Abstract

A watershed is a naturally delineated unit of land that drains water, sediment, dissolved materials and biota to a common outlet along a stream channel. Its development and management creates an opportunity for different people to consider elements of watershed for optimum production with minimum disturbance to the environment. This review paper aims to understand how the knowledge of ethnobotany is important to manage plants in the landscape for better watershed management. To achieve this, the review was focused at concepts and working principles of watershed management; elements of watershed; historical development of watershed management in Ethiopia with its achievements. Furthermore, application of ethnobotany in the understanding and management of watershed and experiences of other countries in using human knowledge of plant for watershed management based on the published facts are key issues addressed by this review. In general, the literature reviewed showed that for watershed development and management, the contribution of local people's knowledge, consortium approach and adoption of new technology are important to achieve desired result for insuring sustainable utilization of natural resources in a given watershed.

Keywords: Watershed; Ethnobotany; Natural resource; Landscape

Abbreviations: AMAREW: Amhara Micro-Enterprise Development, Agricultural Research, Extension, and Watershed Management; CRGE: Climate Resilience Green Economy; CSWCRTI: Centeral Soil and Water Conservation Working Center; EthiOCAT: Ethiopian Overview of Conservation Approach and Technology; FFW: Food for Work; GIZ: e German Agency for Technical Cooperation; GWC: Green Water Credit; ILRI: International Livestock Research Institute; IWMI: International Water Management Institute; LLPPA: Local Level Participatory Planning Approach; MoA: Ministry of Agriculture; MoARD: Ministry of Agriculture and Rural Development; MOFED: Ministry of Finance and Economic Development; MERET: Managing Environmental Resources to Enable Transitions to more Sustainable Livelihoods; PSNP: Productive Safety Net Program; SWAT: Soil Water Assessment Tool; UNEP: United Nations Environment Program; USAID: United States Agency for International Development; WEAP: Water Evaluation and Planning; WFP: World Food Program

Introduction

A watershed is a naturally delineated unit of land that drains water, sediment, dissolved materials, and biota to a common outlet along a stream channel [1]. Many years back, Achouri [2] also de ned hydrologically as an area that water at surface or subsurface ow to a given drainage system or common outlet. Desta et al. [3] De nes watershed based on what it has, i.e., watershed is made up of the natural resources in a basin, especially water, soil, and vegetative factors. At socioeconomic level a watershed includes people, their farming system and interactions with their land resources, coping strategies, social, economic and cultural aspects.

roughout the world, especially In Asia and Africa, poor farmers tend to be associated with marginal lands and low yields [4] and they struggle to cope with a diverse array of agro-climatic, production and market risks [5]. Similarly deforestation, accelerated soil erosion and land degradation are serious problem in Ethiopia [6] and forest degradation Projections indicate that unless action is taken to change the traditional development path, an area of 9 million hectare might be deforested between 2010 and 2030 [7]. Over the same period, annual fuel wood consumption will rise by 65% leading to forest degradation of more than 22 million tons of woody biomass.

e above mentioned global as well as national problems are solved by watershed development projects. Some of the sampled studies in di erent countries like in Ethiopia [8-11] in Kenya [12], in China [13] and in India [14] were con rmed that restoration of natural resource is possible through this program by addressing biophysical, socio-economic, and institutional and policy issues. e watershed approach enables planners to harmonize the use of soil, water and vegetation in a way that conserves these resources and maximize their productivity. In Ethiopia, continued performance in this sector has been contributing to the achievement of the countries green economy plan to the would be abatement potential of 250 Mt CO_2 emission to the global community and multiplying GDP per capital from 380 USD in 2010 to over 1800 USD in 2030 [7]. erefore continuous review to synchronize di erent approaches and adopting new concepts is in demand.

Objective of the review

e general objective of this review is to integrate the discipline of ethnobotany and looking new approaches for better watershed management in Ethiopia. e review is speci cally helpful to study watershed concepts and working principles in Ethiopia; to pinpoint activities done on watershed that demands the knowledge of ethnobotany for better achievement; to study the experiences other countries regarding the use of plant knowledge for watershed management; to initiate people to study ethnobotany and apply it in

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are instrumental in identifying and prioritizing water management issues and opportunities in di erent parts of a river basin [43]. To Promote Improved Rainwater and Land Management in the Blue Nile (Abay) River Basin Cooperation is also possible for sustainable utilization of the river system by green water credit system (GWC) implemented in the Kenyan Tana basin by watershed approach [12].

