Socio-Economic Characterization of Community in Watershed Management: Case of Abaya- Chamo Sub-Basin Project Districts of Southern Ethiopia.

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Research Article

Keywords: Watersheds, characterization, socio-economic, baseline

Posted Date: April 22nd, 2022

DOI: https://doi.org/10.21203/rs.3.rs-1582508/v1

Abstract

Background

Watershed management is being recognized as a suitable alternative intervention in managing natural resources. Characterizations of watershed management project in terms of socio-economic baseline study helps to evaluate whether a change making a difference. It is used during the project to indicate progress toward the objectives, and after the project to measure the amount of the change. This study aimed at baseline characterization with special reference to socio-economic aspects to suggest appropriate policy directions for enhancing watersheds programs towards achieving integrated Water Resource Management. The study area was in the Abaya-Chamo sub-basin of Rift Valley Lakes Basin of southern Ethiopia. To record benchmarks of socio-economic characteristics, the study was carried out in Amaro, Chencha, Humbo, Lokabaya, Mirababaya, Arbaminch city administration, and Abaya districts covering 7 Kebeles and 7 villages that were accessible for data collection.

Results

The major objective of the study was a socio-economic characterization of community in watershed management programs in seven watershed management districts of the Abaya-Chamo sub-basin of southern Ethiopia. The study was carried out using secondary raw data collected by Rift Valley Lakes Basin Authority (RVLBA). StataMP 13 and MS Excel were used for the analysis of the data. The major income sources of the farmers in the study area were crop production, animal husbandry, and tree land. Lack of educational institutions, poor economic conditions, and lack of access to the far located institutions was observed to be the conspicuous reason for the low literacy rate in the study area. Typhoid, typhus, Mosquitoes, Diarrhea, tuberculosis, and other water-borne disease were the major disease found in the study area.

Conclusions

Demographic characteristics, Income status, and social status were the major components of the socio-economy focused in this study. Agriculture in the area is the major source of income basically of a subsistence nature - characterized by low input – low output. Therefore, socio-economic improvement depends upon resource mapping very crucial for planning appropriate intervention. Access to education should be improved and children's attendance at school should be encouraged and facilitated.

1. Background

The main purpose to characterize socio-economic systems in the watersheds is to identify existing and potential production constraints and propose potential areas for targeting technology transfer for sustainable development. It requires huge information from several sources, published, unpublished, and micro-level field investigation. The following broad areas (indicators) may be essential to characterize socio-economic systems in the watershed. Thus, careful identification of these indicators may provide an opportunity for better implementation and monitoring of watershed development programs. Socio-economic characterization helps to evaluate the social status, economic base/status (people), promote the resource existing for socio-economic development, to bring equitable income distribution among the people, and to introduce long, medium, and short term development plans for the area and the country at large (Wani SP et al 2003).

FDRE RVLBA is established through Federal Negarit Gazeta proclamation number 534/2007. The main objectives of the authority are to promote and monitor the integrated water resource management process in the RVLB. To achieve this objective it undertakes many activities through different established Directorates. Watershed and River administration Directorate is one of the departments, that undertake the watershed management projects in selected 23 Districts in collaboration with the respective district level Agricultural development offices. At the beginning of the physical year, RVLBA and the district ADO sign an MOU to achieve their action regarding the watershed management projects. They select the project area of micro watersheds based on the severity of the problem.

The socio-economic characterization of communities in watershed management of Abaya-Chamo sub-basin encompasses so vastly and which laid in two regional states namely SNNPR and ORS their socio-economy is characterized by mixed farming activities to mean that raising crops and animal rearing. The most dominant crop in the basin is that maize, cassava, and teff. crop cultivation is critically dependent on rainfed.

