

Climate Change Intervention and Adaptation in Ethiopia: A Critical Appraisal of Systematic Review

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Received: 25 Nov. 2016, Revised: 06 Feb. 2017, Accepted: 09 Feb. 2017

ABSTRACT

Climate Change affects the agricultural sectors of different countries differently and several studies confirm climate change's negative impact on food security. Ethiopia has experienced repeated famine for a century.

The rationale of this paper is to analyze, report, and discuss the results of a critical appraisal of a systematic review looking at climate change intervention and adaptation in Ethiopia.

This paper systematically appraises methodological aspects of literature reviews examining the relationship between climate change and adaptation published in peer reviewed journal between 2000 to 2016. Systematically, twenty-five relevant articles were examined.

The overall effect of response and adaptation was aware the key informants and participant's awareness creation on Ethiopians climatic change facilitation availability and improves climate change adaptation.

Conclusion: This systematic review reveals that the role of climate change adaptation is crucial for food security in Ethiopia. Thus, sustaining climate change is so important to attain food security in Ethiopia.

Key words: Adaptation, Critical Appraisal, Climate Change, Intervention, Systematic Review

INTRODUCTION

Climate Change affects the agricultural sectors of different countries differently and several studies confirm climate change's negative impact on agriculture. Agriculture is the most important sector in Sub-Saharan Africa (SSA) and it is set to be hit the hardest by climate change [1-5]. Today, climate change is recognized as one of the greatest challenges of the world. It is predicted to have adverse consequences for the world's ecosystems, economies and societies. But, the severity of adverse effects varies across countries, regions, and socio-demographic groups due to differences in exposures, sensitivities and adaptive capacities [6]. The long-term state of the earth's climate is regulated by the balance between incoming and outgoing energy, which determines the Earth's energy balance [7] any factor that causes a sustained change to the amount of incoming or outgoing energy can lead to climate change.

From a food security perspective, sub-Saharan Africa (SSA) is arguably the most vulnerable region to many adverse effects of climate change due to a very high reliance on rain fed agriculture for basic food security and economic growth, and entrenched poverty [12-14]. In the other sub-Saharan countries, agriculture is the base of Ethiopian economy. It comprises about 43% of national GDP, generates 90% of foreign exchange earnings and employs more than 80% of the population [15]. It is also the major source of food for the population and the prime contributing sector to food security. In addition, agriculture is expected to play a key role in generating surplus capital to speed up the country's overall socio-economic development [5]. However, productivity and competitiveness of this sector are increasingly constrained by temporal and spatial variability of climate.

In Ethiopia, the average minimum temperature has increased by about 0.37°C for every ten years [8]

moreover; rainfall was highly variable, both temporally and spatially, with no apparent trend over the country, yet the country has experienced both dry and wet periods. Studies showed that drought frequency and spatial coverage have increased over the last few decades [9]. Several studies [10-11] examined the impact of rainfall variability on the Ethiopian economy, and found that rainfall risk leads to a 20% production deficit and increase in 25% poverty rate, which costs the economy over one-third of its growth potential. Ethiopian agriculture is one of the most vulnerable sectors of current climatic variability and projected climate change, potentially exposing millions of people to recurrent food shortages and episodic famines. Negative impact of climate change and variability on crop and livestock production could result in a nationwide food shortage and greatly hinder the economy [15] For instance, droughts in Ethiopia can shrink household farm production by up to 90% of normal years output and could lead to the death of livestock and human beings [16].

Climate change crisis is affecting the livelihood of Ethiopians in 2016. The first three months of this year will be critical for providing food and water aids to Ethiopia, where strips of the country are reeling under the worst drought in 50 years. Food insecurity has reached to emergency levels, and at least 18 million people in Ethiopia will need humanitarian assistance this year, according to international aid agencies [17-19] Climate Change driven drought is not only affecting humans, but also livestock herders in northern Ethiopia are seeing many of their animals starve. More than half a million livestock have already died, while nearly 2 million more are at risk of dying due to Climate Change. Desiccated livestock that survive are worth much less than healthy

animals, leaving herders with less money to buy food for their families [18-19]. The report, released by the Washington D.C.-based Famine Early Warning Systems Network (FEWSNET), added that conditions are unlikely to deteriorate to a famine like the one in the 1980s, which killed nearly 1 million people; however, Ethiopia's humanitarian need in 2016 will exceed any levels seen in the past 12 years [19,20].

