Science Research
2023; 11(6): 136-142
http://www.sciencepublishinggroup.com/j/sr
doi: 10.11648/j.sr.20231106.12
ISSN: 2329-0935 (Print); ISSN: 2329-0927 (Online)

Assessment of Factors AffectingSeedling Survival in AdamiTullu andDugda District of Central Rift Valley of Oromia, Ethiopia

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To cite this article:
Desta Negayo, Bonsa Fentale, Gemeda Terfassa. (2023). Assessment of Factors Affecting Seedling Survival in AdamiTullu and Dugda District of Central Rift Valley of Oromia, Ethiopia. *Science Research*, *11*(6), 136-142. https://doi.org/10.11648/j.sr.20231106.12

Received: September 20, 2023; **Accepted**: October 12, 2023; **Published**: November 24, 2023

Abstract: Tree planting initiatives and activities have been conducting at different periods of time in Ethiopia specifically in Oromia aiming to curb the effect of climate change and deforestation. Following production of large number of seedling each year; plantation campaign has conducted in large scale. The study was designed to assess the seedling production and its survival inEast Shewa zone of Oromia region. From East ShewaAdami Tulu JidoKombolcha and Dugda Districts were selected as both are one of the districts conducting high plantation campaign every year. Household survey interview (n=132, 66 for each districts) were the methods used to obtain the primary data. As a result, even though there is a massproduction of seedlingandlarge scale plantation, there is insignificant number of survival of planted seedlings on the field according to the data from survey result. Most of the respondent noted that the major biotic factors for seedling survival were animal intervention (62.12%) followed by mallrat (22.73%) and Insects and pests/ including termites (11.67%) were the major biotic factor affecting seedling survival on the field at ATJK district. However its impact was lesser compared to ATJK district the same biotic factors were affecting seedling growth at Dugda district (table 2). The other factors responsible for less seedling survival un accessible water sources and lack of overall management are the common factors that has gotten significance value at p (α=0.05) at both districts. Therefore, it is importantto take the revert action to save the undermined huge investment cost to the success of plantation. Post plantation management and budget allocation for transplanted plants also crucial for plantation success.

Keywords: Community Assumption, Seedling Survival Rate, Private Holdings

1. Introduction

Afforestation is the common approach of restoration on degraded land and biodiversity conservation, and eco-environmental improvement [5]. However, the vegetation establishment on degraded land is constrained by many factors in which the insufficient moisture availability listed as the top constraint [12]. How the environment is much more degraded, tree seedling plantations, with appropriate and well designed in-situ rainwater storing structures can rehabilitate the denuded areas [7].

Restoration practices for degraded and/or deforested forest landscapes are common and old phenomena all over the world [13]. There are many approaches to restoration practices, such as establishing exclosures [4, 9, 15]. area enclosures [14]; planting tree seedlings [1] and direct seeding [10]. From these approaches, tree planting is common to most forest landscape restoration initiatives, in which the quality and quantity of planting material available determine the success of restoration initiatives [19]. Furthermore, tree plantations through sound silvicultural management are used as one of the most effective methods capable of reversing soil, biomass, and biodiversity degradation while providing diverse socio-economic services [11].

A lack of precipitation and belowground water resources leads to increased seedling mortality and extensive dieback in many species [18], while others are minimally affected [10].

The Ethiopian government has a big dream: restoring 22

million hectares of degraded lands and forests by 2030. By doing so, the country aims not only to increase tree cover and restore degraded forests, but also to significantly enhance the forestry sector's contribution to agricultural production systems, water and energy; to improve food and nutritional security; and to create more opportunities for employment and household income (Ethiopia's new forestry law 2018).

In the dry and more degraded lands of central rift-valley of Ethiopia particularly AdamiTullu and DugdaDistrict, have been planting many seedlings of different tree species year after year but the survival of those seedlings were very poor as we informed from district offices. Again, the area had not been given much research attention and are still lacking clear information on factor affecting plantation successes. Therefore, the study was designed to assess the seedling production and responsible factors for the success of plantation to understand forest establishment and development.

1.1. General Objective

The overall objective of this study was to assess the seedling production and responsible factors for the success of plantation to understand forest establishment and development.

1.2. Specific Objectives

1) To assess the success of plantation after five years of planting in the study area and identify more survived species in the study area
2) To identify factors affecting seedling survival after planting in the study area

2. Research Methodology

2.1. Description of the Study Site

This study was conducted in Adami Tulu and Dugda districts in central rift-valley of Ethiopia.

