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SURVIVAL, GROWTH PERFORMANCE AND SOCIO-ECONOMIC IMPACTS OF BILLION TREE INTERVENTION IN DISTRICT KARAK

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ABSTRACT

Forests in Pakistan have been severely affected by deforestation and degradation due to the immense social pressure of forest dependent communities for their livelihood. Billion Tree Afforestation Project (BTAP) is an initiative of mass afforestation by Khyber Pakhtunkhwa government to decrease social pressure on forests and to support forest dwellers livelihood. The present study investigated the survival and growth performance of plantations along with evaluation of the status of Assisted Natural Regeneration (ANR) on specific sites. Furthermore, its socio-economic impacts on the local livelihood were also explored. Circular sample plots of 50 feet radius were used for data collection. The numbers of pits were counted and observed for the survival percentage and growth performance within the same plot. Further, the number of living trees as well as dead was estimated. Pit density was found lesser than the required 10x10 feet spacing. According to 10x10 feet spacing the required number of pits per hectare (ha) is 1075 but found lesser ~ (663). Average regeneration per ha was estimated as 222 and major species were *Prosopis juliflora, Zizyphus nemularia*, *Nannorrhop ritchiana*. All the regeneration was observed outside the pits during data collection in randomly selected areas. The study indicated that only the regeneration i.e. established (mean above 9 inches) were found while the un-established (below 9 inches) were not found. The survival rate of Karak forest subdivision was 92%, while Teri forest range it was found 93%. Species composition in plantations was also found and the percentage of each species is as followed. *Acacia modesta* (18%), *Eucalyptus* (55%), *Acacia nilotica* (7%), *Dodonaea viscosa* (3%), *Tamarix aphylla* (1%) and *Dalbergia sissoo* (16%).

Key word: Survival, growth performance, impact of billion trees, forests.

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INTRODUCTION

Pakistan is a country with a total forest area of 88.43 million has; 4.60 million forest areas and forest, fields representing 5.2% of the total land area (Shaw, 2016) Pakistan's population of 207.774 million, 132.18 million live in rural areas (GOP, 2017) generally people, depending on wood as a source of fuel and construction. Therefore, finding ways to protect and increase forest resources is critical for the environment. The per capita forest is 0.03%, which is imposed negative impacts on the environment as compared to the 0.6 % of the world. The enough demand is not meeting for forests, timber and wood products. The wood debasement in Pakistan was estimated to be 4.42 million cubic meters. The overall timber production was determined as 3.98 million cubic meters in 2009. This indicates a significant difference between production and producing between 0.437 million cubic meters. Here, the demand exceeds the renewal capacity. In Pakistan, during 2008-2010111.38, 91.73 and 92.26 million trees were planted respectively, and measures were taken to increase the forest cover through collective plantation and tree planting (Bukhari and Bajwa, 2012).

Khyber Pakhtunkhwa (KPK) is the province of Pakistan, rich in natural assets offering its owners various goods and services. Khyber Pakhtunkhwa has 7.45 million ha area, of which 1.51 million ha i.e. 20.3% are under Forest, 29% arable area and more than 30% is barren, grazing land or shrub areas. It has been assessed that the forest of Khyber Pakhtunkhwa was excessively degraded with conducive climatic conditions, 72% Forests are under stocked, 74% forests have less regeneration and 72% forest were used for fuel wood (GIZ, 2014). Therefore, it is necessary to address the degradation &rehabilitates degraded forests to optimally exploit the site potential. Pakistan is determined to increase forest cover from 5.3% to 6% within the scope of the forestry sector's thousand-year development goals. According to statistics, in order to increase the forest area by 1%, an area of 1.051 million has must be provided with sufficient financial and human resources, as well as appropriate climatic and edaphic conditions (Bukhari and Bajwa, 2011).

The overall enthusiasm for planting trees has an incredible assurance of the reestablishment of corrupt biological systems, the reduction of the effects of ecological changes, the rationalization of biodiversity, and the creation of elements and administrations to assist the employment of neighborhood individuals. Worldwide, 2 billion hectares of land can profit from improvement; A larger region than South America (Laestadius *et al.*, 2011; WRI, 2011).