Abaya Chamo sub-basin is one of the four sub-basins of RVLB. The sub-basin is considered a high priority because it is an area of significant ecological and environmental interest, with the system of lakes and its national parks and reserves, has substantial areas of productive rain-fed agricultural land and good rangelands, but also because of the great need in the sub-basin for economic and social development. (Halcrow Group Limited and GIRDC, 2007)

Based on the preliminary study survey in the targeted area, the highly eroded sub-watershed of the sub-basin, RVLBA has initiated an integrated watershed management project in seven (7) districts of the Abaya Chamo sub-basin of RVLBA in 2014. The overall objective of the project was to minimize the sedimentations load that will disturb the natural habitat of Abaya and Chamo lakes in the sub-basin. The project components include soil and water conservation, afforestation mainly through agroforestry, and improving income-generating activities of farmers that are involved in integrated watershed management (survey study by RVLBA, 2015).

In the Abaya Chamo sub-basin, there are 7 watershed management project Districts on 18 micro catchments. The reason why the study will take place in the Abaya Chamo sub-basin is due to the availability of the baseline socio-economic data in the sub-basin project Districts.

The performance of watersheds management projects can be measured using baseline characterization. The paper provides insights into the baseline characterization of watersheds with special reference to socio-economic aspects to propose appropriate policy directions for enhancing watersheds programs toward achieving integrated Water Resource Management.

Baseline socio-economic characterization is used during the project to indicate progress towards the goal and objectives and after the project to measure the amount of change. It allows those involved in the project to understand the initial livelihood conditions of the people, and what needs to be done to reach the goal of improving the livelihoods of the poor. Thus, baseline characterization builds the necessary foundation for the plan and obtains proper information for effective planning, implementation, and monitoring (Lakew Desta et al 2005).

Therefore, proper characterization of watersheds is a prerequisite for appropriate policy directions for enhancing productivity and sustainable development. In doing so socio-economic characterization of community in watershed managements projects in the Abaya Chamo sub-basin were the major aims of the paper.

2. Methods

2.1. Study area

The study area was held in the Abaya-Chamo sub-basin project Districts, located in the southern part of the RVLB, and it contains Abaya and Chamo lakes, tributary rivers, and other water bodies. In the Abaya-Chamo sub-basin, there were 66 districts and 1302 Kebeles. From this, the project area includes seven sub-watersheds from a total of 18 sub-watersheds of seven project districts (RVLB master plan, 2010).

The watershed annual rainfall ranges 732 mm/a to 1348mm/a and the elevation of the watershed ranges 1220 m/a.s.l to 2680 m/a.s.l. The basin comprises mainly the two lower lying lakes, Lake Abaya and Lake Chamo, and rivers like Galana, and Bilate drain into Lake Abaya. The rivers Kulfo and Sile enter into Lake Chamo and the overflow from Lake Chamo drains Sagan river which intern drains finally to the Chaw bahire. (Halcrow and GIRD, 2007)

Watershed management project activities were held in 18 micro watersheds which were found in seven districts (Amaro, Chencha, Humbo, Lokabaya, Mirababaya, Arbaminch city administration, and Abaya) of the seven Kebeles, the study was conducted on seven micro catchments from project districts.

Table 1
study area

Name of districts	Name of Kebeles	Name of subwatershed
AMARO	SHIRO	SHACHMENA
CHENCHA	GEMA	TIKIMA
HUMBO	HOBICHA BORKOSHE	ARENGUADE LIMAT
LOKABAYA	ARGIDA HARO DINTU	BEDELCHA
MIRABABAYA	BORDE	ACHEKORE
ARBAMINCH CITY ADMN.	BERE	GENTA BER
ABAYA	LADO	KADITE
Source: own computation, 2019		

Research Design

Based on their nature and purpose, the research design for this study was a descriptive survey method, with qualitative and quantitative data analysis approaches using Microsoft excel and StataMP 13 software.

Data source and method of data collection

To attain the stated objectives, the raw data was obtained from RVLBA as secondary sources. And other necessary and important secondary sources were used.

The raw data obtained from RVLBA were collected in 2016 from seven micro watersheds using enumerators in each study area. In 2016 the RVLBA collected baseline socioeconomics and biophysical survey in the study area (project coordinators were enumerated). And all secondary data available in RVLBA, such as the Master plan of RVLB, survey study, and others, were used.

