is composed of the livelihood assets component of the SLA. Livelihood assets are often represented as a pentagon in the SLF, consisting of the following five categories: natural resources (also called "natural capital"), physical reproducible goods ("physical capital"), monetary resources ("financial capital"), manpower with different skills ("human capital") and social networks of various kinds ("social capital") (FAO and ILO, 2007).

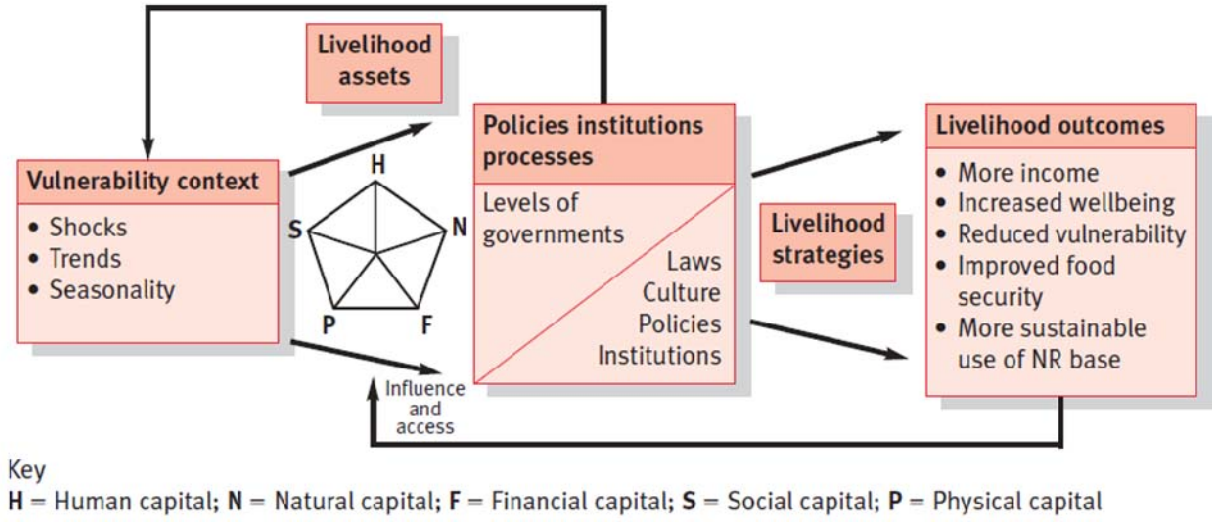

Figure 1: Sustainable Livelihood Approach adapted from DFID (1999).

Human capital represents the skills, knowledge and availability of labour and good health that together enable people to pursue different livelihood strategies and achieve their livelihood objectives. In the context of this study, human capital is represented by the number of family members enrolled in education, change in access to medical checkup and facilities, conditions of nutrition and availability of job. This is due to the fact that human capital is the function of healthy and educated family members that contribute to labor and availability of job.

Social capital refers to the resources people draw upon in pursuit of livelihood objectives. Social capital is developed through networks and connectedness, membership of more formalized groups (governed by mutually-agreed or commonly accepted rules, norms and sanctions) and informal safety nets based upon relationships of trust, reciprocity and exchange. In this study, the impact of participatory irrigation land management in TIP on the accountability of clan leaders (accountability), community participation in social organizations and the amount of support within members of agropastoralist community was investigated.

Natural capital refers to endowments and resources of a region belonging to the biophysical realm, including forests, livestock, air, water, arable land, soil, genetic resources and environmental services. In this study natural capitals are represented by livestock, productivity of land and availability of water.

Physical capital comprises the basic infrastructure and producer goods needed to support livelihoods Farah (2001). Infrastructure consists of changes to the physical environment that help people to meet their basic needs and be more productive. Producer goods are the tools and equipment that people use to function more productively, i.e.ownership of modern irrigation tools, access to safe drinking water and access to road.

Financial capital denotes the financial resources that people use to achieve their livelihood objectives. In this study, they are represented by the amount of annual income and saving. In addition to the livelihood assets, the different new means of livelihood diversification introduced were assessed to understand the contribution of TIP on the livelihood diversification of agropastoralists.