MATERIALS AND METHODS

The systematic review was conducted to provide the available evidence on climate change intervention and adaptation in Ethiopia. Computerized searches from 2000 to 2016 in Google Scholar, Pubmed, Medlines, Procquest, CINAHL, Chocrance library, Google, and OVID were performed. All selected studies which addressed the differences in climatic change intervention and adaptation in Ethiopia were considered. This systematic review addressed the eligibility of each selected study. Its level of evidence and the methodological quality after this step, only twenty-five articles were retrieved, which include 3 qualitative studies, 17 quantitative non randomized control study and 5 quantitative descriptive studies. Inclusion and exclusion criteria were limited the entry of articles into the review process. A checklist was selected and modified to include a wide range of study designs. The reliability was established between four reviewers before the main review process commenced. Each paper was read by two reviewers and given by two reviews and given a quality rating score of any conflicts being resolved by a third reviewed papers were grouped by category: Qualitative, quantitative descriptive and qualitative non randomized trial.

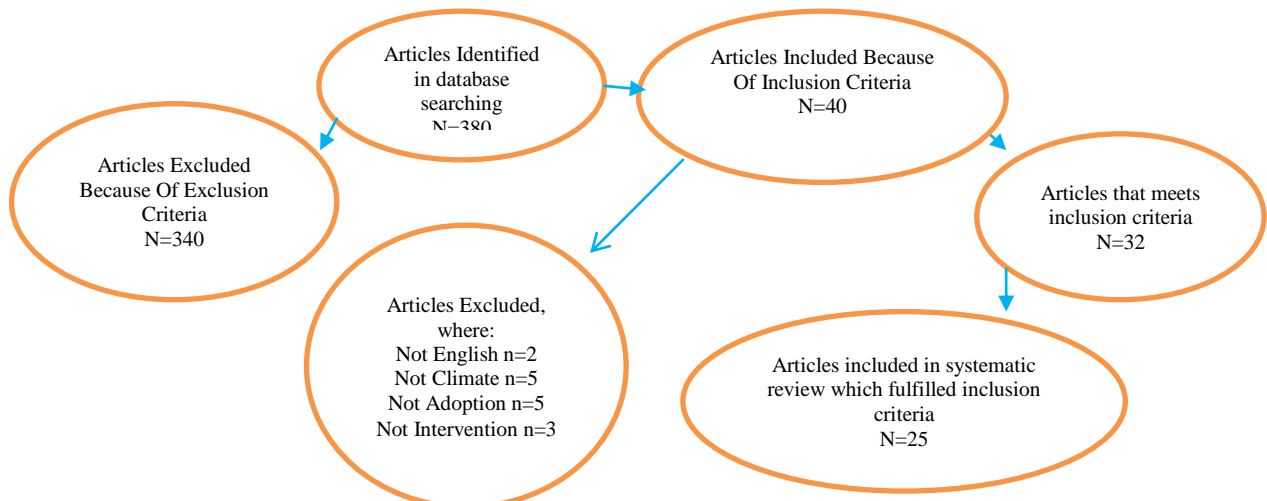


Fig.1: Systematic Review Process for Identifying Articles

RESULTS

According to the objective of this reviewed study, global environmental changes are expected to threaten human life. Therefore, using this systematic review, we synthesized results from 25 articles which are fulfilled the inclusion criteria. However, according to the searches, we found that a total of 380 records, excluding duplications because of limiting the entry of papers into the process. A checklist was selected and modified to include a wide range of study designs. It includes not climate (n=5), not English (n=2), not intervention (n=3), and not adoption (n=5). For a comprehensive review of existing articles and measurements to assess progress on climatic change intervention and adaptation, development of climate change intervention increases and initiatives is highly necessary.

Therefore, the screening process found 25 papers which met our inclusive criteria [21-45][see Table 2].

In this systematic review article, seven studies have been included evaluated qualitative studies which addressed the climate monitoring and forecasting to food security, adaptation to climate change, the impact of adaptation on farm house-holds, food productivity, the role of urban agriculture in attaining urban food security, land use or cover dynamics, food insecurity and strategies that reduce flood- related health risks in developing countries Ethiopia [24,29,30,37-38,44-45].Thirteen studies were quantitative descriptive types of study, which was assessed farmer's perception and adaptation to climate variability, recurrent droughts and food shortages. The major sources of risk coping mechanisms and crop mix and resources have been used as the pattern of small holder farmers under risk, direct as well as indirect effects on human health, effect of adaptation options and episodes of droughts of varying security and duration occur [22,25-27,31,32,34-36,39,41-43].

Five reviewed studies were quantitative non-randomized study, impact of climate change [21], communities with varying socio-cultural and environmental conditions [23], determinants of pastoralist climate change/variability adaptation strategies [28], environmental deterioration [33], and the perception of historic changes in climate and associated impact on local agriculture [40].

