Containing Infectious Diseases and Its Consequences on the Environment in the Angar-Dhidhessa Valley, Western Ethiopia, 1965-1998

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Abstract: This article seeks to explain how development agencies controlled pathogens to make the Angar-Dhidhessa River Valley viable for cultivation from 1965-1998. The valley is one of the extensive plains following the Dhidhessa and Angar Rivers that join the Blue Nile River. Evidences for the study came from feasibility studies, veterinary reports, archives on state farms and settlement projects as well as land lease for large-scale agricultural investments. Herders' and hunters' descriptions and personal records are also helpful to trace a history of valley environment, including diseases. By using sources that describe the valley environment for the precise periods, the article tries to show the process how development agencies used to fight against diseases in the valley and its effects on the environment. The most prevalent endemic human and livestock diseases in the valley were malaria and trypanosomiasis. The study depicts that continuous removal of savanna vegetation where mosquito and tsetse fly breed, and the plantation of exotic trees contained malaria and trypanosomiasis. In addition to the above mechanisms, trypanosomiasis appeared to be contained following the elimination of buffalo and other games as well as the wide use of chemicals such as DDT (Dichloro-Diphenyl-Trichloroethane) to eradicate the tsetse fly that spread the infection from immune wildlife to susceptible livestock. The lost tropical vegetation and wild animals cannot be easily replaced. However, land use and conservation measures that would involve the local society could mitigate the worst environmental crisis and agricultural failure that might be anticipated in the region.

Keywords: Agriculture; Development; Disease; Pathogens; Valley

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1. Introduction

Despite the widely held view that river valleys were centers of ancient civilizations, many of these ecologies in Africa were hardly cultivated and sparsely settled until at least the mid- twentieth century (Molle and Wester, 2009). The presence of dreadful tropical diseases made many of them inhospitable for human habitations and cultivation. Likewise, extensive river valleys in the Blue Nile Basin in western Ethiopia including the Angar-Dhidhessa, Baro, Dabus, Wama, Finca'a etc were infested with diseases, namely *busaa* (malaria) and *gandii* (trypanosomiasis) that deterred human life and livestock production. It was only beginning from 1950s that attempts began to realize large-scale habitation and farming through fighting pathogens and tropical diseases. The Angar-Dhidhessa Valley is an extensive rift in western Ethiopia following the major rivers, the Angar and the Dhidhessa that join the Blue Nile River.[1] For much of its history, the valley had been one of the celebrated forest zones of the country. The extensive forest chain of the valley was the famous habitat for wildlife. As compared to highland areas in the region, river valleys, particularly the Angar-Dhidhessa, was viewed as "a country fit only for monkeys" because of the presence of thick forests, fever, and other environmental hazards (Dunlop, 1937).

The history of endemic tropical diseases such as malaria and trypanosomiasis has already been discussed in a variety of publications. Despite detail epidemiologic data, these reports do not provide full picture on how these diseases jointly deterred agricultural development and their control caused environmental damages. The objective of this paper is to show how development agencies transformed the valley from disease prone area to viable centre of cultivation and the effects of the process on the environment. In this case, small and large-scale farmers were agencies responsible for the change.

Human-Valley Regimes to 1965

Prior to 1965, human interaction with the valley environment relates to the theory of environmental determinism that holds environment shaped human activities (Milton, 1996). As a subtropical environment, perhaps the hostile environmental factors restricting large-scale settlement and agricultural activities in the valley were endemic human and animal diseases. Tropical diseases hindered agriculture through limiting labor and the use of animal draft power. In explaining the effects of tropical environments[2] on agriculture and social development, studies have stressed the shattering effects of diseases on people and their livestock. Diseases such as malaria and trypanosomiasis were, to a larger degree, the principal historical factors causing the slow progress of agriculture by limiting technology and labor investment (Webb, 2005; Moore, 2014). For historians of Africa, disease was a core challenge to the establishment of African civilizations in tropical Africa (Webb, 2005). Moore (2014) argued that tropical climate had an enormous impact on agriculture and social development. The humid climate was hostile to productive agriculture in providing conducive environment for diseases that have had a devastating impact on people and their livestock. It deterred human habitation and agricultural progress by hosting varieties of parasites and vector-borne diseases. A report of an epidemiological survey demonstrates malaria, typhus, schistosomiasis, intestinal parasites and ulcers as top human diseases in the valley. The record shows the shocking demographic effects of malaria and typhus that limited labor investment in agriculture. Malaria and other diseases including typhus had certainly overwhelmed valley inhabitants. Depopulation and the resultant slow progress of agriculture in the lowland are attributed to the effects of disease (East Wollega Zone Health Office Report, 1995). Similarly, a study by veterinary entomologists indicated that of all factors responsible for the slow progress of agriculture, trypanosomiasis played a more profound role that made the valley less tenable for farmers (Reid, 1997). As a result, the ecology of the valley did not support the livestock that could have provided viable draft power for cultivation. During their

