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LAND USE/LAND COVER DYNAMICS AND FLOOD-INDUCED EFFECTS ON SOCIO-ECONOMIC OF HOUSEHOLDS IN DAWO DISTRICT, SOUTHWEST SHEWA ZONE, OROMIA, ETHIOPIA

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This work was carried out in collaboration among all authors. All authors read and approved the final manuscript.

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ABSTRACT

Undesirable conversion of land from natural to human-induced landscape has been increasing in this century because of many interrelated factors thereby increasing the frequency and intensity of flooding. Thus, this study aimed at examining land use/cover dynamics and effects of flooding on socio-economic conditions of households in Dawo District for the past three decades. Data collection techniques employed in this study were questionnaire, key informant interviews, group discussions and personal observation. Sample sizes of 310 households were contacted for questionnaire survey using systematic sampling techniques while purposive sampling technique was applied for identifying participants of group discussions and interviews. Landsat imageries of 1991, 2001, 2011 and 2020 were utilized for studying land cover dynamics and the classification was done by using supervised maximum likelihood classifier algorithm. The results of the study demonstrated that in the past three decades (1991 – 2020), vegetation and grass land have been severely diminished aggravating the severity of flooding on livelihoods of the local communities. Thus, the results obtained from the image reveal that settlement and cultivation land of the study area have been reduced by 202.15 and 640.22 ha respectively. The collapse of grass and vegetation have been documented mainly because of absence of integrated land use planning in the country. The results of the study also show that standing crop, livestock production, grazing land, housing conditions, sources of drinking water and school attendance have been adversely affected by flooding events leading to the disturbance of livelihoods of the households. Therefore, the study recommended the development of integrated land use planning and locally applied flood controlling measures.

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1. INTRODUCTION

In both developed and developing regions of the world, flood is one of the most common disasters adversely affecting natural and human-made assets. Over the past 20 years (2000 – 2019), more than 7348 naturally occurring disasters were documented globally claiming about 1.23 million people (yearly 60,000 lives on average) and disturbing the life system of greater than 4 million people [1] of which flooding is taking the leading role. According to WHO [2] due to flood disaster, over 140 million lives are affected annually on planet Earth. According to Hoeppe [3], the number of naturally occurring disastrous events that caused either life or physical losses generally increased from approximately 300 in 1989 to 900 in 2014 (33%), with the largest (65%) economic collapse associated to storms and floods. These imply that the conditions will continue in the coming decades as long as climate extreme events and pressure on the environment remains.

Existing evidence disclose that there have been some scientific investigations on various natures of flooding in different corners of Ethiopia like North Shewa Zone [4], at Ginfle stream, Addis Ababa (Birehanu, 2018), in Dire Dawa City [5], in Upper Awash River Basin [6] and at Fetam Watershed, Upper Abbay Basin [7]. However, their research outputs cannot be generalized for the current study site as their biophysical and socio-economic settings are different from the Dawa District. In addition, the recent imapcts of flooding on socioeconomic conditions of households have not been incorporated in most of the works.

In Southwest Zone of Dawo District, where the study was conducted, flood events were occurred over the last six consecutive years (2015 – 2020) impacting the socio-economic conditions of the households residing along river bank and flood prone areas in diverse ways likecollapse of houses, farming activities, water wells, sanitation facilities, grazing land, social interaction, road, bridges, social network and displacing many peoples which should be scientifically studied. The above mentioned scenarios are the basis for designing the current study. Therefore, the study was conducted to address the effect of flood hazard on the socio-economic conditions of households settling in the flood prone areas of Dawo district. More specifically, the study was carried out to examine land use/cover dynamicsof the study area and assess perceived effects of flooding on socioeconomic conditions of local communities.

2. LITERATURE REVIEW

The multidimensional nature of human-induced activities are also aggravating flood-based disasters by mostly restricting absorptive and regulating capacity of the ecosystem thereby aggravating the surface runoff which further paves the way for the flood events [8]. Thus, the frequency and impacts of flood have been intensified in recent times and will substantially increase in the future because of many interrelated and complicated factors like ecological disturbances, overpopulation, change in climatic system and its extreme events, lack of integrated land use policy, land use/land cover change, economic development, swift urbanization, collapse of dams and other physical structures among others (Ezekiel et al., 2013), [3,9,4]. In these contexts, flooding has brought huge adverse impacts on the human beings and their livelihoods like economic damages, social disorders, infrastructural collapse and life loss [10] in addition to psychological problems like mental disorders and sleep illness.

According to Onwuka et al. [11] and World Bank [12], in Africa like Nigeria (Anambra State), flood has impacted both social and economic activities including displacement of families, migration of people, damage of health condition, loss of farmlands, loss of income, loss of household and structural properties. In fourteen years' time (2001 – 2015), over 13 major floods events were documented in Ghana affecting more than 178,000 persons with death report of 250 people [13] implying that the return time of flood is escalating due to combined effects of natural and anthropogenic factors.