A practical example is also exist in the Mekong River Basin a similar water length (e Mekong is one of the World's largest rivers, almost 5000 km long, it runs from the Tibetan Plateau to the South China Sea through six countries: China, Myanmar, Lao PDR, ailand, Cambodia and Viet Nam) as de ned by the four Lower Mekong Basin (LMB) countries that includes Cambodia, Lao PDR (People Democratic Republic-a mountainous landlocked communist state in southeastern Asia that achieved its independence from France in 1949), ailand and Viet Nam has resulted in an economically prosperous, socially just and environmentally sound Mekong River Basin. is is to promote and coordinate sustainable management and development of water and related resources for its Member Countries' mutual bene t and the people's well-being [1]. Similarly, due to the presence of Transboundary Rivers, the Nile, in Ethiopia, river basin based development will be a means of integration to other countries for sustainable development [44].

Historical development of watershed in Ethiopia

Practice of watershed development in Ethiopia since its start: e conception of watershed mEcograph

As Tongul and Hobson [38] indicated that the government with the support of World Food Program (WFP) developed Managing Environment Resources to enable Transitions to More Sustainable lively hood (MERET) program across ve regions (Amhara, Oromiya, SNNP, Tigray and Somalia) and Dire Dawa resulted rehabilitation of more than 400, 000 hectare of degraded land in 2003. In 2005 and onwards, other complementary programs to MERET i.e., Productive Safety Net (PSN) and Sustainable Land Management (SLM) program with the support from various donors and leadership from within the ministry of agriculture was developed and published National community based participatory watershed development planning guide line [3] and the Ethiopian Overview of Conservation Approach and Technologies [45] ese two published guide books along with related policies and strategies are being utilized to implement watershed management throughout the country.

Achievements in watershed management in Ethiopia: Ethiopia has a history of watershed management initiatives dating back to the 1970s. e basic approach has shi ed from top-down infrastructure solutions to community-based approaches through time [3] for better achievement. ere is now a supportive policy and legal framework in the form of policies that facilitate decentralized and participatory development, institutional arrangements that allow and encourage public agencies at all levels to work together to rehabilitate degraded lands.

Over the years, more than 400,000 hectares of degraded land have been rehabilitated under MERET, helping households raise their incomes in absolute and relative terms, as well as increasing agricultural production. A recent impact evaluation [51] found that two-thirds of all MERET households (compared to less than half of the control site households) have escaped from poverty during the past ten years in that MERET has delivered a 20% reduction in poverty in its project areas. Besides, the AMAREW project also restored 586 hectares by area closure, performing 1410 km length of hill side terraces on total land area of 1500 ha in Yaku and Lenche Dima for soil and water conservation [8].

e impact assessment evaluation of PSNP program by Tongul and Hobson [38] also resulted in reduced sediment in streams by 40-53 percent in areas closed to grazing and cultivation (Closed Areas); increased woody biomass and forage production three to four-fold; increased water availability and quality; increased ground water recharge and improved downstream base ow of streams; lessened damage from seasonal oods enhanced downstream crop production through soil and water. Other site speci c watershed intervention assessment studies reduce the problem of a ‘decrease’ or ‘ uctuation’ in crop yield at lower and upper catchment area of the watershed [10], increased ground water quality and productivity of the aquifer [9].

e Abrha Atsbha Natural Resource Management Initiative in the Tigray Region has resulted in improved soil quality, higher crop yields, greater biomass production, and ground water functioning and ood prevention. Honey production has increased by 300% over three years and incomes from vegetable and spice production have also tripled. Farmers have developed agro-forestry systems, integrating high-value fruit trees – avocado, citrus, mango and co ee among others. On their farms to generate improved incomes, food security and nutrition [19]. In recognition of all the above change, it received a prize in 2012 from UNDP supported equatorial prize among more than 800 entries from around the world.

like Ministry of Agriculture, the Ministry of Rural Development, the Ministry of Environment and Forest, the Indian council of Agricultural results, with the aim of watershed development is clearly re ected in the national level policy documents, namely Agricultural Development Policy, Water Policy, Land Policy, Forest Policy and 'Watershed development Guidelines towards watershed programs successfully met the initial three principal objectives of raising income, generating employment and conserving soil and water resources [14].