To paint the economy green, the Khyber Pakhtunkhwa (KP) Government launched the Green Growth Initiative (GGI). GGI Task Force was established. Six areas of intervention have been identified: forestry, protected areas, clean energy, climate resistance, water/sanitation and Khyber Pakhtunkhwa waste management. The standard-bearers of the Green Growth Initiative prioritize green and clean forestry revolutions, especially in Pakistan. The Tree Reforestation Project (BTAP) is launched under the aegis of GGI, which addresses the sustainable development needs of forestry, generating green jobs, strengthening gender, improving the

forest resource base, rehabilitating and improving ecosystems existing forests, improved livelihoods and preservation of national forest resources to address the global problem of climate change. Khyber Pakhtunkhwa is the first sub-national institution to register for the Bonn Forest Restoration Challenge (IUCN, 2017).

The "One Billion Tree Planting Project in Khyber Pakhtunkhwa", called BTAP, aims to plan, design, launch and implement a "GREEN GROWTH INITIATIVE" in the KPK forest sector. KPK Forest office carried out this project across the province in three forest territories, the central and southern regions, the Hazara and Malakand region. The Hazara region too comprises of a watershed management area. Two stages are classified in the project; the 1st stage will be implemented in 2015-2017, with a total cost of 1912.0 million Rupees, the 2ndstage in 124.222 million Rupees will be functional in 2014-15.

OBJECTIVES

The objectives of the study were:

- Exploring socio-economic impacts of BTAP activities on local livelihood,
- Determining survival and growth performance of plantation executed within district Karak
- Evaluating the status of Assisted Natural Regeneration (ANR) in the plantation sites.

MATERIALS AND METHODS

Study area: This Study was done in Pakistan's Khyber Pakhtunkhwa (KP) Province; Karak District. The total area is 3,372 km^2, located at 33° 7'12 N and 71° 5'41 E at 586m altitude (figure 1). Geographically, it is situated in north of the District Bannu and Lakki Marwat areas, on the Indus Road between Peshawar and Karachi, south of the Kohat region.

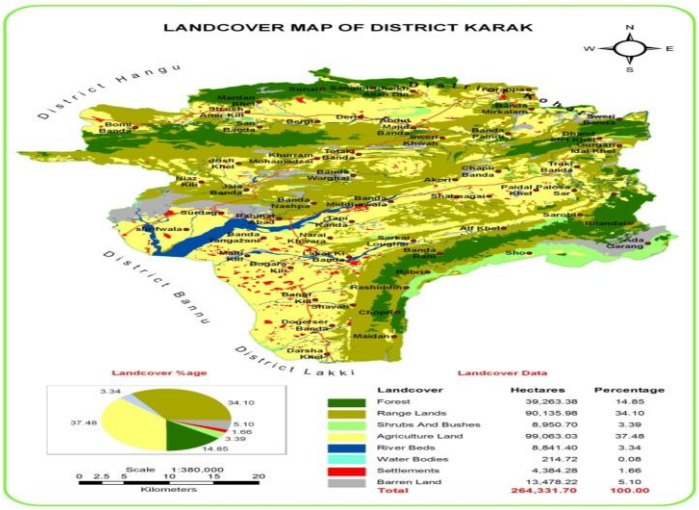

Figure 1: Map of Khyber Pakhtunkhwa (KP) province showing location of district Karak; the study area.

It is situated 123 km from the provincial capital Peshawar, in the main Indus road between Peshawar and Karachi. Karak district is divided administratively into three groups: Banda Daud Shah, Karak and Takht-e-Nasrati, along with 23 union councils. Banda Daud Shah, Karak and Takht-e-Nasrati Tehsils consist of 5, 9 and 7 Union Councils, respectively.

Study design: The study was carried out in Karak district and the study area was divided into ten cultivation areas. Five sites were randomly selected from Karak forest subdivision and Teri forest range respectively. In Karak Forest subdivision, the total area of departmental plantation was 558 ha which comprised of about 192 samples per ha and 58 sampled plots from each selected site. In Teri Range the total area of departmental plantation was 1126 ha which contains 269 samples/ hectare and 41 sampled plots. The total area of departmental plantation in both subdivisions was up to 1684 ha in which 461 ha area was used for sampling and total 99 sampled plots are carried out of ten random sites.

Data collection: The data were collected in two parts; first part of data collection was to gather information from local communities and the second one includes field sampling for the survival and growth performance.