Over the last two decades (1985 – 2005), human-induced activities have increased by 46 million hectares adversely affecting livelihoods of the farming communities in Africa [14]. For instance, marked expansions of farmland and bare land have been documented in Borana areas of Ethiopia at expense of grassland, wetland and forest land which have been also confirmed by the results of Normalized Difference Vegetation Index (NDVI) [15]. Also, it has been underscored that the loss in grasslands and wetlands over the last three decades was highly affecting the livelihoods of pastoral communities as a result of reduction of forge biomass production. Though there are variations spatiotemporally, the wetland and productive grazing lands have been replaced by agricultural and built-up areas which adversely affect the productivity of livestock and crop productions [16,17] thereby contributing for the occurrences of flooding. Thus, vast areas of grazing and forest lands have been converted into other types of land uses. The lands along Awash River are under large-scale plantation of agriculture; National park, sugar plantation, Abadir fruit and vegetation farm, Nura-Hera fruit and vegetation which adversely affects the natural landscape of the area. This condition aggravates the recurrent events of flooding that adversely affects the livelihoods of the surrounding communities.

With respect to its adverse impact, flooding has the second rank in Ethiopia next to drought [18]. High nature of flood events in Ethiopia are mostly connected to the rugged nature of topography, mix of highland and lowland characteristics, stream networks, drainage systems developed by the major river basins and river conditions, surface and rainfall conditions (Birehanu, 2018), [7]. In some flood prone areas of Ethiopia such as Oromia, Gambella and Afar regions, over 300,000 populations were impacted by flood events of 2017 [19]. In central highlands of the country, heavy and prolonged rainfall is common and it is one of the major sources of flooding in Oromia region thereby adversely influencing both rural and urban settlements [7]. Hussein et al. [20] point out that most of flood induced impacts in Oromia region are mostly associated to unusual stage of rivers mainly around Awash River that covers and affects the adjoining areas. For instance, in Southwest and West Shewa Zones of Oromia region, flood events of 2006 adversely affected more than 14,790 people of 2052 evacuated from their home to the temporary shelter. It was also documented that over 1031 populations and 576 hectares of agricultural land were seriously affected in Southwest ShewaZone during the rainy season (June – September) of 2018 [6] implying that flood is adversely affecting the livelihoods of the farming communities.

3. MATERIALS AND METHODS

3.1 Discription of the Study Area

Dawo district is located in the Southwest Shewa of Oromia region at a distance of 96 km from Addis Ababa, Ethiopia. It is bordered in the north and West by West Shewa zone, in the East by Ilu district, in the South by Weliso and Becho District. Astronomically, the district is located between 8°41′ 12″N to 8°56′ 29″N and 37°56′ 50″E to 38° 16′ 09″E as presented in Fig. 1 and it has 22 rural and 1 urban kebeles.

3.2 Data Sources, Types and Software

This study was undertaken based on descriptive survey research design taking into consideration the concurrent procedure that brings qualitative and quantitative data together. For collecting primary data, Landsat imageries, households and experts working at different levels in relevant offices were consulted.

