PHYSICAL PROGRESS REPORT
OF SCHEME

ESTIMATION OF ECONOMIC LOSSES IN REAL TERM PER HECTARE BASIS DUE TO FOREST FIRE IN UTTARAKHAND AND MADHYA PRADESH

(1/04/2020-31/03/2021)

Submitted by
Indian Council of Forestry Research and Education, Dehradun.

(Progress Report of the scheme "Estimation of economic losses in real term per hectare basis due to Forest Fire in Uttarakhand and Madhya Pradesh" funded by National Authority CAMPA)

Table of contents

1. Introduction:

Based on the recommendations of the Parliamentary Standing Committee on Science & Technology, Environment & Forests to Uttarakhand (June 2016) Ministry of Environment, Forest & Climate Change (MoEF&CC), Govt. of India (GoI) vide letter no. F.No.7-2/2016-FPD dated 11th March, 2017 requested Indian Council of Forestry Research and Education (ICFRE), Dehradun to submit a proposal for undertaking the study on Estimation of economic losses in real term per hectare basis due to forest fire. Accordingly, ICFRE proposed a pilot study entitled "Estimation of economic losses in real term per hectare basis due to Forest Fire in Uttarakhand and Madhya Pradesh" for funding from National Authority CAMPA towards addressing the requirements **of estimation of total economic loss in real terms of monetary value on per hectare basis for the study states of Uttarakhand and Madhya Pradesh.** Through the study a framework / approach /methods /tools and techniques will be provided to estimate tangible and intangible losses due to forest fire on per hectare basis which may be used in other similar situations. **The pilot study being multidisciplinary in nature will be conducted by ICFRE through its institutes at Dehradun (Forest Research Institute) and Jabalpur (Tropical Forest Research Institute) in association with partner institutions mentioned below**:-

i. Forest Survey of India (FSI),Dehradun
ii. Wild life Institute (WII) ,Dehradun
iii. National Institute of Hydrology (NIH)
iv. G.B Pant National Institute of Himalayan Environment & Sustainable Development, Kosi-Katarmal, Almora, Uttarakhand (GBPIHESD)

The total outlay of scheme is Rs 378.840 lakhs. The scheme was sanctioned through Order No. 13-35/2019-CAMPA, dated 28th January, 2020 of National Authority Campa, MoEF& CC, New Delhi for recurring expenditure and vide Order No. 13-35/2019-CAMPA, dated 28th January, 2020 of National Authority Campa, MoEF&CC, New Delhi for Non-Recurring expenditure. As per approved scheme 50% of the funds were received on 26th February 2020. The scheme is for 24 months. As per the proposal, the date of initiation of the Project will be from the date of finalization of polygons for the study by FSI. The funds lying balance on 01.04.2020 were revalidated for 2020-21 through letter dated 26th August, 2020 vide File No. 13-35,2019-NA.

2. Objectives of the Scheme are as under:

a) To quantify the forest loss in terms of total economic value i.e., monetary value on per hectare basis for the forest types in the States of Uttarakhand and Madhya Pradesh.
b) Burnt area assessment and severity classification due to forest fire for the respective states.
c) Economic loss assessment of terrestrial flora due to forest fire on per hectare basis for the respective states
d) Economic loss assessment of faunal diversity due to forest fire on per hectare basis for the respective states

e) Economic loss assessment of hydrological changes due to forest fire on per hectare basis for the respective states
f) Economic loss assessment of provisioning services and cultural value of forest produce loss due to forest fire on per hectare basis for specific forest types and extrapolated for the respective states.

3. Physical Progress of Scheme

3a: Coordination review meeting for execution of the project

i. Inception meeting of all the project partners (Forest Survey of India-Dehradun, Wild Life Institute-Dehradun, National Institute of Hydrology-Roorkee, GBPNIHESD Almora, ICFRE Dehradun, Forest Research Institute Dehradun and Tropical Forest Research Institute- Jabalpur) and Nodal Officers of State Forest Departments (Uttarakhand & Madhya Pradesh) was organised at ICFRE, Head Quarter, Dehradun on January 22, 2020 to discuss in detail the methodology and structure of the project for the smooth execution of it. It was discussed at length and all project partners agreed to conduct the study on the burnt polygons of forest areas burnt during fire season 2019 in different forest types as per the parameters identified in the approved project. Recruitment of staff was initiated by partners. Literature survey was under taken and consultation with experts was held in social distancing mode to decide methodology. Tender process for purchases was initiated by all the project partners in their respective institutes as per the project schedule.

ii. The 2nd Coordination meeting was held on 12th May 2020 after unlock 1.0 of COVID-19 to expedite the process of finalization of site of burnt area for the study. As discussed in 1st and 2nd coordination meeting, FSI submitted the Interim Report on findings of Burnt Scar Assessment of Uttarakhand on 9 June 2020. The minimum mappable unit for the study was 3 hectares. The burnt scars were classified into Severely Burnt, Moderately Burnt and Low Burnt severity classes based on the reflectance of a pixel of the satellite data. Based on the analysis of satellite data, a total of 4,897 fire polygons of different sizes with minimum area of 3 ha were identified in Uttarakhand. The 3rd coordination meeting was held on 29 June 2020. The received report on burnt scar polygons as shape files for fire season 2019 and also protocols to open the shape files was circulated amongst the partners of the project. The burnt scar polygon having minimum area of 3 hectare with following attributes have been provided in shape file, Format (.shp).
    a) Polygon ID (ID. No)
    b) Severity classes burnt-severe, moderate and low.
    c) Burnt scar in hectares
    d) Forest range information-boundaries of 18 relevant forest ranges in Uttarakhand
    e) Forest cover/density classes from dense, moderately dense, open, scrub
    f) Forest type group-1-total 9 forest types groups in Uttarakhand

g) Altitude zones ranging from 0-900 meters to above 3600 metres
h) Slope classes ranging from 0-3° to above 36°, Aspect classes-North, South, East, West

iii. In fourth coordination meeting held through video-conferencing (VC) on 24 September 2020, for reviewing progress and to discuss amongst project partners to decide a coherent methodology to work on the selected Burnt and Unburnt Polygons of Uttarakahnd and Madhya Pradesh required to conduct further studies as per the requirement of the approved project it was found that that based on the forest fire year 2019, details of 4897 polygons of Uttarakhand was received from Forest Survey of India, Dehradun. Out of these 4897 polygons identified, tentatively 164 selected Burnt Scar Polygons with minimum area of 3 ha belonging to different forest types, slope, aspect, severity of burnt areas etc were short listed. However FSI Dehradun requested SFD Uttarakhand to validate 4897 polygons along with 164 shortlisted polygons. Uttarakahnd State Forest Department and FSI validated 289 polygons of Uttarakhand. The statistical expert from ICFRE identified 42 forest fire polygons (moderately burnt =32, low burnt =10) for the study in Uttarakhand which stands communicated to all the project partners. Also the permission received from PCCF & HoFF Uttarakhand has also been communicated to all the PIs of the Project.

iv. FSI submitted information regarding Burnt Scar Polygons' for State of Madhya Pradesh to ICFRE. Total 17288 fire polygons of different sizes with minimum area of 3 ha have been listed in Madhya Pradesh. The burnt scar polygons belong to Severely Burnt, Moderately Burnt and Low Burnt classes. Out of 17288 fire polygons 178 polygons were finalized as per statistical requirements and keeping in view different parameters like forest types, slope, aspect etc. Madhya Pradesh State Forest Department and FSI validated 228 polygons. The statistical expert from ICFRE identified total 49 fire affected polygons (severe burnt = 5, moderately burnt =24, low burnt =20) for M.P. These details of polygons have been communicated to all the partners. Also the permission received from PCCF & HoFF during 2nd week of December, 2020, has been forward to all the PIs of the project.

v. In fifth coordination meeting held through video conferencing (VC) on 21 May 2021, to review the progress so far made by all the Partner Institutes for last financial year ending 31st March, 2021 and submission of Utilization Certificates and cumulative physical progress reports (along with photographs and data) by all the Partner Institutes for last financial year i.e., 01st April, 2020 to 31st March, 2021. All project partners presented their work. The progress made by all the partners for duration 1/04/2020 to 31/03.2021 is briefed in following paragraphs.

3b: <u>Progress made by Partner institutes</u>:

i. **G.B. Pant National Institute of Himalayan Environment Institute** (GBPNIHEI) working on economic loss assessment provisioning services and cultural value of

forest /produce loss due to forest fire on per hectare basis for specific forest types has initiated work in Uttrakhand and Madhya Pradesh.

Uttarakhand Region:-

In the Uttarakhand site across the 39 polygons studied a total of 150 plant species (47 trees, 42 shrub, 61 herbs) were recorded from identified polygons of burnt forests. The complete list of speciesis given in **Annexure I.**

The highest number of species was noted from the family Pinaceae followed by Ericaceae, Fabaceae, Rubiaceae and Dipterocarpaceae. *Pinus, Terminalia, Mallotus, Syzygium, Lyonia, and Shorea* were the dominant genera of these forests. The dominant tree species were *Pinus roxburghii* (Chir Pine), *Tectona grandis* (Teak), *Terminalia elliptica* (Asna), *Shorea robusta* (Sal), *Mallotus philippensis* (Rohini) and *Cassia fistula* (Amaltas). The regeneration status of tree layer in burnt polygon sites is presented in Table 1:

Table 1: Loss of regeneration of forests (tree seedlings/saplings) in the studied polygons of Uttarakhand.

S. No.	Forest Beat/ Polygon ID	Un-burnt site			Burnt site			Regeneration Loss
		Seedling (ind/ha)	Sapling (ind/ha)	Total	Seedling (ind/ha)	Sapling (ind/ha)	Total	Un-burnt Burnt (ind/ha)
1.	Ganiadeoli Beat/2201	680	710	1390	230	140	370	1020
2.	Punarkot Beat/4603	1630	770	2400	500	260	760	1640
3.	Nagar Beat /1238	700	450	1150	380	110	490	660
4.	Badechina Beat /2179	890	210	1100	320	170	490	610
5.	Charchali Beat/2041	360	180	540	160	80	240	300
6.	Ogala Beat/1867	1300	460	1760	540	50	590	1170
7.	Balatari Beat/2090	760	690	1450	470	140	610	840
8.	Nawlara Beat/1430	270	180	450	130	40	170	280
9.	Durgapeepal Beat/3484	2360	340	2700	260	110	370	2330
10.	Chhatina Beat/1518	360	190	550	90	40	130	420
11.	Gannanath Central Beat/1783	700	90	790	220	20	240	550
12.	Pungar-I Beat /1293	330	50	380	130	20	150	230
13.	Khabdoli South Beat/1313	220	210	430	240	50	290	140
14.	Shikharkot-III Beat/1388	450	120	570	260	40	300	270
15.	Chhatina Beat/4452	630	320	950	340	50	390	560
16.	Jaulkande Beat/4507	850	100	950	850	50	900	50
17.	Tanda Centre Beat/3690	130	280	410	50	40	90	320
18.	Hathgad Beat/3625	260	600	920	170	140	310	610
19.	Ratarao Beat/3300	100	480	580	220	60	280	300
20.	Kalpeshwar Beat/2374	530	120	650	250	210	460	190

21.	North Lowaranala Beat/3167	350	650	1000	270	80	350	650
22.	Tumaria Beat/2655	1750	2080	3830	1880	140	2020	1810
23.	Kishanpur South Beat/3700	160	640	800	220	90	310	490

The sapling layer density ranged between 20 saplings ha^{-1} (polygon no. 1783, Gannanath Central Beat, Bageshwar and polygon no. 1293, Pungar-I Beat, Bageshwar, polygon no. 1867, Ogala Beat forest, Pithoragarh) and 1150 saplings ha^{-1} (polygon no. 1008, Kharkhari North Beat, Dehradun) and seedling layer density from 50 seedlings ha^{-1} (polygon no. 3690, Tanda Centre Beat, Nainital and polygon no. 4007, Daragad Beat, Uttarkashi) to 1880 seedlings ha^{-1} (polygon no. 2655 Tumaria Beat, Nainital). The shrub layer was dominated by *Flemingia strobilifera, Eupatorium odoratum, Colebrookea oppositifolia, Achmenthera gossypium, Rhus parviflora, Carissa macrocarpa and Murraya koenigii* etc. The herb layer density ranged between 260 herbs ha^{-1} (polygon no. 3884 West Kilpura-I Beat forest, Udham Singh Nagar) to 14970 herbs ha^{-1} (polygon no. 1867, Ogala Beat forest, Pithoragarh). The herb layer was dominated by *Carex cruciata, Anaphalis adnata, Conyza sumentrensis, Desmodium microphyllum, Cassia memosoides, Ajuga bracteosa and Crysopogon grillus* etc.

Loss of Timber, Fodder and Fuel Wood in Burnt Polygons of Uttarakhand:

a. Loss estimates of timber:

Total wood volume lost due to 2019 FF ranged between 0.55 and 168.1 m^3 ha^{-1} across the studied polygons in U.K. Highest timber loss (i.e. 168.01 m^3 ha^{-1}) was recorded at Nagar Beat (polygon ID-1238) and lowest timber loss (0.55 m^3 ha^{-1}) was recorded at North Lowaranala Beat forest area (polygon ID 3167). The total timber monetary loss was calculated ranging between Rs. 10,525 and 25,20,849 ha^{-1} in the studied polygons with a mean value of Rs. 324469/ha across all the 39 polygons studies. Major tree species damaged due to FF were *Pinus roxburghii* (168.1 m^3 ha^{-1}), followed by *Moringa olerifera* (4.3 m^3 ha^{-1}), *Tectona grandis* (1.3 m^3 ha^{-1}) etc. Estimates of the timber loss (m^3) as well as monetary loss (Rs.) for the entire area of the polygons for each of the tree species separately across all the 39 polygons studied in U.K. is given in Table 2 & 3.

Table 2: Loss of timber, fodder, fuel wood and regeneration (sapling/ seedling) in burnt polygons of 2019 in the forests of Uttarakhand.

S.No.	Study site/ polygon Id	Loss of timber (m^3/ha)	Loss of fuelwood (t/ha)	Loss of ground fodder (t/ha)	Loss of Regeneration (ind/ha)
1.	Ganiadeoli Beat/2201	69.33	6.09	0.13	1020
2.	Punarkot Beat/4603	39.45	4.06	0.23	1640
3.	Nagar Beat /1238	168.05	8.75	2.40	660
4.	Badechina Beat /2179	51.37	6.09	0.22	610

5.	Charchali Beat/2041	0.00	0.00	0.95	300
6.	Ogala Beat/1867	55.46	6.98	0.025	1170
7.	Balatari Beat/2090	7.03	0.53	4.00	840
8.	Nawlara Beat/1430	19.03	2.43	0.15	280
9.	Durgapeepal Beat/3484	0.00	0.00	1.40	2330
10.	Chhatina Beat/1518	0.00	0.00	1.43	420
11.	Gannanath Central Beat/1783	72.16	7.85	0.23	550
12.	Pungar-I Beat /1293	36.03	4.40	0.44	230
13.	Khabdoli South Beat/1313	31.00	3.26	1.15	140
14.	Shikharkot-III Beat/1388	29.43	2.29	1.28	270
15.	Chhatina Beat/4452	32.09	3.40	3.54	560
16.	Jaulkande Beat/4507	66.75	7.24	1.83	50
17.	Tanda Centre Beat/3690	0.00	0.00	0.10	320
18.	Hathgad Beat/3625	4.33	1.46	4.35	610
19.	Ratarao Beat/3300	0.00	0.00	0.25	300
20.	Kalpeshwar Beat/2374	27.85	2.88	1.33	190
21.	North Lowaranala Beat/3167	0.55	0.21	0.075	650
22.	Tumaria Beat/2655	0.00	0.00	2.43	1810
23.	Kishanpur South Beat/3700	1.29	0.38	0.00	490
24.	Maniyar Beat/548	12.92	4.32	0.13	1220
25.	Syansu/336	37.70	5.16	0.75	2090
26.	Nailbagi Beat/397	0.00	0.00	0.20	340
27.	Naolbagi Beat /367	0.00	0.00	0.35	700
28.	Kathud Beat/534	0.00	0.00	0.10	780
29.	Bamnath Beat/552	10.56	2.04	2.53	540
30.	AmsorBeat/4344	26.06	2.09	0.63	770
31.	Sirtoli Beat/4204	74.01	10.15	2.75	1410
32.	Sainj Beat /4255	24.13	2.36	0.58	460
33.	West Kilpura-I Beat/3884	0.00	0.00	0.00	490
34.	Purola Beat/4002	3.51	1.13	0.50	2180
35.	Kotawali Beat/1552	0.00	0.00	2.10	730

Table 3: Monetary loss of timber, fodder, fuel wood and regeneration (sapling/ seedling) in burnt polygons of 2019 in the forests of Uttarakhand.

S.No.	Polygon ID/ Nameof Site	Timber Loss (Rs/ha)	Loss of Fodder (Rs/ha)	Loss of Fuel Wood (Rs/ha)	Regeneration loss (seedling / sapling (Rs/ha)	Total Monetary loss (timber + fuelwood+ ground fodder +regeneration) (Rs/ha)
1.	Ganiadeoli Beat/2201	1040087	974	35219	25500	1101780
2.	Punarkot Beat/4603	591766	1754	23469	41000	657989
3.	Nagar Beat /1238	2520849	18714	50557	16500	2606620
4.	Badechina Beat /2179	770695	1657	35242	15250	822844
5.	Charchali Beat/2041	0	7407	0	7500	14907
6.	Ogala Beat/1867	831932	194	40391	29250	901767
7.	Balatari Beat/2090	105598	31190	3069	21000	160857
8.	Nawlara Beat/1430	285525	1169	14022	7000	307716
9.	Durgapeepal Beat/3484	0	10916	0	58250	69166
10.	Chhatina Beat/1518	0	11111	0	10500	21611
11.	Gannanath Central Beat/1783	1082532	1657	45342	13750	1143281
12.	Pungar-I Beat /1293	540547	3411	25454	5750	575162
13.	Khabdoli South Beat/1313	465147	8967	18820	3500	496434
14.	Shikharkot-III Beat/1388	441462	9942	13254	6750	471408
15.	Chhatina Beat/4452	481413	27584	19654	14000	542651
16.	Jaulkande Beat/4507	1001349	14230	41809	1250	1058638
17.	Tanda Centre Beat/3690	0	779	0	8000	8779
18.	Hathgad Beat/3625	27741	33919	8474	15250	85384
19.	Ratarao Beat/3300	0	1949	0	7500	9449
20.	Kalpeshwar Beat/2374	417802	10331	16651	4750	449534

21.	North Lowaranala Beat/3167	10524	584	1232	16250	28590
22.	Tumaria Beat/2655	0	18909	0	45250	64159
23.	Kishanpur South Beat/3700	34933	0	2192	12250	49375
24.	Maniyar Beat/548	193853	974	24974	30500	250301
25.	Syansu/336	565568	5848	29858	52250	653524
26.	Nailbagi Beat/397	0	1559	0	8500	10059
27.	Naolbagi Beat /367	0	2729	0	17500	20229
28.	Kathud Beat/534	0	779	0	19500	20279
29.	Bamnath Beat/552	158487	19689	11822	13500	203498
30.	Amsor Beat/4344	390917	4873	12120	19250	427160
31.	Sirtoli Beat/4204	1110225	21443	58659	35250	1225577
32.	Sainj Beat /4255	362030	4483	13667	11500	391680
33.	West Kilpura-I Beat/3884	0	0	0	12250	12250
34.	Purola Beat/4002	52658	3898	6510	54500	117566
35.	Kotawali Beat/1552	0	16375	0	18250	34625
36.	Ranipur East Beat/1020	0	389	0	19500	19889
37.	Kharkhari North Beat/1008	0	3119	0	154250	157369
38.	Batoli-II Beat/386	0	3314	0	24250	27564
39.	Daragad Beat/4007	144027	22710	5812	47250	219799

b. Loss estimates of fodder:

The quantity of fodder (ground herbage) burnt due to FF and its monetary value as per the local rates based on consultations with the local people is given in Table 2 & 3. Highest ground fodder loss (i.e. Rs. 33,920 ha^{-1}) was recorded at Hathgad forest area (polygon ID- 3625), and lowest fodder loss (Rs. 195 ha^{-1}) was recorded at Ogala forest area (polygon ID -1867), and the mean value of fodder loss due to FF across all the 39 studied polygons was computed Rs. 8450/ha. In terms of quantity the mean loss of ground fodder across all the 39 polygons studied was found 1.08 ton/ha. The details of loss of fodder in burnt polygons of U.K. is given in Table 2 & 3. Loss of shrub fodder will be estimated subsequently and given in the FTR.

c. Loss estimates of fuel wood:

The quantity of fuel wood (computed for the branches and twigs those might have burnt along with the burnt tree logs lying on the forest floor) and its monetary value as per the local rates based on consultations with the local people is given in Table 2 & 3. Highest fuel wood loss (i.e.Rs. 58660/ha) was recorded at Sirtoli forest area (Polygon ID- 4204) and lowest Rs. 1232/ha (North Lowaranala Beat Polygon ID- 3167), and the mean value of fuelwood loss due to FF across all the 39 studied polygons was computed Rs. 14315/ha. In terms of quantity the mean fuel wood loss due to FF across all the 39 studied polygons was computed 2.48 t/ha in U.K.Loss of fuel wood will be estimated subsequently and given in the FTR.

d. Loss estimates of wild edibles, NTFPs, MAPs in burnt polygons:

Local people use a range of NTFPs and MAPs for their livelihood and curing various ailments traditionally. People use as many as 93 species (trees, shrubs and herbs) for various edibles,fuel wood and fodder and more importantly curing a variety of ailments as a substitute of medicines purchased from the markets. However, valuation of the loss will be subsequently made.

e. Loss estimates of Forest Regeneration (Seedlings/Saplings):

It was observed that the the total number of seedlings and saplings varied considerably across the polygons due to differences in forest types and severity of forest fire etc. Across theunburnt plots the regeneration (number of seedlings + saplings / ha) was found ranging from 380 (polygon ID 1293) and 8860 (polygon ID 1008). Similarly, across the burnt sites it was found ranging from 90 (polygon ID 3690) and 2690 (polygon ID 1008). Thus the net loss of seedlings and saplings was recorded minimum (50/ha) in polygon ID 4507 and maximum (6170/ha) in polygon ID 1008. Monetary loss (using the Forest Deptt. rates) was computed ranging from Rs. 1250/ha (polygon ID 4507) and 1, 54,250/ha (polygon ID 1008) with a mean value of Rs. 23692/ha (Table 3).

f. Stakeholder Consultations for Valuation of Forest Goods:

In U.K. total 35 stakeholder consultation meetings were organized for valuation of forest resources in which 366 people (230 male and 136 female) participated. Summary of stakeholder consultation meetings are presented in Table 4.