Method of data analysis

The major objective of the study was a socio-economic characterization of a watershed. Therefore, data describing the study area, demographic data, major income source data, and social status of the respondents were analyzed using both descriptive statistics and econometric analysis using Microsoft excel and StataMP 13 software.

3. Results And Discussions

Results

Demographic characteristics

Family composition and size

The information regarding family size and composition of the respondents was collected from RVLBA and analyzed using Excel and Stata software as given in Table 2. The average family size in the research area was found to be eight persons. The main reason for the large average family size was the lack of family planning. The study shows the high dependency of single earning people.

Table 2: classification of the family according to the size of the family

NAME OF VILLAGES	FAMILY COMPOSITION AND SIZE		
	Average members	Adults >16	Children <16
SHACHMENA	8.2	3.2	5
TIKIMA	8	5	3
ARENGUADE LIMAT	9	4.8	4.2
BEDELCHA	7.3	3.3	4
ACHEKORE	7.6	3.6	4
GENTA BER	7.3	4.9	2.4
KADITE	8.6	5.3	3.3
Average	8	4.3	3.7

Source: own computation, 2019

According to the raw data obtained from RVLBA, the main occupation of households in the study area was agriculture except for Arbaminch City Administration districts of Genta ber sub-watershed households. Households in the Genta ber subwatershed were laborers. The reason behind this was the unavailability of cultivable land for farming practice and the land was degraded due to deforestation and soil erosion and households in the study area living in city administration have the opportunity to be employed. While the rest households in the six sub-watershed areas' main occupation were farming as shown in Table 3, mainly the type of agriculture was based on rain-fed agriculture and therefore the productivity and production were not satisfactory. As shown in table 3 the major language spoken in the study areas is Korete, Gamogna, Wolayitegna, Sidamigna, and Oromiffa. This indicates the study area covers about five major clan types of the sub-basin.

Table 3: a general description of the selected villages

Name of villages	population	Main occupation	No of household	Major language spoken	Area in hectares.
SHACHMENA	1021	Farming	195	Korete	280
TIKIMA	112	Farming	36	Gamogna Language	102
ARENGUADE LIMAT	290	Farming	44	Wolaytgna language	801.4
BEDELCHA	230	Farming	73	Sidamigna language	484
ACHEKORE	888	Farming	148	Gamogna Language	303
GENTA BER	781	Laborers	73	Gamogna Language	150
KADITE	1,634	Farming	313	Oromiffa language	626

Source: own computation, 2019

The women's average population size (43.9%) was a bit lower than men and this indicates that in an integrated watershed management approach the participation of women should play a significant role in their participation. Comparing the study area concerning population number, the largest number of population was obtained in Abaya districts Kadite sub-watershed and the lowest obtained in Chencha districts Tikima sub- watershed. The highest and lowest numbers of women population were also found in Kadite and Tikima sub-watershed respectively. The same was true largest and lowest number of

households. The average numbers of households were 115 male and 11 female. The deviation among them is very large, which indicates the holder was mainly towards the men.

Size of operational Holding

The land is a scarce resource hence its optimal use is very important. Farm size is one of the major determinants of the financial status of the farmers, which in turn affects farmers' ability to adopt modern farming practices. Operational land holding plays a vital role in the family laborers' employment as well as income generation. The main problem in the study area was small and fragmented land holding which results in management difficulties and ultimately less productivity. The land utilization of households in the selected sub-watersheds mainly includes residence, tree land, backyard, and rain-fed. As shown in figure 3 the largest average landholding size per household was 4.717 ha. in Kadite sub-watershed and the lowest is 0.623 ha. in Arenguade limat sub-watershed.