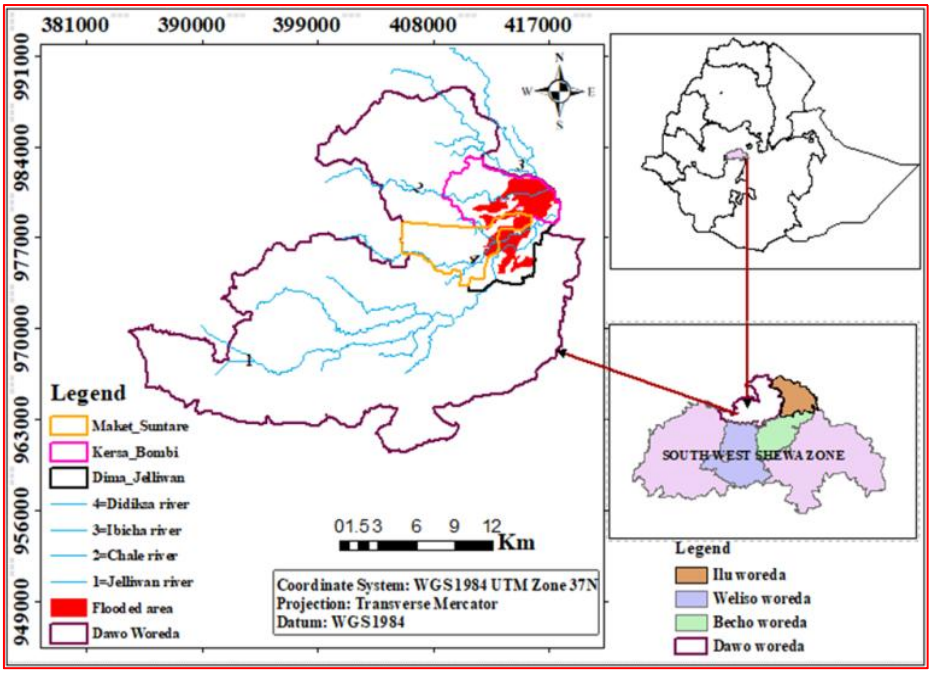

Fig. 1. Location map of Dawo district

Thus, various natures of data were obtained from the mentioned primary data sources. These data include the major causes of flood events, land use/land cover and flood-induced impacts on social and economy of households. With respect to Landsat imageries, TM of Landsat 5 (1991), ETM of Landsat 7 (2001 and 2011) and OLI of Landsat 8 (2020) were download from USGS website, all having 30m resolution. Concerning the materials and software, ERDAS Imagine 2015, ArcGIS 10.4, SPSS 20, GPS, Google Earth and digital camera were utilized for managing quantitative and geospatial data. They helped the researchers to assess the land use/cover dynamics of the past thirty years in connection with the flood events. For obtaining various secondary data, published and unpublished materials from websites, libraries and offices were consulted and reviewed.

3.3 Sample Size, Sampling Procedure and Instruments

Out of the total *kebeles*, three of them: Kersa Bombi, Maket Suntare and Dima Jeliwan *kebeles* were selected purposively based on the severity and frequency of flood events as the *kebeles* are lying at flood prone area of the district. Then, systematic random sampling method was applied to get 310 households that filled the questionnaire. The sample size was determined by Yamane [21] statistical formula of $n = \frac{N}{1+N(e)2}$ from the total households of 1385. Accordingly, 310 households were used as a sample size in this article and all the questionnaires were properly filled and returned for analysis. The participants of group discussions and key informant interview were selected purposively considering their connection to the flood related actions and knowledge. Household questionnaire, interview checklists, focus group discussion guides, personal observations were used as tools for collecting relevant primary data. Reliability of the instruments was established by measuring the questionnaires and checklists in different times and settings. Regarding the validity of instruments, questionnaires and checklists were checked, literatures had been reviewed and internal validity evaluation was carried by academicians and experts before going to the field for data collections.

3.4 Household Survey Analysis

With respect to analysis of data generated from households, quantitative aspect of data were analyzed using descriptive statistics by the help of graphs and tables while data collected through interviews and discussions were organized thematically and qualitatively analyzed in line with the results of both household survey and image interpretations.

3.5 Image Pre-processing

The relevant pre-processing actions were carried out using ERDAS Imagine 2015. Some of these actions include layer stacking, image enhancement, radiometric corrections, image preparations and others using ArcGIS 10.4. For instance, it was observed that Lands at 7 of both 2001 and 2011 has scan line errors. Radiometrically, the problem was corrected using fix Lands at 7 scan line error tool box in ArcMap. Accordingly, the image was corrected by filling the missed data. Image enhancement was also done for better interpretation of the image in which visual interpretation approach was applied by displaying the image in true color composite (band 3, 2, 1) and the band combination (4, 3, 2) for having the standard False Color Composite (FCC). Furthermore, Google Earth software was also utilized to check land use/cover dynamics of the area for visually identified land features.

3.6 Image Classification Process and Technique

According to Lilles and et al. [22], the overall target of image classification is providing clear arrangement of all pixels in a way that it shows specified land cover classes. Thus, the output of image classification is development of land use/cover classes based on their brightness value. In this context, supervised maximum likelihood classifier algorithm was applied in which analyst identified pixels having homogenous characteristics of land features.

3.7 Change Detection Process

Using the study years of Lands at imageries, change detection was done in order to examine spatiotemporal dynamics of land use/cover classes. All the images were classified into four classes: settlement, vegetation, grass and cultivated land using supervised image classification approach as explained in the above section. Area extent based method was used to examine the change between two classified study periods. Change statistics have also been computed by subtracting area of final year from area of initial year. Mathematically, it is represented as:

$$\text{Total land use or cover change (ha)} = \text{Area}_{\text{final year}} - \text{Area}_{\text{initial year}}$$

In this regard, the positive value imply that there is an increase area extent of land while and negative value indicates decrease in extent of land use/cover. The definitions of the four classes were presented in the Table 1.

Table 1. Description of land use/land cover classes

Land use/cover classes	Code	Definition of classes
Cultivated land	Cl	The land area that is used primarily for production of food
Grass	Gr	Open and continuous land areas dominated by grasses
Vegetation	Vg	Forest, shrub, trees, inset with varieties of inter locked vegetation
Settlement	St	Permanent residential areas of varied pattern towns and villages

4. RESULTS AND DISCUSSION

Land Use/Land Cover of the Study Area between 1991 and 2020.