[1] The combined catchment area of the Didessa (19,630km^2) and the Angar (7,901 km^2) rivers system make up about 27, 530 km^2.

[2] Environment in this context refers to its climate, disease, wild animals and pests.

travel in 1934, Captain A. Dunlop's group attributed the underdevelopment of agriculture to this disease. They classified the valley as the belts of what they called the doba fly. Trypanosomiasis was a threat to their pack animals in their journey to the junction of the Abbay and the Dhidhessa Rivers.[3] Consequently, local societies devised and utilized different land use strategies for resource extraction and food production as will be discussed shortly.

For long, local people used to encounter the valley to extract resources including forest products, salt lick (*hora*), and small-scale swidden cultivation (Gebregzabiher, 1971). The valley was a significant source of plant and animal products. The intensity in the use of these products for diet increased in the times of food shortage. Hunting was practiced to obtain animal products sport and fame. People hunted to obtain animal products such as meat, hides, horns, and for prestige. On the other hand, ethno-medicinal studies reflected that the tropical forest of the valley was a source of medicinal plants (Suleiman and Alemu, 2012). Our knowledge of medicinal plants comes from traditional healers who accumulated the knowledge on the collection and utilization of medicinal plants.[4]

Agriculture showed slow growth because of limited investment in farm inputs. Due to the high infestation of diseases in the region, farmers did not raise cattle except some goats, sheep and donkeys. The impossibility of the use of animal traction forced farmers to cultivate using rudimentary tools. The cultivation system is known as the hoe system.[5] This involved agronomic strategies such as periodic removal of vegetation, burning the stalks, hoeing and field rotation. The hoe was the main implement and its use was characterized by limited labor, farm resources and technological stability which also limited land use (Hinew, 2018).

Each activity that was undertaken to obtain the resource in question had a defined schedule. The schedule considered the availability of the resource required and non-disease prevalent seasons. The utilization of the resources required knowledge and skill without causing much damage to other resources. The use fire, make a path in the savanna, collect honey, fight or trap wild animals, prepare land for cultivation, and others were among some required from valley explorers for resources (Hinew, 2018).

The overall aim of the manuscript is to show how human activities changed the valley environment from 1965 to 1998. While the year 1965 marks the time when development agencies launched farming in the valley by fighting lowland disease, 1998 marks the period when state farms were disintegrated and extensive commercial farming began.

2. Research Methods

2.1. Description of the Study area

The study area, the Angar-Dhidhessa Valley is located in western Ethiopia. The first written description of the valley was produced by Alexander Bulatovich, a Russian military advisor to Ethiopia in the close of the nineteenth century. He described the valley environment as a perfect ecological niche where the dreadful human and animal diseases completely blocked permanent agrarian life. At that time, he observed very insignificant plots of cotton fields cultivated by a few Oromo farmers who seasonally migrated from the highlands. He was told that almost half of the population of a farmstead died from terrible fever in that specific season (Bulatovich, 2000).

Almost at the same time, a British explorer, C.W. Gwynn, who surveyed the section between the Blue Nile and the Sobat as far as Lake Rudolf, observed the valley as rich nature but of less worth for dwelling. Gwynn remarked, "...the Didessa and Angur [Angar] valleys proper were, till recently, great

[3]To avoid the possible catastrophe, they travelled in the valley by the use of donkeys for transportation: (Dunlop, 1937).