Based on the risk of bias through these reviewed studies, the included studies which have been provided in this study had insufficient information/data's based on how participants were selected, how the intervention was implemented the attention of participants and factors which affecting the study findings. This reviewed study was conducted by mixing methods for their descriptions;

regarding to no single study method discrimination among all studies.

We didn't have any provider biases because it may be due to individual study covered a different intervention. In addition, the representative of the compared research population was not identified, because there were obvious biases that affect our results. Regarding level of evidence, from the total of 25 reviewed studies, a quantitative descriptive [22, 25-27, 31-36, 39, 41-43] have been used in thirteen studies, qualitative methodology in seven studies [4,9,10,17,18,24,25], and quantitative on randomized methods in five studies [1,3,8,13,20]. The result also indicated level of evidence that has been ranked in these descriptive studies. 11 studies were used as a level 3 [21-22,24,26,27,30-33,41-44] followed by level four evidence [28,32,35,37,40] and level 6 [29,38,45] [Show Table 1].

Climate change intervention was conceptualized with in the study objectives. In addition, it is a statement of problems but not in the methods, study design and measures in all included studies were not suitable but also inappropriate. We were anticipated that many climatic change intervention review questions were employed mixed methods reviewed. The association between climate change and its intervention strategies was reviewed and determined by a narrative synthesis. Studies were carried out based on motivational, behavioral and cognitive characters, capacity and effective response, actual climate risks and response alternatives. The individual perception has focused on skill strategies, individual effort, task involving climate location sensitivity and vulnerability, climate change intervention through vulnerability, climate change determines and challenges. Sustainable community has been designed based on climate change adaptation for development climate change and food security, climate change and health.

Climatic Change Intervention for Response and Adaptation

Six reports have described the specific adaptation strategies to reduce the impact and exploit the opportunities of climate change between 2000 and 2016 in Ethiopia [21,22,25,32,34,35]. Effective response and adaptation reduced provoke of social and biological systems to recent climate changes and thus affected the effects of climatic change intervention. These strategies was included the Models(GCMS) of emission scenarios for ten stations regarding spatial variability of future climate changes and its design local level adaptation options [21], the farmers which use change in crop type and variety, soil and water conservation practices [22,32,34,35] and using palacosoil analysis [25]. The effective response and adaptation that required to farmer

households in North Shawa had exhibited in high level of perception to climate change induced disaster and they cope various mechanisms. In addition, two steps process of Heckman Model was applied for perception to climate change as prone determinant for adaptation.

The overall effect of response and adaptation was aware the key informants and participants' awareness creation on Ethiopians climatic change facilitation of credit availability and improves climate change adaptation [25,32,35]. By contrast, the awareness of the human impact of state level (regional level) was very limited and crucial to adaptation. Because the community's response and relevant documents expressed that the increase in temperatures may cause changes in the environment with increased risk of malaria transmission [34]. A total twenty-four of the reviewed studies have addressed the strategies which reduce the impact and future result of climate change [21,22,25,32,34,35].

Climate Change Intervention for Response Alternatives

Three studies explored climatic change intervention that addressed opportunities and challenge of climate change adaptation in 2013[23], determinants of agro-pastoralist climate change adaptation strategies in 2014[28] and in the same year vulnerability to food insecurity and coping strategies in the face of climate change [36]. These studies were discussed change interacts with climate variability and non-climatic stresses that interventions and development efforts take the determinant factor into consideration and augment food security [19] found that some support for this result when they conducted that smallholders' farmer perceptions and adaptation to climatic variability and climate change in Doba District in West Hararghe in Ethiopia. The finding indicated that there are nearly unified perception of climate variability and change among gender and social groups in determinant factors for adaptation strategies [39]. In addition, sex, family size, plot size, off-farm income and the frequency are the determinant factors [39]. The vital aspect of climate change interventions may have been the capacity to contribute [20]. Described that perception of climate change and its impact by small holders in

pastoral/agro pastoral systems of Borena, South Ethiopia, and increase access to agricultural support services, which improve the availability and the quality of relevant climate information [40]. There was no any significant effect on the perception level of small holders. Consequently, this family size of the house holders was also negatively related and statically significantly food security status [42].