Adami Tulu district lies between 7° 9'N lat, 38° 7'E long; elevation 1650 m above sea level. The mean annual rainfall and temperature of the area is 760.9 mm and 19.8°C respectively. The pH of the soil is 7.88. The soil is fine sandy loam in texture with sand, clay and silt in proportion of 34, 48 and 18% respectively (ATARC, 1998). The altitude ranges from 1500-2300 m.a.s.l. Adami Tulu Jido Kombolcha Woreda has semi-arid and arid agro-climate zones. The Woreda receives an average annual rainfall of 760 mm. The mean monthly temperature varies from 18.5°C to 21.6°C with mean annual temperature of 20°C. Rainfall extends from February to September with a dry period in May to June, which separates the preceding short rains from the following long rains [6]. Three land use systems: croplands, controlled grazing lands with closed areas and communal open access grazing land exist in the study area [16]. The soil is fine sandy loam in texture with sand, clay and silt in proportion of 34, 48 and 18% respectively (ATARC, 1998).

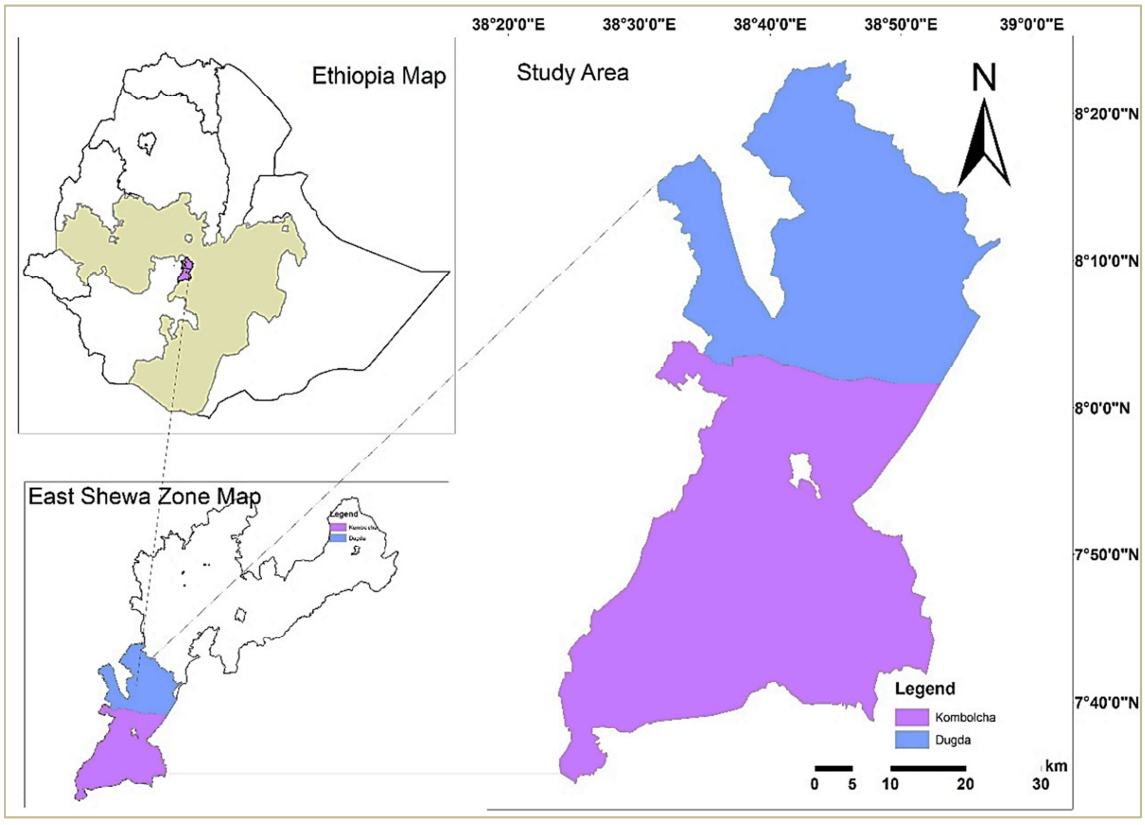

Figure 1. *Map of the study area.*

DugdaWoreda is located in East Shewa Zone of Oromia Regional State. Geographically the Woreda is located between 8°01'N to 8°10'North latitude and 38°31'E to 38°57'E longitude. The total area of the Woreda is 959.45 km^2. Altitude ranges from 1600 to 2020 meters above sea level (Spielman*et al.*, 2011). The mean annual temperature was about 22.8°C, while mean annual rainfall was 750 mm (DugdaWoreda Agricultural Office, 2015). The land use of the Woreda consists of cultivated land (65.25%), forest (8.32%), pasture (3.55%), water bodies (12.54%), swampy and rocky mountain areas (0.31%) and 10.03% others and, the dominant types of crops are maize, wheat and teff (DWAO, 2015). These soil types have light texture making them vulnerable to both wind and soil erosions. In addition, these soil types are saline and alkaline contents, though the degree of salinity is very low.