Primary data collection: For socio-economic information, a questionnaire survey was conducted. The local community was interviewed for primary data collection with the help of specially designed and pre tested questionnaires by randomly selecting from all ten sampling sites of District Karak. During interview vernacular language was used. All community members participated in BTAP was interviewed from different age groups (20-30, 30-40 and 40-50 years). During the informal meeting the authentic and objective types of questions were asked of the respondents to get detailed information.

Field sampling: To meet objective 2, field data about girth, height and age of the plantation was required. For this purpose, circular sample plot of 50 feet radius was used for data collection. The numbers of pits were counted and observed for the survival percentage and growth performance within the same plot. Further, the number of species as well as dry species was determined and the growth rate of the plants at different sites were recorded and comparatively analyzed. Different formulas were used as per BTAP guidelines and WWF monitoring protocols. As the plantation was raised in three phases as per BTAP activities, therefore measurement of species growth was assessed by measuring the following attributes; like girth, height and age of the plantation. Height and girth are considered best indicators of growth performance comparatively. Pit density is an important indicator for assessing the success and the survival rate of a plantation program.

Besides sampling planted in the pits, natural regeneration also comes out in the plantation areas. Assisted Natural Regeneration (ANR) was also observed during sampling in each site. ANR is one of the simple and cost-effective restoration approaches for FLR (Eliott, 2016) because the expenditure on ANR is half as compared to other restoration techniques (Appanah *et al.*, 2015). Height was the key factor to distinguish regeneration establishment. ANR was assessed by counting the number of regeneration with respect to height in inches. Regeneration enumeration was divided into two categories, one having less than 9 inches height (not established) and other having more than 9 inches height (established).

Sampling sites selection: A total of ten (10) sampling sites were selected in the study area, based on the survey conducted at the start of the study (table 1).

Site No	Sampling site name	Forest subdivision+ forest fange	Area (ha)	Latitude	Longitude	Elevation (m)	Land status/ features
I	Alwarbanda	Karak	30	3012588	976649	381	Plain area, communal land
II	Chakmanzi	Karak	27	3019767	964194	462	Plain area. Communal land
III	Jangrezi	Karak	45	3029186	963561	528	Plain area, marginal land
IV	Toordhand	Karak	25	3025500	983458	534	Plain area, communal land
V	Umer din plain area communal land	Karak	63	3020278	965896	411	Plain area, private land, communal land
VI	AkhoonBaig	Teri	60	3044855	1007884	607	Plain area, communal land
VII	Gagari	Teri	108	3033799	111706	643	Hilly area, communal land
VIII	Khaderkhel	Teri	30	3059859	1022466	531	Undulating area having gentle slopes, communal land
XI	Kot Banda	Teri	29	3034866	1006474	617	Water logged, saline area
X	Shewaki	Teri	42	3058883	1010158	588	Undulating area having gentle slopes, communal land

Table 1: Details of ten selected sampling sites in Karak Forest Subdivision and Teri Forest Range for data collection during the current study period (2017, 2018).

RESULTS AND DISCUSSION

Socio-economic livelihood: The data showed that 82% respondents gained profit due to BTAP interventions, while 60% neither gained profit nor loss (figure 2). According to the data, 41.66% of respondents have raised tube nurseries and 58.34% have raised Bare rooted nurseries (figure 3 & 4).

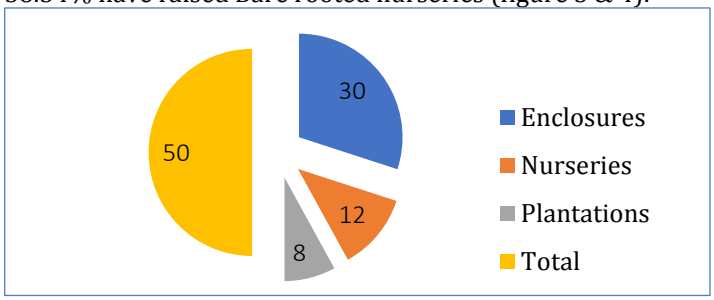

Figure 2: Employment opportunities created via BTAP interventions.

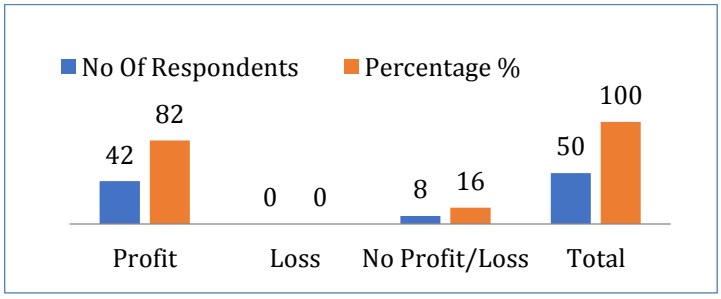

Figure 3: Profit and loss due to BTAP interventions.