Climatic Change Intervention for Cognitive, Behavioral, Motivational Effort

Eight studies described the changes in agricultural practices and improved natural resource management and capacity building improving access be a tool to encourage rural development and adapt the new condition [24,27,31,37,40-42,44]. Cognitive, behavioral, motivational and individual effort in climatic change intervention was represented by social objects, the aggregate of responses to internal and external factors accomplishment and individual participation. The strategies included the global climate forecast to change significantly as a consequence of increasing concentrations of greenhouse gases in Africa [24,28,31,38]. Most frequency of climatic change interventions used to come up with the negative impact of shocks food insecurity, vulnerability and risks adopted by local small farmers, urban agriculture development, policy issues, access to credit, information and resources [24,27,31,37,40-42,44].

Climatic Change for Capacity Institutional Links and Social Networks to Action

Eight studies determined that the effectiveness of local knowledge interesting adaptation responses in a cost effective and socially acceptable manner [26,39,45], and future policy which promotes soil conservation research on use of new crop varieties and livestock species suited for better come with climate change [29,30,33,38,43]. For instance, a study conducted by [23] assessed the evidence of climate variability in the northern part of Ethiopia; adaptation was one of key central concern to policy makers and needs to be integrated into the development strategy of government policy [43].

Table 1:Summary of Critical Appraisal Results Using the Mixed Methods Appraisal Tool (MMAT)

| Study Type | MMAT Question | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 | 19 | 20 | 21 | 22 | 23 | 24 | 25 | | |
|-----------------------------|--|---|--|---|---|---|---|---|---|---|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|---|---|
| | | | Are the sources of qualitative data (archives, documents, informants, observations) relevant to address the research question (objective)? | - | - | - | ◆ | - | - | - | - | ◆ | ◆ | - | - | - | - | - | - | ◆ | ◆ | - | - | - | - | - | X | ◆ |
| | Is the sampling strategy clearly described and justified, and Is it clear how participants were selected? | - | - | - | ? | - | - | - | - | ◆ | X | - | - | - | - | - | - | ? | ◆ | - | - | - | - | - | - | ◆ | ◆ | |
| | Is the method of data collection well Described and Is it clear what methods were used to collect data? | - | - | - | X | - | - | - | - | ◆ | ? | - | - | - | - | - | - | X | ◆ | - | - | - | - | - | - | ? | ◆ | |
| | Is the process for analyzing qualitative data relevant to address the research question (objective)? | - | - | - | ◆ | - | - | - | - | ◆ | ◆ | - | - | - | - | - | - | - | ◆ | ◆ | - | - | - | - | - | - | ◆ | ◆ |
| | Is the data analysis/interpretation process described and justified well. | - | - | - | ◆ | - | - | - | - | ◆ | ◆ | - | - | - | - | - | - | - | ◆ | ◆ | - | - | - | - | - | X | ◆ | |
| | Is appropriate consideration given to how findings and conclusions relate to researchers' influence, eg, through their interactions with participants? | - | - | - | X | - | - | - | - | ◆ | X | - | - | - | - | - | - | - | ◆ | ◆ | - | - | - | - | - | - | ◆ | ◆ |
| Quantitative Descriptive | Is the sampling strategy relevant to address the quantitative research question (quantitative aspect of the mixed methods question)? | - | ◆ | - | - | ◆ | ◆ | ◆ | - | - | ◆ | ◆ | - | - | ? | ◆ | ◆ | - | - | ◆ | - | ◆ | X | ◆ | - | - | - | |
| | Is the sample representative of the population understudy? | - | ◆ | - | - | X | X | X | - | - | ? | ◆ | - | - | ? | ◆ | ◆ | - | - | ◆ | - | ◆ | ? | ◆ | - | - | - | |
| | Are measurements appropriate (clear origin, or validity known, or standard instrument)? | - | ? | - | - | ? | ◆ | ◆ | - | - | ◆ | ◆ | - | - | X | ◆ | ◆ | - | - | ◆ | - | ? | ◆ | ◆ | - | - | - | |
| | Did the authors identify any limitations? | - | X | - | - | X | X | X | - | - | X | X | - | - | X | X | ◆ | - | - | ◆ | - | X | X | X | - | - | - | |
| | Are the conclusions the same in the abstract and the full text and are the authors' conclusions adequately supported by the results? | - | ◆ | - | - | ◆ | ◆ | ◆ | - | - | ◆ | ◆ | - | - | ◆ | ◆ | ◆ | - | - | ◆ | - | ◆ | X | X | - | - | - | |
| Quantitative Non Randomized | Are participants (organizations) recruited in a way that minimizes selection bias? | ◆ | - | X | - | - | - | - | ◆ | - | - | - | - | ◆ | - | - | - | - | - | - | - | ◆ | - | - | - | - | - | |
| | Are measurements and outcome data appropriate (clear origin, or validity known, or standard instrument; groups when appropriate) regarding the exposure/ intervention and outcomes? | ◆ | - | ? | - | - | - | - | ◆ | - | - | - | - | ◆ | - | - | - | - | - | - | - | ◆ | - | - | - | - | - | |
| | Was the sample size sufficient? Were there enough participants? Were the conclusions and outcome measures reliable (eg objective or subjective measures) and Were all important outcomes assessed? | ? | - | X | - | - | - | - | ◆ | - | - | - | - | ? | - | - | - | - | - | - | - | ◆ | - | - | - | - | - | |
| Level of Evidence | ◆ | | 3 | 3 | 1 | 3 | 2 | 3 | 3 | 4 | 6 | 3 | 3 | 4 | 3 | 1 | 4 | 5 | 4 | 6 | 5 | 4 | 3 | 1 | 3 | 3 | 6 | |
| | X | | 0 | 1 | 2 | 2 | 2 | 2 | 0 | 0 | 2 | 1 | 1 | 0 | 2 | 1 | 0 | 1 | 0 | 0 | 0 | 1 | 3 | 2 | 2 | 0 | | |
| | ? | | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 1 | 1 | 0 | 1 | 2 | 0 | 0 | 1 | 0 | 0 | 0 | 1 | 1 | 0 | 1 | 0 | |