As it has been highlighted in methodology section, four major land use/cover classes have been identified using reconnaissance survey, information from land use of district and Landsat imageries of the four study years. In order to reduce ambiguity of identifying natural forests and human-induced plantation trees which mostly have the same reflectance, the researchers used vegetation as one class which is similar with the work of [23]. Each land use/land cover class has been briefly analyzed for each study year as presented in the Table 2. In the first study year, most of the area were covered by cultivated land (65.8%) followed by grass land (17.5%) and vegetation (14.3%) whereas the land occupied by settlement was very small, only 2.4% of the district. From the stated figure, one can understand that in the early 1990`s almost all the study areas were covered by crops and natural landscape with very small built up area which is supported by the views of elderly people. The pattern of 1991 continued up to 2001 with small increment in their coverage with exception of the grassland that reduced by 3.5%.

Comparing the third study year (2011) with the second (2001), area coverage of cultivated and settlement land was increased by 4% and 2.2% respectively while vegetation and grassland get reduced by 3.2% and 3% respectively in 2011. The summarized views of participants in group discussions revealed that cultivated land took over the place of grass and vegetation while settlement largely took over the place of cultivated land. In this context, more land was eroded and more surface runoff added to the river paving the way for the occurrences flooding events. As it can be seen from Table 2 and Fig. 2, the landscape of the study area was dramatically changed in thirty years (1991 – 2020). Spatially, more than half (78.6%) of the district was covered by cultivated land in 2020 while the remaining three classes covered only less than one fourth (21.4%) of the district. In the past three decades, vegetation and grass land have been severely declined implying that the scenario is one of the significant factors that aggravate the flood-induced impacts.

4.1 Land Use/cover Change Matrix

Land use/cover changes in each study years are mostly shown using conversion matrix in which the row of the table represents for the initial year and the column of the table stands for the final year. As it can be observed from Table 3, the result of image classification indicates that except grassland, all the remaining land use classes have been expanded in ten years' time. For instance, cultivated land increased from 32958.7ha in 1991 to 33808.7 ha in 2001 while vegetation increased from 7160.52ha in 1991 to 7916 ha in 2001. On the same way, the area under settlement was increased from 1224.27 ha in 1991 to 1365.1 ha in 2001. Cultivated land has expanded mainly at the expense of settlement land (738 ha), vegetation (1753.7 ha) and grassland (2413.11 ha) while vegetation expansion was at the expanse of mostly settlement land (17.48ha), grass (1915 ha) and cultivation land (1332 ha). Settlement land has been also increased mainly at an expense of vegetation land (35.237 ha), grassland (108.22 ha) and cultivation land (871.14 ha). On the other hand, most of grassland has been changed to cultivation land (2413.11 ha), vegetation land (1915 ha) and settlement (108.22 ha).

Table 2. Status of land use/cover of the study area from 1991 – 2020

Classes	1991		2001		2011		2020	
	Area (ha)	%	Area (ha)	%	Area (ha)	%	Area (ha)	%
Settlement	1224.36	2.4	1365.12	2.7	2473.11	4.9	3245.67	6.5
Vegetation	7160.76	14.3	7915.68	15.8	6294.24	12.6	3879.63	7.7
Grass	8750.43	17.5	7004.97	14	5530.05	11	3608.1	7.2
Cultivation	32958.95	65.8	33808.73	67.5	35797.1	71.5	39361.1	78.6
Total	50094.5	100	50094.5	100	50094.5	100	50094.5	100

Source: Developed from Landsat data (1991, 2001, 2011 & 2020)