3. Materials and Methods

3.1. Study Area

The study was conducted in TIP, which is situated in the Lower Awash Valley of the Afar National Regional State (ANRS), northeastern Ethiopia. The Project is located at about 600 km from Addis Ababa. It is situated at 11° 40' 77"N and 40°57'49"E between Dubti and Asaita Districts at an altitude of 402 m a.s.l. (Figure 2). It is a man-made dam constructed, mainly, for the purpose of irrigation of sugar cane plantations. TIP is designed to irrigate about 60,000 ha of land at the Dubti, Dat- Bahri, Asaita and Afambo areas for sugarcane plantations. The project is expected to benefit nearly 35,000 families living in the basin from irrigated pasture development and animal feed from sugar by-products. During the implementation process, a number of job opportunities have been created. It is fed by the River Awash, one of the longest perennial rivers originating from the highlands of Ethiopia. The vast irrigable land resources, grazing land, bush lands and the Awash River flood plain are the most important dryland resources in Ethiopia.

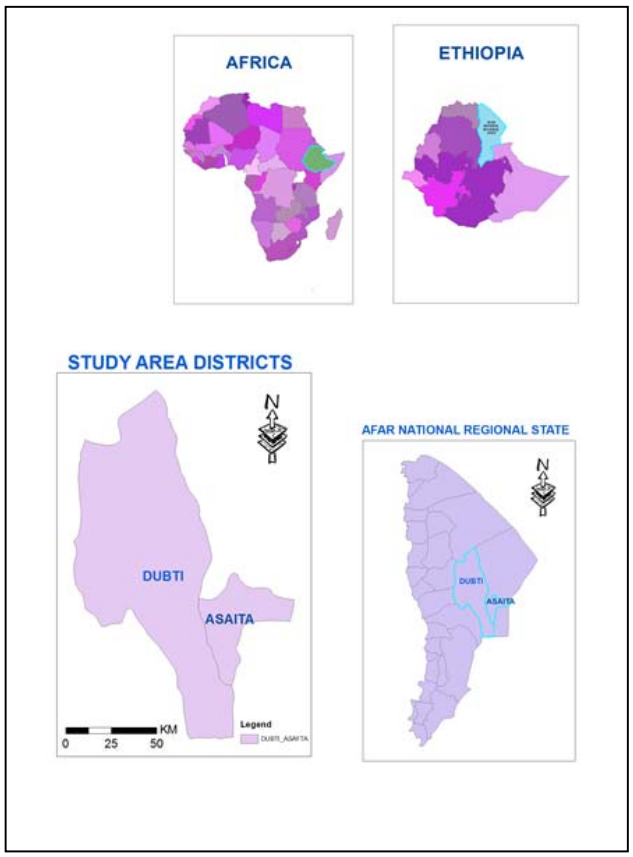

Figure 2: Map showing the study areas

TIP is characterized by lowland plain and a very hot area located in the arid zone of Ethiopia. The mean maximum temperature ranges from about 32 to 42 °C and mean minimum temperature as about 16 to 25 °C. The hottest months occur from March to October and the coldest months from November to February. Mean monthly rainfall ranges from about 4 to 58 mm. March, April, July and August receive more rainfall. Destructive high level wind, accompanied with dust, is very common in the afternoons of every day. As a result, ANRS is one of the drought-prone areas with major shocks and hazards associated with the recurrence of drought that disrupts the livelihoods of communities.

The Tendaho irrigation site is located within an area known as 'Tendaho', which forms the center of the Afar triangle, a low lying area of land, where the East African, the Red Sea and the Gulf of Eden Rift systems converge. This area is filled by various types of sedimentary deposits ranging from clay to gravel, volcanic tuffs and hot spring deposits. The Pleistocene age sediments in the area consist of marine and lacustrine clays, silts, sandstones, siltstones, mudstones and conglomerates. The bedrocks underlying the sedimentary rocks are Pleistocene age flood basalts belonging to the Afar group of the Ethiopian volcanic series (Mohr, 1971).