Table 4:-population characteristics of selected villages

STRICTS	Name of kebele	Population number			Household number			Name of watershed	Population number			Household number		
		male	female	total	male	Female	total		Male	female	total	male	female	total
ʎARO	SHIRO	2535	2555	5090	750	23	773	SHACHMENA	502	519	1021	182	13	195
HENCHA	GEMA	739	787	1526	268	8	276	TIKIMA	50	62	112	24	12	36
JMBO	HOBICHA BORKOSHE	1938	2090	4028	670	107	777	ARENGUADE LIMAT	205	85	290	35	9	44
)KABAYA	ARGIDA HARO DINTU	1887	2090	4028	558	19	577	BEDELCHA	170	60	230	61	12	73
IRABABAYA	BORDE	1391	1399	2790	319	9	328	ACHEKORE	486	402	888	145	3	148
RBAMINCH TY ADMN.	BERE	5283	5593	10876	1262	295	1557	GENTA BER	559	222	781	66	7	73
ʒAYA	LADO	4064	4080	8144	1343	353	1696	KADITE	805	829	1,634	292	21	313
total		17,837	18,594	36,482	5,170	814	5,984		2,777	2,179	4,956	805	77	882

Source: own computation, 2019

The average landholding size In SHACHMENA, TIKIMA, ARENGUADE LIMAT, BEDELCHA, ACHEKORE, and KADITE sub-watersheds were 1.2, 1.35, 0.624, 1.335, 1.19, and 4.717 ha. respectively. This shows that the land size variation of the study area was not much except Kadite sub-watershed. Fragmented lands are mainly found in Genta ber, moderately in Arenguade limat, and scarcely in Shachmena. According to the respondents if some action is taken by the government to consolidate the land it could bring a definite change in the production level and income status of the households.

Land types

It is generally observed that sloppy lands are subjected to different kinds of erosion problems. In selected villages of subwatershed almost all farmers had the experience to live with eroded land. The major reason reported according to the farmers was the negligence in the past when land start to erode no one paid attention to it and it continues and now it's all most eroded and out of limits of the individual farmer to refill its eroded land or reclaim its land from local weed. However, after the intervention of the watershed management project some major changes have been observed physically and socioeconomically.

Land Allocation to crops

In the agriculture sector, land allocation decisions for various crops hold great importance in determining the profit of that particular entrepreneur. In modern agriculture, it is determined through different economic tools but for those farmers who do not have access to reach the agriculture economist to determine their allocation ratio, have their judgment of allocating land to different crops. The farm area was allocated In Shachmena to Tef and corn, in Tikima to Wheat, Barley, and potato, in Arenguade limat to Haricot bean and corn, in Bedelcha to Haricot bean and corn, Achekore to wheat and barley, in Kadite to corn and cassava crops for sustainable agriculture

Income status of respondents

The major income sources of the farmers in the study area were crop production, animal husbandry, and tree land. Average highest income obtained from crop production in Achekore sub-watersheds and the lowest in Bedelcha sub-watersheds, from tree land highest in Bedelcha sub-watersheds and lowest in Kadite sub-watersheds. As shown in Figures 4 & 5, the very high income from tree land in Bedelcha micro watersheds was due to chat production. The average larger share of income was from animal husbandry and crop production. From animal husbandry, the highest income was in Kadite sub-watersheds and the lowest was in Genta ber sub-watersheds.

Table 5: total earnings and expenses

Watershed Villages	Earnings Crop production	Animal husbandry	Tree land	Totals	Expenses Seeds	Fertilizer	Annual consumption	totals	Net earnings
hachmena	13,998.8	21,679.5	9,400	45,078.3	608.35	3,275.1	6,086.85	9,970.3	**35,108**
ikima	45,046	21,599.5	35,758	102,403.5	1,212.6	3,799.106	14,917.75	19,929.456	**82,474.044**
renguade mat	14,396.2	10,234.67	36,753	61,383.87	233.725	1,517.62	39,875	41,626.345	**19,757.525**
edelcha	13,835.6	24,345	748,740	786,920.6	740.38	1,574.08	148,200	150,514.46	**636,406.14**
chekore	40,752	16,540	12,852	70,144	1,151.52	2,868.65	7,085	11,105.17	**59,038.8**
enetber	-	-	-	-	-	-	-	-	**-**
adite	19,734	35,600	5,852	61,186	1,160.88	3,785.87	11,170.5	16,117.25	**45,068.75**

Source: own computation, 2019

Seed, fertilizer availability

The crop seed variety used by farmers in the study area were BH-140, BH-540, and local seeds for corn, Dampe, Shorma, and Dendea for wheat, Red Wolayita, and Awassa Dume for Boloqe, local seeds for potato, barley and Tef respectively. The types of fertilizer used were DAP, Urea, and NPS for crop production. There was no agricultural machinery and they use backward-type plows of animals.