Recently India extensively done farm ponds to bring long lasting solution for continued drought Over a period of many centuries (between 1801 and 2002), India has experienced 42 severe droughts. One of these, in 1979, cut food grain production by 20 percent; another, in 1987, damaged 58.6 million hectares of cultivated land, a ecting 285 million people. In the last decade (2002-2012), three major droughts hit the country, including the one in 2012 that shaved o half a percentage point from the Asian giant's gross domestic product (GDP) (http://www.kpit.com/csr/activities/Farm-Ponnds). erefore, pond farm is away through solution that recently performed in the agricultural land scape to harvest rain water for crop production.

Application of Ethnobotany to the Understanding and Management of Watershed

De nition and concepts of ethnobotany

e American botanist, Harshberger [54], rst de ned the term "ethnobotany" in 1896 as "the studies of plants used by primitive and aboriginal people" [54]. Since then, many attempts have been made to provide a descriptive de nition. In broad terms, ethnobotany is the study of the relationship and interactions between plants and people [55]. It includes collaboration with disciplines such as Ecology, Chemistry, Anthropology, Economics, and Linguistics [56]. However, the amount of interdisciplinary work done in ethnobotany needs to be increased in the future [57,56] due to the growing interest of researchers from di erent discipline to document plant use by primitive people.

Human race has been dependent on plants both for their material needs and emotional needs since its evolution. is enables to evolve a unique system of knowledge on the utilization and conservation of plant genetic resources [58]. is plant use knowledge has several important advantages over projects that operate outside them [59]. Practically, indigenous peoples knowledge is the basis for local level decision making in agriculture, health care, food preparation, education, natural resource management and a host of other activities in rural community [60].

Application of ethnobotany for proper watershed management

Management of watershed requires all actions in watershed from small erosion control project to develop large scale restoration of the landscape. In the landscape ecology, plants have traditionally been the focus on so much research because plants are producers [61] and its knowledge in uences the detailed components of watershed including soil and water conservation practices, integrated pest and nutrient management, crop diversi cation and livestock production [62]. Its diverse application is pronounced due to its existence at di erent parts of watershed i.e., upland vegetation, riparian vegetation, and wet land vegetation and intern exerts important in uence up on various watershed processed [63,64] e ect on erosion, hydrological processes and in uence on bank stability, channel morphology and water animals. And hence the ethnobotanical study of all these plants has a lot of signi cance to support all actions in a given watershed.

e search for answers to many of the problems of conservation and sustainable development in developing countries requires a more holistic approaches that need to correspond more closely to the multi-dimensional realities of people's lives, acknowledgement of the knowledge and wisdom of local people and their close engagement in the identi cation of problems and potential solutions [65]. To accomplish these, Applied Ethnobotany, an interdisciplinary subject, is well placed to surmount the divisions imposed by the narrowness of many modern academic elds and professions concerned with human livelihoods and the environment [66]. It can also be applied for many practical purposes like land-use development, agriculture, forestry, cultural conservation, education and the development of the health food and herbal medicine industries [67].

New watershed management paradigms also emphasize that watershed management should be part of a local socioeconomic development process that focuses on multi stakeholder participation

pollen whilst generating income for local communities from bee products Wassihun et al. [78], FAO [79], Ste an-Dewenter and Kuhn [80]. Diversi cation of cropping systems such as vegetables, legumes, oilseeds, and forage crops in watershed improved the rain water harvesting capacity and the impacts on environmental resources [81].

Crop varieties planted in watershed observed as major honeybee forage and important to maximize honey yield and spread the farmer's economic risk. Moreover, the crop growers bene ted from the pollination services of the honeybees indirectly but not yet quanti ed. Application of the diverse techniques of quantitative ethnobotany can be applied here. A mixture of di erent weedy species maintained between crop boarders and uncultivated land of watershed contributed as major honeybee forage, rain water harvesting, watershed biodiversity conservation and climate adaption as well [82]. erefore, for good

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