Afar, Amhara, and Tigriyan are the ethnic groups in the study area. The majority of the sampled population belong to the Afar ethnic group. Traditional livestock production, rain-fed and irrigation Agriculture and selling of charcoal are the principal sources of livelihoods for most of the people. They cultivate mainly maize, tomato, cotton, cabbage, onion and sugar cane. Cattle, camels, donkeys, sheep and goats are the main livestock types raised in the area. TIP is initiated and ran by the Sugar Corporation of the Federal Government of Ethiopia.

3.2. Data Collection

3.2.1. *Sampling procedure and sample size determination*

Multi-stage sampling was used to select agropastoralists to be interviewed. The first stage involved a purposeful selection of respondents from the *Kebelle*[4]Peasant Association (KPA) administrations under TIP sites from Dubti and Asaita Districts. The second stage involved the selection of agropastoralists from lists of households in the selected KPAs. A total of 70 respondents were sampled of whom 35 were from Asaita and 35 from Dubti Districts.

[4]The lowest administrative unit in Ethiopia.

Furthermore, thirty households were purposively selected based on their knowledge as recommended by the local people (mainly elders) and Development Agents for the focus group discussion (FGD) and interview.

3.2.2. Questionnaire survey

A structured questionnaire (open-ended and close-ended) was developed to address the impact of collaborative natural resource management on the improvement of the livelihoods of agro pastoralists. The questionnaire was tested before implementation for its consistency, logical flow, coding and length, and amended. Enumerators who had completed preparatory schools and college and who understand and speak the local language (*Afarif*) were recruited. Training on the content of the questionnaires including how to conduct the interviews with agro pastoralists was conducted in advance for these enumerators. Secondary data were obtained from the Agricultural Offices and Natural Resource Units of the selected districts, Afar Region Land Administration Bureau and Tendaho Sugar Factory Project Office.

3.2.3. Interviews

Semi-structured interviews were conducted with concerned TIP officials, clan leaders, agropastoralists, development agents, concerned officials of the ANRS and district land administration offices. The interviews with clan leaders were carried out using the local language (*Afarif*). At the beginning of each interview, the aim of the interview was clearly explained to informants to invoke clear and objective responses. Data on collaborative natural resources management of the irrigation project were also collected. This technique enabled us to tap indigenous land administration system and state-community interactions over irrigable land resources.

3.2.4. Focus group discussion (FGD)

Focus group discussions with individuals from KPA, clan leaders, agropastoralists, development agents and community representatives were carried out. The discussions were held at the irrigable fields. Proportionally three focus group discussions one in Asaita and two in Dubti were made. In each group 10 participants composed of women, elders and youngsters were included. To facilitate the discussion under each group check list was prepared in advance. The collected data help to triangulate the information obtained under different approaches.

3.3. Data processing and analyses

To analyze the data, both qualitative and quantitative data analyses tools were used. Triangulation method was employed to analyze and evaluate the validity of the information collected using the different methods. The collected data was coded, interpreted and synthesized using Statistical Package for Social Sciences (SPSS) software Version 17. Accordingly, the contribution of TIP for the improvement of livelihood of agropastoralists was analyzed using descriptive statistics, chi-square test and paired samples T-Test.

4. Results and Discussion

4.1. Demographic Characteristics of Respondents

The age of respondents ranged between 21 and 64 with an average age of 40 years. The overwhelming majority of the people are young, implying that the pressure on the land is on the increase. The average household size was five, which is similar to other areas in Ethiopia and ANRS. Nearly all the households were nucleated families. The level of education was low as almost all of the respondents (94.3%) were illiterates (Table 1). According to the respondents, since the people in the study areas are agropastoralists (semi-permanent settlers) it was hardly possible to expand education service for those people who have no fully permanent settlement, which explains the high level of illiteracy. The levels of education and training have implications on the capability of households to manage their resources and accept extension service. The livelihoods of the respondents are dependent on crop cultivation, livestock production and selling of fuelwood and charcoal. Hence, the socio-economic status of the respondents was measured in terms of the size of agricultural land and the number of livestock heads they have.