2.2. Sampling Procedure and Data Collection

Based on the population data, sample of the people to be interviewed were selected from farmers in the study area. From this list, semi-structured questionnaires wereprepared to farmers randomly selected from the study area to ask their perception on factors hindering seedling survival including which one they consider mostly affecting factor in the area. Discussion with concerned development workers and local leaders was conducted mainly focused on strengths, weakness, opportunities and threats to forest development and facts about the failure of forest development in the study area.To get information about last five years plantation status and the main challenges for plantation success was assessed through household survey method.

2.3. Sample Size and Sampling Techniques

The sample size was determined using the method proposed by Yamane (1967).

$$n = \frac{\mathrm{N}}{1+\mathrm{N}\ (\mathrm{e2})}$$

Where n is the sample size, N is the population size, and e is the desired level of precision.

2.4. Statistical Analyses

Data from the questionnaire responses and field observationwascoded and entered in Statistical Package for Social Scientists (SPSS version 20) and converted to status for analysis. Descriptive statistics was used to show the major factors that farmers considered as mostly dominant problem for survival of the plants on field.

3. Results and Discussion

3.1. Demography of Household Respondents'

Table 1. *Demographic characteristics of household respondents' at Adami Tulu District (n=66).*

Description	Frequency (N)	Percentage (%)
	Sex	
Male	60	90.9
Female	6	9.1
Total	66	100
	Marital status	
Married	63	95.5
Widow	3	4.5
Total	66	100
	Education	
Illiterate	2	3
Primary Education	51	77.3
Secondary Education	11	16.7
College/University	2	3
Total	66	100
	Average	Range
Age	37	22-80
Family size	7	1-12

Table 2. *Demographic characteristics of household respondents' at Dugda District (n=66).*

Description	Frequency (N)	Percentage (%)
	Sex	
Male	58	87.9
Female	8	12.1
Total	66	100
	Marital status	
Married	61	92.4
Single	3	4.6
Widow	2	3

Description	Frequency (N)	Percentage (%)
Total	66	100
	Education	
Illiterate	5	7.6
Primary Education	41	62.1
Secondary Education	19	28.8
College/University	1	1.5
Total	66	100
	Average	Range
Age	37	20-82
Family size	7	1-12

3.2. Tree Seedling Plantation and Survival Under Private Holdings

The government initiative of degraded areas rehabilitation has led to establishment of more species for plantation purposes. Seedlings raised in the nurseries of Adami Tulu and Jido Kombolcha and Dugda District mainly consisted of *Melia azandrich Casuarina equestifolia, Eucalyptus spp, Cordia africana, Moringa stenopetal, Schinusmolle, Acacia senegal, Acacia seligna, Sesbania sesban, Jacaranda mimosifolia Leucaena leucociphala, Grevilea robusta Pericia americana, Mangifera indica and Carica papaya* are the most importantly produced tree seedlings. Among seedling under the nursery *Melia azandrich Casuarina equestifolia, Eucalyptus spp, Cordia africana, Moringa stenopetal, Schinus molle, Pericia americana, Mangifera indica and Carica papaya* are species that are planted under theprivate land. The average survival rate of those planted species under private land was 33% and 28% at Adami Tulu and Jido Kombolcha and Dugda District respectively. The survival rate under the private land is relatively better than that of communal land plantation. This may be due to better management of seedling under private land compared to communal land plantation.