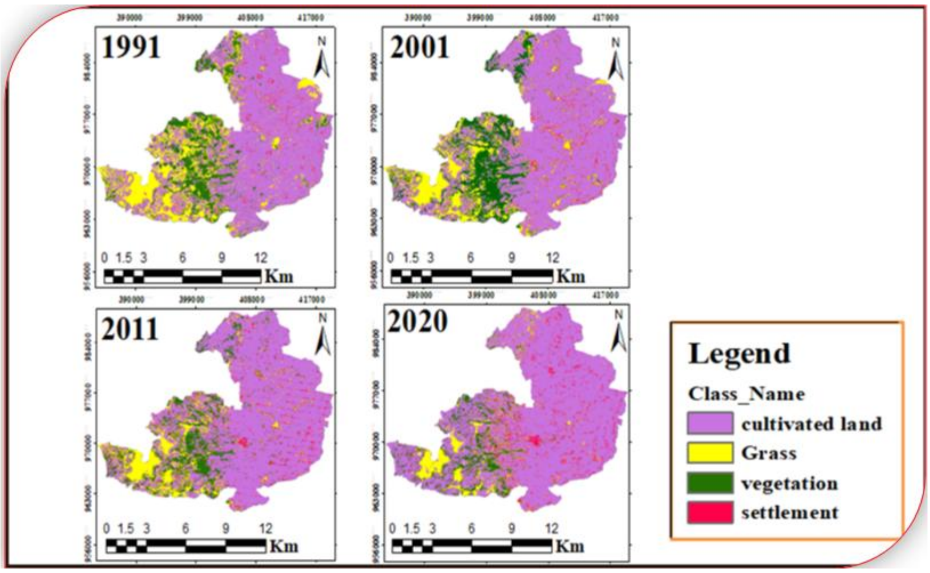

Fig. 2. Spatial extent of the stud area from 1991 – 2020
(Source: developed from Landsat data)

Table 3. Post-classification matrix of study area between 1991 and 2001

Year	Class	2001				
		Cl	**St**	**Gr**	**Vg**	**Grand total**
1991	St	738.00	350.54	118.25	17.48	1224.27
	Vg	1753.70	35.24	720.42	4651.00	7160.52
	Gr	2413.11	108.22	4313.60	1915.00	8750.41
	Cl	28903.90	871.14	1851.90	1332.00	32958.70
	Grand total	33808.70	1365.10	7004.20	7916.00	50093.80

Source: developed from Landsat data (2001)

As indicated in Table 4, it was noticed that there is substantial dynamics in land use/cover categories from 2001 to 2011. The expansion of cultivation was mostly at the expanse of settlement (777.335 ha), grassland (2134.61 ha) and vegetation land (2219.36 ha). Similarly, settlement has taken area of cultivated land (1306.9 ha), grassland (407.03ha) and vegetation land (318.27 ha). It was also understood from the result that a sharp reductions of vegetation and grassland have been documented due to the fact that cultivation and settlement land have been progressed in years (2001 to 2011).

As it can be observed from Table 5, the land use/cover pattern of study area has undergone fast dynamics from 2011 to 2020 which was reflected in the exchange of area coverage between the identified land use/cover classes. In the overall study periods, vegetation land and grass showed continuous reduction while cultivated land and settlement showed continuous increment. Vegetation land alarmingly decreased from 6294.28 ha in 2011 to 3879.43 ha in 2020 and grassland decreased from 5529.75 ha in 2011 to 3607.9 ha in 2020. However, it was revealed that cultivation land has been increased from 35797.1ha in 2011 to 39361.1ha in 2020and settlement from 2472.72 ha in 2011 to 3245.52ha in 2020.This high change in vegetation land and grassland has been documented due to the fact that large area have been consumed by cultivation and settlement land cover. Stated differently, most of grassland and vegetation land have been changed to cultivation and settlement land resulting into the expansion of the two land use/cover classes.

As the result of land use/cover transition matrices revealed in Table 6, substantial changes in the land use/cover pattern have been documented in the past three decades (1991 –2020). Accordingly, cultivation land has been expanded at the expense of grassland (4742.8 ha), vegetation (4695.51ha) and settlement (1082.42 ha) while that of settlement has been at the expense of cultivation land (1958.7 ha), grassland (621.66 ha) and vegetation land (566.12 ha). Likewise, grassland decreased from 8750.43 ha in 1991 to 3608ha in 2020 while vegetation land decreased from 7160.75 ha in 1991 to 3879.6 ha ha at the end of the study year.

Table 4. Post-classification matrix of study area between 2001 and 2011

Year	Class	2011				
		St	**Cl**	**Gr**	**Vg**	**Grand total**
2001	Cl	1306.90	30665.80	1023.12	812.80	33808.70
	St	440.49	777.34	115.39	31.70	1364.92
	Gr	407.03	2134.61	3792.87	670.31	7004.82
	Vg	318.27	2219.36	598.50	4778.98	7915.12
	Grand total	2472.70	35797.10	5529.88	6293.79	50093.50

Source: developed from Landsat data (2011)

Table 5. Post-classification matrix of study area between 2011 and 2020

Year	Class	2020				
		Cl	**Gr**	**Vg**	**St**	**Grand total**
2011	St	1054.59	55.25	64.36	1298.53	2472.72
	Cl	33818.40	627.32	399.97	951.45	35797.10
	Gr	2314.09	2354.70	420.98	440.00	5529.75
	Vg	2174.02	570.61	2994.12	555.54	6294.28
	Grand total	39361.10	3607.90	3879.43	3245.52	50093.90

Source: developed from Landsat data (2011 and 2020)

Looking into gain and loss, 4742.8 ha and 621.66 ha of grassland were converted to cultivation and settlement respectively while 4695.51 ha and 566.12 ha of vegetation land were converted to cultivation and settlement land respectively. From the overall results, one can see that grasslands were continually changed to cultivation and settlement lands. Similarly, vegetation lands were also converted to cultivation land and settlements with the exception of the first decade. So, the study area land coverage of grassland and vegetation were mostly changed to cultivation and settlement land, and the land was easily eroded by rainfall and causes soil erosion. Consequently, the rivers and stream were filled with sediments which were the causes for overflow of water and flood inundation. Similarly, the scientific work carried out Erena & Worku [24] also demonstrated that when vegetation and grassland replaced by agricultural land and other forms of human-induced cover, small nature of rainfall results into surface runoff instead of being added to ground water and soil. When these conditions are combined with high nature of rainfall and highland, large scale flood-induced impacts are expected as a result of overflow of the rivers which are commonly observed in the study sites.