[4]Traditional Healers known as *Ayyantu* provided an ecstatic ritual, investigated the causes of a disorder, and advised the patient on what to do. Healing was often associated with religious and spiritual practices, such as divination and the appeasement of spirits. In the practice of traditional medicine, the use of prayer to a supernatural being as a therapy was common.

[5]Hoe agriculture has many forms and local names such as slash-and-burn agriculture, field forest rotation, shifting field system, temporary fire-field system, land rotation, swidden agriculture, and bush fallow system (Hunter and Ntiri, 1978).

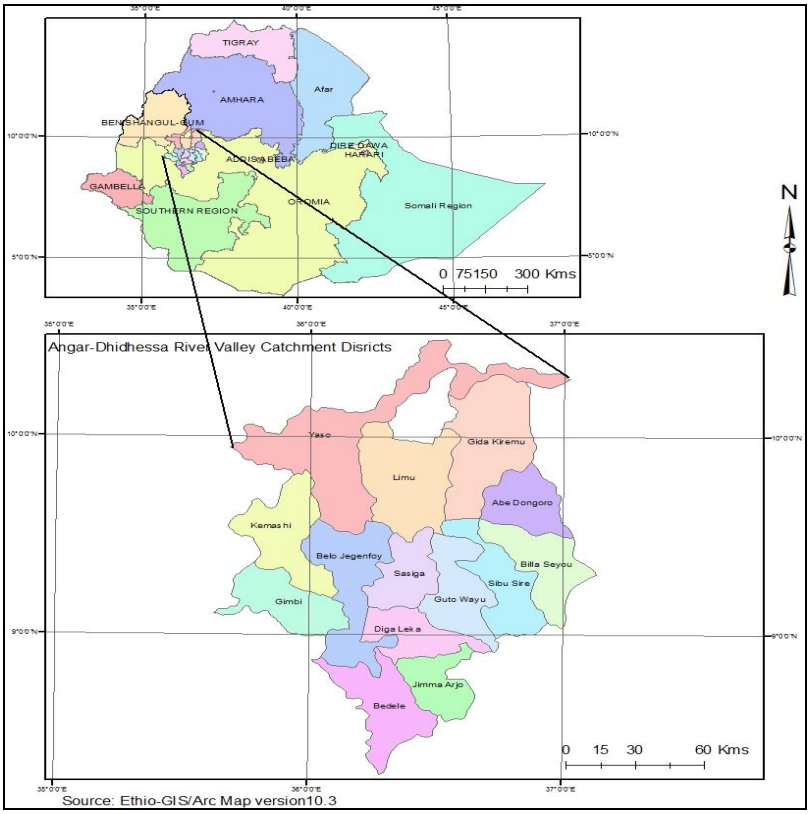
elephant grounds up to the Abai (Gwynn, 1901)." Other written records of the time indicate that the valley was a paradise of wildlife including mammals, birds, and butterflies of wonderful coloring, snakes, fish, and insects (Rey, 1923; Bulatovich, 2000).

In 1905, Weld Blundell, a British traveler who crossed the valley with the mission of exploration of the Abbay Basin, was impressed by its rich scenery. Pertaining to agriculture, he remarked that cultivation in valley was generally undesirable owing to disease (Blundell, 1906).

Likewise, in1934, a map-making expedition by travelers (Captain Dunlop and Captain Taylor) in western Ethiopia, observed some cleared bush and cultivation of beans, maize, and Indian corn by the Gumuz farmers (Dunlop, 1937). In addition, in 1936, Frank Edward Hayter, who crossed the valley from east to west, reflected a fuller picturesque view of the valley's vegetation and wildlife.

> Never shall I forget the unutterable gloom, which pervaded that vast game reserve. The narrow track we followed was covered with dead and decaying vegetation, stamped flat by the feet of countless animals traversing it for more years than I should care to say, and was enshrouded in perpetual twilight, caused partly by enormously lofty and heavily-foliaged trees, but mainly by the almost unbelievable quantity of matted creepers...formed a black canopy (Hayter, 1936: 78).