Table 3. *The status of tree seedlings planted under private Holdings at Adami Tulu District (n=66, multiple responses possible).*

List of trees	Frequency planted	% planted	Frequency survived	% survived	Total seedlings Planted	Total seedlings Survived	Survival rate %
Schinusmolle	28	42%	27	41%	434	99	22.8
M. azandrica	38	58%	32	49%	725	106	14.6
C. equestifolia	15	23%	14	21%	429	53	12.4
Eucalyptus spp.	24	36%	24	36%	1045	394	37.7
A.saligna	6	9%	6	9%	445	250	56.2
D. engustifolia/ittacha	1	2%	1	2%	2	2	100
C. africana	10	15%	10	15%	51	14	27.5
O. africana	1	2%	1	2%	2	1	50
F. sychomorous	3	5%	3	5%	5	2	40
J. procera	1	2%	1	2%	5	0	0
C. lusitanica	2	3%	2	3%	302	20	6.6
H. nilotica	1	2%	1	2%	2	2	100
Moringa spp.	24	36%	23	35%	175	50	28.6
A.tortilis	1	2%	1	2%	10	0	0
Z. spinachristi	1	2%	1	2%	1	1	100
A.Senegal	1	2%	1	2%	10	0	0
D. abyysinica/Koshim	5	8%	5	8%	70	58	83
G. robusta	5	8%	2	3%	140	4	2.9
S. sesban	1	2%	1	2%	5	0	0
L. leucociphala	1	2%	1	2%	2	1	50
J. equistifolia	5	8%	4	6%	26	2	7.7
D. regia	1	2%	0	0%	300	0	0
Psidiumguajava	1	2%	1	2%	3	1	33.3
Periciaamericana	19	29%	18	27%	470	185	39.4
Carica papaya	15	23%	16	24%	467	287	61.5
Mangiferaindica	6	9%	6	9%	129	4	3.1
Casimiroaedulis	2	3%	2	3%	20	3	15
Average survival rate (%)							33%

Table 4. *The status of tree seedlings planted under private Holdings at Dugda District (n=66, multiple response possible).*

List of trees	Frequency of planted	% planted	Frequency of Survived	% survived	Total seedlings Planted	Total seedlings Survived	Survival rate %
S. mole	43	65%	39	59%	657	174	26.5
M. azandrica	46	70%	39	59%	822	258	31.4
C. equestifolia	23	35%	18	27%	305	104	34.1
Eucalyptus spp.	19	29%	16	24%	921	294	31.9

List of trees	Frequency of planted	% planted	Frequency of Survived	% survived	Total seedlings Planted	Total seedlings Survived	Survival rate %
A.saligna	8	12%	6	9%	237	11	4.6
D. engustifolia/ittacha	4	6%	4	6%	110	28	25.5
C. africana	9	14%	8	12%	54	13	24.1
C. macrostachyus	2	3%	2	3%	17	2	11.8
O. africana	4	6%	2	3%	39	6	15.4
J. procera	2	3%	2	3%	15	6	40.0
C. lusitanica	7	11%	7	11%	134	7	5.2
Moringa spp.	7	11%	6	9%	89	7	7.9
A.tortilis	2	3%	2	3%	7	7	100.0
Axxee	2	3%	1	2%	12	1	8.3
B. egyptica	1	2%	1	2%	12	10	83.3
A.Nilotica/laaftoo	1	2%	1	2%	7	3	42.9
Z. spinachristi	1	2%	1	2%	20	3	15.0
D. viscosa/Harooressa	1	2%	0	0%	15	5	33.3
A.Senegal	4	6%	4	6%	22	5	22.7
D. abyysinica/Koshim	6	9%	5	8%	292	245	83.9
G. robusta	12	18%	11	17%	213	45	21.1
S. sesban	2	3%	1	2%	12	0	0.0
L. leucociphala	2	3%	1	2%	25	10	40.0
J. equistifolia	3	5%	3	5%	21	4	19.0
D. regia	1	2%	1	2%	5	3	60.0
Zaytun	3	5%	3	5%	35	2	5.7
Avucado	14	21%	11	17%	115	16	13.9
papaya	14	21%	12	18%	129	21	16.3
Mango	17	26%	16	24%	70	11	15.7
Average survival rate (%)							28%

3.3. Factors Affecting Seedling Survival

3.3.1. Biotic Factor

Most of the respondent noted that the major biotic factors for seedling survival wereanimal intervention (62.12%) followed by mallrat (22.73%) and Insects and pests/ including termites (11.67%) were the major biotic factor affecting seedling survival on the field at ATJK district. However its impact was lesser compared to ATJK district the same biotic factors were affecting seedling growth at Dugda district (table 2). According to the respondent, lack of management like fencing and guard after planting and absence of regular monitoring at site were result for animal trampling and browsing. Similarly,[17] stated that Cattle can negatively affect seedling growth rate and survival by trampling and browsing on seedling and pests including termites seem to be a negative factor for plants in that they cause trees to wither and suppress plants' growth.