Key to responses:Applicable (◆); No(X); Can'ttell (?),Not applicable (—)

Where,1= [Hadgu, et al., 2014^a];[21] 2= [Hadgu, et al., 2014^b];[22]3=[Tafere et al., 2013];[23]4=[Verdin et al. 2005];[24]5=[Conway,2000];[25]6=[Habtu,2014];[26]7=[(Mesfin,W(2014))];[27] 8=[Getachew et al., 2014];[28]9=[Tadesse et al., 2009];[29]10=[Falco et al., 2011^a];[30]11=[Falco et al., 2011^b];[31]12=[Tesso et al., 2012];[32]13=[Kassa, 2014];[33]14=[Grasso et al., 2012];[34]15=[Hadgu, et al., 2015];[35]16=[Zemedu et al., 2014];[36] 17=[Mulugeta, 2010];[37]18=[Assen, 2011];[38]19=[Legesse et al., 2012];[39] 20=[Debela et al., 2015];[40] 21=[Bezabh et al., 2015];[41] 22=[Asmelash,2014];[42]23=[Gebrehiwot et al., 2013];[43]24=[Canali et al., 2010]; [44] 25=[Wakuma et al., 2009][45].

Table 2: Summary of Search Results and Conclusions

| Authors | Sample Description | Design and Analysis | Intervention | Result | Conclusion |
|-----------------------------------|---|---|---|---|---|
| Hadgu, et al, 2014a. | Using 2030 and 2050 temperature and rainfall data. Models (GCMs) using A2 and B1 emission scenarios for ten stations. | Comparative Study; RCLimDex1.0 software was used for analysis. | Spatial variability of future climate changes is important and advises the need to design local level adaptation options. | The mean maximum and minimum temperature would increase by 2–2.3 and 0.8–0.9 °C in 2030 and by 2.2–2.7 and 1.4–1.7°C in 2050, respectively. | Site-specific adaptation strategies to reduce the impact and exploit the opportunities of climate change. |
| Hadgu, et al, 2014 ^b . | Respondents selected through the multi-stage and using 3 stage sampling technique. (n=253) | Case Report; Analyzed using t-test and chi-square. | Farmers use change in crop type and/or variety, soil and water conservation practices and crop diversification, for climate change adaptation. | Most of the farmers in the studied region perceive drought as the major climatic hazard that encroaches their livelihood. | Adopting climate resilient options is an important strategy for societal groups and including policy makers. |
| Tafere et al, 2013 | 136 in Easter Tigray and 128 in Wolaita Zone participated. A focus group discussion method were employed n=264 | Comparative Study; Policy & Discussion Analysis were conducted | Climate change interacts with climate variability and non-climatic stresses. Thus, adaptation methods, and technologies need to address the combined impacts. | Groups on community awareness levels, corresponding attitudinal and behavioral expressions are manifested in the form of coping mechanisms and adaptation responses. | If GHG emissions continue unabated even more resources will be needed in the future to respond to climate change impacts. |
| Verdin et al .2005 | RFE are used to characterize and simple indices and stream flow models. Climate Variability in the Northeast Ethiopian Highlands. 10000years (Holocene). Household survey with focus group discussion done from December 7, 2010 & January 1, 2011. n=271 | Qualitative Descriptive; Gridded Rainfall time-series used for analysis | Satellite rainfall estimates (RFE) are used to characterize flood hazards, in both simple indices and stream flow models. | The global climate is forecast to change significantly as a consequence of increasing concentrations of greenhouse gases in Africa. | Changes in agricultural practices and improved natural resources management is needed to adapt to new conditions. |
| Conway, 2000 | Household survey with focus group discussion done from December 7, 2010 & January 1, 2011. n=271 | Case Series Study; time-series used for analysis. | Work is done on climate reconstruction in Tigray and Wollo. There is new strategy using palaeosoil analysis. | 1984 stands out as the driest year on record due to very low rain fall in winter. Whilst 1999's was the driest record. | The climate experienced in the Ethiopian highlands has shown major shifts over long time during Holocene. |
| Habtu, 2014 | Farmers Household and Two stage simple random sampling used. n=175 | Case Report; Descriptive statistics & risk programming model analysis. | Using their indigenous knowledge, local community have developed and implemented extensive adaptation strategies. | Highlights some indigenous adaptation strategies and the benefits of integrating them into formal climate change adaptation strategies. | The effectiveness of local knowledge in integrating adaptation responses in a cost-effective and socially acceptable manner. |
| Mesfin,W (2014) | Household data collected in 2013 systematic random sampling used. n=155 | Case Report; Descriptive statistics & risk programming model analysis. | To safeguard themselves against risks, farmers employ crop diversification. | The risk programming model result signifies farmers in the study areas are risk averse and oriented on risk-minimization. | Farmers in developing countries are risk averse, and farming takes place under a situation of risk. |
| Getachew et al, 2014 | Household data collected in 2013 systematic random sampling used. n=155 | Cross Sectional Study; A binary Logistic Regression Model Used. | Temporal migration, livestock mobility, irrigation and herd diversification are the most practiced adaptation methods. | The study presents result of significant association between household size, level of education, and land holdings. | Interventions & development efforts take these determinant factors into consideration for climate change. |