4.2 Land Use/Cover Change Detection

As presented in Table 7, out of the identified four land use/cover classes, three of them revealed the increasing trend in their coverage with different magnitudes while grassland has reduced by the annual rate of 174.56 ha of land in the first decade (1991 – 2001) implying that the general direction is toward human-induced landscapes. In the second decade (2001 – 2011), land under vegetation and grassland get reduced by more or less similar magnitudes whereas settlement and cultivation areas expanded by annual rates of 110.78 ha and 198.84 ha respectively. The results of image classification clearly showed that the pattern observed in the second decade has continued from 2011 – 2020 with increasing rates (Table 7). Over the last three decades, cultivation and settlement land of the district have been expanded by the annual rates of 640.22 ha and 202.15 ha respectively while grass and vegetation land have been collapsed by 514.24 ha and 328.12 ha respectively. This kind of change paves the way for the formation of fragile environment thereby reducing the resilience of the ecosystem. The results obtained from image classification have been supported by the elderly people and experts working environmental issues. The summary of their ideas revealed that natural landscape of the district has been changed over the last twenty years. The study conducted by Hundera et al. [25] also revealed that the recent pattern of land use/cover changes are moving to cultural landscapes at the expense of physical environments mainly because of heavy dependence of the local communities on the environment. Similarly, Niekerk [26] states that deterioration of natural landscape leads to the frequent occurrences of disasters like food.

4.3 Major Deriving Forces of Land Use/Land Cover Changes

The unplanned change of land use in study area is partly attributed to the absence of integrated land use policy. In line with this, the results obtained from experts of district land use and administration office reveal that there is no as such strong policy that limit developmental and settlement pattern in risky areas like floodplains. Furthermore, it was observed that there were highland areas utilized for settlements and cultivation purposes indicating that land use pattern of the area is not line with the potential capability of the land. The results of group discussion also revealed that the exiting pattern of land use is also attributed the landlessness of the youth in the community. As a result, they were directly or indirectly converting the natural environments to the cultural landscapes. According to the Tesemma [27], the absence of nationally approved integrated land use plan in Ethiopia is the primary cause for the on-going problems like land use related conflicts, misplaced development projects, uncoordinated investments and over exploitations of land resources. Stated differently, on-going land use practices do not consider the best fit/capability of the land for specific use as there is no such scientific strategy that has been accredited and approved nationally. Wehrmann [28] also underscored that land use plan that do not consider and incorporate the pre-requisite subjects for land use plan, views of the relevant stakeholders, social, economic and cultural contexts of the communities cannot be a solution for land use conflicts, land grabbing and other land based issues.

4.4 Effects of Flooding on the Economic Aspects of the Households

As it can be observed from Table 8, flooding various natures people`s livelihoods. Out of the total respondents, nearly half (47.7%) and 39.4% of them pointed out that their standing crops and farmlands respectively were highly affected as a result of flooding events. Similarly, livestock production and grazing land were also highly affected owing to flooding occurrences as reported by 66.1% and 76.1% of household who filled the questionnaire respectively (Table 8). It can also be understood from the table that only few households were in the view that their livelihoods were not adversely influenced by flood inundations implying that almost all the households participated in the questionnaire survey underscored the adverse effect of the flooding in their localities though the magnitude varies spatiotemporally.

Table 6. Post-classification matrix of between 1991 – 2020

Year	Class	2020					
		Cl	Gr	Vg	St	Grand total	Gross loss
1991	St	1082.42	26.65	15.88	98.99	1223.94	1124.95
	Vg	4695.51	401.48	1497.60	566.12	7160.75	5663.11
	Gr	4742.80	2312.00	1074.00	621.66	8750.43	6438.46
	Cl	28840.30	867.84	1292.10	1958.70	32958.90	4118.64
	Grand total	39361.10	3608.00	3879.60	3245.50	50094.00	17345.16
	Gross gain	10520.73	1295.97	2384.98	3146.48	17348.16	

Source: developed from Landsat data (1991 – 2020)