Social status

Education level of respondents

Education plays an important role in the overall growth and development of any country. The level of education affects the planning and managerial abilities of the farmer in decision-making. The education status of the sample respondents has also explored the detail which is given in Table 6 and 7 primary schools and one secondary school, Average dropouts of students in the study area per year are male 46 female 30 in total 76. the number of educational institutes was increasing and institutions were being made by the government sector Lack of educational institutions, poor economic conditions, and lack of access to the far located institutions were observed to be the conspicuous reason for the low literacy rate in the study area. The average number of schooling years in all seven villages was the same as the highest level.

*Table 6: **Education Facility in the Village***

ershed ges	Levels of schools	Number of schools		Number of students									Rate of drop		
		Villages	Kebeles	Villages			Kebeles			Villages			Kebeles		
				Male	female	total	male	female	total	male	female	total	male	female	Total
chmena	Satellite school	1		85	92	177	-	-	-	7	8	15	-	-	-
	Primary school(1-4)	-	2	-	-	-	361	374	735	-	-	-	21	20	41
	Mulu Primary school (1-8)	-	1	-	-	-	405	413	818	-	-	-	27	31	58
ma	Mulu Primary school (1-8)	-	1	-	-	-	137	124	261	-	-	-	-	-	-
nguade it	Primary and secondary cycle school	-	1	-	-	-	461	426	887	-	-	-	-	-	-
elcha	Mulu Primary school (1-8)	-	1	-	-	-	579	533	1117	-	-	-	-	-	-
ekore	Morede Mulu Primary school (1-8)	-	1	120	144	264	336	291	627	7	4	11	6	10	16
	Hager Primary school (1-8)	-	1	-	-	-	32	37	69	-	-	-	-	-	-
	Kalchama Primary school (1-4)	-	1	-	-	-	26	39	65	-	-	-	-	-	-
etber	Sikela Mulu Primary school (1-8)	1	-	881	211	1092	-	-	-	-	-	-	-	-	-
	Abaya secondary school	1	-	774	504	1228	-	-	-	-	-	-	-	-	-
ite	Mulu Primary school (1-8)	–	2	248	149	397	553	289	842	19	14	33	41	27	68
	Primary school (1-6)	–	1	125	95	220	125	95	220	13	4	17	13	4	17
Totals		3	12	2233	1195	3378	3015	2621	5641	46	30	76	108	92	200

Source: own computation, 2019

*Table 7: **Number of teachers***

Watershed villages	Levels of schools	Villages			Kebeles		
		Male	Female	total	male	female	total
Shachmena	Satellite school	2	-	2	2	-	2
	Primary school(1-4)	-	-	-	12	5	17
	Mulu Primary school (1-8)	-	-	-	14	6	20
Tikima	Mulu Primary school (1-8)	-	-	-	4	4	8
Arenguade limat	Primary and secondary cycle school	-	-	-	15	2	17
Bedelcha	Mulu Primary school (1-8)	-	-	-	13	4	17
Achekore	Morede Mulu Primary school (1-8)	3	2	5	10	11	21
	Hager Primary school (1-8)	-	-	-	-	3	3
	Kalchama Primary school (1-4)	-	-	-	1	3	4
Genetber	Sikela Mulu Primary school (1-8)	55	44	99	55	44	99
	Abaya secondary school	38	21	59	38	21	59
Kadite	Mulu Primary school (1-8)	6	1	7	6	1	7
	Primary school (1-6)	10	1	11	19	4	23
Total		114	69	183	189	108	297

Source: own computation, 2019

Health status of respondents

Social and economic factors, such as income, education, employment, community safety, and social support can significantly affect how well and how long we live. These factors affect our ability to make healthy choices, afford medical care and housing, manage stress, and more (Adefires Worku et al, 2013).