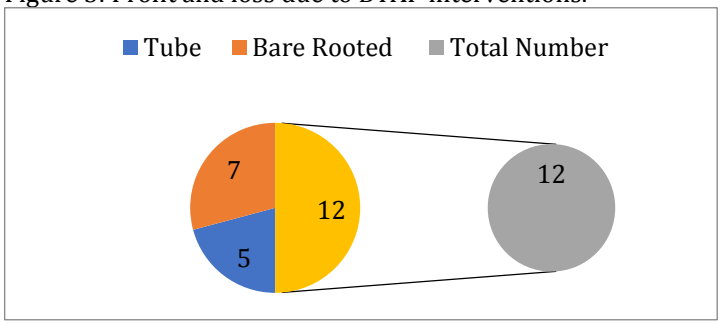

Figure 4: Type of nurseries rose via locals.

The data showed that 83.33% of respondents could not get profit from nurseries given to them under BTAP, 8.33% number of respondents get profit from nurseries and 8.33% were is not aware of profit/loss (as it was departmental nursery). The main reasons of loss of private nursery holders are lacking of required technique, lack of coordination with Forest Department and unavailability of skilled labor (figure 5). According to the data, the first unit was given to 58.33% of respondents, second units were given to 16.66% of respondents, and three, four and six units were given to 8.33% respondents (figure 6). The data showed that 58.33% of respondents were assisted by Forest department while 41.66% of respondents were assisted by imported labor (figure 7).

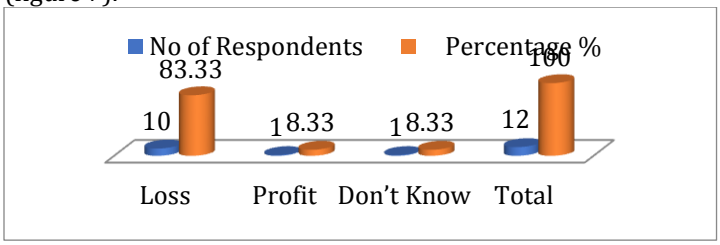

Figure 5: Profits /loss in the data.

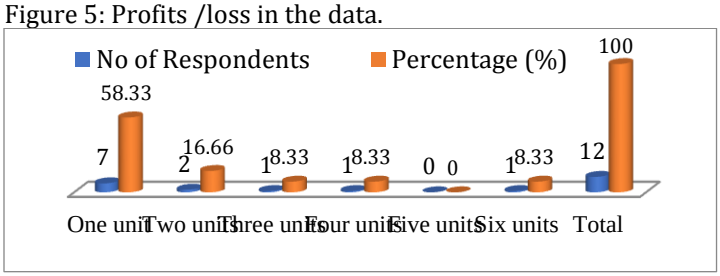

Figure 6: Nursery units in the data.

Determination of survival and growth performance of plantation.

Pit density: It is the number of pits per unit area. Furthermore critical examination resulted that 211 pits were empty per ha so from these empty pits the dry percentage and survival percentage of sites in each subdivision were calculated as shown in (figure 8).

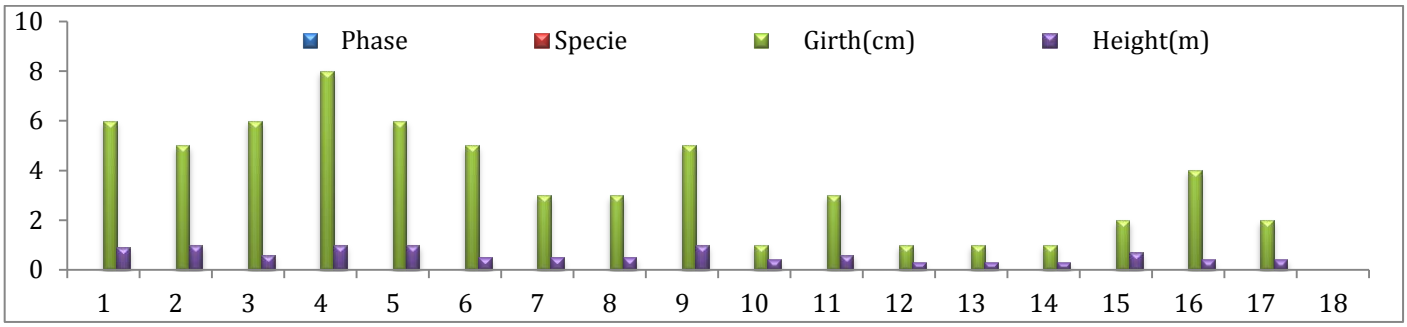

Figure 7: Provision of assistance during nursery rising.