| Tadesse et al, 2009 | A 20 districts n=1000 | Case Study; Multinomial Logit(MNL) model is used for analysis | Farmers adapt climate change using crop varieties, tree planting, soil conservation, early and late planting and irrigation. | Discrete choice model employed indicate that the level of education, gender, age, and wealth and agro ecological settings, influence farmers' choices for climate change. | Future policy which promotes soil conservation, research on use of new crop varieties and livestock species suited better cope with climate change. |

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|-----------------------------|--|---|--|--|--|
| Falco <i>et al</i> , 2011a | A survey in Nile Basin Ethiopia n=1000 | Case Study; Simultaneous Equations model were used | Food Security maintained by adapting climate change. | Access to credit, extension and information are found to be the main drivers behind adaptation. | Adaptation increases food productivity, that the farm households that did not adapt. |
| Falco <i>et al</i> , 2011b | A survey in Nile Basin Ethiopia n=1000 | Case Series; Thin Plate Spline Method used for analysis | Household characteristics, age and literacy of the household head are important drivers of adaptation. | It is found that climate change adaptation has a significant impact on both farm productivity and farm net revenues. | Extension services (both formal and farmer to farmer), as well as access to credit and information on climate changes are key drivers of adaptation. |
| Tesso <i>et al</i> , 2012 | A survey shocks n= 452 | Case Report; A two steps process of Heckman Model used. | Awareness creation on climate change, facilitation of credit availability, improves climate change adaptation. The recent efforts towards restoring Lake Alemaya, though not to its original capacity, at least to the extent of refilling a portion of the different restorative measures of the watershed. | Perception to climate change was the prime determinant for adaptation and farmers follow different coping mechanisms. Population dynamics, land use patterns, shifting crops, extracting drinking water, waste disposal, chemical contamination, and lack of poor research is responsible for the gap. | The farm households in North Shewa have exhibited a higher level of perception to climate change induced disasters. Particular attention to both action and inaction of social entities. It also underlines that restorative policies and programs should always maintain a balance between these two. |
| Kassa, 2014 | A primary & secondary data were used. | A cross sectional survey; Socio-anthropological techniques. | | | |
| Grasso <i>et al</i> , 2012 | A primary & secondary data were used. | Case Series Study; Time series models, panel data and spatial models, and non-statistical approaches. | Regional analysis, as the understanding of the human impact at regional level is often very limited but also crucial to adaptation. | The increases in temperatures may cause changes in the environment with increased risk of malaria transmission. | Climate change is already affecting human health, livelihoods, & expectation is that these effects will become greater. |
| Hadgu, <i>et al</i> , 2015 | Respondents selected through the multi-stage sampling technique and surgery (n=253) | Case Report; Multinomial Logit Model(MNL). | Farmers use change in crop type and/or variety, soil and water conservation practices for climate change adaptation. | Farmers usage of crop type, conservation practice, planting date and house hold head sex affect climate adaptation. | Climate resilient options are an important strategy that should considered for varietal social groups. |
| Zemedu <i>et al</i> , 2014 | A multi-stage sampling technique was used to randomly select sample in three districts. n=279 | Case Report; Descriptive statistics and probit model were used for analysis. | The vulnerability analysis also revealed that more households are to be food insecure in the future(40.5%) than present | Male headed households, per capita income and climate change adaptation through changing planting dates are likely to augment food security. | It is advisable to diversify livelihood sources, adapt to climate change and promote activities that can increase per-capita income. |
| Mulugeta, 2010 | A primary & secondary data were used. A systematic analysis of remotely sensed data (at 1: 50 000 scale for 1965 and 1996 aerial photographs and 2007 Spot-5 satellite). | Case Study; Using Household food balance model. | 40% of the surveyed sample households were obtaining well over the nationally set minimum dietary energy requirement from farmlands. | The study indicates that urban agriculture in the town of Adama is found to have multifaceted importance. small-scale agriculture. | Urban agriculture development intervention schemes, and policy issues are recommended for urban food security. |
| Assen, 2011 | | Case Study; A Digital Elevation Model (DEM) | The study showed that aquatic vegetation, urban built-up area, cultivated and rural settlement, forest, grass, open water, marsh and shrub land use/cover patterns. | The study demonstrates that remote sensing and GIS tools were effective approaches for analyzing the direction, rate, and spatial pattern of LUC change. | To tackle problems, development of a watershed land-use plan and soil and water conservation methods is needed. |
| Legesse <i>et al</i> , 2012 | A multistage stratified random sampling. n=160 | Case Report; Multinomial Logit Model(MNL). | Adaptation strategies used in MNL model were crop diversification and livestock diversification. | The study finds that there are nearly unified perceptions of climate variability and change among gender and social groups. | Sex, family size, plot size, off-farm income, frequency are the determinant factors for adaptation strategies. |