As shown in table 8, there were 7 health Kela, 2 health stations, and 2 private clinics in the study area. Major diseases found in micro- watersheds were Typhoid, typhus, Mosquitoes, *Diarrhea*, TB, and another water-borne disease. As the data indicated the health coverage reaches approximately 100%.

Table 8: health status

atershed lages	Number of health stations in the kebele	Public toilets in kebeles	Major disease in the village	Health coverage
achmena	one health kela and two private clinics	1010	Mosquitoes, Typhoid, Typhus, and children TB	100%
kima	one health kela	8	*Diarrhea*, Typhoid, and Typhus	Better than before
enguade nat	one health kela	17	Mosquitoes and Itch	100%
delcha	One health center one health kela	450	TB and *Diarrhea*	85%
hekore	one health kela	6	Mosquitoes, Typhoid, Typhus, and children TB	100%
netber	One health center one health kela	2	Mosquitoes, water-borne diseases, and *Diarrhea*	100%
dite	one health kela	-	Mosquitoes	Medium
		1493		

Source: own computation, 2019

Concerning the right of women, for the ownership and administration of land and other assets, the holding and administration were better in the past years. However, still, there were problems, for example, in Kadite sub-watersheds the women were unable to own and administer the land unless their husbands passed away.

Discussions

The average family size in the research area was found to be eight persons. The main reason for the large average family size was the lack of family planning. The study shows the high dependency of single earning people. According to Shonde Yohannes (2014) in his study on Socioeconomic Evaluation of Moringa tree in southern Ethiopia, the reason for large family size in the study area was in the communities' culture large family size has a cultural value and this is also a typical characteristic of rural households in Ethiopia and elsewhere in developing countries.

The major source of income in the study area was agriculture except in the Arenguade Limat sub-watersheds of Arba Minch City Administration. The reason behind this was the unavailability of cultivable land for farming practice and the land was degraded due to deforestation and soil erosion and households in the study area living in city administration have the opportunity to be employed. This study was in line with the finding of Wolde-Selassie Abbute (2001). The sources of income in the study area were categorized as sources of crop production, animal husbandry, and tree land. The results of the study revealed that 31%, 48%, and 21% of average household income was shared from crop production, animal husbandry, and tree land respectively. This is similar to a study by Melaku Berhe, Dana Hoag, Girmay Tesfay, and Catherine Keske (2017) in rural Ethiopia.

The main problem concerning operational land size in the study area was small and fragmented land holding which results in management difficulties and ultimately less productivity. The shortage of land is a basic problem in the study area to maximize agricultural production. This is in line with the study by Adefires Worku, Mulugeta Lemenih, Masresha Fetene, and Demel Teketay (2011) in Borena, Southern Ethiopia. This study also indicated that land shortage is a basic problem that resulted in small-scale production on fragmented and degraded land.

The literacy rate in the study area per year was very large. the number of educational institutes was increasing and institutions were being made by the government sector lack of educational institutions, poor economic conditions, and lack of access to the far located institutions were observed to be the conspicuous reason for the low literacy rate in the study area. The average number of schooling years in all seven villages was the same as the highest level. This result is supported by Haradhan Kumar Mohajan (2013) with his study of Ethiopian socio-economic study.

The health station was found few that should be increasing/ improving in the future for the betterment of the community in the study area. According to the study, a major disease in the village is water-borne related diseases. The stakeholder mapping and engagements are very important especially water and health sectors for community health protection together with integrated water resource management. This study was supported by Adefires Worku et al (2013) and Shonde Yohannes (2014).

4. Conclusions

An integrated approach to watershed management would ideally address the complex system dynamics in watersheds and achieve global environmental benefits, and locally maintain holistic social, economic, and ecological balance.