Table 4: Details of stakeholder meetings/consultation with forest officials and local people held around the polygons studied in Uttarakhand.

S.No.	Polygon ID	Forest range	Place of meeting held	No of Forest officials consulted/ present during fieldwork	Number of participants(M / F)
1	2201	RanikhetRange	Pandeykota	-	4 Male, 3 Female
2	4603	Someshwar Range	BhatniyalJyula	1	5 Male, 7 Female
3	1238	Jaurasi Range	Kothyu	2	2 Male, 2 Female
4	2179	Almora Range	Panatoli,Kumoli	2	2 Male, 2 Female
6	2041	Kanarichina	Salla Bhatkote	-	2 Male, 2 Female
7	1867	Didihat Range	Ogla	2	6 Male, 8 Female
9	2090	Gangolihat Range	Bhattgau, Balatari	2	6 Male, 5 Female
10	1430	Didihat Range	Ringunia	-	11 Male, 5Female
11	3484	Danda Range	TallaJhadgaon	8	16 Male, 1Female
12	1518	Bageshwar	Mandalsera	2	11 Male, 5Female
13	1783	Almora Range	Harkhola	2	7 Male, 8 Female
15	1293	Dharamgarh	Mahatgad	-	4 Male
16	1313	Bageshwar	Gangaad	1	9 Male, 5 Female
17	1388	Baijnath	Thaklad	-	8 Male, 7 Female
18	4452	Bageshwar	Falyanti	-	13 Male, 7Female
19	4507	Bageshwar	Kanargaon	-	4 Male
20	3690*	HaldwaniRange	-	-	-
21	3625	Jaulasal Range	Hathgad	6	5 Male, 3 Female
22	3300	Nandhaur Range	Harishtal	5	12 Male, 6Female
23	2374	North Gola Range	Reetha Pokhari	1	4 Male, 2 Female
24	3167	Danda Range	Chirakhan	2	8 Male, 4 Female

25	2655	South Jaspur	Tumariya	12	15 Male
		Range			
26	3700*	Kishanpur Range	-	4	-
27	548	Tehri Range	Paligaon	-	1 Male, 4 Female
28	336	Tehri Range	Sunargaon, Darbalgaon	-	4 Male, 3 Female
29	397	Tehri Range	Uppu	-	4 Male
30	367	BalgangaRange	Konti	-	13 Male, 17Female
31	534	Gopeshwar	Pilang	1	4 Male, 3 Female
32	552*	Nagnath	-	-	-
33	4344	Pindar West Range	Mauna	1	3 Male
34	4204	Nandprayag Range	Saim	2	6 Male, 13Female
35	4255	Nandprayag Range	Sunali, Kandara	-	6 Male
36	3884*	Kilpura Range	-	5	-
37	4002	Purola Range	Pora,Kandyal	2	7 Female
38	1552	Chiriyapur Range	Dhalpuri, Laldhang	7	11 Male, 1Female
39	1020	Haridwar Range	Ranipur	2	2 Male
40	1008	Haridwar Range	Bhopatwala	6	5 Male
41	386	Langha Range	Dalani, Devidhar	3	7 Male, 4 Female
42	4007	Bawar Range	Silwara	5	10 Male, 2Female

*** Stakeholders meetings/consultations could not be held; In all other places near to studied polygons stakeholders meetings/consultations were held.**

Based on these consultative meetings local rates for different products of forests such as NTFPs, wild edibles, medicinal plants etc. were recorded and used for calculation of monetary loss of NTFP due to FF. Direct and indirect impacts of FF, loss in forest areas and mitigation and management options were also discussed with stakeholders during the consultation meetings and will be presented in the FTR.

Madhya Pradesh region:

In the M.P. forests across the 47 polygons studied a total of 125 plant species (64 trees, 27 shrub, 34 herbs) were recorded from burnt area polygons. The complete list of species found across all the studied polygons is given in **Annexure-I**. The highest number of species were noted from the family Leguminaceae followed by Rubiaceae and Malvaceae. Terminalia, Dalbergia and Casearia were the dominant genera of these forests. The dominant tree species were Ougeinia oojeinensis (Tinsa), Pterocarpus marsupium (Beeja), Diospyros melanoxylon (Tendu), Terminalia tomentosa (Sanjha), Tectona grandis (Shagon) and Buchnania lanzan (Chaar). The tree sapling density was

recorded between 240 and 1610 ind./ha and seedling density between 130 and 1500 ind./ha. The shrub layer was dominated by Lantana camara, Flemingia strobilifera, Tilpendra, Chakora etc. The herb layer density ranged between 760 and 5220 ind./ha across the studied polygons. The herb layer was dominated by Hyptis suaveolens, Sida cordata, Sida acuta, Alternanthera sessilis, Waltheria indica, Eragrostis tenella, Ageratum conyzoides etc. Summary of phytosociogical attributes of burnt polygons for sapling and seedling, tree, shrub and herb layers is given in Tables 5, 6 &7; **Annexure I**.

Table 5: Loss of regeneration of forest trees (seedlings/saplings) in the polygons of Madhya Pradesh burnt forests.

S.No.	Polygon ID	Unburnt site			Burnt site			Loss of regeneration
		Seedling (ind/ha)	Sapling (ind/ha)	Total	Seedling (ind/ha)	Sapling (ind/ha)	Total	(Unburnt-Burnt (ind/ ha)
1	16581/ North Balaghat	1210	1300	2510	1210	840	2050	460
2	16627/ North Balaghat	1350	1640	2990	850	1290	2140	850
3	16470/ North Balaghat	1590	1470	3060	1320	810	2130	930
4	10369/ North Balaghat	1790	1450	3240	1260	1200	2460	780
5	16455/ North Balaghat	1730	1310	3040	1500	1480	2980	60
6	11563/ North Balaghat	1480	1250	2730	1030	1610	2640	90
7	6993/ Hoshangabad	1470	1430	2900	220	860	1080	1820
8	10013/ Hoshangabad	2190	1670	3860	0	870	870	2990
9	15522/ Narsinghpur	1440	1360	2800	810	1040	1850	950
10	6534/ Narsinghpur	1110	1130	2240	510	810	1320	920
11	6865/ Narsinghpur	1790	2300	4090	320	1240	1560	2530
12	15762/ Narsinghpur	1060	1460	2520	580	850	1430	1090
13	1357/ Satna	1930	1640	3570	300	700	1000	2570
14	1316/ Satna	2120	1750	3870	0	1400	1400	2470
15	1312/ Satna	2010	1590	3600	0	860	860	2740
16	1358/ Satna	2090	1820	3910	670	1130	1800	2110
17	14683/ South	1020	800	1820	620	1050	1670	150

	Panna							
18	14676/ South Panna	1040	840	1880	610	1110	1720	160
19	16720/ Khandwa	800	620	1420	640	450	1090	330
20	16722/ Khandwa	290	960	1250	0	820	820	430
21	16645/ Khandwa	1140	1350	2490	0	240	240	2250
22	16622/ Khandwa	1330	1560	2890	0	620	620	2270
23	11754/	810	1440	2250	180	330	510	1740
	Khandwa							
24	11530/ Khandwa	1520	1790	3310	0	320	320	2990
25	9169/ Barwah	810	1220	2030	570	1110	1680	350
26	16311/ Barwah	1800	2180	3980	540	1110	1650	2330
27	16181/ Barwah	1770	1560	3330	0	1410	1410	1920
28	16068/ Barwah	1560	2010	3570	750	940	1690	1880
29	1443/ Sidhi	1020	1160	2180	0	980	980	1200
30	11001/ South Balaghat	980	890	1870	690	1120	1810	60
31	11546/ South Balaghat	970	840	1810	710	320	1030	780
32	11791/ South Balaghat	1230	1180	2410	630	480	1110	1300
33	16860/ South Balaghat	520	750	1270	140	1040	1180	90
34	11995/ South Balaghat	1320	490	1810	130	1380	1510	300
35	4524/ Dindori	1650	1630	3280	870	620	1490	1790
36	15203/ Dindori	1440	1970	3410	380	1040	1420	1990
37	16529/ KNP (Core)	1300	1220	2520	1200	860	2060	460
38	14057/ South Betul	1280	1170	2450	950	1260	2210	240
39	12459/ South Chhindwara	1660	1480	3140	320	870	1190	1950
40	12563/ South Chhindwara	1650	1380	3030	0	790	790	2240
41	12628/ South Chhindwara	1540	1370	2910	0	830	830	2080

42	16826/ South Chhindwara	1590	1410	3000	0	1160	1160	1840
43	12508/ South Chhindwara	1320	1320	2640	600	1100	1700	940
44	10701/ Harda	1480	1430	2910	830	1040	1870	1040
45	10758/ Harda	1920	1540	3460	930	520	1450	2010
46	11473/ Harda	1530	1550	3080	0	1150	1150	1930
47	11576/ Harda	2030	1920	3950	0	1350	1350	2600

Table 6: Volume loss of timber, fodder, fuel wood and regeneration (sapling/ seedling) in burnt polygons of 2019 in the forests of Madhya Pradesh.

S.No	Polygon ID /Fire severity	Loss of timber (m^3 / ha)	Loss of fuel wood (t/ha)	Loss of ground fodder (t/ha)	Regeneration loss (sapling/ Seedling) (ind/ha)
1.	16581 North Balaghat(Low)	1.63	0.39	0.475	460
2.	16627 North Balaghat(Low)	0.37	0.22	0.35	850
3.	16470 North Balaghat (Moderate)	0.28	0.097	0.6	930
4.	10369 North Balaghat(Low)	0.87	0.19	0.27	780
5.	16455 North Balaghat (Moderate)	0.09	0.089	0.36	60
6.	11563 North Balaghat (Moderate)	0	0	0.45	90
7.	6993 Hoshangabad (Moderate)	1.79	0.42	0.57	1820
8.	10013 Hoshangabad (Moderate)	0.44	0.28	0.5	2990
9.	15522 Narsinghpur (Low)	1.82	0	0.32	950
10.	6534 Narsinghpur (Moderate)	1.53	0	0.41	920
11.	6865 Narsinghpur (Moderate)	0.42	0.26	0.37	2530

12.	15762 Narsinghpur (Moderate)	2.91	0.34	0.55	1090
13.	1357 Satna (Low)	0.17	0.34	0.58	2570
14.	1316 Satna (Low)	0.55	0.37	0.41	2470
15.	1312 Satna (Low)	0	0	0.38	2740
16.	1358 Satna (Low)	0	0	0.38	2110
17.	14683 South Panna (Moderate)	1.05	0.54	0.13	150
18.	14676 South Panna (Moderate)	0	0	0.23	160
19.	16720 Khandwa (Low)	2.37	0.87	0.63	330
20.	16722 Khandwa (Moderate)	3.28	0.83	0.35	430
21.	16645 Khandwa (Low)	1.7	0.46	0.42	2250
22.	16622 Khandwa (Low)	1.7	1.21	0.7	2270
23.	11754 Khandwa (Low)	5.41	0.53	0.31	1740
24.	11530 Khandwa (Moderate)	1.18	0.69	0.77	2990
25.	9169 Barwah (Moderate)	2.24	0.81	0.18	350
26.	16311 Barwah (Moderate)	0.26	0.10	0.51	2330
27.	16181 Barwah (Low)	0.92	0.40	0.275	1920
28.	16068 Barwah (Low)	1.03	0.18	0.55	1880
29.	1443 Sidhi (Moderate)	0	0	0.21	1200
30.	11001 South Balaghat (Severe)	0.41	0.26	0.18	60
31.	11546 South Balaghat(Low)	0.44	0.34	0.2	780
32.	11791 South Balaghat(Low)	0.52	0.34	0.12	1300
33.	16860 South Balaghat(Low)	0.37	0.32	0.43	90
34.	11995 South Balaghat(Low)	0	0	0.08	300

35.	4524 Dindori (Moderate)	1.02	0.52	0.47	1790
36.	15203 Dindori (Low)	0.54	0.27	0.5	1990
37.	16529 KNP (Core) (Low)	0.38	0.29	0.58	460
38.	14057 South Betul (Moderate)	1.94	0.58	0.0125	240
39.	12459 South Chhindwara (Moderate)	1.24	0.45	0.11	1950
40.	12563 South Chhindwara (Moderate)	0.52	0.32	0.16	2240
41.	12628 South Chhindwara (Moderate)	0.75	0.25	0.225	2080
42.	16826 South Chhindwara (Moderate)	1.76	0.73	0.175	1840
43.	12508 South Chhindwara (Severe)	0.37	0.32	0.18	940
44.	10701 Harda (Moderate)	2.88	0.74	0.65	1040
45.	10758 Harda (Moderate)	1.97	0.37	0.45	2010
46.	11473 Harda (Severe)	0.62	0.47	0.56	1930
47.	11576 Harda (Moderate)	0	0	0.46	2600

Table 7: Monetary loss of timber, fodder, fuel wood and regeneration (sapling/ seedling) in burnt polygons of 2019 in the forests of Madhya Pradesh.

S.No	Polygon ID / Fire severity	Monetary value of timber loss (Rs./ha)	Monetary value of fuel wood (Rs./ha)	Monetary value of ground fodder (Rs./ha)	Monetary value of regeneration loss (ind/ha)	Total Monetaryloss per ha (timber+ fuelwood+ ground fodder+ regeneration loss) (Rs/ha)
1.	16581 North Balaghat (Low)	16975	1856	2384	11500	32715
2.	16627 North Balaghat	3721	1037	1757	21250	27765

	(Low)					
3.	16470 North Balaghat (Moderate)	1889	453	3012	23250	28604
4.	10369 North Balaghat (Low)	7029	910	1380	19500	28819
5.	16455 North Balaghat (Moderate)	508	418	1819	1500	4245
6.	11563 North Balaghat (Moderate)	0	0	2296	2250	4546
7.	6993 Hoshangabad (Moderate)	23108	2003	2886	45500	73497
8.	10013 Hoshangabad (Moderate)	13217	1333	2510	74750	91810
9.	15522 Narsinghpur (Low)	45379	0	1631	23750	70760
10.	6534 Narsinghpur (Moderate)	36488	0	2070	23000	61558
11.	6865 Narsinghpur (Moderate)	10439	1254	1882	63250	76825
12.	15762 Narsinghpur (Moderate)	186271	1593	2761	27250	217875
13.	1357 Satna (Low)	1114	1588	2949	64250	69901
14.	1316 Satna (Low)	11561	1747	2070	61750	77128
15.	1312 Satna (Low)	0	0	1945	68500	70445
16.	1358 Satna (Low)	0	0.00	1945	52750	54695
17.	14683 South Panna (Moderate)	7623	2539	652	3750	14564
18.	14676 South Panna (Moderate)	0	0	1189	4000	5189
19.	16720 Khandwa (Low)	86071	4059	3200	8250	101580
20.	16722 Khandwa (Moderate)	131162	3868	1757	10750	147537
21.	16645 Khandwa (Low)	42956	2162	2133	56250	103501

22.	16622 Khandwa (Low)	78875	5646	3514	56750	144785
23.	11754 Khandwa (Low)	92777	2497	1581	43500	140355
24.	11530 Khandwa (Moderate)	64195	3227	3890	74750	146062
25.	9169 Barwah (Moderate)	10823	3805	941	8750	24319
26.	16311 Barwah (Moderate)	2319	474	2572	58250	63615
27.	16181 Barwah (Low)	6980	1885	1380	48000	58245
28.	16068 Barwah (Low)	15110	883	2761	47000	65754
29.	1443 Sidhi (Moderate)	0	0	1066	30000	31066
30.	11001 South Balaghat (Severe)	2666	1254	941	1500	6361
31.	11546 South Balaghat (Low)	5709	1593	1004	19500	27806
32.	11791 South Balaghat (Low)	4959	1588	627	32500	39674
33.	16860 South Balaghat (Low)	1817	1527	2196	2250	7790
34.	11995 South Balaghat (Low)	0	0	439	7500	7939
35.	4524 Dindori (Moderate)	15642	2451	2384	44750	65227
36.	15203 Dindori (Low)	9272	1271	2510	49750	62803
37.	16529 KNP (Core) (Low)	1684	1352	2949	11500	17485
38.	14057 South Betul (Moderate)	53985	2744	62	6000	62791
39.	12459 South Chhindwara (Moderate)	12440	2102	564	48750	63856

40.	12563 South Chhindwara (Moderate)	9814	1532	815	56000	68161
41.	12628 South Chhindwara (Moderate)	40686	1173	1129	52000	94988
42.	16826 South Chhindwara (Moderate)	98126	3427	878	46000	148431
43.	12508 South Chhindwara (Severe)	7318	1512	941	23500	33271
44.	10701 Harda (Moderate)	166015	3467	3263	26000	198745
45.	10758 Harda (Moderate)	148270	1743	2259	50250	202522
46.	11473 Harda (Severe)	13282	2234	2823	48250	66589
47.	11576 Harda (Moderate)	0	0	2321	65000	67321

Loss of Timber, Fodder and Fuel Wood in Burnt Polygons of Madhya Pradesh

a. Loss Estimates of Timber

Total wood volume lost due to 2019 FF ranged between 0.09 and 5.41 m^3/ha across the studied polygons in M.P. Highest timber loss (i.e. 5.41 m^3/ha) was recorded at Khandwa forest (Polygon ID 11754) and lowest timber loss (0.09 m^3/ha) was recorded at North Balaghat forest (Polygon ID 16455). The total timber monetary loss was calculated between 509 and 1,86,272 Rs./ha in studied polygons, and the mean value of timber loss across all the 47 studied polygons was calculated Rs. 31,666/ha. Major tree species damaged due to forest fire were: Tectona grandis (4.80 m^3/ha), followed by Anogeissus latifolia (8.48 m^3/ha), Terminalia tomentosa (4.96 m^3/ha) etc. The timber loss (m^3) and monetary loss (Rs.) for the entire area of polygons across all the 47 studied polygons polygons studied in M.P. is given in Table 6 &7.

b. Loss Estimates of Fodder

The quantity of fodder (ground herbage) burnt due to FF and its monetary value as per the local rates based on consultations with the local people. Highest ground fodder loss (i.e. 3891 Rs./ha) was recorded at Khandwa forest (polygon 11530) and lowest fodder loss 63 Rs./ha was recorded at South Betul (polygon 14057), and the mean value of fodder loss due to FF across all the 47 studied polygons

was computed Rs. 1916/ha. In terms of quantity the mean loss of ground fodder due to FF across all the 47 studied polygons was computed 0.38 t/ha. The details of loss of ground fodder in burnt polygons of M.P. is given in Tables 6 & 7.

c. Loss Estimates of Fuel Wood

The quantity of fuel wood (calculated as the branches and twigs burnt along with burnt trees fallen on the forest floor) due to FF and its monetary value as per the local rates based on consultations with the local people is given in Table 11 & 12. Fuel wood lost was recorded between 0.09 to 1.22 t/ha. Highest fuel wood loss i.e. 5646.52 Rs./ha was recorded at and lowest 418.84 Rs./ha and the mean value of fuel wood loss due to FF across all the 47 studied polygons was computed Rs. 1621.79/ha. In terms of quantity the mean fuelwood loss due to FF across all the 47 studied polygons was computed 0.35 t/ha.

d. Loss of Wild Edibles, NTFPs, MAPs in Burnt Polygons

Local people use a range of NTFPs and MAPs for their livelihood and curing various ailments as a replacement of medicines purchased from the distant markets. People use as many as 43 species (trees, shrubs and herbs) for curing a variety of ailments that is one of the important provisioning services of forests which is lost due to FF. However, valuation of the loss will be subsequently made after their quantification in the polygons of both burnt and unburnt forests.

Figure 1: NTFPs used by local communities of Madhya Pradesh: (A) Different products (Broom, Basket and Mat) for local use and sale; (B) Ayurvedic medicine for self consumption and sale.

e. Loss of Forest Regeneration (Seedlings / Saplings)

It was observed that the total number of seedlings and saplings varied considerably across the polygons due to differences in forest types and severity of forest fire etc. Across the unburnt plots the regeneration (number of seedlings + saplings / ha) was found ranging from 1250 (polygon ID 16722) to 4090 (polygon ID 6865). Similarly, across the burnt sites it was found ranging from 240 (polygon ID 16645) to 2980 (polygon ID 16455). Thus the net loss of seedlings and saplings was recorded minimum (60/ha) in polygon ID 16455 and maximum (2990/ha) in polygon ID 10013. Monetary loss (using the Forest Deptt. rates) was computed ranging from Rs. 1500/ha (polygon ID 16455) and 74,750/ha (polygon ID 10013) with a mean value of Rs. 34575/ha (Table 5).