Hayter (1936) described that the vegetation of the valley ranged from savanna to montane moist evergreen forest, which includes rain forest, woodland, savanna and grassland types of vegetation. The most dominant vegetation of the valley was broad-leaved deciduous woodland vegetation and high tropical forest, strong epiphyte including *hidda-Gebo* (*landolphia*) (Hawas, 2007). The valley was one of the well-known forest ecologies in western Ethiopia. Outsider observers generally attributed the disease ecology of the valley to the presence of vegetation, swampy, grassland and also wildlife.



2.2. Research Design and Approach

This study employed qualitative research method from broad assumptions to detailed methods of data collection and interpretation. The basic philosophical assumptions employed here is the human-ecology interaction and the role of technology in changing the valley environment. First data were collected from written evidences. Secondly, questions were formulated, strategies of inquiry were

prepared, and evidences were collected from oral sources to explore and understand the anthropogenic agency and environmental changes. The collected data were interpreted to produce this report.

2.3. Data Sources and Types

Various types of data have been employed to produce this manuscript. The source can be grouped into travelers' accounts, oral evidences, archives, and secondary literature. Travelers' accounts provide data on environmental landscape, disease, agricultural settings and their livelihoods south of the Blue Nile in the 19th and 20th centuries. Oral tradition offers a broad picture on the dynamics of land uses and resources related to the valley. Likewise, archives of various periods on agriculture in various government sections and in the hands of individuals were significant sources of insights on the topic. Documents from 1880s to 1970s including correspondence, reports, and personal files provide useful information about the effects of disease on land use and agriculture in general. Archives on resettlement projects, state farms and pathogens control are sources of data to trace a series of disease fighting in the valley. The study also benefited from different empirical studies in the region. Putting these sources together gives the comprehensive picture on the history of making the valley viable for agriculture from 1965-1998. Oral evidences was collected from eleven selected elders who in one way or another witnessed or part of the development activities in the valley.

2.4. Method of Data Analysis

The study report has been produced by identifying and describing patterns of human activities in the valley and environmental changes. In the process of analysis, the grand narrative was the attempt to understand and explain the chronological change the valley witnessed in relation to the anthropological factors. In data analysis, ideas that surface in the environmental history were employed, interview data were transcribed, diaries and field notes were reviewed.

3. Results and Discussion

3.1. Farming and Fighting Pathogens, 1965-1998

The result of the study shows that beginning from the early 1950s, a number of factors have increased the demand for valley land cultivation. The need for more fertile land to produce sufficient food crops for the growing population was the driving factor behind the increase in valley cultivation. The period also witnessed the growth of commercial farming such as grain, pulses, oilseeds, cotton, sugar cane etc. This was supported by the introduction of medicine that enabled development agencies to fight against anopheles mosquito and tsetse fly (Hinew, 2018).

The major turning point in the valley development was the completion of Blue Nile Basin development feasibility study from 1958-64.[6] In view of the great economic prospects, the Ethiopian and the United States Co-operative Program conducted a feasibility study on the Blue Nile River Basin for six years. The study included thirteen big tributaries of the Blue Nile River from Gonder to Jimma and from Ambo to Gambella (Imperial Ethiopian Government Ministry of Public Works and Communication Water Resources Department, 1964). The report on the Angar-Dhidhessa River Valley revealed great economic potential of the valley for agriculture and hydroelectric power. Above all, the study indicated the possibility of developing 600,000 hectares of land for agriculture. However, it became clear that any attempt to practice agriculture in disease prone areas was possible through fighting pathogens (Ibid).

Among others, malaria was a serious human disease in the valley. Until the mid 1960s, there was no modern medical service to fight malaria. People in the region resorted to diverse traditional remedies to treat malaria. The Oromo used onions, herbs, fruits, and alcohol when they had malaria-induced fever. The Gumuz boiled very sour leaf of some plants and drank it when they felt feverish. Drinking

[6]The First (1957-61) and the Second Five Years Plan (1963-67) considered agriculture as "the leading economic activity."

boiled leaf helped patients to heavily sweat for temporary relief. They also utilized strong hot pepper mixed with grain as medicine to treat illness from malaria. Eating garlic by mixing with honey was commonly utilized during malaria prevalent seasons (informants).