Table 1: Education, wealth status and social position of the respondents

Variable	Total	
	Frequency	Percentage (%)
Education		
Illiterate	66	94.3
Primary education	3	4.3
Read and write	1	1.4
Wealth status		
low	51	73
Medium	17	24.3
High	2	2.9
Social position		
Clan leaders	12	17.1
pastoralists	58	82.9

Most of the respondents (73%) were classified under low income level. The majority of the respondents were agropastoralists (82.9 %) and the remaining are clan leaders. The low income level of the respondents was attributed to not only the displacement of agropastoralists from their grazing lands. Crop cultivation using irrigation agriculture, animal rearing and selling of fuelwood/charcoal offer good opportunities for improvement of the livelihoods of agropastoralists (Table 2). Especially, the agropastoralists of Asaita district are highly dependent on irrigation agriculture to sustain their daily lives.

Table 2: Means of income generation to improve the livelihoods of agro pastoralists

Sources of income	Response	Frequency	Percentage (%)
Crop cultivation	Yes	66	94.3
	No	4	5.7
Animal rearing	Yes	62	88.6
	No	8	11.4
Selling fuel wood and charcoal	Yes	40	57.1
	No	30	42.9

4.2. Improvement of Livelihoods of Agro pastoralists

The livelihoods of the majority of respondents (74.3%) have improved due to the collaborative natural resource management approaches that are practiced in and around TIP (Table 3).The Chi-Square Test result (X^2 = 7.479; df = 1, P = 0.013) indicates that, there is a significant difference in the improvement of agropastoralists livelihood across the two districts of the study area. This finding is consistent with the findings reported by Birhanu et al. (2001) from Tigray National Regional State, northern Ethiopia where collaborative management of woodlots has contributed substantially to community wealth, increasing willingness of members to provide collective effort to manage the resources. Sixty and 88.6% of the respondents in Asaita and Dubti districts, respectively, stated that their involvement in the TIP has enhanced their livelihoods (Table 3).

Focus Group Discussion (FGD) and interviews of key informants (KI) revealed that, Tendaho irrigation is more extensive in Dubti than Asaita district. Hence, the number of agropastoralists that have benefited from the collaborative irrigation resource management and utilization is higher in Dubti than Asaita district. The second prominent reason for this obvious difference is that, in Dubti district, the number of agropastoralists that have joint ownership and use of land is higher than that in Asaita district where land is owned and utilized communally.

The role of government in the ownership and utilization of irrigable land decreases away from Dubti towards Asaita district.

Table 3: Response of households for the question whether or not their livelihood have improved as a result of their involvement in TIP

District		**Response**			
		No	Yes	**Total**	$\mathbf{X^2}$
Asaita	Respondents	14	21	35	7.479 **
	Proportion (%)	40	60	100	(df = 1, P = 0.013)
Dubti	Respondents	4	31	35	
	Proportion (%)	11.4	88.6	100	
Total	Respondents	18	52	70	
	Proportion (%)	25.7	74.3	100	

*** Significant at 1% level.*

4.3.Improvements of Livelihood Assets of Agro pastoralists

4.3.1. Natural Capital

The paired statistical results indicates that the average number of cattle, sheep, goats and camels increased from 8.34 to 12.3, 16.3 to 20.1, 18.6 to 24.1 and 4.2 to 6.1, respectively, after their involvement in TIP (Table 4). The standard deviations for pre- and post-involvement in TIP reveal that, changes of the number of herds were more variable with respect to sheep and goats than the others. Paired sample correlation results of the Paired-Samples T-Test between the number of cattle, sheep, goats and camel also indicated an almost perfect Pearson Moment Correlation of 0.845, 0.883, 0.868 and 0.910, respectively (Table 4). The increase in the number of herds owned by the agropastoralists was due to their involvement in TIP. In addition to the correlation and descriptive statistics, the t-value of the Paired-Samples T-Test indicated that there was a significance ($\alpha = 0.01$) difference between the number of herds of agropastoralists before and after their involvement in TIP (Table 4). This indicates that there is a considerable difference between the average number of herds owned by agropastoralist households before and after their involvement in agriculture. As indicated by Regmi (2007) and Farah (2001), the number of livestock owned by agropastoralists is an important component of natural capital, which acts as a store of wealth and buffer against bad times.