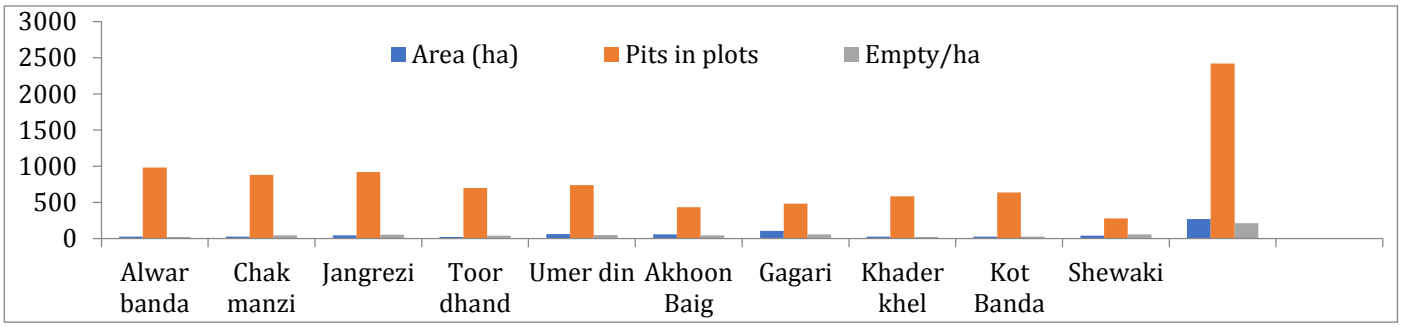

Figure 8: Sites wise classification of the study area along with number of pits.

The Growth rate of different species in different phases: To determine the rate of growth of the different species in the Karak Forest and Teri Forest Subdivision Study Area, data on plants, circumference, height and age were collected from different planting sites. Firstly, we compiled the data phase wise. In phase I highest performance was shown by *Eucalyptus* and *Dodonea viscosa. Eucalyptus* attained an average girth of 8.17cm and height of 1.5m in 28 months; this might be due to the site which is suitable for *Eucalyptus*. While in phase II the higher growth performance was observed in *Acacia modesta* and *Eucalyptus*. *Acacia modesta* attained an average girth of 5.7cm and height of 0.5m 18 months. In phase III, the highest growth performance was exhibited by *Dalbergia sissoo* and *Eucalyptus*. *Dalbergia sissoo* attained an average girth of 4.62cm and height of 0.41m. The data of average girth and height of different species in different phases are shown in the figure 1.8. The highest growth rate was due to better conditions of the sites where species have been planted. However, it is worth mentioning that species has been planted in few sites except eucalyptus as shown in (figure 9).

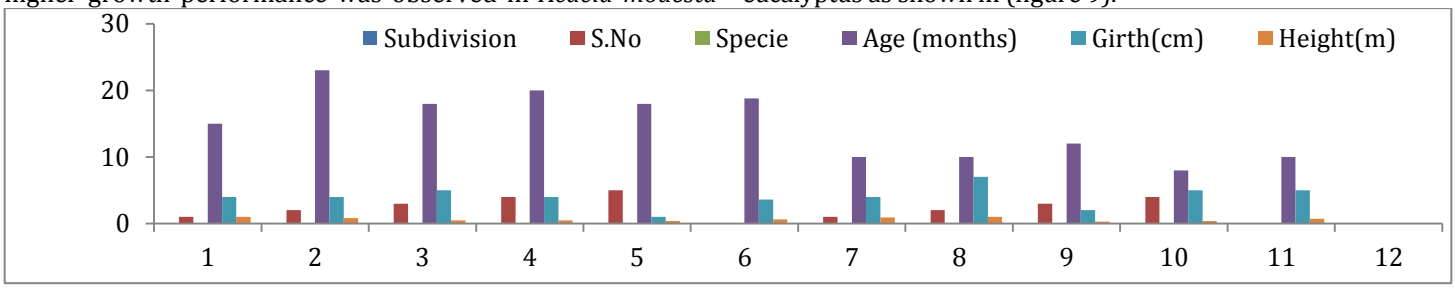

Figure 9: Comparison of growth rate between species of phase1, 2 and 3.