State intervention against malaria in the Angar-Dhidhessa was in the 1960s. This was after the establishment of Malaria Eradication Service (MES) at national level by Imperial order number 22 of 1959 (Tekle-Haimanot, 1959 EC). This was state's reaction to the death of 130,000 people at national level and the highest morbidity rate that coincided with the harvest season resulted in shortage of labor across the country. Anti-malaria activities had already been started as pilot projects in Awash Valley as part of the Global Malaria Eradication Program since 1955. Following the Imperial Order of 1959, Malaria Eradication Service was gradually extended to provinces by National Health Development Network (NHDN) (Ministry of Health, 1984; *Negarit Gazeta,* No.22, 1959).

Since the early 1960s, the Ministry of Health announced the tasks to be undertaken by the Malaria Eradication Service (MES) after which it opened its provincial offices in different areas. In the study area, development agencies employed combined traditional and modern approach to fight disease. In 1971, based on the recommendation of the WHO and the national evaluation result, Malaria Eradication Service was discontinued (Ibid). In 1972, following the change of approach from malaria eradication to control, the malaria control program was reorganized as a vertical program operating across the country through 17 regional and 70 sector offices. The program was known as National Organization for the Control of Malaria and Other Vector-Borne Diseases (Ministry of Health, 2007).

However, the national program gave emphasis to Agro-Industrial Project areas like the Awash Valley (Ministry of Health, 2007). Thus, the peripheral regions like the Dhidhessa could not get due attention in the newly structured program of malaria control. As a result, malaria remained one of serious environmental barriers of habitation and social development in the valley. Fighting malaria was tiresome and it remained to be one barrier of agricultural development until late 1980s. In particular, in the state farms and settlement areas of the valley, malaria remained to be the major causes of illness and death (Wollega Agricultural Development Enterprise [WADE], 1975 EC). During the early 1980s, on the average, about 700 patients visited each health posts every week at the state farms. Owing to the absence of sufficient health service personnel, disease prevention and treatment in the state farms and settlement areas were made through seasonal campaign (Didessa Farm Project). It was only in the late 1980s that the Ministry of Health facilitated diagnoses and treatment of malaria at each farm site and settlement center (ibid).

Likewise, attempts made to improve livestock health in the Angar-Dhidhessa involved the control of Tsetse fly that caused *gandii* (trypanosomiasis). Trypanosomiasis was one of the severe environmental barriers of livestock rearing in the region. Traditionally, people reduced its damages through bush burning and game chasing (killing). Buffalo and other wild beasts were presumed to be carries of the disease. The traditional approach of disease fighting was widely practiced by herders in the adjacent highland s of the valley. There were old traditions of buffalo drives or hunting that used to be conducted twice in a year to protect crops as well as separate the grazing areas from livestock (EPMG, Ministry of Agriculture and Forestry to Wildlife Conservation Organization, 1968 E.C).

Following the completion of the feasibility study in 1964, the Imperial government sought to control livestock diseases to realise cattle breeding and the expansion of plough agriculture in the valley. The feasibility studies indicated that potentially productive vast lowland was constrained because of the impact of the trypanosomiasis. Although veterinary service was as early as 1927 in Ethiopia, Ministry of Agriculture did not realize cattle vaccination until late 1950s. It was after the proclamation of 1951 that cattle owners were forced to vaccinate and get treatment for their cattle even in the highlands (*Negarit Gazeta,* No.104, 1951). Even so, vaccination was limited to fighting against lung disease, anthrax, smallpox and rinderpest (informants).

Until late 1970s, fighting trypanosomiasis largely involved traditional methods. Agricultural experts who conducted feasibility study in the Dhidhessa Valley indicated that trypanosomiasis would be eradicated only if buffaloes, the agents of the disease, were chased away and bush area was cleared.