Socioeconomic improvement depends upon resource mapping very crucial for planning appropriate intervention. The available land resource could be used alternatively by applying different technological packages.

Agriculture in the area is basically of a subsistence nature - characterized by low input – low output. Both livestock and crop production systems are poorly intensified and productivity is kept to a minimum. For crops rain, fed agriculture system which lacks in agriculture machinery was account for low production and productivity. The study concludes that households should use irrigation technology to increase yield per hectare and safeguard food security in the area.

Access to education should be improved and children's attendance at school should be encouraged and facilitated. The poorest families are supported or the schooling system adapted as in most the cases the children are used in production activities. Non-agricultural employment opportunities should also be promoted. These activities should be adapted to the existing potentialities at the HH level. The health facilities in the study area should be increased to attain a better socioeconomic condition in the community.

The followings were the major recommendations from the study

- In watershed management, women's participation should have to be improved
- There should be the development of farm mechanization
- The government should work on educational quality towards minimizing the literacy condition in the study area.
- The major disease in the study area should be minimized.
- Easy, cheap, and timely access to agriculture inputs in all areas of selected villages
- Full land resources use should be maximized for achieving high productivity and prosperity goals in all villages
- The education and health facilities should be improved for all selected villages

Abbreviations

ADO	Agricultural Development Office
FDRE	Federal Democratic Republic of Ethiopia
GIRDC	General Integrated Rural Development Consultant
MOU	Memorandum of Understanding
ORS	Oromiya Regional State
RVLB	Rift Valley Lakes Basin
RVLBA	Rift Valley Lakes Basin Authority
SNNPR	South Nation Nationalities Peoples Regional State
TB	Tuberculosis

Declarations

Ethics approval and consent to participate

- Not applicable

Consent for publication

- Not applicable

Availability of data and materials

- All data supporting my article are organized in soft copy in excel format. The main raw data that were used in this articles are belongs to Rift Valley Lakes Basin Development Office, therefore, I have no right to share the data.

Competing interests

- No computing interest at all.

Funding

- All funds with regards to design of the study, analysis and interpretation of data were only by researcher him selves, no external funds were used.

Authors' contributions

- All contribution towards data organization, analysis and interpretation is goes to one author.

Acknowledgments

- I am very much grateful to RVLBA for providing my raw data in the process of research work. Many thanks should also go to Mr. Andualem Gezahegn director of Watershed Departments of Rift Valley Lakes Basin Authority, and the staff of Watershed Departments.

Authors' information

- The author has significant experience with socio-economic study in the area of watersheds and water resources (water allocation plan). He is a level III certified professional in water resource consultancy concerning socio-economy.