Stakeholder Consultations for Valuation of Forest Goods:

In M.P., a total of 31 stakeholder consultation meetings were organized for valuation of forest resources in which 345 people (316 male and 29 female) participated (Plate 7). In most ofthese interactive meetings, Forest Department staff also participated. Based on these consultative meetings local rates for different products of forests such as NTFPs, wild edibles, medicinal plants etc. were recorded. Summary of stakeholder consultation meeting is presented in Table 8.

Table 8: The details of stakeholder meeting and consultation with forest officials held around the studied polygons in Madhya Pradesh.

S. No.	PolygonID	Forest Range	Place of meeting held	No of Forest officials consulted/present during fieldwork	Number of participants (M / F)
1	16068	Katkut	Chandupura	3	07 Male
2	16181	Katkut	Mehandikheda	3	07 Male
3	15203	Shahpur	Surkhi	5	Joint meeting withpoly Id 4524
4	16529*	Mukki	-	7	-
5	11754	East Kalibhit	Khategaon	3	15 Male
6	16622	Aonliya	Tawkhedi	2	10 Male
7	16645*	Aonliya	-	3	-
8	16720	East Kalibhit	Bagda	3	15 Male
9	15522	Gotegoan	Dungariya	4	09 Male
10	10369	North Lamta	Basegaon	3	19 Male (16 Male 03Female)
11	16581*	South Lamta	-	2	-
12	16627*	South Lamta	-	2	-

13	1312	Nagod	Shyam Nagar	2	10 Male
14	1316	Nagod	Khagaha	2	12 Male
15	1357	Nagod	Jhingodar	3	11 (08 Male 03 Female)
16	1358*	Nagod	-	2	-
17	11546	Lougur	Khursudh	3	11(06 Male, 05 Female)
18	11791*	Lougur	-	2	-
19	11995*	Katangi	-	2	-
20	16860*	Balaghat	-	2	-
21	9169	Mandleshwar	Ahilyapura	2	17 Male
22	16311	Katkut	Badel	1	07 Male
23	4524	Shahpur	Surkhi	1	08 (05 Male 03Female)
24	10701*	Magardha	-	2	-
25	10758	Magardha	South Magarda	2	12 Male
26	11576	Magardha	Ratamati	2	13 Male
27	6993	Bankhedi	Dolni	1	19 Male
28	10013*	SeoniMalwa	-	2	-
29	11530*	Aonliya	-	1	-
30	16722	East Kalibhit	East Bagda	2	Joint meeting withpoly Id 16720
31	6534	Narsinghpur	Kislai	1	14 Male
32	6865	Narsinghpur	Usri	1	15 (14 Male & 01Female)
33	15762*	Narsinghpur	-	1	-
34	16455*	North Lamta	-	1	-
35	16470*	North Lamta	-	1	-
36	16846*	South Ukwa	-	0	-
37	1443	Sidhi	Sidhi	1	06 Male
38	14057	Athner	Satkund	1	12 Male
39	12459*	Ambada	-	1	-
40	12563	Ambada	Morkha	1	21 (17Male & 05Female
41	12628	Ambada	Morkha	1	Joint meeting withpoly Id 12563
42	16826	Ambada	East Dukarjhila	1	20 Male
43	14676	Kalda	Jursinha	1	10 Male
44	14683	Kalda	Kutmi Khurd	1	12 Male
45	7596	Tanda	Ambasoti	0	-
46	11473	Magardha	Ratamati	1	Joint meeting withpoly Id

					11576
47	11563*	South Lamta	-	1	-
48	11001	Lougur	Varudgota 1	1	12(03 Male 09 Female)
49	12508*	Bich	Panathawari	1	18 Male

*** Stakeholders meetings/consultations could not be held; In all other polygons stakeholders meetings/consultations were held.**

This study based on the field work of one season has attempted to estimate the loss to various forest goods (i.e., timber, fuel wood and fodder, NTFPs and MAPs) due to FF of 2019. Monetary loss for timber was distinctly higher for U.K. as compared to M.P. (3,24,469.00 vs. 31,665.8 Rs./ha). Also, loss of fuelwood and ground fodder for U.K. (14315.00 and 8450.00 Rs./ha) was markedly greater for fuel wood and fodder than recorded for M.P. (4607.73 and 1916.09 Rs./ha). Loss of forest regeneration (seedlings and saplings) due to FF was computed Rs. 23692.31/ha (range= Rs. 25550 to Rs. 47250/ha) in U.K. and Rs. 1625000 in M.P. (range= Rs. 1500 to Rs. 74750). The studied polygons of U.K. forests were rich in floral diversity (total = 150) compared to M.P. forests (total = 125). Similarly, the richness of NTFPs species was greater in U.K. (total NTFPs= 93) than in the polygons of M.P. forests (total NTFPs= 43) studied by us. However, this species richness is likely to increase with more field visits this year. Valuation of NTFPs and MAPs is in progress. In the FTR we will provide the total ecosystem value (TEV) of all the forest goods lost due to FF. Also, similar data set we generated for all the unburnt polygons adjacent to the burnt polygons will be compiled to give a comparative account of both burnt and unburnt polygons and actual estimates of loss due to FF.

However, it may be pointed out here that the monetary values we have computed for timber, fuelwood, fodder and forest regneration (loss of seedlings and saplings due to fire) given in this report is yet to be finalized given certain limitations. For example, all the burnt logs lying on forest floor do not have market value; all the ground herbage is not used as fodder; and all the trees and its branches/twigs are not used for fuel wood. More relaistic estimates of these forest products among others will be assessed after conducting more field work and consultaions with experts will and will be given in the FTR.

Figure 2: Field work in different forests of Uttarakhand and Madhya Pradesh

ii. **During the reporting period the work done by WII is as follows:** Binsar Wildlife Sanctuary was selected as a candidate site among the four probable sites (Figure 2). A reconnaissance survey was conducted in the identified study area i.e. Binsar Wildlife Sanctuary for 2-3 days based on the history of the burnt scar of the last five years (2016 onwards) and forest types. The study area was divided into 30 grids (2 x 2 km), which were mostly covering Chir pine, Banj oak, Tilonj oak, Tilonjoak-Deodar and Moist temperate deciduous forest forests. Camera traps were deployed to capture the presence of wild animals in the study area. Eighteen camera traps have been installed within the identified grids. These cameras are installed on the fixed and frequently used animal trails with no or least human interference minimum for 15 days. The location of camera traps has been shown in Figure. 3. The species recorded through camera traps are as follows: Goral, Barking deer, Sambhar deer, Leopard, Jackal, Wild pig, Flying squirrel, Himalayan yellow-throated marten and Kalij pheasant. A total of 11 transects were run to count the ungulates and birds in the study area. The transects varied in length from 1.5 to 3.0 km and replicated twice. The sign survey trails have been shown in Figure. 4. A total of 50 birds were encountered during the transect survey and listed in Table 9 below:

Table 9: List of 50 brids encountered during the transect survey

S. No	Common Name
1	Hill Partridge
2	Kalij Pheasant
3	Koklass Pheasant
4	Rock Pigeon
5	Oriental Turtle-Dove
6	Spotted Dove
7	Himalayan Griffon
8	Crested Serpent-Eagle
9	Changeable Hawk-Eagle
10	Black Eagle
11	Steppe Eagle
12	Black Kite
13	Collared Owlet
14	Barn Swallow
15	Red-rumped Swallow
16	Slaty-headed Parakeet
17	Plum-headed Parakeet
18	Great Barbet
19	Blue-throated Barbet
20	Brown-fronted Woodpecker
21	Rufous-bellied Woodpecker
22	Himalayan Woodpecker

S. No	Common Name
26	Black-headed Jay
27	Red-billed Blue-Magpie
28	House Crow
29	Large-billed crow
30	Rufous-bellied Niltava
31	Verditer Flycatcher
32	Blue Whistling-Thrush
33	Spotter Forktail
34	Himalayan Bluetail
35	Blue-fronted Redstart
36	Blue-capped Redstart
37	Chestnut-bellied Rock-Thrush
38	Siberian Stonechat
39	Gray Bushchat
40	Gray-headed-Flycatcher
41	White-throated Fantail
42	Long-tailed Minivet
43	Mistle Thrush
44	Gray-winged Blackbird
45	White-collared Blackbird
46	Red-vented Bulbul
47	Black Bulbul

23	Gray-headed Woodpecker
24	Greater Yellownape
25	Eurasian Jay

48	White-throated Laughingthrush
49	Streaked Laughingthrush
50	Rufous sibia

To estimate the density of rodents and reptiles 20 rodent traps were installed and a plot count was done for reptiles. Habitat data were also collected along the transect for habitat use by wild animals. To support the wild animal's record from the study area, a questionnaire survey was also conducted to get the information from villagers as well as forest staff.

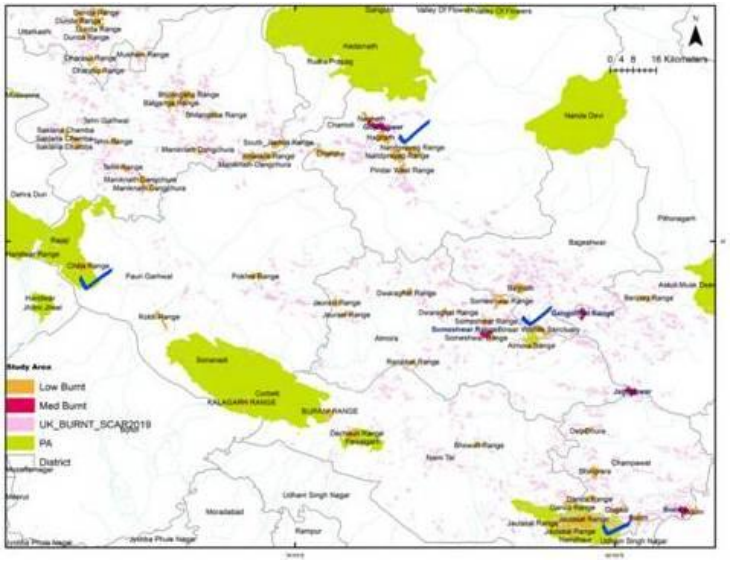


Figure 2: Probable areas for study marked with blue ticks

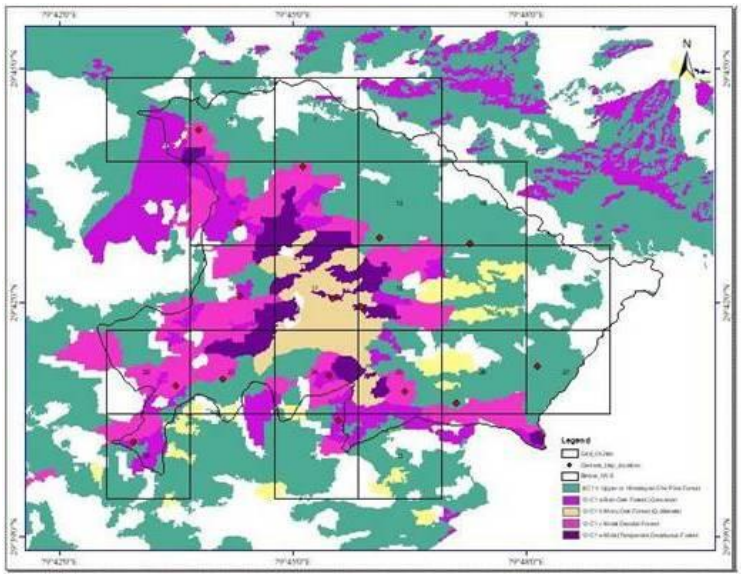


Figure 3: Location of camera traps installed in the study area

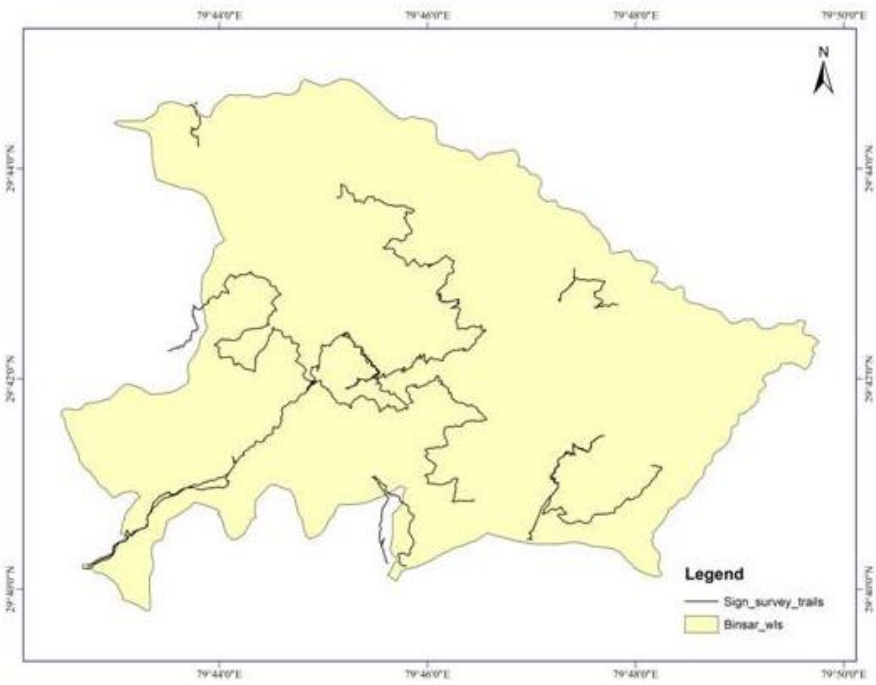


Figure 4: The sign survey trails

iii. **Work carried out by NIH:** The objective of the NIH part of study is to assess the economic losses due to hydrological changes caused by forest fires in different types of forests in Uttarakhand and Madhya Pradesh. The field investigations (including double ring infiltrometer tests and Guelph Permeameter Tests and soil sample collection for texture, soil moisture retention, organic matter content etc.) at the burnt and unburnt plots are going on. Till now, we have completed the field investigations at 11 burnt polygons in Uttarakhand and 24 burnt polygons in Madhya Pradesh alongwith equal number of neighbouring unburnt plots. The laboratory investigations for the analysis of collected soil samples are also going on in parallel. The required gridded precipitation data, Actual Evapotranspiration (AET) data, National Bureau of Soil Survey and Land Use Planning (NBSS&LUP) soil maps and Leaf Area Index for both the burnt and unburnt plots in both the states have been obtained. The development of various maps required for the assessment of change in hydrologic responseas well as for assessment of soil erosion patterns is in progress.
One component of the study titled "Estimation of economic loss due to change in hydrologic variables caused by forest fires in Uttarakhand and Madhya Pradesh" has been awarded to the Department of Humanities and Social Sciences, IIT Roorkee. Their assessment of economic losswill be based on surveys and the inputs on hydrologic response provided by NIH. They have finalized the questionnaire for the survey and started the field surveys.

Field Investigations in Madhya Pradesh

The 49 burnt sites in forests of Madhya Pradesh comprise of 20 low burnt, 24 moderately burnt and 5 severely burnt sites. The burnt sites are distributed in the various regions of Madhya Pradesh and field experiments along with soil sampling

cannot be performed at one go for all the49 sites. Therefore, the experiments have been planned in four phases to cover these 49 test sites spread all over Madhya Pradesh. 24 burnt sites were selected to be covered in the first andsecond phase of the field visits to cover the burnt sites located in the districts of Hoshangabad, Narsinghpur, Katni, Satna, Sidhi, Dindori, and Balaghat. The experiments have been performedat these 24 burnt sites and the adjoining 24 unburnt/control sites so that the changes that might have resulted due to forest fires can be evaluated. The location of selected 24 burnt sites and adjoining 24 unburnt control sites covered during the first two phases of field visit is given in Figure7:

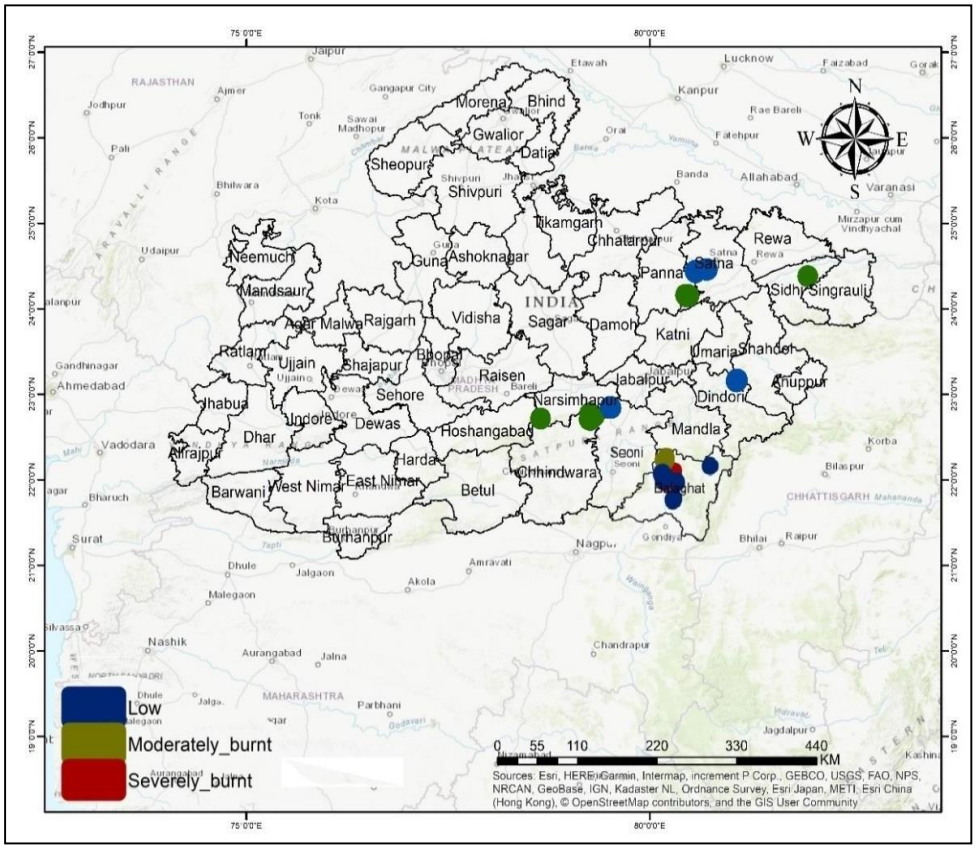


Figure 7 : Completed 24 burnt and unburnt (control) sites in forests of Madhya Pradesh

Field experiments were carried out to determine the saturated hydraulic conductivity and infiltration capacity at the selected 24 burnt forest sites and adjoining unburnt (control) sites. Thecumulative infiltration that took place during the test duration of 5 hours and 50 minutes was also computed from the analysis. The results of the infiltration tests and Guelph Permeameter tests for the burnt and unburnt forest sites are summarized in Table 10 whereas Table 11 shows the testresults at the adjoining unburnt (control) test sites. At few sites, the infiltration tests could not be conducted due to topographical constraints and trekking time limitations within the forests to reach some of the test sites.