With the belief that livestock were the basis of agricultural life, farmers were engaged in getting rid of these wild animals. They also reported to the state that keeping buffalo from the intention of making the valley a tourism site instead of cultivation was just meant saving wild animals at the expense of the lives of the poor farmers. Agricultural experts hence requested the eradication of buffalo to make the valley viable for livestock production (EPMG, Ministry of Agriculture and Forestry to Wildlife Conservation Organization, 1968 E.C.). There are some indications that the government supported the local people's desire to chase away wildlife to secure livestock and crops. The campaigns to chase away buffaloes in the need to eradicate game-hazards were common practices in 1960s, 1970s and 1980s. For instance, in1976, Wallagga Province Administration distributed about 1000 bullets to each *awuraja* for this purpose. In general, frequent and large-scale hunting under the pretext of self-defense not only caused large-scale devastation of wildlife but also created security problem in the *awuraja*. Such large-scale campaigns were supported by annual savanna burning and clearance of vegetation swampy areas where tsetse fly breed at least in the grazing areas (Ibid).

Meanwhile, it became clear that game chasing and savanna burning alone would not overcome trypanosomiasis and malaria. One prominent change in the time was the shift to veterinary priorities, concurrent with advances in insecticide technologies. In the period, mortality from rinderpest pandemic was also high compared with other diseases, thereby attracting government attention for livestock disease research and control. The disease spread after the Congolese drove their cattle into the area and reached Dambi-Dollo to escape this cattle disease. The disease attacked livestock and game animals such as buffalo, wildebeest, and antelope. The mechanisms of disease avoidance involved livestock slaughter that accounted for more devastation (informants). Therefore, parallel with the need to utilize the vast uncultivated lowland, western Ethiopia had become one focal place of veterinary attention. As a result, there was a window of opportunity to tackle trypanosomiasis. On the other hand, the introduction of DDT created new prospects for insect eradication through chemical spraying (informants).

One major change in the agricultural experiment was the establishment of Bako Agricultural Research Center in 1962 and its scientific investigations in western parts of the country (Degefe, 1976). With its sub-stations in the valley, the research centre provided entomological and biomedical data to control disease. Based on this, the state embarked on fifty-year campaign to control lowland disease for fifty years with the support from WHO, UNICEF and ICA (Huffnagel, 1961). Accordingly, the first anti-malaria campaign for the region under the study began in the late 1960s. Similarly, the attempt to control tsetse fly coincided with the plan to use *tsetse* belts of the western lowlands for large-scale development in the 1970s (Huffnagel, 1961; Hinew, 2018).

Two significant non-governmental agricultural projects preceded the state farms and settlement farms in the valley. In 1965 and 1970, the projects were established with the mission to modernize agriculture. The first was the Dimtu Resettlement Project (1965-77) (Qanno, 2011) established by Ethiopian Evangelical Church Mekane-Yesus (ECMY), and the second was Angar-Guttin Agricultural project launched by three Dutch brothers. The former with the financial assistance from the Swedish Evangelical Mission (SEM), the Norwegian Evangelical Society (NES), German, Finland and American Sister Churches, established settlement farms through providing agricultural implements and some medicines from 1965-77. The latter project known as **'***Solidaritè et Developement'* made significant contribution by supporting livestock and dairy farming, through the use of vaccination and animal hybridization from 1970-76 (informants). As a result, in the early 1970s, the project was able to establish six settlement farms each comprising 500 farmers. However, in both cases, agricultural activities were deterred by disease, pests and wild animals. While livestock disease consumed thousands of heads of cattle each year, the loss of livestock due to the attack from wild animals was countless (Wollega Administrative Province, 1962 EC).

Strong fight against pathogens to realize valley agriculture was made by the *Darg* government. It sought that any lasting useful and compatible development in the valley is likely to be the reduction of disease that required the eradication of pathogens. This came following the establishment of state

farms and settlements in the valley as of 1975. The state had ambitious plans to tame the environment with the help of science and technology under the motto of "the conquest of nature," (*Negarit Gazeta*, No.44, 1977/78). The state established state farms and settlement farms by using the earlier experiment centers to fight disease.