3.3.2. Abiotic Factor

Another factor which was negatively affecting seedling growth and plantation success on the field was abiotic factor in addition to biotic factor. According to the survey results major abiotic factors were water stress (54.5%) followed by soil factor like compactness and salinity (18.18%) at Adami Tulu and Jido Kombolcha District. [2] that most notably seedlings in dry lands are highly limited by water availability and may have less survival in dry and moisture stressed areas where desiccation is high probable during the dry season.[3] also stated that compaction of soil or low soil fertility results in high dry density which definitely reduced the rate of root penetration and development. In moisture stress environment like the study area planting seedling on time to harvest the shortest rain season is crucial for energetic and vigorous seedling growth and watering during the dry season up to seedlings developed deep roots to consume water from the soil. In Reverse to this in the study areaSome respondents, 7.57%, were indicated that late Planting time was problem at Adami Tulu and Jido Kombolcha District and Problem with planting technique were another biotic factors for seedling survival at Adami Tulu Jido Kombolcha and Dugda District.

Table 5. *Binomial test (Yes/No) of factors affecting Seedling Survival at Adami Tulu District.*

List of Factors	N	%	Observed Prop.	Test Prop.	P-value (α=0.05)
SoilFactors (Hard soil core, saline soil, etc)	12	18.18	1.00	.50	***
Water (Shortage, salty, un accessibility)	36	54.55	1.00	.50	***
Delayedplantingtime	5	7.57	1.00	.50	ns
Problem in planting technique	2	3	1.00	.50	ns
Lackof management (Protection/Fencing, Browsing/	41	62.12	1.00	.50	***
Mallrat	15	22.73	1.00	.50	***
Diseases and Insect/ pests	11	11.67	1.00	.50	**

Table 6. *Binomial test (Yes/No) of factors affecting Seedling Survival at Dugda District.*

List of Factors	N	%	Observed Prop.	Test Prop.	P-value (α=0.05)
Water (Shortage, salty, un accessibility)	45	68.18	1.00	.50	***
Problem in planting technique	5	7.58	1.00	.50	ns
Lack of management (Protection/Fencing, Browsing, Fertilizing, Watering/	29	43.94	1.00	.50	***
Mallrat	5	7.58	1.00	.50	ns
Diseases and Insect pests	2	3	1.00	.50	ns

As the average result from the two districts indicates the two factors namely moisture deficit (61.37%) and lack of seedling protection from animal browse (53.03%) were ranked as the first and seconded bottle neck for seedling survival on the field at both districts. At Dugda district among the factors affecting seedling survival moisture deficit was ranked as first (68.18%) while seedling protection from animal browse (43.94%) was the second rank. In addition to the two factors mallrat (22.73%) and soil compactness (18.18%) were affecting seedling growth and survival at Adami Tulu and JidoKombolcha. Similar to this finding [12] also stated internal water status at planting, the condition of the nursery root system, the ability to control water loss through the stomata, the area of contact between the soil and functioning roots after planting, the soil moisture availability and the ability of the plant to produce new roots are all important factors.

4. Conclusion and Recommendations

Tree planting has the vital role in ecosystem productivity and enhance biological and chemical restoration of degraded land. Over all from what have been seen managements of the trees especially at the seedling stages is very crucial. Keeping the quality of the planting procedure followed by post seedling management after planted was the major problems in both areas.

Different factors that are greatly affect the survival of tree seedlings on the field were identified. This factors were compounded by the environmental factors and human induced factors. However, the contribution of livestock grazing, and water stress impacts were pointed out by the farmers as main barriers for plantation success in the study area, the other factors that hindering tree seedling survival were, technique of planting, inappropriate site preparation, small rat, soil factors, pest/insect and delayed time of planting were also raised by the farmers as the obstacles for tree and shrub plantation development.

Therefore, as dry land areas commonly known by its moisture stress, integrating seedling plantation with soil and water conservation stricture to encourage water retention and soil fertility, and supplementing water in a hard season of the year (prolonged drought periods) is compulsory to enhance seedling survival rate. This mean that planning management the same as planning for production is a win-win solution the failed survival and over all to our degrading environment. Also to enhance early growth and survival of planted seedlings; critical evaluation and selection of best nursery soil mixing ratio is important, protecting of planting site from animalinterference are ideal toimproveseedling survival, and seedling transportation and planting techniques must be adjusted as suitable for dryland areas.

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