Table 10 : Saturated hydraulic conductivity, Infiltration capacity and Cumulative infiltrationat burnt forest sites

SN	Forest Division	Forest Range	Burnt forest sites (Beat)	Comp. No.	Fire Severity	Saturated hydraulic conductivity (cm/sec)	Infiltration rate (cm/hr)
1.	Hoshangabad	Bankhedi	Dolni	321	Moderate	2.952	3.8
2.	Narsinghpur	Narsinghpur	Usri	136	Moderate	1.008	1.1
3.	Narsinghpur	Narsinghpur	Jatlapur	150	Moderate	5.436	5.1
4.	Narsinghpur	Narsinghpur	Kislai	155	Moderate	5.868	-
5.	Narsinghpur	Gotegaon	Dungariya	39	Low	2.952	2.9
6.	South Panna	Kalda	Kutmi khurd	851	Moderate	0.900	1.9
7.	Satna	Nagod	Surdaha	321	Low	0.468	1
8.	Satna	Nagod	Jhingodar	330	Low	1.332	-
9.	Satna	Nogod	Shyam Nagar	294	Low	2.340	-
10.	Sidhi	Sidhi	Sidhi	1007	Moderate	1.944	1.8
11.	Dindori	Shahpur	Surkhi	120	Low	2.916	-
12.	Dindori	Shahpur	Surkhi	120	Moderate	3.384	-
13.	Satna	Nagod	Khagaha	293	Low	2.340	-
14.	South Panna	Kalda	Jursinha	817	Moderate	-	-
15.	South Balaghat	Balaghat	Bori	667	Low	0.049	1.6
16.	South Balaghat	Loungur	Varudgota	5	Severe	1.065	4
17.	North Balaghat	South Lamta	Dongarbodi North	1373	Severe	0.324	0.9
18.	North Balaghat	South Lamta	Manpur	1356	Low	0.294	5.2
19.	North Balaghat	South Lamta	Mohgaon	1314	Low	0.292	3.3
20.	North Balaghat	North Lamta	Basegaon	1195	Moderate	0.006	3.9
21.	North Balaghat	North Lamta	Kumjhar	1211	Moderate	0.607	4.4
22.	North Balaghat	North Lamta	Basegaon	1210	Low	0.457	4.8
23.	South Balaghat	Lougur	Khursudh	56	Low	0.144	2.7
24.	Kanha National Park (Core)	Mukki	Samnapur	195	Low	0.342	1

Table 11: Saturated hydraulic conductivity, Infiltration capacity and Cumulative infiltrationat Unburnt (control) sites

SN	Forest Division	Forest Range	Burnt forest sites (Beat)	Comp.No.	Fire Severity	Saturated hydraulic conductivity (cm/sec)	Infiltration rate (cm/hr)
1	Hoshangabad	Banhedi	Dolni	321	Moderate	3.636	4.7
2	Narsinghpur	Narsinghpur	Usri	136	Moderate	2.052	1.7
3	Narsinghpur	Narsinghpur	Jatlapur	150	Moderate	11.052	6.9

4	Narsinghpur	Narsinghpur	Kislai	155	Moderate	7.956	-
5	Narsinghpur	Gotegaon	Dungariya	39	Low	3.132	3.2
6	South Panna	Kalda	Kutmi khurd	851	Moderate	2.088	2.8
7	Satna	Nagod	Surdaha	321	Low	1.764	1.2
8	Satna	Nagod	Jhingodar	330	Low	5.796	-
9	Satna	Nogod	Shyam Nagar	294	Low	2.952	-
10	Sidhi	Sidhi	Sidhi	1007	Moderate	2.700	2.4
11	Dindori	Shahpur	Surkhi	120	Low	6.264	-
12	Dindori	Shahpur	Surkhi	120	Moderate	6.264	-
13	Satna	Nagod	Khagaha	293	Low	3.240	-
14	South Panna	Kalda	Jursinha	817	Moderate	-	-
15	South Balaghat	Balaghat	Bori	667	Low	0.370	4
16	South Balaghat	Loungur	Varudgota	5	Severe	0.454	5.4
17	North Balaghat	South Lamta	Dongarbodi North	1373	Severe	0.068	3.7
18	North Balaghat	South Lamta	Manpur	1356	Low	0.008	5.8
19	North Balaghat	South Lamta	Mohgaon	1314	Low	0.144	5.8
20	North Balaghat	North Lamta	Basegaon	1195	Moderate	0.538	5.6
21	North Balaghat	North Lamta	Kumjhar	1211	Moderate	0.023	5.6
22	North Balaghat	North Lamta	Basegaon	1210	Low	0.363	5.7
23	South Balaghat	Lougur	Khursudh	56	Low	0.063	4.2
24	Kanha National Park (Core)	Mukki	Samnapur	195	Low	0.098	5.7

Field Investigations in Uttarakhand

The 42 burnt sites in the forest areas of Uttarakhand comprise of 10 low burnt, 32 moderately burnt sites distributed across five forest types. The burnt sites are distributed in the various regions of Uttarakhand, therefore, the experiments have been planned to cover the sites according to the forest divisions. The field investigations were started during last week of January. Considering the harsh winter climate at the hilly sites, it was planned to carry out the field investigations starting from the plain areas of Uttarakhand and further approaching towards the hilly sites. The experiments have been performed at the 11 burnt sites and the adjoining 11 unburnt/control sites so that the changes that might have resulted due to forest fires can be evaluated. The location of selected 11 burnt sites and adjoining 11 unburnt control sites coveredduring the field visit is given in Figure below.

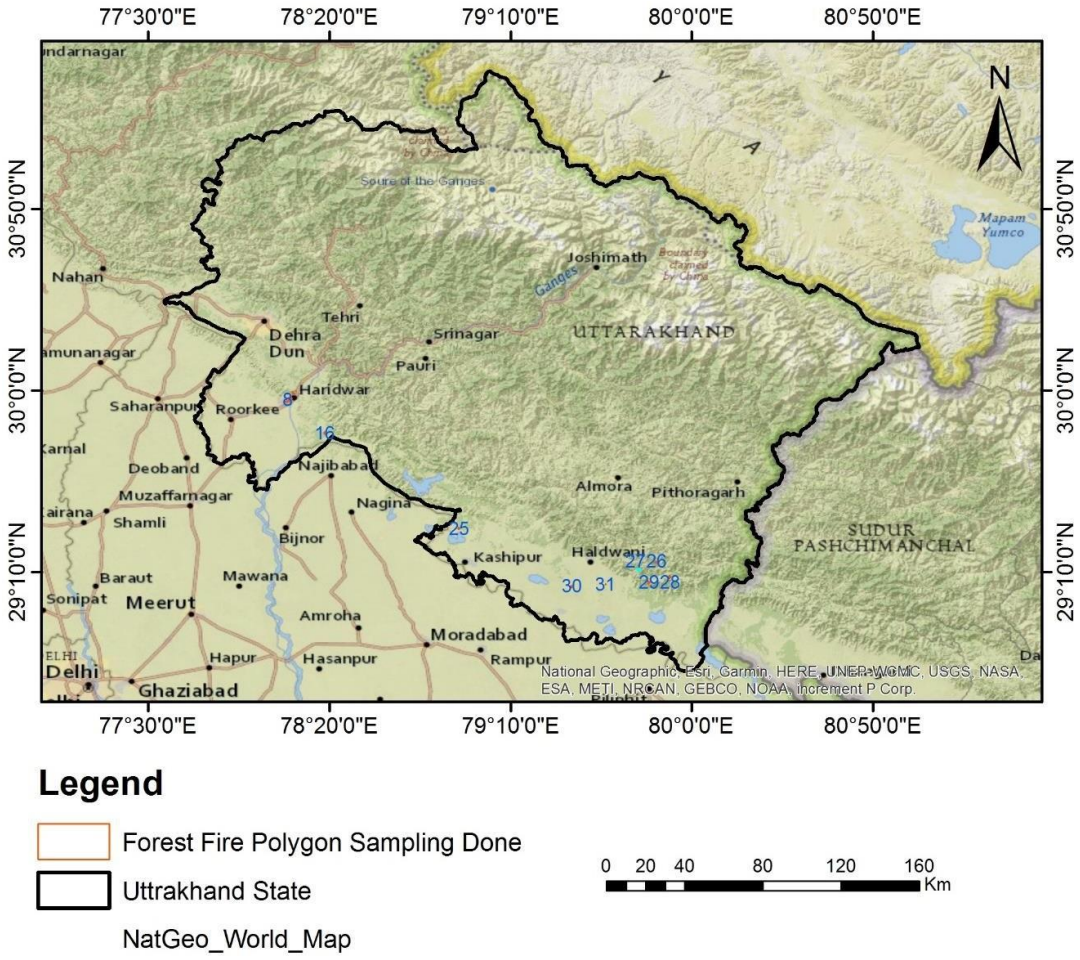


Figure 8: Completed 11 burnt and unburnt (control) sites in forests of Uttarakhand

Field experiments were carried out to determine the saturated hydraulic conductivity and infiltration capacity at the selected 11 burnt forest sites and at equal number of adjoining unburnt(control) sites. The results of the infiltration tests and Guelph Permeameter tests for the burnt andunburnt forest sites are summarized in Table 12 whereas Table 13 shows the test results at the adjoining unburnt (control) sites.

Table 12: Saturated hydraulic conductivity, Infiltration capacity and Cumulative infiltrationat burnt forest sites

SN	Division	Range	Beat	Comp. No.	Hydraulic Conductivity (Kfs) (cm/hr)	Infiltration Rate (cm/hr)
1	Raja Ji National Park	Haridwar	Ranipur East	0	0.997	9.546
2	Raja Ji National Park	Haridwar	Kharkhari North	0	2.303	1.069
3	Haridwar	Chiriyapur	Kotawali	10	0.250	0.7

4	Terai East	Kilpura	West Kilpura - 1	51	0.979	1.82
5	Terai East	Kishanpur	Kishanpur South	8	0.409	2.959
6	Tarai Central	Haldwani	Tanda Center	109	0.064	1.018
7	Tarai West	South Jaspur	Tumaria	39	1.754	2.036
8	Haldwani	Danda	North Lowaranala	0	-	19.855
9	Haldwani	Danda	Durgapipal	4	0.054	2.291
10	Haldwani	Jaulasal	Hatgarh	9	-	6.491
11	Haldwani	Nandhaur	Ratarao	5	-	26.727

Table 13: Saturated hydraulic conductivity, Infiltration capacity and Cumulative infiltrationat Unburnt (control) sites

SN	Division	Range	Beat	Comp. No.	Hydraulic Conductivity (Kfs) (cm/hr)	Infiltration Rate (cm/hr)
1	Raja Ji National Park	Haridwar	Ranipur East	0	1.965	29.591
2	Raja Ji National Park	Haridwar	Kharkhari North	0	1.479	7.255
3	Haridwar	Chiriyapur	Kotawali	10	0.827	0.682
4	Terai East	Kilpura	West Kilpura - 1	51	3.354	2.036
5	Terai East	Kishanpur	Kishanpur South	8	0.013	5.727
6	Tarai Central	Haldwani	Tanda Center	109	0.556	0.509
7	Tarai West	South Jaspur	Tumaria	39	3.529	2.291
8	Haldwani	Danda	North Lowaranala	0	0.076	91.636
9	Haldwani	Danda	Durgapipal	4	-	14.891
10	Haldwani	Jaulasal	Hatgarh	8	-	-
11	Haldwani	Nandhaur	Ratarao	4	-	26.727

Inferences Drawn from the Field Investigations

For most of the sites, the infiltration capacity and saturated hydraulic conductivity at unburnt (control) sites have been found to be more than that at the burnt forest sites. The reasonfor the same may be attributed to the repulsive behaviour due to the ashes of the burnt trees getting accumulated over the soil surface and soil pores. The deposition of the

ash as well as its downward movement in the subsequent monsoon season causes coagulation and formation of soil aggregates that generally acts as an impervious medium like a cement layer and thereby reducing the infiltration rate and movement of water within the soil matrix.

The Figures showing the infiltration capacity and cumulative infiltration for burnt and adjoining unburnt (control) sites in forests of Madhya Pradesh and Uttarakhand are given in **Annexure II.**

iv. **Work carried out by Forest Research Institute, Dehradun** is involved in economic loss assessment of terrestrial flora due to forest fire on per hectare basis for the respective State. Forest Research Institute for phyto-sociological survey laid out plots size 10M × 10M, 5M × 5 M and 1M × 1M for Trees, Shrubs and herbs layers respectively. Collected dead twigs, litter, and diameter for Tree Carbon pool while entire plant for shrubs and Herbs have been harvested. Collected soils samples from different burnt and unburnt polygons areas for bulk density and carbon pool. Field survey have been conducted to collect vegetation and carbon pool data from 22 burnt and unburnt polygons (ID 336, ID 367, ID 386, ID 397, ID 548, ID 1008, ID 1020, ID 1238, ID 1430, ID1552, ID 1783, ID 1867, ID 2041, ID 2201, ID 2045, ID 2179, ID 2374, ID 2655, ID 4007, ID 4002, ID 4446, ID 4603) in different Forest Types of Uttarakhand viz. Himalayan Moist Temperate Forests and Subtropical Pine Forests, Tropical Moist Deciduous Forest, Tropical Dry Deciduous Forest, at Haridwar Forest Division, Rajaji National Park, Binsar Wildlife Sanctuary, Almora Forest Division, Civil Soyam Almora, Nainital Forest Division, Tarai West Forest Division, Tons Forest Division, Chakrata forest Division, Tehari Forest Division and Bageshwar Forest Division **(Annexure III).**

v. **Further following work was also done :**

- The Phytosociological data have been collected from different burnt areas and adjoining unburnt areas.
- Rare, endangered and threatened category species (RET) have also been identified referring to the Red Data Book of Botanical Survey of India, IUCN Red data list as well other published records.
- The preparation of listing of Cryptogamic flora (Bryophytes and Lichens) and invasive species has been initiated.

vi. **Work carried out by Tropical Forest Research Institute has surveyed 27 sites** out of 49 sites in MP as given in table 14 :

Table 14: Sites in respective divisions.

Division	**Sites covered**
North Balaghat	4
South Balaghat	5
Narsinghpur	4
Kanha National Park (Core)	1

Barwah	4
Dhar	1
Harda	0
Khandwa	0
Hoshangabad	1
Satna	4
South Panna	2
Sidhi	1
Dindori	0
South Chhindwara	0
South Betul	0
Total	**27**

Conclusion: -

In financial year 2020-2021 5 coordination meetings (22/01/2020, 12/05/2020, 29/05/2020, 24/09/2020.21/05/2021) were held online by ICFRE Hq to ensure the smooth working of all the project partners. During these meetings project partners have exchanged data and all required information amongst each other. Through coordination meetings it was ensured that all the hassles faced by working partners are resolved and they follow the methodology adopted in the project. The progress of all partners is further summarised below:

i. **G.B. Pant National Institute of Himalayan Environment institute** (GBPNIHEI) working on economic loss assessment provisioning services and cultural value of forest /produce loss due to forest fire on per hectare basis for specific forest types has so far has covered 32 polygons of selected 42 polygons in Uttarakhand. Likewise out of 49 polygons in Madhya Pradesh so far their team has visited and studied **31** polygons in all selected polygons for estimation of economic loss due to forest fire such as timber, NTFPs, fuel wood, fodder and others.

ii. **During the reporting period Wild Life Institute, Dehradun** has covered Binsar Wildlife Sanctuary in Uttarakhand and Kanha National Park in Madhya Pradesh. For Uttarakhand, pre-fire and post-fire data collection has been done**.** The species recorded through camera traps are as follows: Goral, Barking deer, Sambhar deer, Leopard, Jackal, Wild pig, Flying squirrel, Himalayan yellow-throated marten and Kalij pheasant. A total of 11 transects were run to count the ungulates and birds in the study area.

iii. **National Institute of Hydrology, Roorkee** is assessing the economic losses due to hydrological changes caused by forest fires in different types of forests in Uttarakhand and Madhya Pradesh. So far the field investigations at 11 burnt polygons in Uttarakhand and 24 burnt polygons in Madhya Pradesh alongwith equal number of neighbouring unburnt plots

have been completed. The field investigations (including double ring infiltrometer tests and Guelph Permeameter Tests and soil sample collection for texture, soil moisture retention, organic matter content etc.) at the burnt and unburnt plots are going on. The laboratory investigations for the analysis of collected soil samples are also going on in parallel.

iv. **Forest Research Institute, Dehradun** is involved in economic loss assessment of terrestrial flora due to forest fire on per hectare basis for the respective State has collect vegetation and carbon pool data from 22 burnt and unburnt in different Forest Types of Uttarakhand viz. Himalayan Moist Temperate Forests and Subtropical Pine Forests, Tropical Moist Deciduous Forest, Tropical Dry Deciduous Forest, at Haridwar Forest Division, Rajaji National Park, Binsar Wildlife Sanctuary, Almora Forest Division, Civil Soyam Almora, Nainital Forest Division, Tarai West Forest Division, Tons Forest Division, Chakrata forest Division, Tehari Forest Division and Bageshwar Forest Division. **Tropical Forest Research Institute, Jabalpur has covered** 33 sites out of 49 polygons of Madhya Pradesh.

Photogallery : -

Figure 9: Different Unburnt Sites in the Forest Type Subtropical Pine Forest of Uttarakhand

Figure 10: Burnt Site (Devtadanada in Tehari Forest division) in Scrub Forest in Forest Type

Figure 11: Burnt Site (Rajaji National Park), Forest Type Tropical Dry Deciduous Forests

Figure 12: Burnt Site (Rajaji National Park), Forest Type Tropical Moist Deciduous Forests

Figure 13: Unburnt Site (Devtadanada in Tehari Forest division) in Scrub forest in Forest Type

Figure 14: Unburnt Site (Rajaji National Park), Forest Type – Tropical Dry Deciduous Forests

Figure 15: Unburnt Site (Rajaji National Park), Forest Type – Tropical Moist Deciduous Forests

Figure 16: Photographs captured during filed experiments and soil sampling at Bori burnt forest site

Figure 17: Photographs captured during filed experiments

Annexure I

Inventory of Flora Recorded from Uttarakhand and Madhya Pradesh Forest Fire Affected Polygons.

S.No.	Tree species		Shrub species		Herb species	
	Scientific Name	**Family**	**Scientific Name**	**Family**	**Scientific Name**	**Family**
1.	*Pinus roxburghii*	Pinaceae	*Flemingia strobilifera*	Fabaceae	*Carex*	Cyperaceae
2.	*Ficus roxburghii*	Moraceae	*Berberis aristata*	Berberidaceae	*Desmodium microphyllum*	Fabaceae
3.	*Sapium insigne*	Euphorbiaceae	*Barleria cristata*	Acanthaceae	*Oxalis corniculata*	Oxalidaceae
4.	*Myrica esculenta*	Myricaceae	*Flemingia macrophylla*	Fabaceae	*Micromeria biflora*	Lamiaceae
5.	*Viburnum nervosum*	Adoxaceae	*Indigofera tinctoria*	Fabaceae	*Galium aparine*	Rubiaceae
6.	*Terminalia chebula*	Combretaceae	*Pyracantha coccinea*	Rosaceae	*Arundinella prunella*	Poaceae
7.	*Q.leucotrichophora*	Fagaceae	*Phyllanthus amarus*	Phyllanthaceae	*Gonostegia hirta*	Urticaceae
8.	*Rhododendron arboreum*	Ericaceae	*Eupatorium odoratum*	Asteraceae	*Panicum verticillatum*	Poaceae
9.	*Lyonia ovalifolia*	Ericaceae	*Solanum aculeatissimum*	Solanaceae	*Conyza elliptica*	Asteraceae
10.	*Fraxinus micratha*	Oleaceae	*Colebrookea oppositifolia*	Lamiaceae	*Persicaria chinensis*	Polygonaceae
11.	*Ficus palmata*	Moraceae	*Rubus ellipticus*	Rosaceae	*Erigeron canadensis*	Asteraceae
12.	*Syzygium cumini*	Myrtaceae	*Aechmanthera wallichii*	Acanthaceae	*Geranium wallichianum*	Geraniaceae
13.	*Phyllanthus emblica*	Phyllanthaceae	*Asparagus filicinus*	Asparagaceae	*Ajuga bracteosa*	Geraniaceae
14.	*Jacaranda mimosifolia*	Bignoniaceae	*Lycoperdon*	Agaricaceae	*Anaphalis adnata*	Asteraceae

15.	*Alnus nepalensis*	Betulaceae	*Inula cuppa*	Asteraceae	*Arundinella nepalensis*	Poaceae
16.	*Shorea robusta*	Dipterocarpaceae	*Woodfordia fruticosa*	Lythraceae	*Agrimonia japonica*	Rosaceae
17.	*Moringa oleifera*	Moringaceae	*Ziziphus Nummularia*	Rhamnaceae	*Valeriana wallichii*	Caprifoliaceae
18.	*Bauhinia variegata*	Fabaceae	*Rosa acicularis*	Rosaceae	*Bidens pilosa*	Asteraceae
19.	*Engelhardia spicata*	Juglandaceae	*Lantana camara*	Verbenaceae	*Cirsium arvense*	Asteraceae
20.	*Cassia fistula*	Fabaceae	*Urena labata*	Malvaceae	*Oxalis corniculata*	Oxalidaceae
21.	*Schleichera oleosa*	Sapindaceae	*Rhus parviflora*	Anacardiaceae	*Cynoglossum furcatum*	Boraginaceae
22.	*Ehretia laevis*	Ehretiaceae	*Carissa spinarum*	Apocynaceae	*Cassia mimosoides*	Fabaceae
23.	*Aegle marmelos*	Rutaceae	*Teucrium quadrifarium*	Lamiaceae	*Viola spp*	Violaceae
24.	*Haldina cordifolia*	Rubiaceae	*Laptodermis lanceolata*	Rubiaceae	*Leucas lanata*	Lamiaceae
25.	*Acacia catechu*	Fabaceae	*Litsea japonica*	Lauraceae	*Vitis vinifera*	Vitaceae
26.	*Holarrhena pubescens*	Apocynaceae	*Artemisia vulgaris*	Asteraceae	*Euphorbia prolifera*	Euphorbiaceae
27.	*Ficus virens*	Moraceae	*Phoenix dactylifera*	Arecaceae	*Artemisia vulgaris*	Asteraceae
28.	*Anogeissus latifolia*	Combretaceae	*Himalrandia tetrasperma*	Rubiaceae	*Osbeckia stellata*	Melastomataceae
29.	*Tectona grandis*	Lamiaceae	*Clerodendrum infortunatum*	Lamiaceae	*Gallium aparine*	Rubiaceae
30.	*Mallotus philippensis*	Euphorbiaceae	*Murraya koenigii*	Rutaceae	*Setaria parviflora*	Poaceae
31.	*Bombax cieba*	Malvaceae	*Helicteres isora*	Malvaceae	*Praxelis clematidea*	Asteraceae
32.	*Careya arborea*	Lecythidaceae	*Dendrocalamus strictus*	Poaceae	*Apluda mutica*	Poaceae