Thus, pathogen-control trails, particularly Tsetse, have been undertaken in the valley beginning from the early 1970s. The first trial began in northern part of the valley (Angar-Guttin) where the Dutch brothers established agricultural project. The area was close to the Settlement Authority Office and agricultural experiments. Another pathogen-control trail was established near Bedele, in upper parts of the valley. Trial at the two centers has been successful in significantly reducing tsetse populations and trypanosomiasis prevalence using insecticides (Wollega Administrative Province, 1970). Such centers also served as agricultural experimental bases for the state farms and settlement farms in the decades that followed.

From the objective of strengthening the link between crop and livestock agriculture, the valley was among the regions that had been targeted by vaccination campaign during the 1970 and 80s (Wedajo, 1989). The case in point was the UNDP's US $ 2.5 million (1983-86) for general livestock development (UNDP Country Program, Ethiopia 1983-1986). Livestock production was considered as an important factor for developing the material and technological base of settler farmers. The state conducted large-scale livestock immunization campaign particularly in the settlement farm areas and its livestock farm in the valley. The vaccinators camped at the agricultural experiment centers and used to conduct a series of cattle vaccination campaigns. Oral evidences indicate that vaccinations played a crucial role in mitigating livestock mortality due to disease, which according to local farmers was quite rampant in the valley in the past (informant).

In addition, the state also introduced anti-insect plant known as *neem tree (Azadirachta indica)* that has the potential to harm tsetse fly and mosquitoes. The plant has an anti-insect aroma, which kills them. Evidence shows that the state planted about 246,657 seedlings in both the western and eastern parts of the Dhidhessa River since 1973 (Wollega Administrative Province, 1962 EC). By eliminating disease, the state intended to encourage livestock production and habitation.

Ultimately, decades' long extensive campaign to eradicate disease resulted in the creation of agriculturally suitable environment for both crop and livestock cultivation through spraying the bush with DDT, clearing bush and chasing game presumed to be carriers of the disease. DDT clearly killed tsetse but aerial spraying was not effective in thick vegetation areas. In such cases, bush clearing was an alternative to eradicate pathogens. The campaign against malaria and trypanosomiasis from 1975 to 1991 enabled the state to establish nine state farms with nearly 17,000 workers and ox- drawn cultivation in the settlement areas of the valley (state farm report, 1983). The land size cultivated by the state was nearly 40,000 hectares. By the late 1990s and the early 2000s, the process revolutionized livestock production and the region turned to a place of surplus crop cultivation. In 1998, following the disintegration of state farms, the government has leased out nearly 70,000 hectares of land to more than 167 investors (Beni-Shangul-Gumuz Region, 2004).

Besides, smallholder farmers that depended on ox-drawn ploughing and livestock production settled large size of land in the valley. By 1984/85, out of 47,138 hectares of valley land planned to be developed for the resettlement, about 19,391 hectares were utilized in the northern part of the valley (Settlement Authority, 1980). In early 2000s, in the northern part of the valley alone, more than 58,000 hectares of land were claimed for smallholder cultivators (Tefera, 2009). As a result, large number of population settled the valley and farmers were able to keep large number of livestock. Control of the disease also helped famers not only to keep large livestock populations but also to plow the land using animal traction (informants).

3.2. Environmental Effects of Disease Control

The making of the valley viable for farming resulted in significant change on the valley ecosystem. Disease control put strong pressure on land through settlement, cultivation, and grazing. The process

introduced land use change that can be described in terms of the change in forest and wild animals. The process of disease fighting resulted in removal and depletion of the forest and reduction of wildlife. Although there were little changes in the structure of the grassland and shrub in the pathogen control, the changes on the composition layers of forest and tree species were very vivid (Hinew, 2018).