Table 7. Land use/Land cover change detection

Classes	1991 – 2001		2001 – 2011		2011 – 2020		1991 – 2020	
	Area (ha)	%	Area (ha)	%	Area (ha)	%	Area (ha)	%
Settlement	+140.98	0.3	+1107.8	2.2	+772.78	1.5	+2021.56	4
Vegetation	+754.37	1.5	-1620.84	3.3	-2414.7	4.8	-3281.2	6.6
Grassland	-1745.65	3.4	-1475.07	2.9	-1921.8	3.8	-5142.4	10.2
Cultivation	+849.8	1.8	+1988.4	3.9	+3564	7.17	+6402.2	12.8

Source: developed from Landsat data (1991-2001)

Table 8. Effects of flooding on standing crops, farmlands, livestock and grazing land

Effects of flooding	Highly affected		Moderately affected		Not affected	
	Number	Percent	Number	Percent	Number	Percent
Standing crop	148	47.7	13	4.2	5	1.6
Farmland	122	39.4	20	6.5	2	0.6
Livestock production	205	66.1	83	26.8	22	7.1
Grazing land	236	76.1	56	18.1	18	5.8

Source: computed from the field survey (2001)

The respondents were also asked to state the details of flood effect on their livelihoods in the form of open ended questions. Accordingly, some of their responses were modification cropping pattern, widespread of human diseases, damage of the crops, reduction in the productivity of the livestock, selling the milking cows and hens without planning since they are sensitive to flood events, investing additional money for the re-establishment of assets like water well, house equipment, bridges and other facilities. Almost all respondents also pointed out that the nature flooding is increasing through 2016 – 2020. The result of this article is similar with the findings of Haile et al. [29] who underscore the adverse effect of flooding event like loss of livestock, damage of grazing land, failure of crops, disease outbreak and collapse of housing conditions.

Supporting the result of household questionnaire survey, experts working in the office of Disaster Preparedness and Prevention of the district confirmed that farmers were forced to change their cropping pattern due to the fact that cultivation lands were inundated by flood showing the increasing trend from time to time. It was also understood that farming communities are usually depend on either borrowing money or the aid given by the local institutions to compensate the damaged standing crop because flood inundation adversely affecting the livelihoods of the farming communities.

Furthermore, the time series data obtained from agricultural office of the district reveal that the effect of flooding on the farmland and yield are increasing during 2016– 2020 particularly in Kersa Bombi *kebele* (Table 9). Accordingly, 135 ha and 397 ha of farmland were adversely affected by 2016 and 2020 respectively by flood inundation while 4320 and 25026.24 quintals of yield were lost in 2016 and 2020 respectively in the same *kebele*. Moreover, as it can be referred from Table 9, the adverse effects of flooding were also documented in 2020 in 3809.48 ha and 871.12 quintals of farmland and yield were respectively affected in Maket Suntare and Dima Jeliwan *kebeles*.

The views of the participants about standing crops and farmlands were also confirmed during field observation as indicated in Fig. 3 indicating inundation of the areas by the flooding water.

Table 9. Effect of flooding on the community`s farmland and yield lost

Effect of flooding on farmland and yield	**KersaBombi**					**MaketSuntare**	**DimaJeliwan**
	2016	**2017**	**2018**	**2019**	**2020**	2020	2020
Farmland affected (ha)	135	175.28	367.5	385	397	181.75	41.58
Yield lost in (quintal)	4320	4771.12	9909	21840	25026.24	3809.48	871.52

Source: agricultural office of the Dawo district (2020)

Fig. 3. Effects of flooding on standing crops and farmlands
(Source: taken from the field during data collection phase)

The effects of flooding are very strong for the households having their properties along the river side and in areas where there are conversion of natural to human oriented landscape. In connection to this, one local elderly man who lived in the Kersa Bombi *kebele* over the past three decades stated that:

In Kersa Bombi kebele, there are four rivers (Jeliwan, Didiksa, Calle and Ibicha) having their own many tributaries coming from different directions while the other two rivers are in Maket Suntare. As a result of these rivers and their tributaries, overflow of water and flood inundation are very common events especially during the rainy seasons. When it reaches Dima Jeliwan and Kersa Bombi kebeles, the volume of the rivers increases which result into flooding large areas of settlement, agriculture and grazing land. As a result, it was very common to hear the loss of life and severely injured individuals during flooding events while people are struggling to divert flooded water in a way that it does not harm their properties associated to farming practices.

The above narrations reveal that the existence of drainage network aggravates the occurrences and intensity of flooding as studied areas are situated at lower altitude. The narration was also supported by the key informants who are living in the Maket Suntare and Dima Jeliwan *kebeles*. As it was explained in the methodology section, the mentioned *kebeles* were part of the sampled *kebeles*. The summarized views of group discussions also revealed that the carrying capacities of the rivers are also getting reduced due to the heavy production of siltation as most of the surrounding areas were converted to human-induced actions. In addition, it was also observed that as there is no clarity in the determination of flood buffer zone as people are frequently settling and performing their farming practices in flood prone areas which further aggravate the adverse imapcts of flooding on the various natures of community`s livelihood. The results established in this study has similarity with an empirical study conducted by Zerihun and Befikadu [30] who states that rivers and flash based flooding documented in three years (2018, 2019 and 2021) has affected about 172,000 people in different parts of Ethiopia.