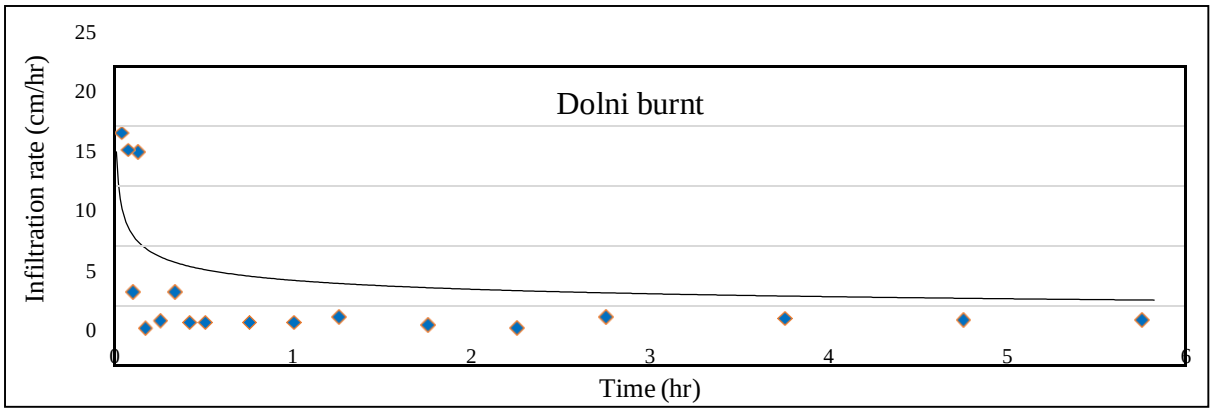
33.	*Lagerstroemia parviflora*	Lythraceae	*Glochidion velutinum*	Phyllanthaceae	*Isodon japonicus*	Lamiaceae
34.	*Eucalyptus alba*	Myrtaceae	*Plectranthus lanuginosus*	Lamiaceae	*Dioscorea deltoidea*	Dioscoreaceae
35.	*Diospyros melanoxylon*	Ebenaceae	*Myrsine africana*	Primulaceae	*Justicia procumbens*	Acanthaceae
36.	*Terminalia bellirica*	Combretaceae	*Thalictrum*	Ranunculaceae	*Ageratum conyzoides*	Asteraceae
37.	*Semecarpus anacardium*	Anacardiaceae	*Dioscorea floribunda*	Dioscoreaceae	*Polygala elongata*	Polygalaceae
38.	*Stereospermum tetragonum*	Bignoniaceae	*Lespedeza capitata*	Fabaceae	*Ocimum tenuiflorum*	Lamiaceae
39.	*Ailanthus excels*	Simaroubaceae	*Maesa indica*	Primulaceae	*Reinwardtia indica*	Linaceae
40.	*Terminalia elliptica*	Combretaceae	*Euphorbia royleana*	Euphorbiaceae	*Chrysopogon gryllus*	Poaceae
41.	*Toona ciliata*	Meliaceae	*Symplocos nairii*	Symplocaceae	*Cyperus rotundus*	Cyperaceae
42.	*Sapindus mukorossi*	Sapindaceae	*Coriaria nepalensis*	Coriariaceae	*Bergenia ciliata*	Saxifragaceae
43.	*Ficus racemosa*	Moraceae			*Anaphalis contorta*	Asteraceae
44.	*Cocculus laurifolius*	Menispermaceae			*Cynodon dactylon*	Poaceae
45.	*Acer oblongum*	Sapindaceae			*Miscanthus nepalensis*	Poaceae
46.	*Acacia dalabata*	Fabaceae			*Lespedeza cuneata*	Fabaceae
47.	*Pyrus pashia*	Rosaceae			*Saccharum ravennae*	Poaceae
48.					*Ocimum tenuiflorum*	Lamiaceae
49.					*Saccharum spontaneum*	Poaceae
50.					*Hypericum oblongifolium*	Hypericaceae

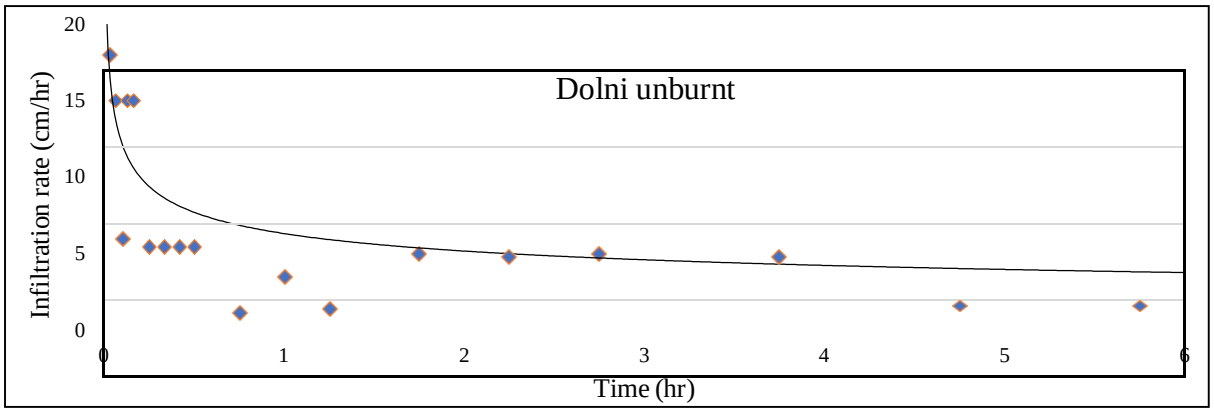
51.					*Ipomoea aculeata Blume*	Convolvulaceae
52.					*Orchid*	
53.					*Commelina benghalensis*	Commelinaceae
54.					*Aeriseama serratum*	Araceae
55.					*Capillipedium parviflorum*	Poaceae
56.					*Cyperus iria*	Cyperaceae
57.					*Persicaria chinensis*	Polygonaceae
58.					*Drosera indica*	Droseraceae
59.					*Anaphalis triplinervis*	Asteraceae
60.					*Smilax zeylanica*	Smilacaceae
61.					*Terrescum*	

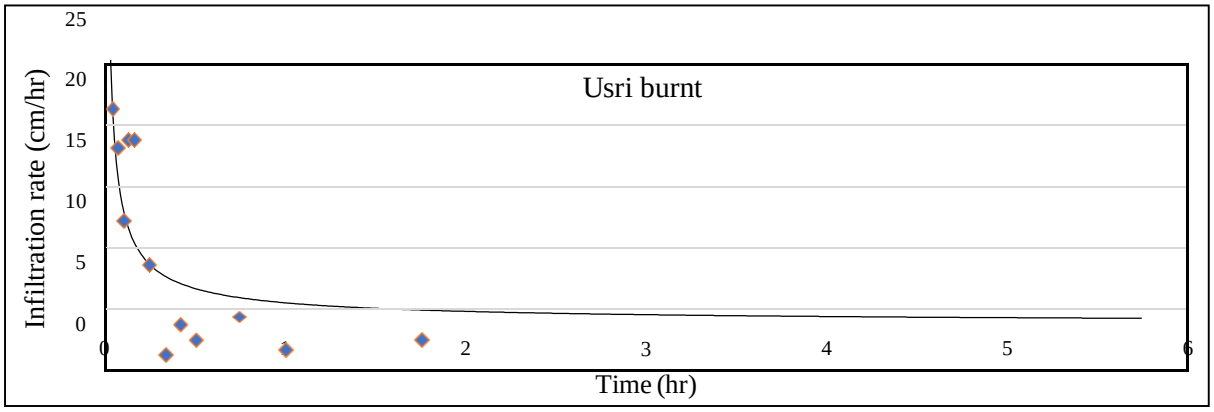
Annexure II

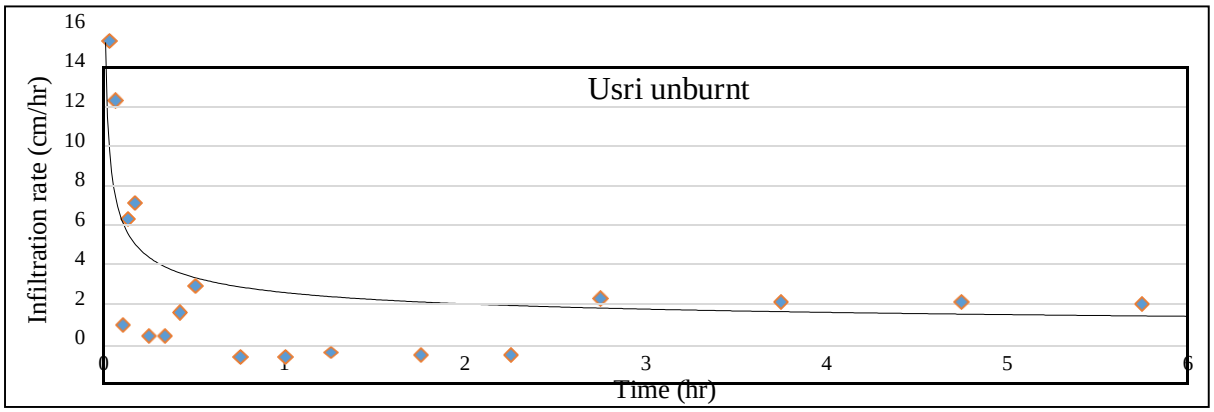
INFILTRATION CHARACTERISTICS OBSERVED DURING FIELD INVESTIGATIONS

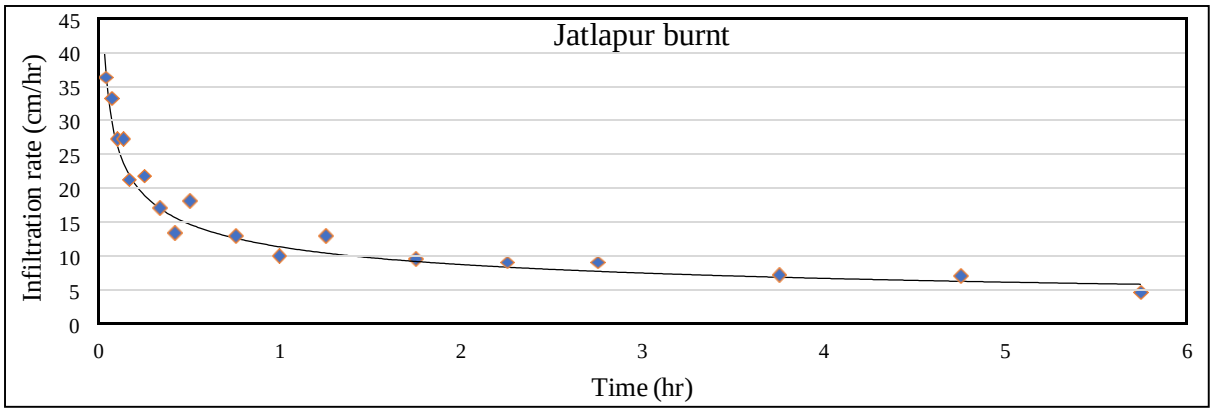
(A) Infiltration characteristics at the selected burnt & unburnt plots in Uttarakhand

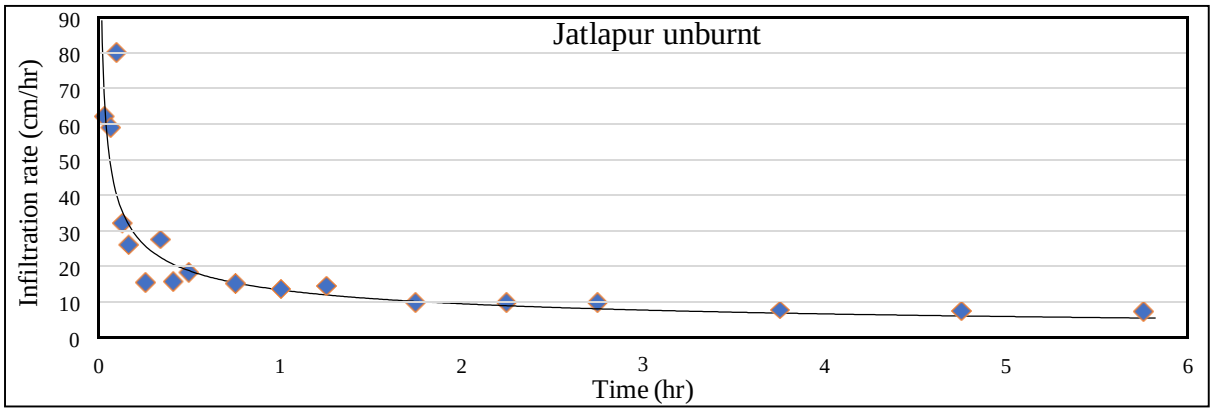


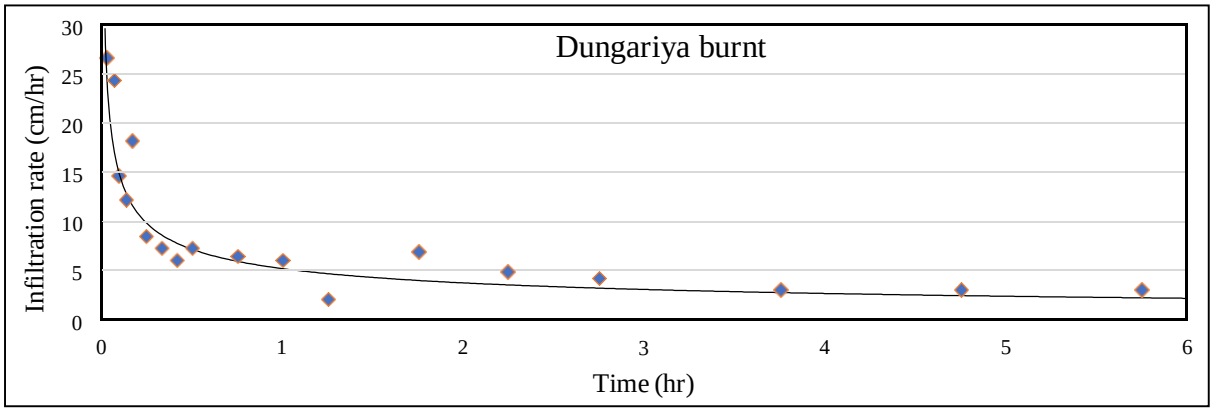


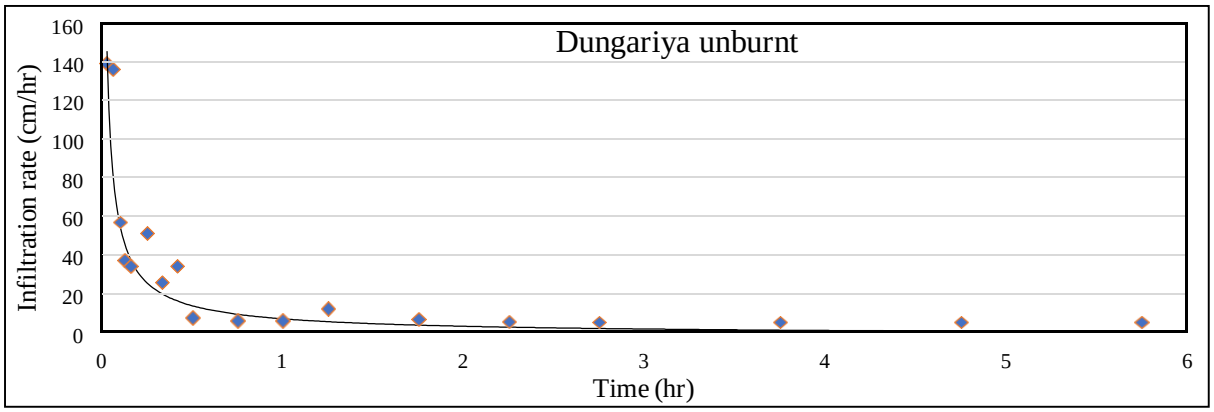


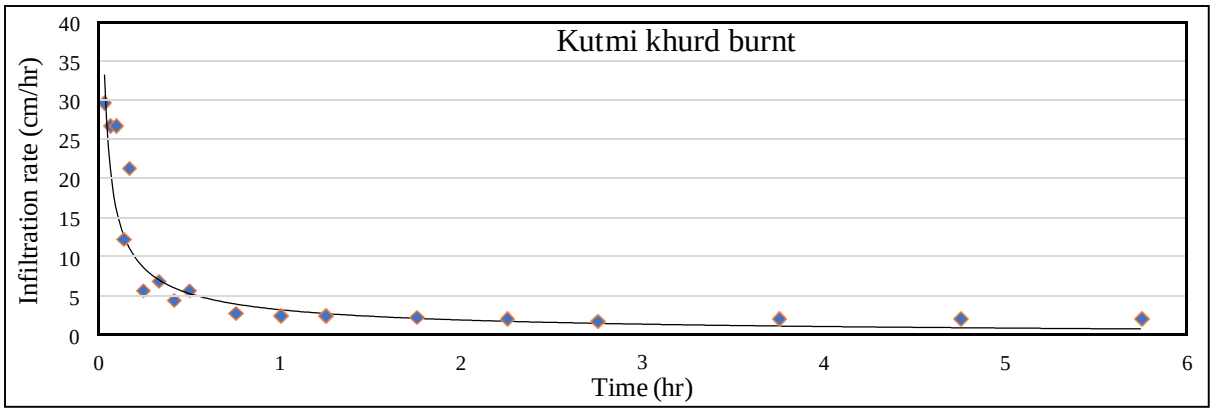


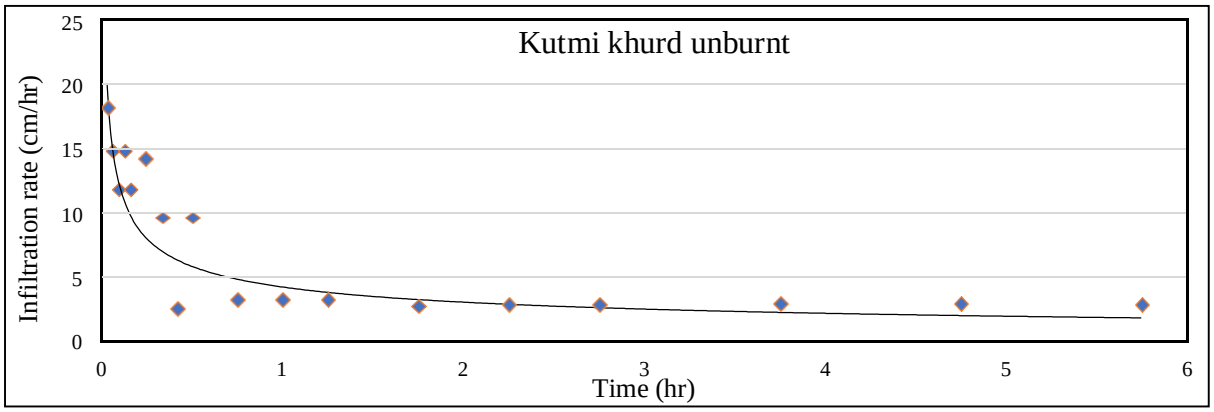

Jatlapur burnt
Infiltration rate (cm/hr)
Time (hr)
0
5
10
15
20
25
30
35
40
45
0
1
2
3
4
5
6

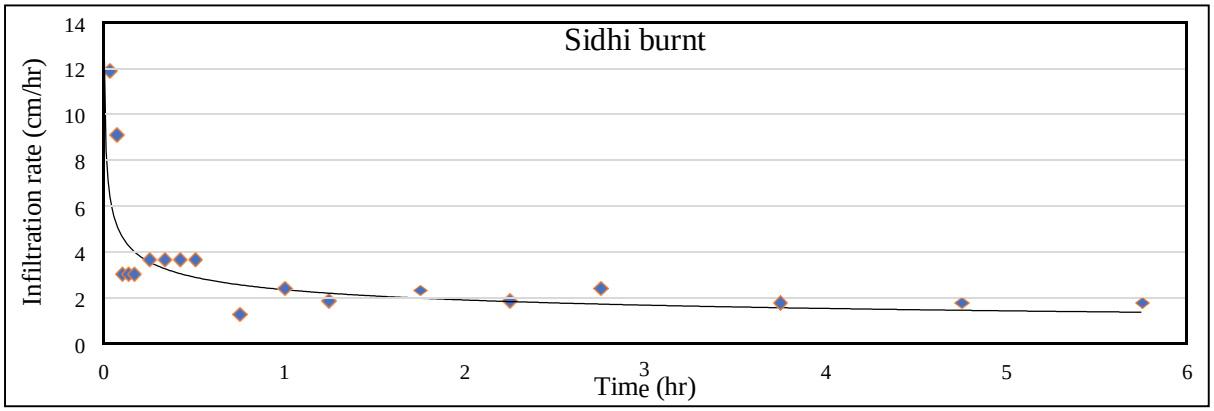

Jatlapur unburnt
Infiltration rate (cm/hr)
Time (hr)
0
10
20
30
40
50
60
70
80
90
0
1
2
3
4
5
6

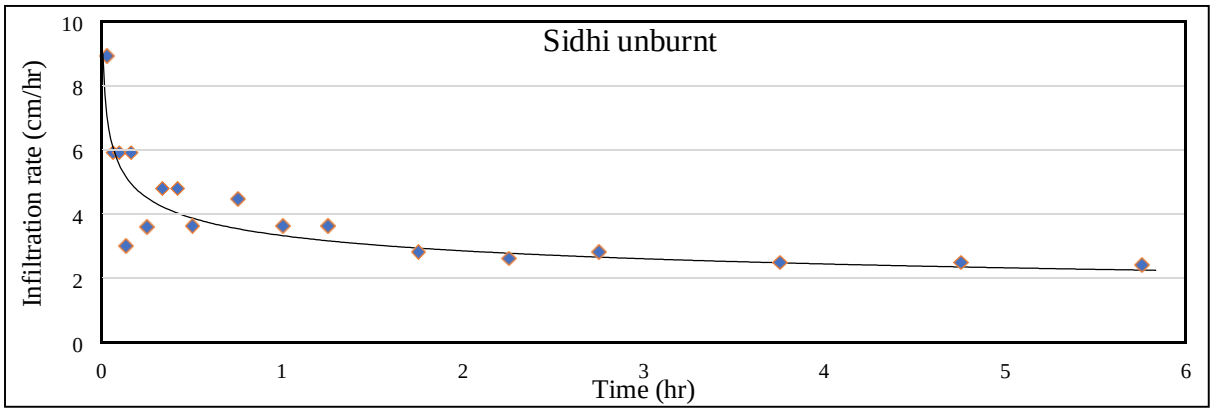

Dungariya burnt
Infiltration rate (cm/hr)
Time (hr)
0
5
10
15
20
25
30
0
1
2
3
4
5
6