Participants in FGD and KIs stated that before their involvement in TIP, they had to depend on livestock and livestock products for almost all of their necessities. Nowadays, however, TIP is providing them with additional source of income, which they can spend to fulfill their needs such as food, clothing, jewelries and may others commodities. Due to the decrease in the number of livestock sold for fulfilling basic needs, the number of livestock per household has increased over time. According to the agropastoralists, the other positive contribution of TIP, in terms of increasing the number of livestock, is the provision of forage and increased source of animal feed as well as drinking water. Availability of feed and water is very essential for the herds and agropastoralists since it improves the quality of livestock while decreasing their death.

Table 4: Results from the Paired Samples T-Test on number of livestock heads owned by the respondents before and after involvement in the TIP

Paired Variable		Paired Samples Statistics		Paired Samples Correlation		Paired Samples T-Test	
		Mean	S.D	r	Sig.	t	Sig.
Pair 1	Number of cattle before involvement	8.34	8.22	0.845	0.000**	-5.665	0.000**
	Number of cattle after involvement	12.3	10.8				
Pair 2	Number of sheep before involvement	16.3	20.03	0.883	0.000**	-3.122	0.003**
	Number of sheepafter involvement	20.1	21.41				
Pair 3	Number of goats before involvement	18.6	20.77	0.868	0.000**	-4.111	0.000**
	Number of goats after involvement	24.1	22.54				
Pair 4	Number of camels before involvement	4.2	3.97	0.910	0.000**	-8.062	0.000**
	Number of camels after involvement	6.1	4.85				

** Significant at 1% level; N=70;df=69.

Selected clan leaders and project managers who participated in the key informant interviews also agreed that land productivity improved over time due to TIP. The area currently managed by TIP was mostly not used for irrigation except for limited traditional irrigation fields run by agropastoralists. Currently, however, crops and vegetables, which were not commonly cultivated in the area, such as tomato, maize, onion, cabbage, etc. have been introduced and widely produced.

As in many arid and semiarid areas of Ethiopia, the agropastoralists engaged in the traditional irrigation activities around the area currently managed by TIP were dependent on scarce water resources and experienced inefficient use of water. However, TIP has provided them with sufficient water that enabled them to produce as much as they can throughout the year.

Moreover, since TIP uses modern irrigation system, its water use efficiency is also very high compared with the traditional irrigation scheme that prevailed in the area for many years.

4.3.2. Physical Capital

More than 80% of the respondents have access to safe drinking water, modern irrigation tools and improved quality of houses (Table 5). The managers of TIP stated that with the aim of providing infrastructure and basic public services to the local agropastoral communities, TIP has constructed schools, houses (permanent settlement), health centers and village level roads from which the agropastoralists have benefited. KI interviewees and selected agropastoralists stated that agro pastoralists can now send their children to school, and make medical checkup when needed. Also, their traditional residential houses have been replaced by modern ones. The dry season roads also helped them to transport their surplus products to the surrounding cities, such as Dubti, Logia, Samara and Asaita. This indicates that TIP is making remarkable contribution to the improvement of the physical capitals of the area.