This study revealed that the Land cover and flooding has inverse relationship. When land cover is more, there will be less flood susceptibility. Similarly, Mojaddai et al., 2017 revealed that Land cover is a crucial factor in the assessment of flood susceptibility because areas with relatively less vegetation are relatively more prone to flooding However, cities and towns are covered with impervious surfaces and barren lands, which increase the flow of surface runoff.

4.5 Effects of Flooding on the Social Aspects of the Households

With the objective of assessing the major effects of flooding on social aspects of the households, respondents were asked some questions in the form closed and open ended. Accordingly, the results of closed ended questions were summarized in the Table 10 and majority (67.1%) of the respondents reported that the housing conditions in the study areas were highly affected because of flooding while only 7.7% of respondents were in the view that the housing conditions were not affected. Those respondents who pointed out that the housing conditions were highly affected further asked to indicate the level of damage and it was understood that there were houses which were totally destroyed, filled with water and affected by the sediments (Fig. 4) which has similarity with the findings of Haile et al. [29]. Furthermore, results obtained from group discussions also revealed that 67 households were displaced from Kersa Bombi and Dima Jeliwan *kebeles* as a result of flooding which was again confirmed by the experts working in the office of disaster prevention and preparedness of the district. This implies that properties of households were also damaged and relocation by itself disrupts living styles of the households as it has multiple effects.

As it can be seen from Table 10, out of the total respondents participated in this study, 34% of them pointed out that school related infrastructures have been highly affected while 70.6% of them said that school infrastructures have not been affected by flooding events.The result of study also revealed that the school attendance was disrupted attributed to the flood inundation as it was pointed by almost half (51.9%) of the respondents. Moreover, as it was underscored by the group discussants, some classes and teacher`s houses were damaged because of flooding in Dima Jeliwan *kebele* implying that children could not properly attend their classes. The damages of roads and bridges were also documented in the study *kebeles* adversely affecting the movement of people and materials. Though health institutions were not that much damaged, health related services were seriously disrupted as residents were unable to reach institutions because of flood inundation. In line with this, *kebele* leaders pointed out that health extension workers were unable to serve communities of flooded areas though water related diseases were commonly observed in the studied *kebeles* during flooding events.

Fig. 4. Effect of flooding on housing conditions (source: taken from the study area)

Table 10. Effects of flooding on some social elements of the community

Effects of flooding	Highly affected		Moderately affected		Not affected	
	Number	Percent	Number	Percent	Number	Percent
Housing conditions	208	67.1	78	25.2	24	7.7
School facilities	34	11	57	18.4	219	70.6
Drinking water	146	47.1	99	31.9	65	21
School attendance	161	51.9	105	33.9	44	14.2

Source: computed from field survey

Furthermore, water related effects were also observed in studied areas as close to half (47.1%) of the respondents reported that drinking water was highly affected while 21% of them stated that it was not affected (Table 10). Respondents who reported that the drinking water was highly affected were asked to state the condition of the damage. Thus, their summarized results revealed that the sources of drinking water such as borehole and hand pump were damaged owing to the flood events and households were forced to use unsafe sources of water for different purposes. The results of household survey were also confirmed by the results obtained from group discussions and expert related interviews.The results of this study are in agreement with the output of Alemu [31] who identifies significant effects of flooding on socioeconomic conditions of households residing in the flood prone areas. Furthermore, Bitew et al. [6] underscored that one of the regions that adversely affected by recurrent flooding is Awash River basin which has more or less similar biophysical and socio-economic setting with the current study site implying that the studied sites have been identified as flood prone areas.

5. CONCLUSION AND RECOMMENDATIONS

Land use change that does not consider the potentials of the land for meeting social, economic and environmental concerns of present and future generation at its best is disastrous. Expansion of human-induced landscape (agricultural land, settlement areas and other forms) and the reduction of natural landscape (shrub land, vegetation, grassland, open wood land and others) have direct implications in enhancing surface runoff generation thereby reducing the carrying capacities of the rivers. These conditions in turn escalate the intensities of flooding that has the potential to erode the livelihoods of the communities. As a result of flooding, the damages of socioeconomic conditions of the communities were documented. At this point, it is good to point out that integrated land use plan and policy are essential for transformation of socioeconomic conditions of the local communities and environmental sustenance which should be initiated by the land and administration offices of the regions.

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COMPETING INTERESTS

Authors have declared that no competing interests exist.

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