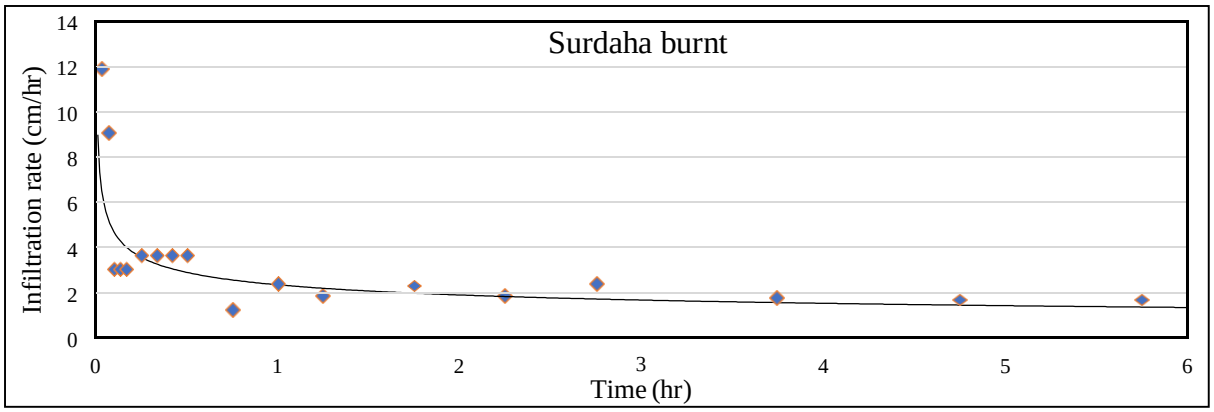

Dungariya unburnt
Infiltration rate (cm/hr)
Time (hr)
0
20
40
60
80
100
120
140
160
0
1
2
3
4
5
6

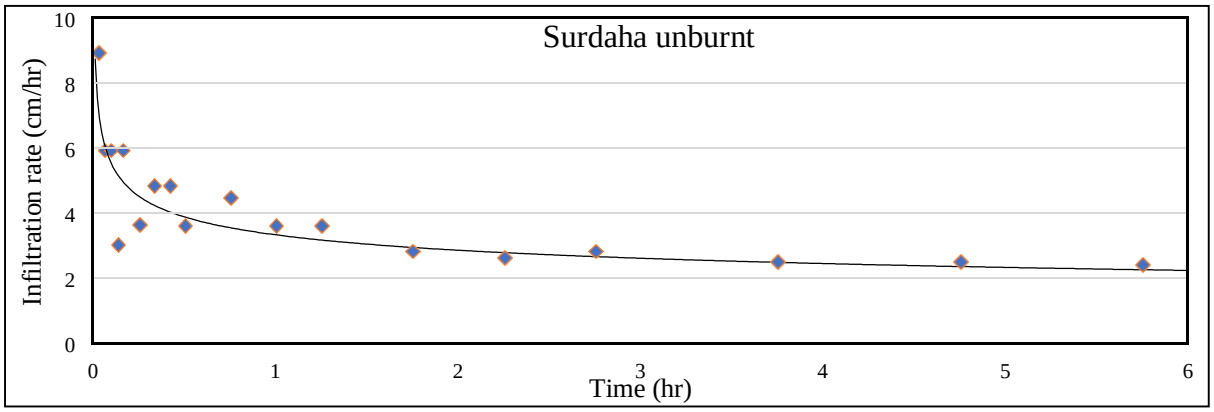

Kutmi khurd burnt
Infiltration rate (cm/hr)
Time (hr)
0
5
10
15
20
25
30
35
40
0
1
2
3
4
5
6

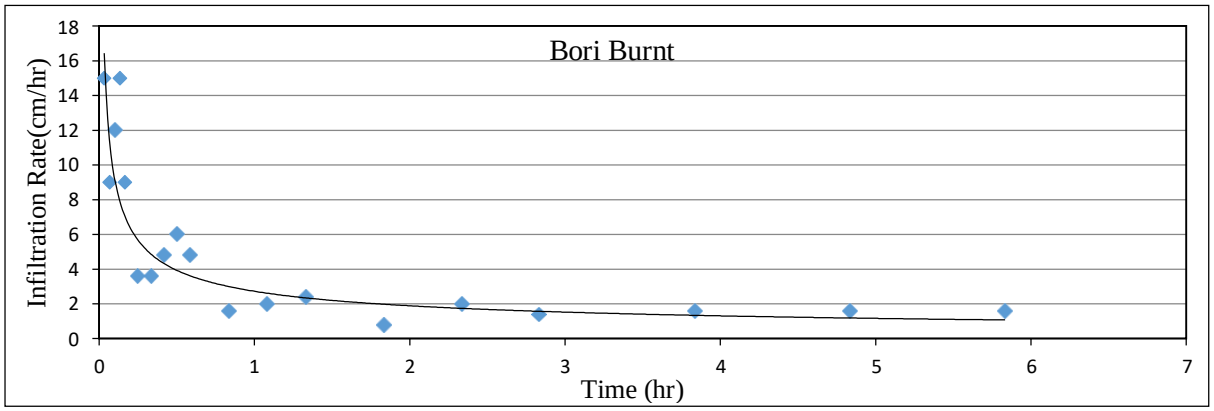

Kutmi khurd unburnt
Infiltration rate (cm/hr)
Time (hr)
0
5
10
15
20
25
0
1
2
3
4
5
6

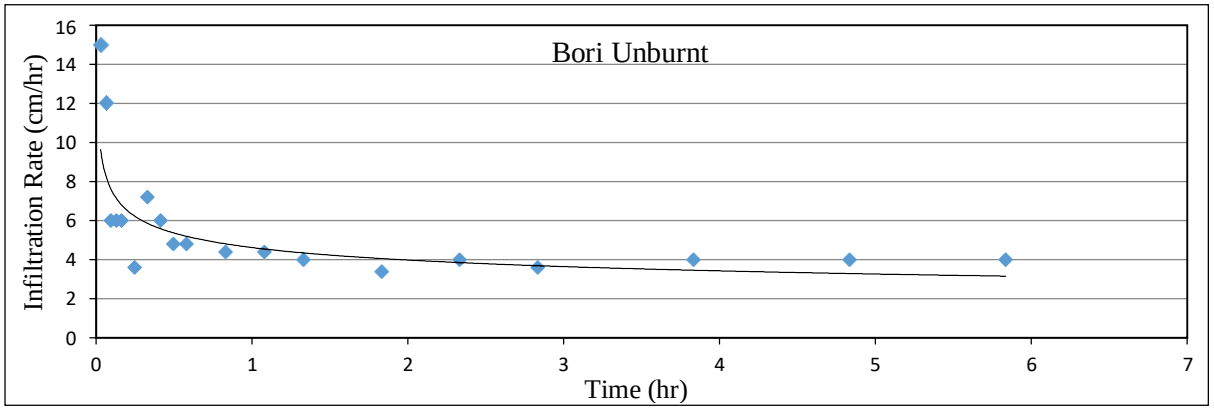

Sidhi burnt
Infiltration rate (cm/hr)
Time (hr)
0
2
4
6
8
10
12
14
0
1
2
3
4
5
6

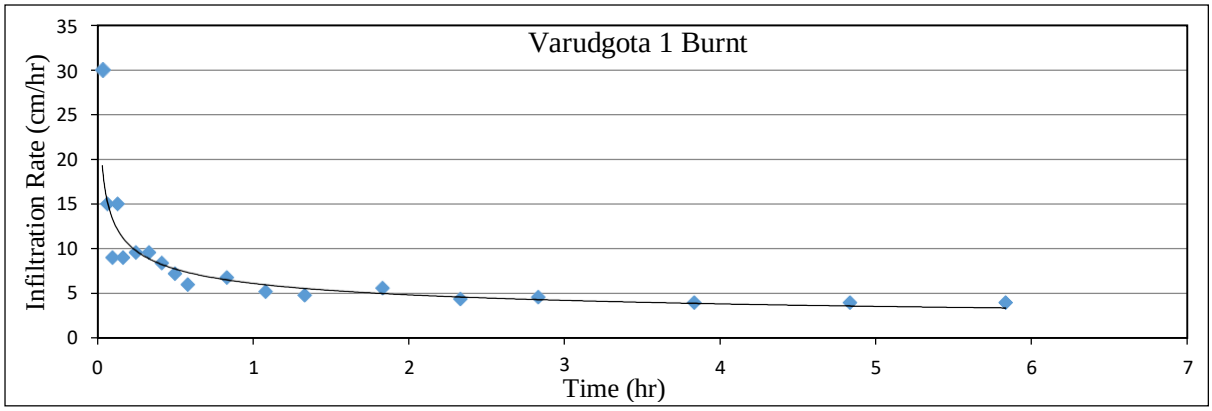

Sidhi unburnt
Infiltration rate (cm/hr)
Time (hr)
0
2
4
6
8
10
0
1
2
3
4
5
6

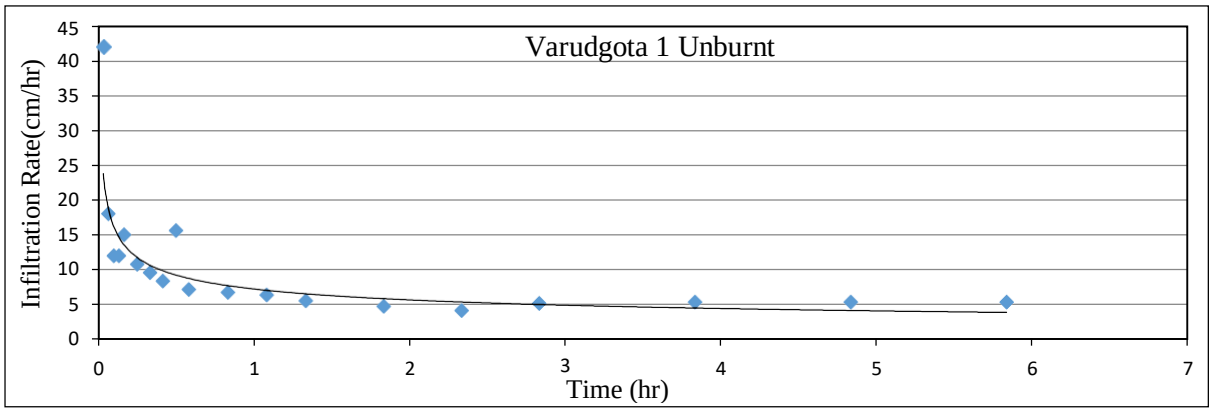

Surdaha burnt
Infiltration rate (cm/hr)
Time (hr)
0
2
4
6
8
10
12
14
0
1
2
3
4
5
6

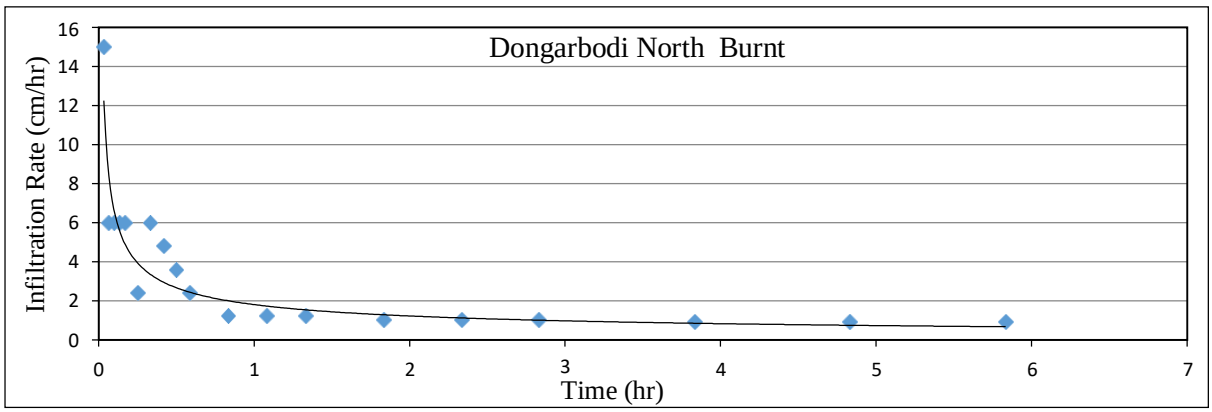

Surdaha unburnt
Infiltration rate (cm/hr)
Time (hr)
0
2
4
6
8
10
0
1
2
3
4
5
6

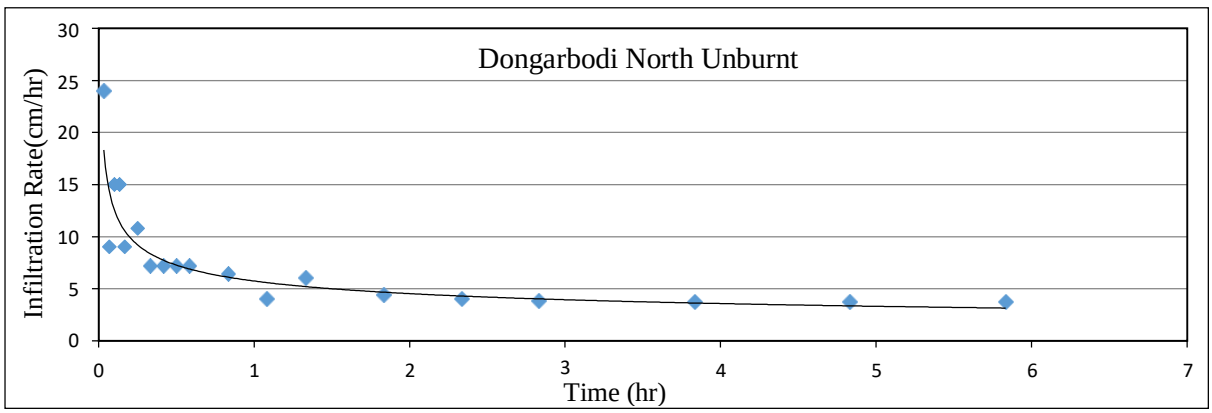

Bori Burnt
Infiltration Rate(cm/hr)
Time (hr)
0
2
4
6
8
10
12
14
16
18
0
1
2
3
4
5
6
7

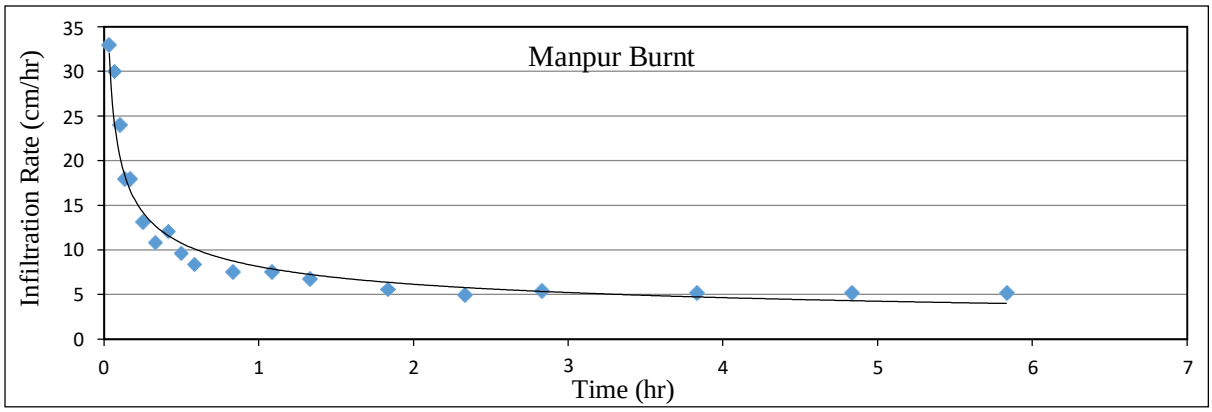

Bori Unburnt
Infiltration Rate (cm/hr)
Time (hr)
0
2
4
6
8
10
12
14
16
0
1
2
3
4
5
6
7

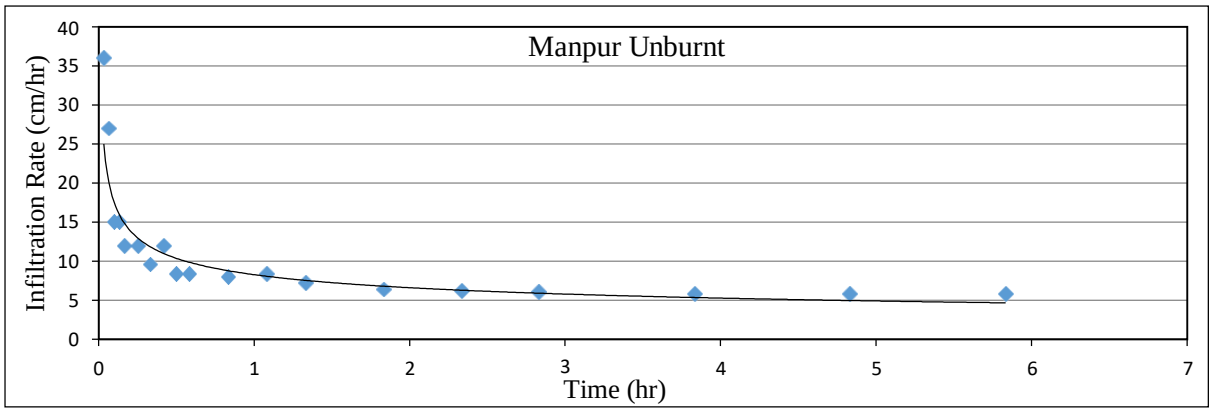

Varudgota 1 Burnt
Infiltration Rate (cm/hr)
Time (hr)
0
5
10
15
20
25
30
35
0
1
2
3
4
5
6
7

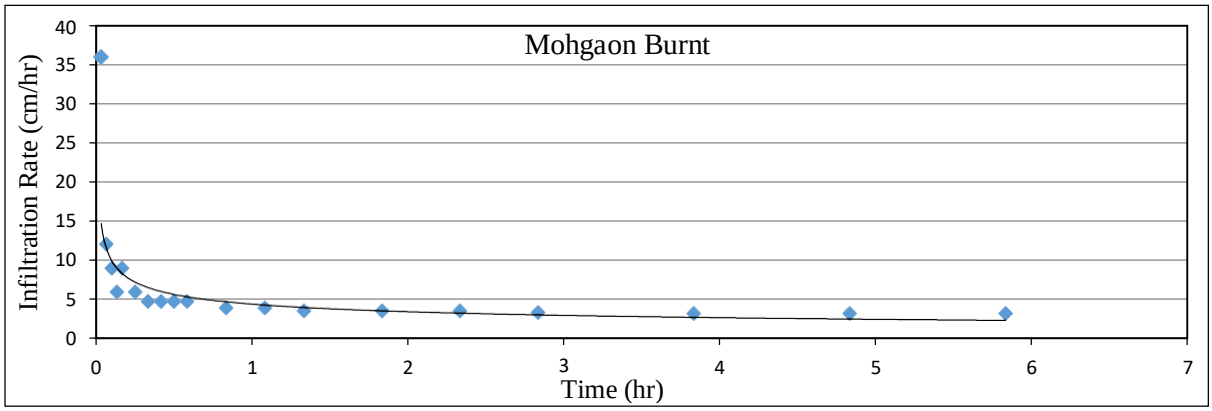

Varudgota 1 Unburnt
Infiltration Rate(cm/hr)
Time (hr)
0
5
10
15
20
25
30
35
40
45
0
1
2
3
4
5
6
7

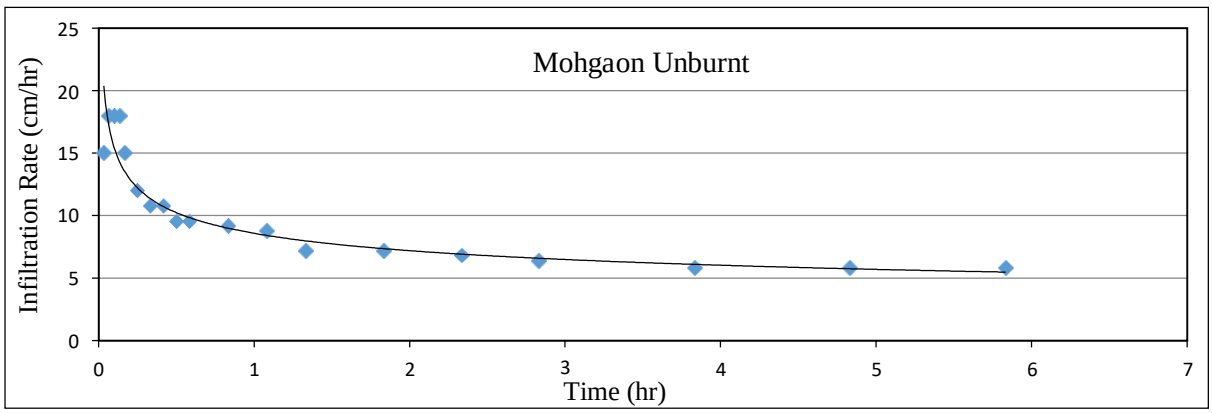

Dongarbodi North Burnt
Infiltration Rate (cm/hr)
Time (hr)
0
2
4
6
8
10
12
14
16
0
1
2
3
4
5
6
7