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|-------------------------|--|--|---|--|--|
| Debela et al, 2015 | Empirical data obtained from farm household and a multiple stage surveys conducted in 5 districts, 20 pastoral/ n=480 | A cross sectional; Multinomial Logit Model(MNL). | Different levels of perception were expressed in terms of climate change and the impact on traditional rain-fed agriculture. | Household size, production system, farm and non-farm incomes did not significantly affect perception levels of smallholders. | Increased access to agricultural support services, which improves the availability and the quality of relevant climate information. |
| Bezabh et al, 2015 | A semi-structured questionnaire was prepared and interview was conducted among households. n=150 | Case Report; Principal Component Analysis and Multinomial Logit Model(MNL). | Credit are less likely to adopt food storage as major adaptation to impacts of climate change as compared to water harvesting and irrigation. | Education, land size, access to irrigation, farm income, livestock ownership, access to credit were factors that significantly affected farmers' choice of major adaptation. | Adaptation to the predictable impacts of climate change is necessarily local, and rural institutions have a critically important role in promoting effective adaptation. |
| Asmelash, 2014 | Randomly selected households using simplified formula n=125 | logistic distribution (logit) model analysis. | Integrated watershed management and irrigation helps for attaining rural household food security. | Family size of the households was found negatively related and statically significant to food security status. | Improving household total annual income and decreasing family size is so important for climate change adaptation. |
| Gebre hiwot et al, 2013 | Historical records of monthly rainfall and temperature data from 46 in-situ stations for the period 1954-2008 were used. | Case Serious; Using Temporal analysis. | Characterize and analyses the long-term spatial and temporal behavior of rainfall and temperature in Tigray, northern Ethiopia is done. | The average annual minimum temperature is increasing faster than average annual maximum temperature, which is an indication of warming nights over the years. | Adaptation should therefore be of a central concern to policy makers and needs to be integrated into the development strategy of government policy. |
| Canali et al, 2010 | The sampling is based on stratification of nutritional survey & household individuals. | Qualitative Descriptive; Environmental and Spatial Analysis. | Understanding on food insecurity, vulnerability and risks adopted by local small farmers. | The strategies most frequently used to cope up with the negative impact of shocks are reduce number of meals. | Capacity building and improving access to micro credit can be a tool to encourage rural development. |
| Wakuma et al, 2009 | Data gathered through interviews with 14 officers from different GOs & NGOs given to 35 flood victims n=35 | Qualitative Descriptive; content analysis using Yesil(13) analytical framework | Recovery efforts subsequent to flooding have been made in three main areas: rehabilitation with in flood-affected communities. | Flood frequency and magnitude has increased rapidly during the last decade. The increase in floods was driven mainly by climate change and changes in land use | The effectiveness of the current flood coping strategies to sustainably address the impact of flooding on human health. |