On the other hand, frequent burning of the vegetation depressed tree species and grasslands. Besides, exotic tree species such as Eucalyptus globules, Neem tree, and Jacaranda acuminata were favored more than the indigenous trees. Development agencies quickly expanded exotic trees at the expense of native tree species. The increase in the demand of timber also negatively affected the tree species providing strong woods (Tefera, 2009). Moreover, cultivation techniques and farm size also affected vegetative structure and tree species diversity of the valley. Control of trypanosomiasis was followed by the expansion of farming in the study area. The conversion of forest ecology to farming centre caused extensive ecosystem disturbance. Mechanized farming, in particular, involved effective technology on large size of land. Apart from forest clearing, it employed chemicals and fertilizers in the production process (informants).

The depressing part of the valley development program was the failure of development agencies to consider game protection. It is obvious that pathogen control and cultivation involved habitat destruction. In addition, the process involved chasing (hunting) games of the valley presumed to be carriers of trypanosomiasis. The process in general brought deforestation of known forest zones of the valley and deterioration of wildlife. The criticism was that little was done to preserve a living space for wildlife and control hunting in the process of making the valley suitable for agricultural life. Deforestation and game chasing were the principal factors for the loss of wildlife population in the valley. Above all, habitat fragmentation restricted the territory of wild animals and the process made hunting easier contributing to the extermination of wildlife (informants).

4. Conclusion

The study of fighting disease in the valley reveals that development agencies have been successful in the control of trypanosomiasis, malaria, and other tropical diseases and these diseases are no more hazardous to farmers in the region. The eradication of disease was the result of game chasing, vegetation clearance and spraying chemicals. Understanding how disease and agriculture interact, such as the link between livestock, disease, human in the valley, and the decrease in numbers of wild animals would explain the history of the valley. However, we remain convinced that the process caused the major disruption of the environment through habitat destruction and the extermination of wildlife. The state coercive measures for the expansion of mechanized agriculture in the river valley were repressive acts that instigated environmental pressure. The environmental crisis is deemed to be the result of ambitions and misguided land use strategy, and an uncontrolled utilization of forest land in post 1990 period.

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List of informants

S.N.	Name	Age	Place and date of interview	Remark
1	Alemayehu Kumsa	57	Naqamtee, May 8, 2017	Served as health officer in Ukkee and provided data on lowland disease in the 1970s and 1980s.
2	Bayata Tiba	64	Soogee, May 13, 2016	A Gumuz elder and provided information on the livelihood in the disease ecology.
3	Dargo Reda	78	Angar-Guttin, February 8, 2017	Originally from Raya (Wallo) and was one of the early settlers in 1979. He provided data on the activities of the Settlement Authority, RRC and cooperative farms in the Angar-Guttin resettlement areas.
4	Dorsis Dhuguma	69	Angar-Guttin, December 2, 2016	Formerly a tenant who migrated into the valley in 1960s in search of land. He provided information on old resource relations, early valley agriculture, and environmental barriers of agricultural life.
5	Ejeta Tolesa	72	Naqamtee, December 3, 2016	A graduate of Jimma College of Agriculture, served in the AGADP and Bako Agricultural Research Centre. He provided data on early development efforts of valley agriculture.
6	Fekadu Gemechu	67	Naqamtee, May 1, 2016	Worked as an agricultural officer in the *Darg* Period. He provided data on the beginning and operations of the "*Fetan Irsha.*"
7	Gebre-Michael Etana	69	Naqamtee, December 6, 2016 and July 18, 2016	Worked as manager of Lookoo state farm, and provided data on the constraints of farming.
8	Gemechu Shone	77	Naqamtee, December 6, 2016	He was one of the personnel in the Dhidhessa state farm and participated in the opening of the "Fetan Irsha." He provided data on the establishment and operation of the state farms.
9	Ibrahim Ali	57	Soogee Qarsaa, November 26, 2016	Lived among the Gumuz for more than 20 years and well witnessed the livelihood changes in the last two decades.
10	Mengistu Hirpha	75	Angar, January 22, 2017	Worked as a hired labor in the AGADP and later as a cadre in the Angar-Guttin resettlement project. He provided data on the development activities in the valley.
11	Teshome Gemeda	78	Naqamtee, October 9, 2015	Worked as director of RRC and later as head of the Food Security Disaster Prevention and Preparedness Office. He provided data on the history of valley settlements.