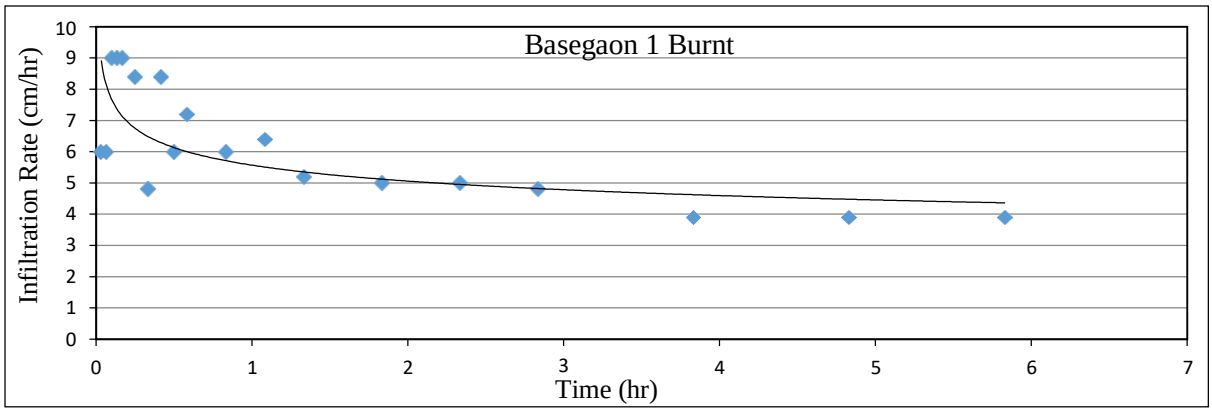

Dongarbodi North Unburnt
Infiltration Rate(cm/hr)
Time (hr)
0
5
10
15
20
25
30
0
1
2
3
4
5
6
7

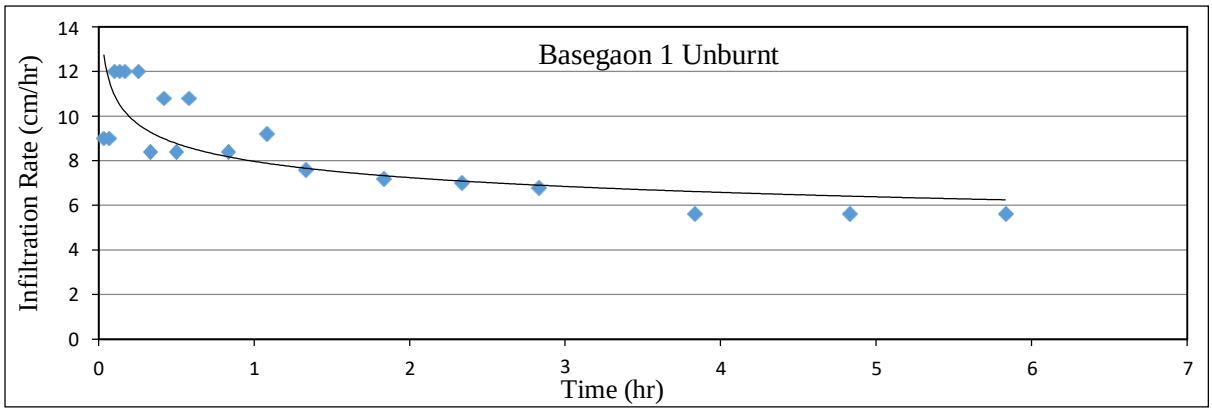

Manpur Burnt
Infiltration Rate (cm/hr)
Time (hr)
0
5
10
15
20
25
30
35
0
1
2
3
4
5
6
7

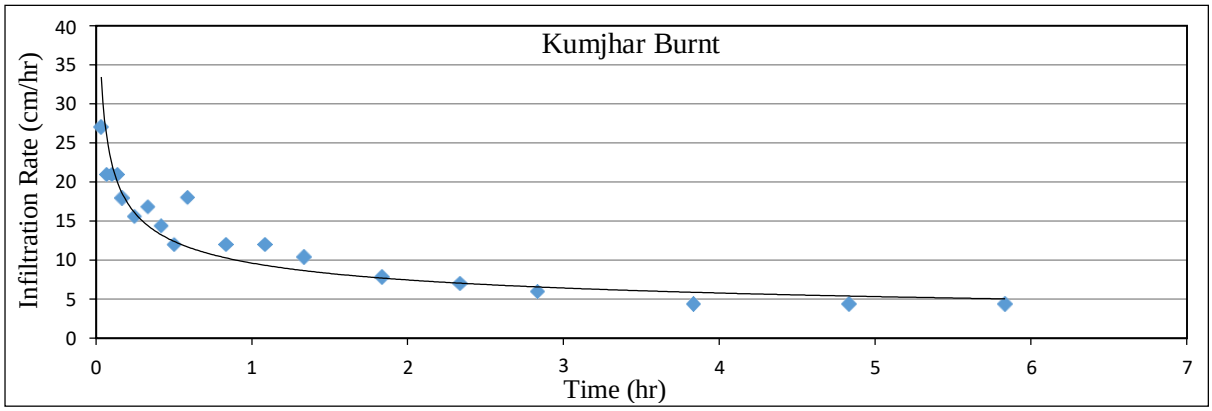

Manpur Unburnt
Infiltration Rate (cm/hr)
Time (hr)
0
5
10
15
20
25
30
35
40
0
1
2
3
4
5
6
7

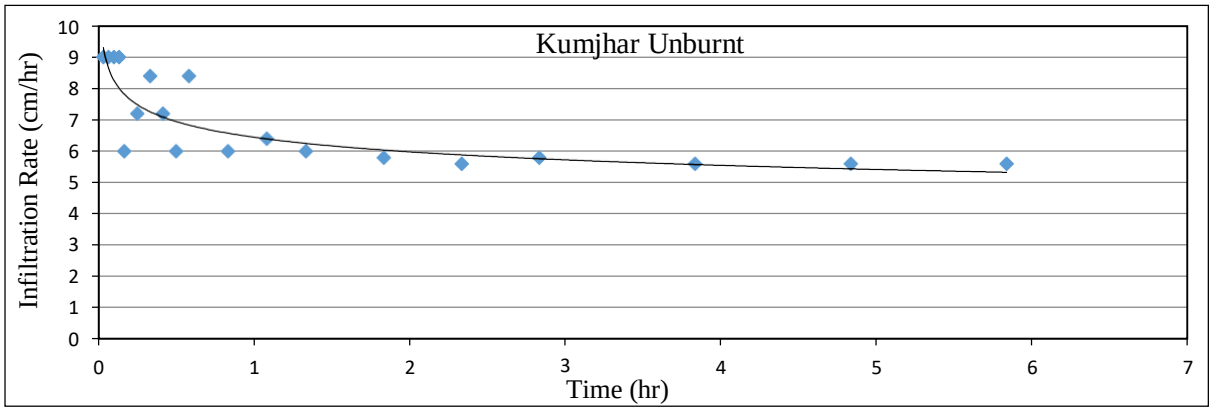

Mohgaon Burnt
Infiltration Rate (cm/hr)
Time (hr)
0
5
10
15
20
25
30
35
40
0
1
2
3
4
5
6
7

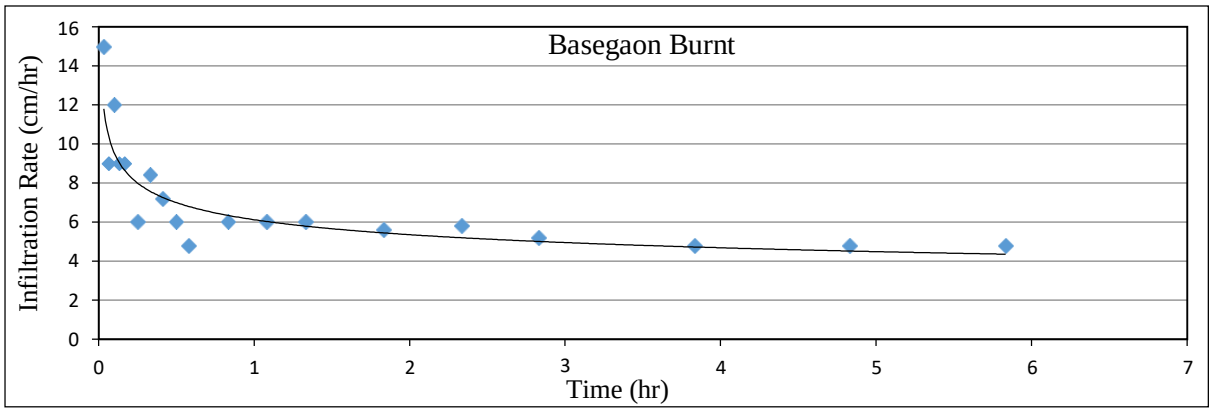

Mohgaon Unburnt
Infiltration Rate (cm/hr)
Time (hr)
0
5
10
15
20
25
0
1
2
3
4
5
6
7

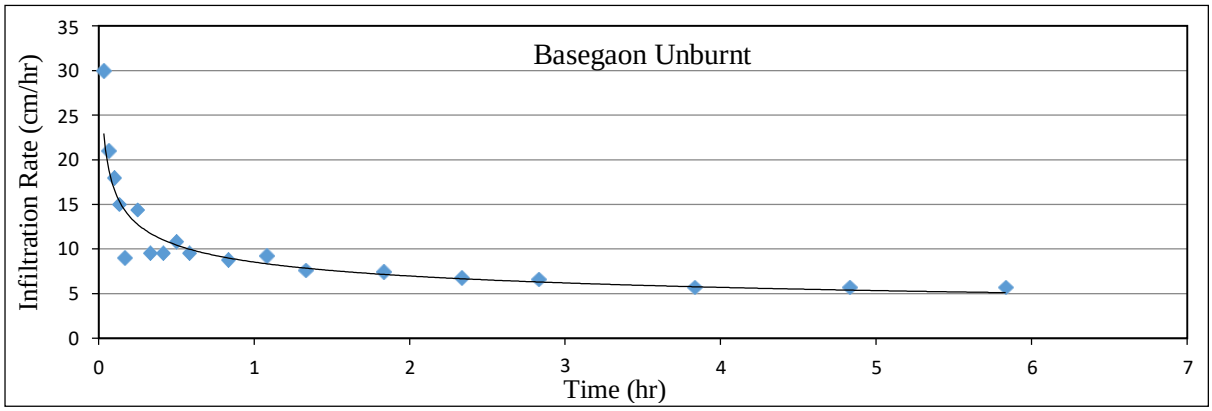

Basegaon 1 Burnt
Infiltration Rate (cm/hr)
Time (hr)

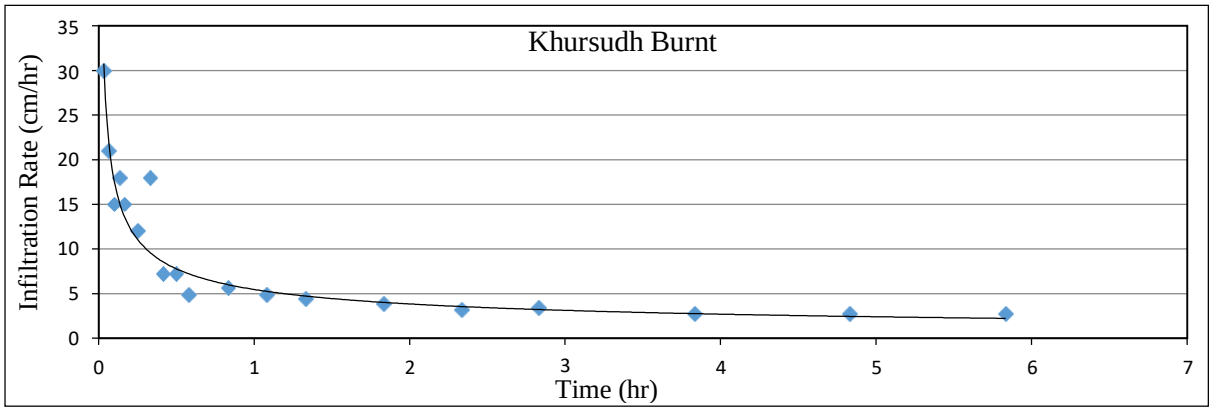

Basegaon 1 Unburnt
Infiltration Rate (cm/hr)
Time (hr)

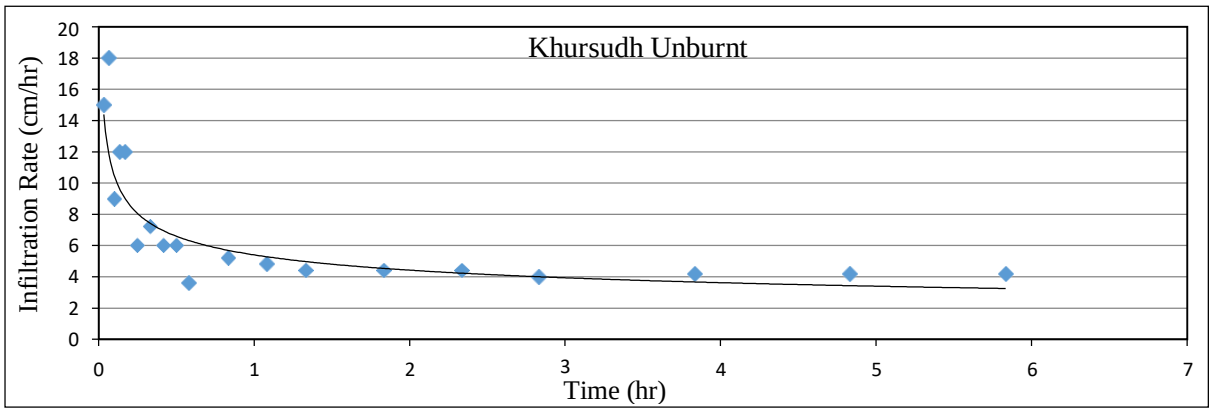

Kumjhar Burnt
Infiltration Rate (cm/hr)
Time (hr)

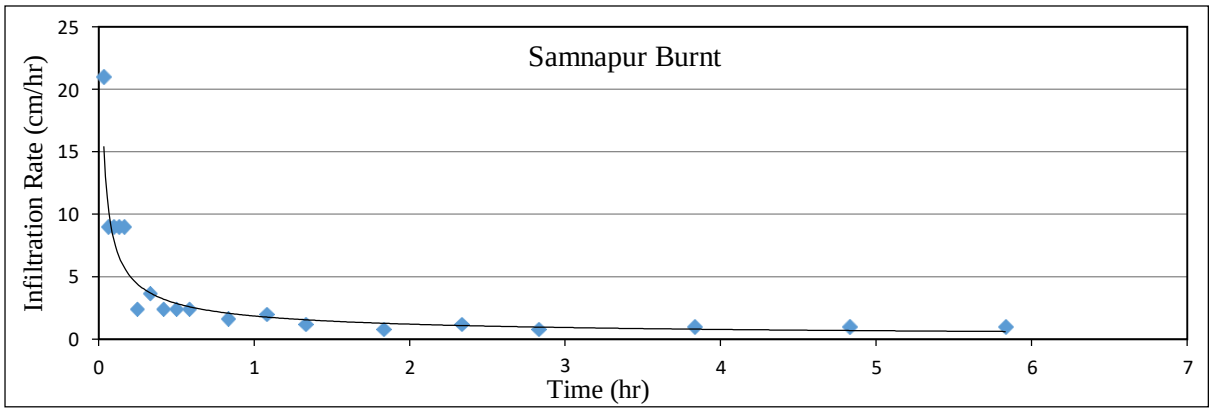

Kumjhar Unburnt
Infiltration Rate (cm/hr)
Time (hr)

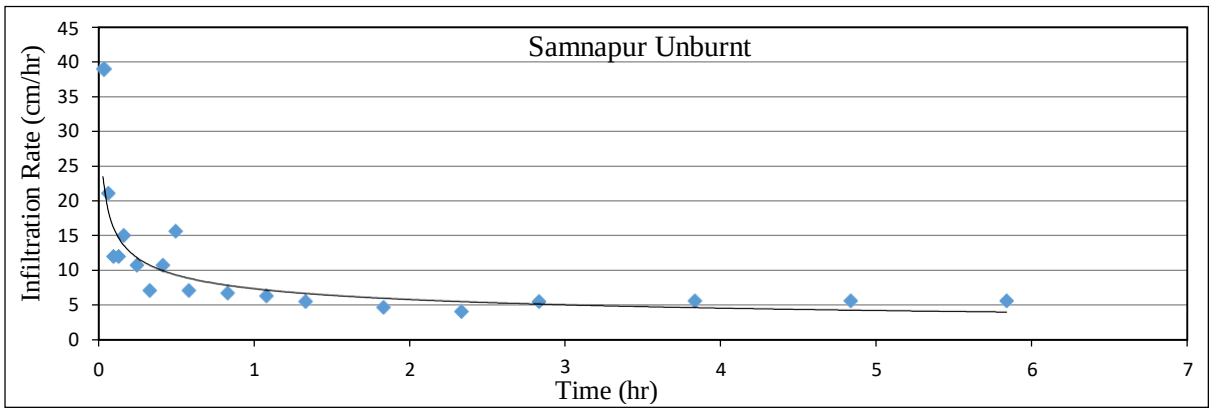

Basegaon Burnt
Infiltration Rate (cm/hr)
Time (hr)
0
2
4
6
8
10
12
14
16
0
1
2
3
4
5
6
7


Basegaon Unburnt
Infiltration Rate (cm/hr)
Time (hr)
0
5
10
15
20
25
30
35
0
1
2
3
4
5
6
7

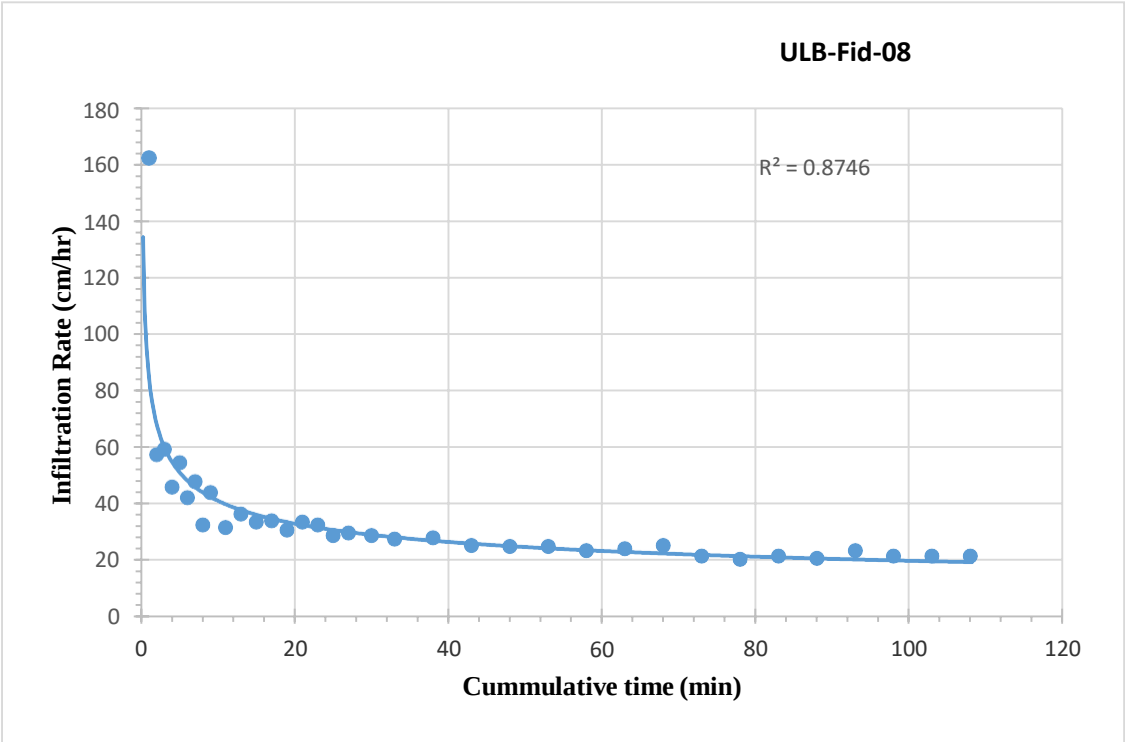

Khursudh Burnt
Infiltration Rate (cm/hr)
Time (hr)
0
5
10
15
20
25
30
35
0
1
2
3
4
5
6
7