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Figures

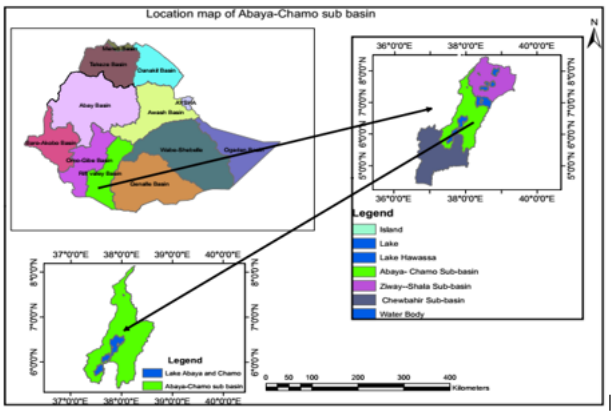

Figure 1: location map of Abaya Chamo sub basin

Source: RVLB strategic plan, 2017- unpublished

Figure 1

land utilization in the study area

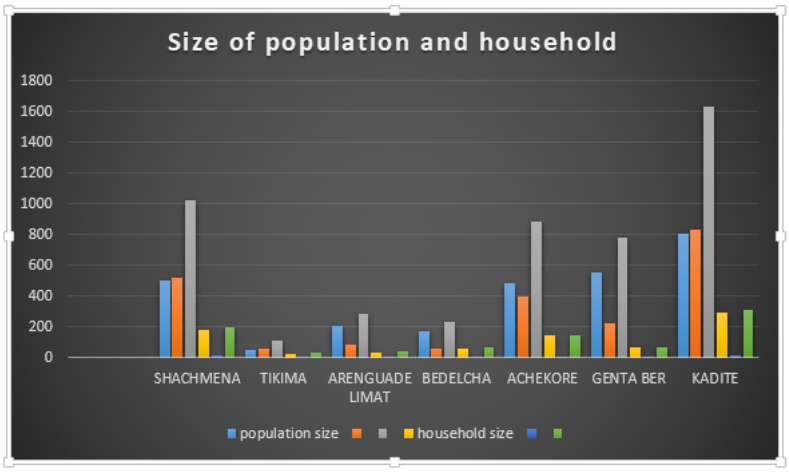

Figure 2: population and household size in the villages.

Source: own computation, 2019

Figure 2

population and households sizes in the study are

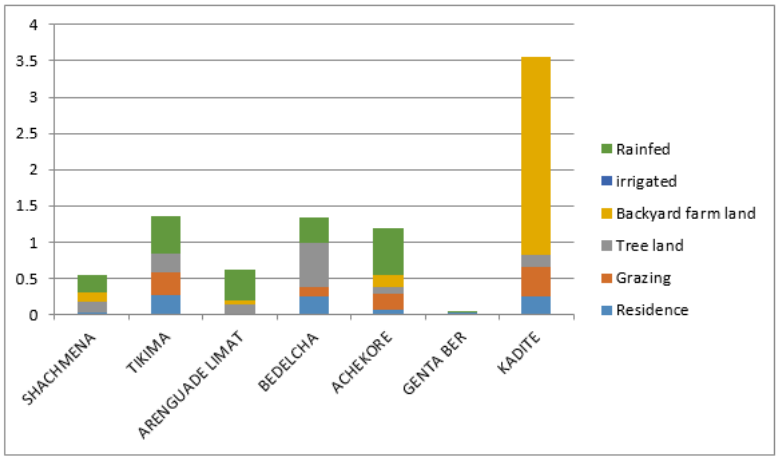

Figure 3:- land utilization of household

Source: own computation, 2019

Figure 3

land utilization in the study area

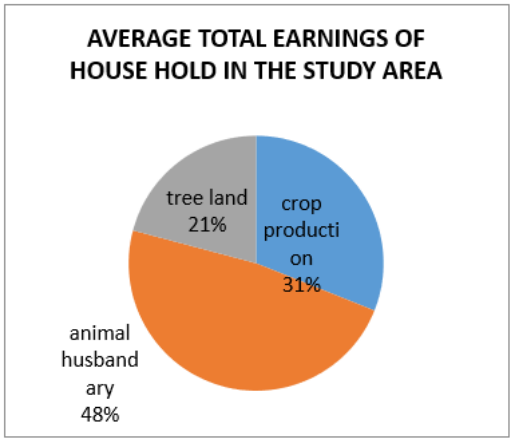

Figure 4

total earnings

Source: own computation, 2019

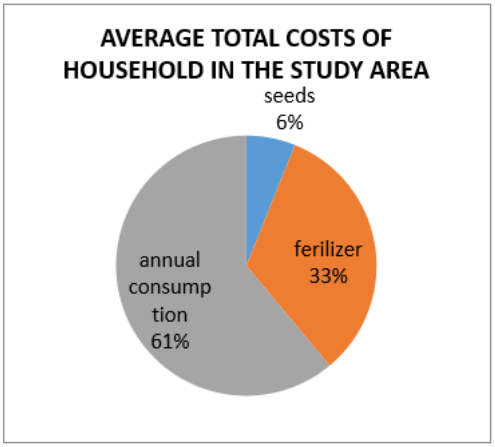

Figure 5

total costs

Source: own computation, 2019

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