Table 5: Change in access to basic physical capitals by due to respondent's involvement in TIP

Physical capital	Response	No. of Respondents	Percentage (%)
Do you think that your access to safe drinking water has improved?	Yes	13	18.6
	No	57	81.4
	Total	70	100.0
Do you think that your access to modern irrigation tools has improved?	Yes	14	20.0
	No	56	80.0
	Total	70	100.0
Do you think that your access to quality residential house has improved?	Yes	13	18.6
	No	57	81.4
	Total	70	100.0

4.3.3. Financial capital

The mean annual income of respondents has increased from 850.00 (≈ USD 45.00; exchange rate: 1 USD ≈ 18.85 Birr) to 4528.57 (≈ USD 240.00) Ethiopian Birr before and after their involvement in TIP, respectively. However, the standard deviation (SD) of about 2721.00Birr indicates that there is huge variability in the distribution of annual income across the respondents. The results also showed that, none of the respondents had annual savings before the implementation of TIP. The mean annual savings by the respondents was 107.14 Birr (SD ≈

664.3Birr) after their involvement in TIP. Even though the mean annual saving is small, it is a sign of improvement in the saving culture of the agropastoralist communities. No correlation was found in the change of the annual savings due to the involvement of agropastoralists in TIP. According to the paired samples T-Test, the difference between the annual incomes of respondents before and after their involvement in TIP was significant (T = -4.515, P = 0.000) (Table 6).

Table 6: Paired sample T-Test of respondents on the basic financial capital

	Paired variables	Paired statistics		Paired Correlation		Paired Samples T-test	
		Mean	SD	r	sig	t	sig
Pair 1	Annual income before involvement	850.00	2720.494	0.933	0.000	-4.515	0.000**
	Annual income after involvement	4528.57	9282.946				
Pair 2	Annual saving involvement	.00	.000	-	-	-1.349	0.182NS
	Annual saving after involvement	107.14	664.268				

*** Significant at 1% level; N=70;df=69, NS=Not Significant*

Respondents also claimed that the positive change in their annual income is associated with the additional income they got directly from their involvement in TIP and the new livelihood sources that they have invested in using the income they obtained from their participation in the TIP. However, the information from the FGD and KIs revealed that, even though the respondents get annual income from their involvement in TIP, no significant changes were observed in the amount of money they save. This has been attributed to the lack of culture of saving by the agropastoralist communities.

4.3.4. Human capital

The information obtained from the FGD and KIs indicated that, TIP has contributed to the enhancement of the human capital of the agro pastoralist communities. TIP has created a good opportunity for the education of children of the agropastoralists. The difference between the mean number of children attending school before and after the engagement of respondents in TIP was highly significant (T = - 7.16, df = 69, P = 0.0001). The correlation results (r = 0.595, df = 69, P = 0.0001) between the pairs also demonstrated similar situation. The respondents stated that, they are now sending their children to school because of two principal reasons. Firstly, the project has constructed a school for the community. Secondly, they have relatively good income

so that they can afford the fees required for the education of their children. This implies that, in the long-term, some members of the agropastoralist households will have a better opportunity to be educated and skilled so that they can also secure salaried jobs. Hari et al (2010) stated that households with members having better level of education have relatively better chance to get skilled jobs and, hence, they can easily adjust to challenging livelihood vulnerabilities.

The human resource of a given household in particular and a community in general depends on the status of its health. As a component of the human capital, agropastoralists having good health condition will necessarily have good command of labour as well as effective accomplishment of their livelihood activities (Howden et al, 2010). About 79% of the respondents reported that their access to medical checkup and facilities have improved due to TIP while the remaining respondents have no adequate access to such facilities. According to the KI interviews made with the project officials and managers, one modern health center was constructed to serve the project employees and the nearby agropastoralists. This has significantly improved respondents access to medical checkup and facilities.

The other function of productive human capital is also nutrition. When agropastoralists get balanced diet first they will have good health and they can work effectively in any job which can provide income. KIs and participants in the FGD indicated that, agro pastoralist had been dependent on livestock products for their diets. However, the current situation is becoming obviously different. They have access to better variety of food both from products of the irrigation and the market. In addition, they have quite a good knowledge about food preparation, also due to the lessons they got from the Health Centre.

TIP also created employment opportunities in the area for the people to work and get income. According to the TIP human resource management document, the project has employed 1,401 tractor drivers and field supervisors as well as 1,080 office workers on a permanent basis. The project has also employed 1,113 guards and up to 9,000 daily laborers (seasonally).