DISCUSSION

This reviewed studies presented that both climate change adaptation and male headed household per capital income are evidenced changing planting date are likely to august food security. Similarly, a study was conducted by [46] found that households with many members are more likely to engage in non-farm generating activities between non-farm income buffers financial losses from farming, the households are less likely to perceive climate change[46]. This reviewed study result revealed that there was significantly change of the global climate as consequence of increasing concentrations of greenhouse gases in Africa. In addition, this finding indicates that drought as the major climatic hazard that encroaches their livelihood. In contrast, the study was conducted by [47] described that even through rainfall variability and the associated shocks like drought and flooding are not new phenomena and the public perception is also improving, there is no

sufficient evidence as to whether or not climate change is perceived as a major problem among small holder farmers, particularly by the poor and most vulnerable farmers in the rural areas [47].

This reviewed study result showed that there is an increasing mean maximum and minimum temperature in 2050. This finding is similar with a study conducted by [48] stated that at lower latitude in tropical dry areas of crop production is expected to decrease for small local temperature increases (1-29)[48]. This reviewed study indicated that the benefits of integrating and indigenous adaptation strategies in the country. This study fining is similar with the research conducted by [49-51] found that the sample was not sufficient to represent the study area as most of the previous studies focused on different agro-ecologies with different social, instrumental and ecological settings. Furthermore, their study result indicated that most of the studies focused on issues at

national or Regional levels and hence lack details at the household or farm level [49-51].

This reviewed study also revealed that awareness levels, cross ponding attitudinal and behavioral express regarding groups on community are manifested in the form of coping mechanisms and their adaptation responses. In similar, [52-53] are found that adaptive capacity is the ability of a system to adjust to climate change to moderate potential damage to take advantage of opportunities or to cope with the consequences[52,53].As the result of this reviewed study the risk programing model result was signifies farmer are risk averse and oriented on risk minimization. In addition, this study result revealed that there was a very low rainfall in winter in Ethiopia related to [53] reported that there was a generous estimate on hectare of Alemaya lake site with in the year of 2003 and 2004, it is almost completely dries up[54].

Most of this reviewed study result indicated that climate change intervention addressed opportunities and challenges of climate change adaptation, vulnerability to food insecurity and coping strategies in the face of climate change. The previous study supported for this reviewed study that progress has been made towards the Millennium Development Goal of reducing the globalpoverty rate below 23%. However, climate change remains a threat to attain the goals since it generates a profound impact on the food insecure that already vulnerable to the impacts of fluctuating food prices population growth and environmental degradation [55-57].

CONCLUSION

The cognitive, behavioral, motivational and individual effort in climate change intervention was the highest representative of social objects the aggregate of response to both internal and external factors accomplished individual participation on natural resources management and adapt new condition. The review of the study reveals that it is role in food security attainment is crucial due to a very low rainfall in winter and climate change in Ethiopia.Most of the reviewed study articles indicated that farmers use a change in crop type and verity soil, and water conservation practice and crop diversification for climate change adaptation.Climate change has been occurring persistently in Ethiopia, with devastating social and economic impact for decades. The primary causes of climate change driven desertification inEthiopia have been identified as overgrazing, overexploitation, deforestation and poor irrigation practices leading to negative impacts like; resource-use conflicts, problem of food security, losses of flora and fauna among others. It has been shown that land degradation resulting from droughts

has been accelerated by anthropogenic factors.Suggestions for future research are also mentioned. Perhaps the implications discussed in this review are not only confined to climate change, but also can be utilized by researchers of other disciplines as a guideline to design, plan and conduct similar researches in their own settings.There is a need to rapidly build the adaptive capacity in existing climate change institutions inEthiopia, and to develop a stronger evidence base for local adaptation strategies in vulnerable sectors such as health. Such action will also assist the region to successfully access additional adaptation funding that may be available.

ETHICAL ISSUES

This study is not involved human subjects or an animal experiments; therefore, we didn't need any ethical approval.

CONFLICT OF INTEREST

We declare that we have no conflicts of interest.

AUTHOURS' CONTRIBUTIONS

All authors have participated in computerized search, articles review process sufficiently in the work to take public responsibility for appropriate portions of the content.

FUNDING/SUPPORTING

We have not received any financial support for preparation of this manuscript.

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