Correlation matrix and simple linear regression: Results showed that girth and height were positively correlated with survival percentage while empty pits per hectare were negatively correlated. According to Table 4.5, the girth shows highest R^2 (0.874) while height also showed a similar relationship (R^2 = 0.857) while the empty pits has the lowest correlation with survival percentage (R^2 = -0.104). The details of simple linear regression models for survival percentage against girth and height were summarized in figure 3, figure 6 and figure 7. Both models showed the relationships were strongly significant relationships as P-values were equal to 0.001. The regression summary showed that R^2 and adjusted $R^2$was 0.73 and 0.70 respectively, for height and survival percentage. Whereas in case of girth and survival percentage the R^2 and adjusted R^2 were 0.764 and 0.735 respectively (table 2, 3 & 4).

Evaluation of status of assisted natural regeneration (ANR): Natural regeneration also comes out in areas closed for raising plantations. To quantify natural regeneration in the plantations areas in the study area, the number of regeneration was also counted in the sample plots laid out in the study area. It was found that the average number of regeneration is 74.8 per ha. The established regeneration was up to 222 and the un-established regeneration was not found in any site. These results are in conformity with (WWF-Pakistan, 2017) findings who reported that natural regeneration in southern region is 25.1% on average 27 seeding were recorded per ha. This is an added benefit and an indicator of good maintenance and management. The status of regeneration in different sites is summarized in the following table (table 5).

	Survival	Girth	Height	Empty Pits
Survival	1	0.874	0.857	-0.104
Girth	0.874	1	0.973	-0.490
Height	0.857	0.973	1	-0.551
Empty Pits	-0.104	-0.490	-0.551	1

Table 2: Correlation of girth, height and empty pits against survival percentage (level of significance 0.05).

ANOVA

	Df	SS	MS	F	Significance F	
Regression	1	157.55	157.55	22.29	0.001	
Residual	8	56.546	7.06			
Total	9	214.1				
	Coefficients	Standard Error	t Stat	P-value	Regression Statistics	
Intercept	80.42	2.53	31.75	1.05E-09	R Square	0.73
Height	18.19	3.85	4.72	0.001	Adjusted R Square	0.70

Table 3: Simple Linear Regression between Survival Percentage and Height

ANOVA

	Df	SS	MS	F	Significance F	
Regression	1	163.78	163.78	26.04	0.000	
Residual	8	50.31	6.28			
Total	9	214.1				
	Coefficients	Standard Error	t Stat	P-value	Regression Statistics	
Intercept	60.39	6.18	9.76	1.015E-05	R Square	0.764
Height	6.35	1.24	5.102	0.000	Adjusted R Square	0.735

Table 4: Simple linear regression between survival percentage and girth

Sub Division	Site	<9"	>9"	Total	no of plots	Average no of regeneration per site	Regeneration per ha
Teri	Akhonbaig	0	53	53	7	6	66
	Gagari	0	25	25	10	5	50
	khedarkhel	0	52	52	10	4	43
	kotbanda	0	9	9	9	9	90
	Shewaki	0	33	33	5	6.6	66
Karak	Alwarbanda	0	32	32	12	36	366
	Chakmanzi	0	0	0	12	0	0
	Janagrezi	0	13	13	12	3	32
	Toordhand	0	3	3	10	1	15
	Umerdın	0	2	2	12	2	20
	Total	0	222	222	99	7	75

Table 5: Status of assisted natural regeneration in sites.

CONCLUSION

- Pit density is found lesser than the required 10x10 spacing. According to 10x10 spacing the required number of pits per hectare is 1075 but here it is found 663.
- Average regeneration per hectare is estimated as 222 and major species were *Prosopis juliflora, Zizyphus nemularia* and *Nannorrhop sritchiana.*
- The study indicated that only the regeneration, i.e established (mean above 9 inches) were found while the un-established (below 9 inches) were not found.
- The study revealed that average survival rate was 93% in both Karak subdivision and Teri range. The survival rate of Karak forest subdivision is found as 92% while that of Teri forest range it was found 93%.

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