4.3.5. Social capital

Accountability of clan leaders, participation of communities in social organizations and the amount of support within members of the agropastoralist communities are very essential components of social capital. About 79% of the respondents reported that, there is no change in

the accountability of clan leaders associated with the administration of irrigation related resources and benefits, especially distribution of the payments made for land compensation. This finding is in contrast to those of Catley (2008) and Birhanu et al. (2000) who concluded that collaborative natural resource management enhances accountability of local administration. According to the information from the FGD and KI interviews, clan leaders who are responsible to manage distribution of the payments made for land compensation of the irrigable land taken over by TIP failed to fairly distribute the money. This has caused serious conflicts and clashes within the clans, among the clans and with the State. This finding concurs with the findings of (Sandford, 2011) who stated that outside intervention to local agropastoralist irrigation system leads to conflict and bad governance because such outside intervention fails to accommodate the local traditional agropastoralist land tenure systems and administration structures.

About 79% of the respondents stated that the social support they got from their relatives and neighbors when they are in need has increased due to their participation in TIP. Since the commencement of the project, a number of agropastoralists have been involved in the irrigation activities, which increased their income. This, in turn, has enabled them to support each other. Participants in the FGDs and KI interviews have also made similar reflections.

About 81 percent of respondents indicated that TIP has enhanced their participation in the local social institutions, such as the social support system at the village (locally known as *Ganda Budda*) with traditional leadership system, which includes clan leader (*Kedo Aba*) and lineage (*Dala Aba*), or sometimes called *Dabala Aba*), youth leaders (*Fei'ma Aba*), Council of Elders, etc. In addition, respondents stated that the enhanced income and number of livestock have enabled them to participate in social institutions that entail financial requirements, such as marriage dowry, gifts, exchange, bride wealth and fines. Catley (2008) also stated that the increase in the number of livestock is a constant source of solid social interaction and interrelationship.The rationale they provide for this reality is that TIP has created collaborative natural resource management in which decisions are given collectively.

Our results indicated that, TIP has affected the social capital of the society by positively enhancing their social support system and participation in social institutions. However, the

accountability and fairness of clan leaders is still bound with problems of injustice and lack of transparency.

4.4. Diversification of Livelihoods of Agro pastoralists

One of the most important impacts of irrigation projects, such as TIP, is enhanced diversification of the livelihood system of a given local community. Agro pastoralists involved in the collaborative irrigation management of TIP have stated that, their livelihood is diversified due to the income they earned from the project. The analyses of our survey data indicated that, out of the total respondents, about 49% have invested in rural trade, such as selling locally demanded goods like cloths, cosmetics, jewelries, electronic equipments and packed foods while about 26% of them have begun small scale trade activities (selling fish, vegetables, crops, small shops, etc.) in urban areas such Logia, Samara, Dubti and Asaita. In other words, about 75% of respondents have diversified their traditional livelihoods because of their involvement in TIP. The assessment carried out by the humanitarian policy group of the Overseas Development Institute (2010) has revealed that, the resource base of agropastoralists is getting fragile due to increasing population, environmental degradation, climate change, conflict and related hazards. Hence, livelihood diversification is not the only option but the only way out. Irrigation is both an option and source of livelihood diversification.

5. Conclusions and Recommendations

Collaborative natural resource management, such as the collaborative irrigation resource management of TIP, is very essential to the improvement of the livelihoods of the local communities. Our results indicated that the involvement of agropastoralists communities in TIP has enabled them to change their livelihood assets (natural, social, financial, physical and human capital). TIP, is also prominent in diversifying the already threatened agropastoralist livelihoods into new and more productive livelihood systems, such as trade and provision of services.

To make the contribution of TIP to the livelihood improvement of local agro pastoralist communities successful, land transfer systems and compensation payment administration should be fair and transparent. In addition, the local communities should be involved more in all decisions that directly or indirectly affect their lives. Moreover, concerned bodies should create a

system that enables agro pastoralists to save money in modern ways and invest in more productive activates using the income they obtain from TIP.

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