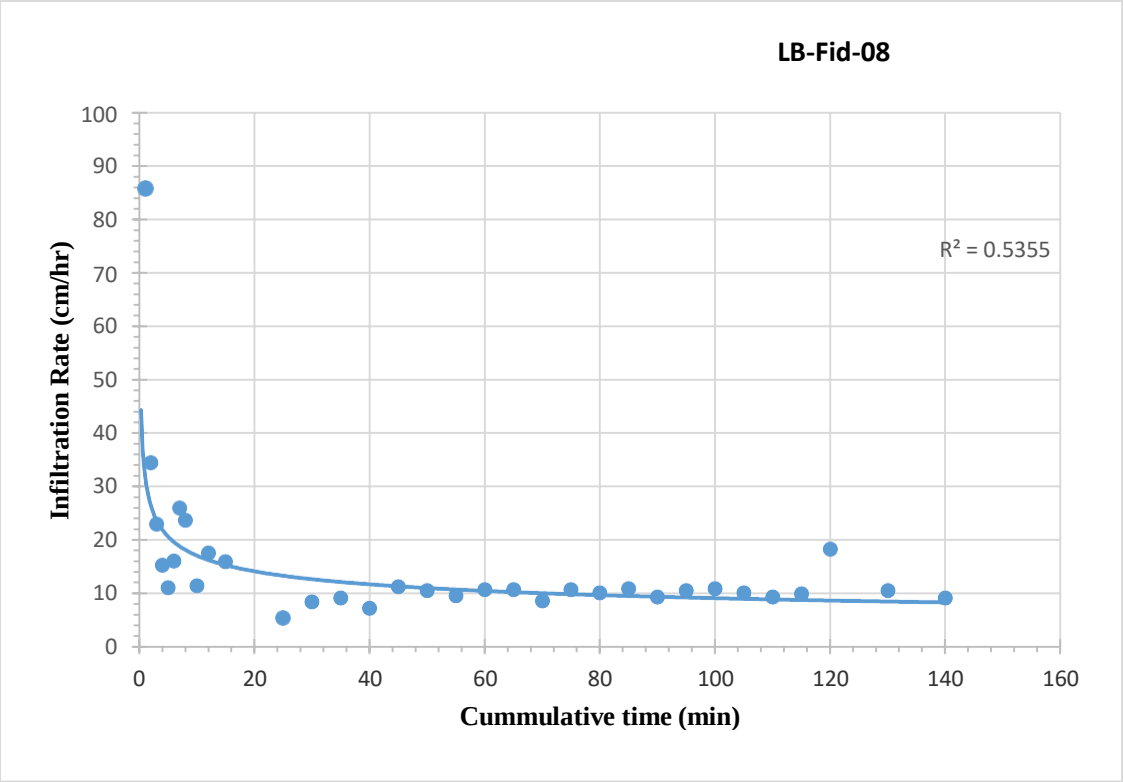

Khursudh Unburnt
Infiltration Rate (cm/hr)
Time (hr)
0
2
4
6
8
10
12
14
16
18
20
0
1
2
3
4
5
6
7

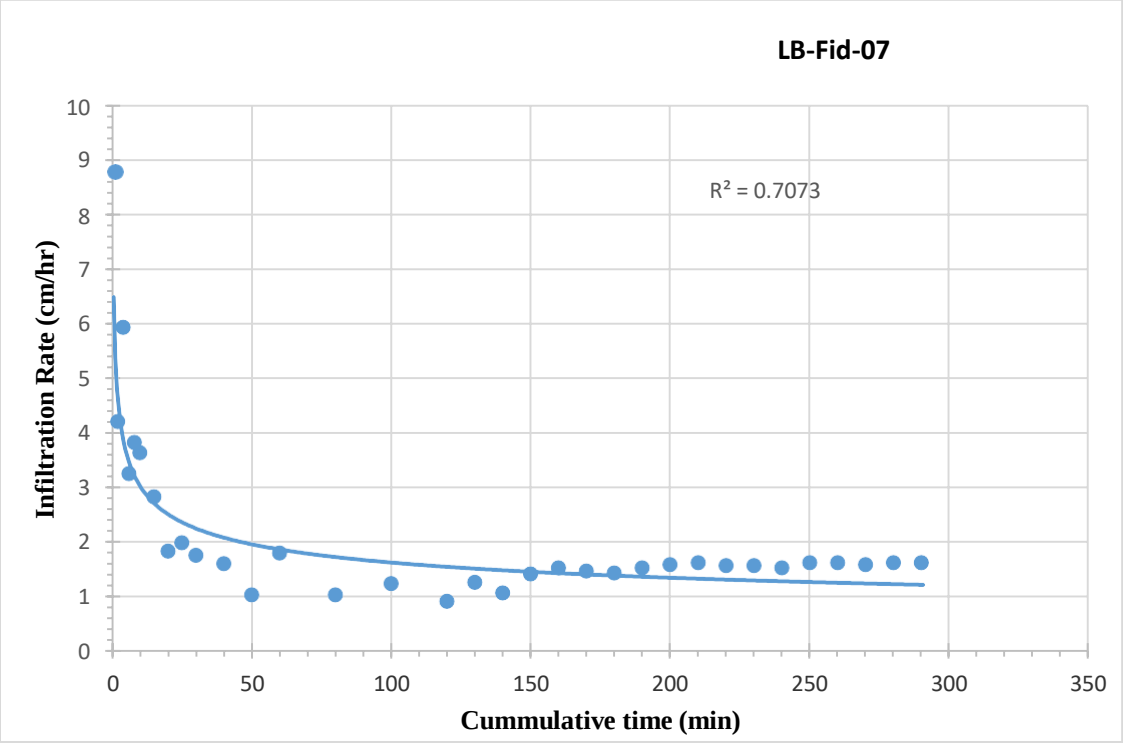


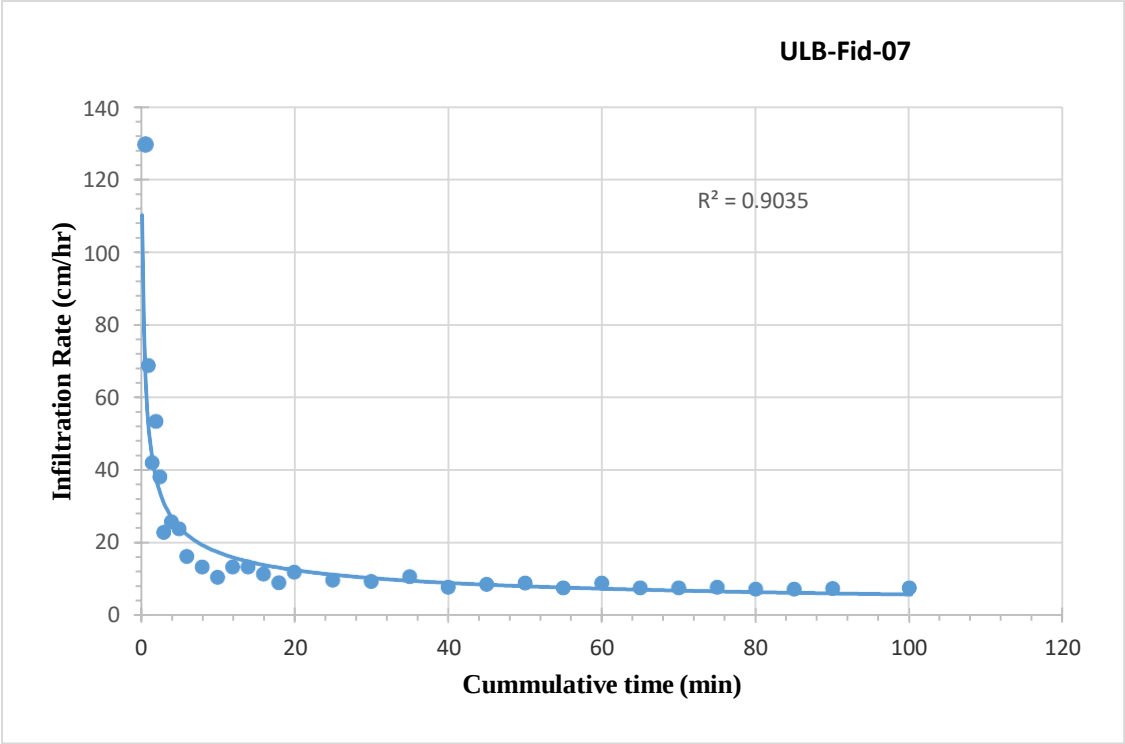


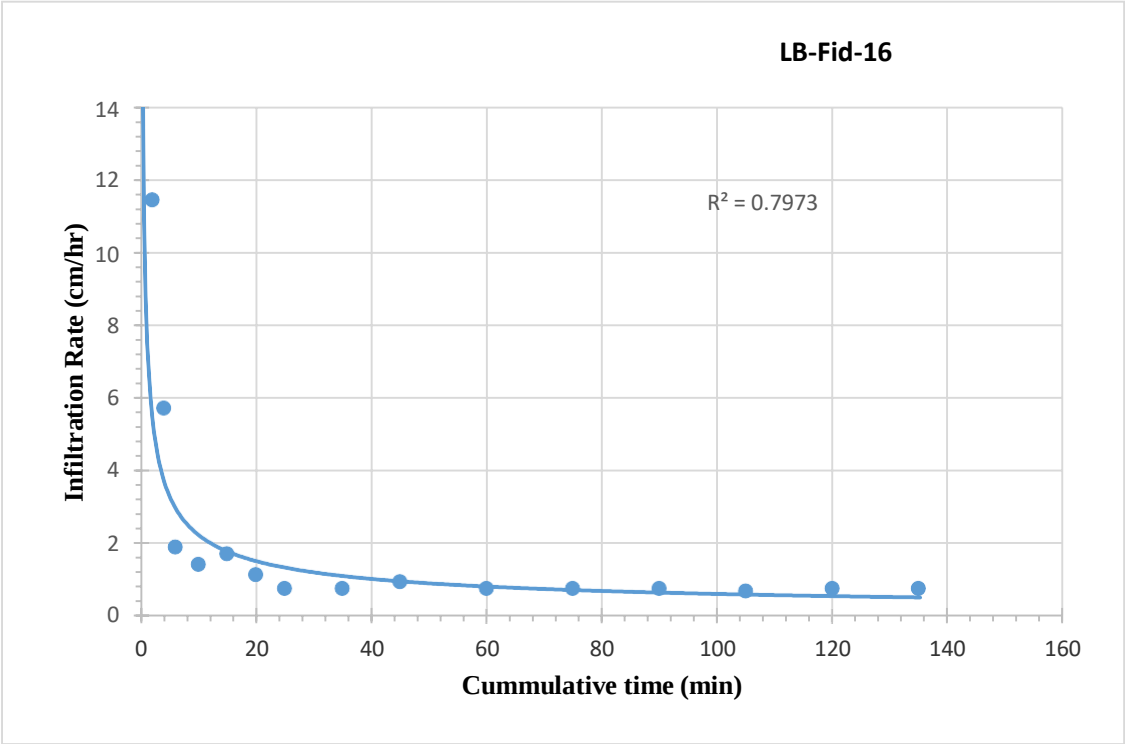
(B) Infiltration characteristics at the selected burnt & unburnt plots in Uttarakhand

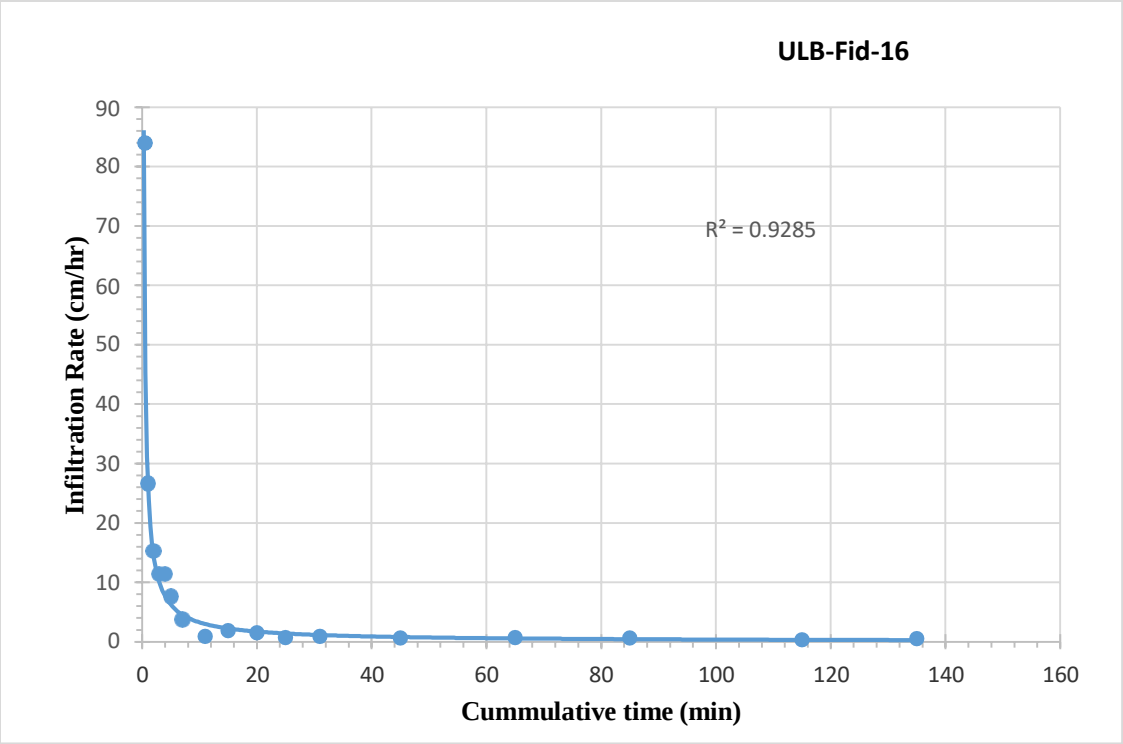


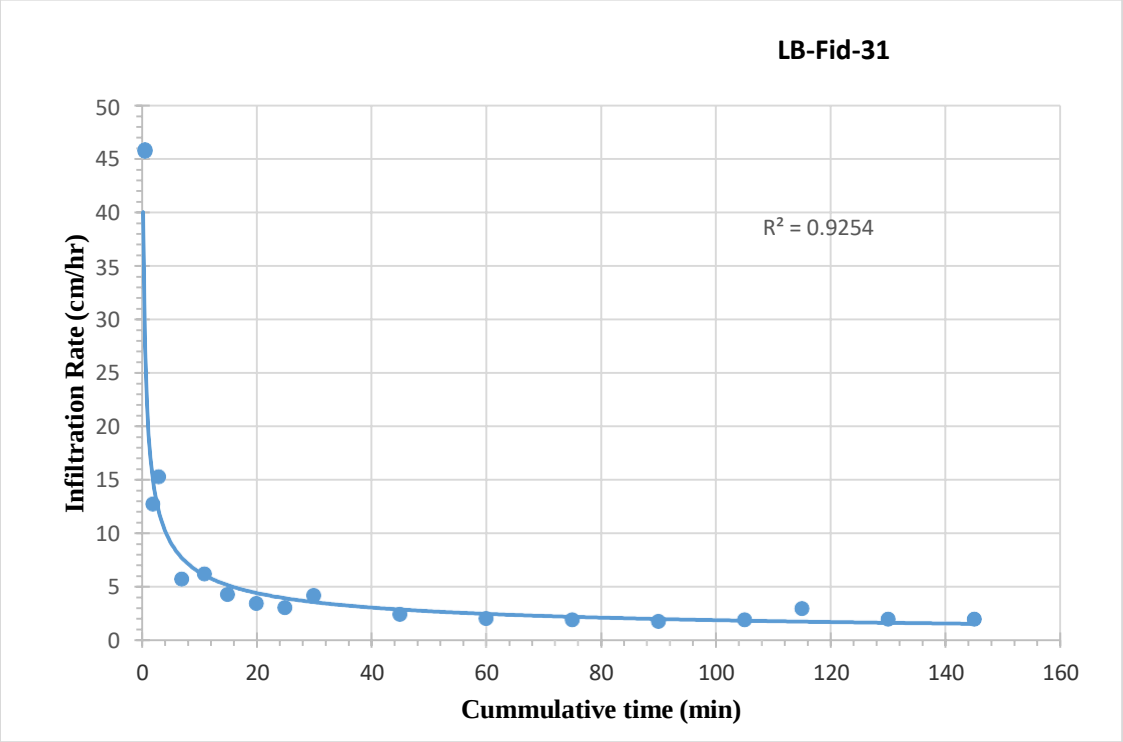

LB-Fid-08
Infiltration Rate (cm/hr)
Cummulative time (min)
R² = 0.5355
0
10
20
30
40
50
60
70
80
90
100
0
20
40
60
80
100
120
140
160

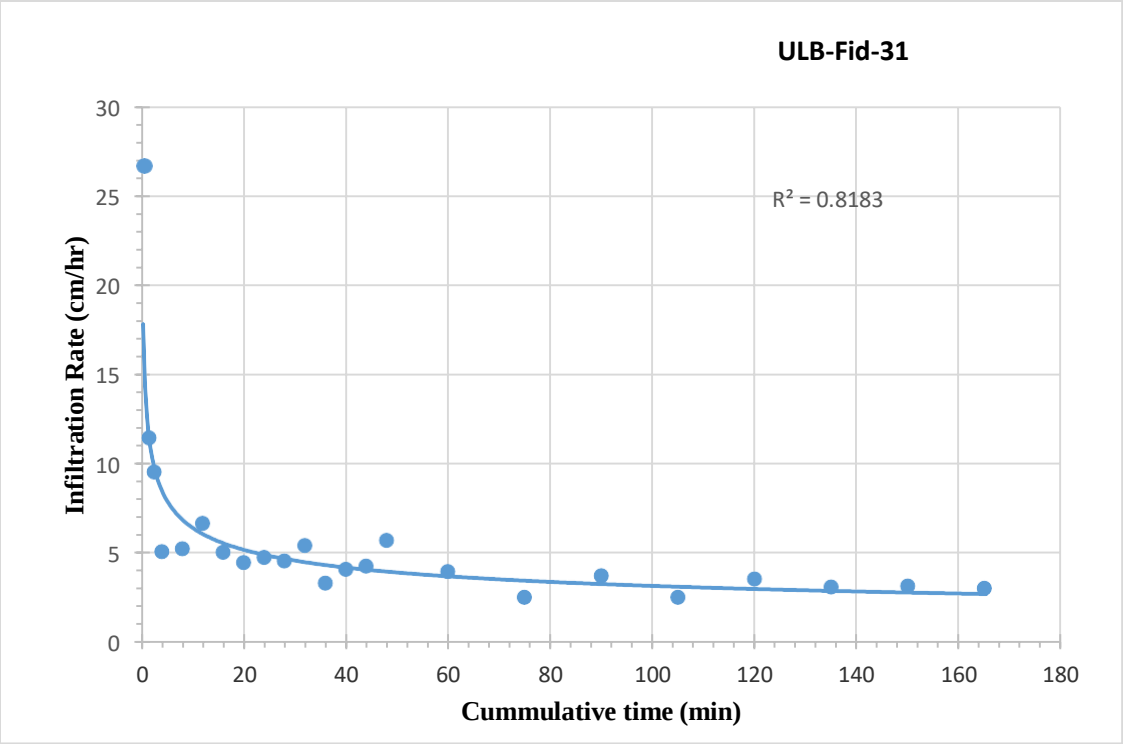

LB-Fid-07
Infiltration Rate (cm/hr)
Cummulative time (min)
R² = 0.7073
0
1
2
3
4
5
6
7
8
9
10
0
50
100
150
200
250
300
350

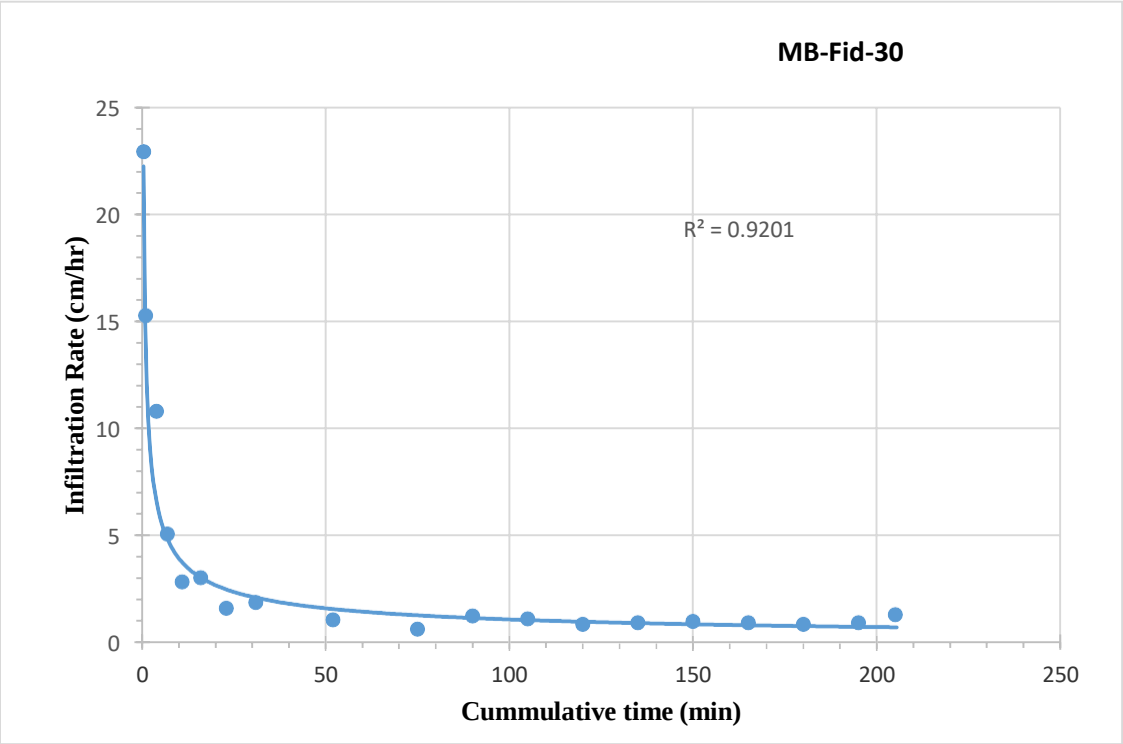

ULB-Fid-07
R² = 0.9035
Infiltration Rate (cm/hr)
Cummulative time (min)
0
20
40
60
80
100
120
140

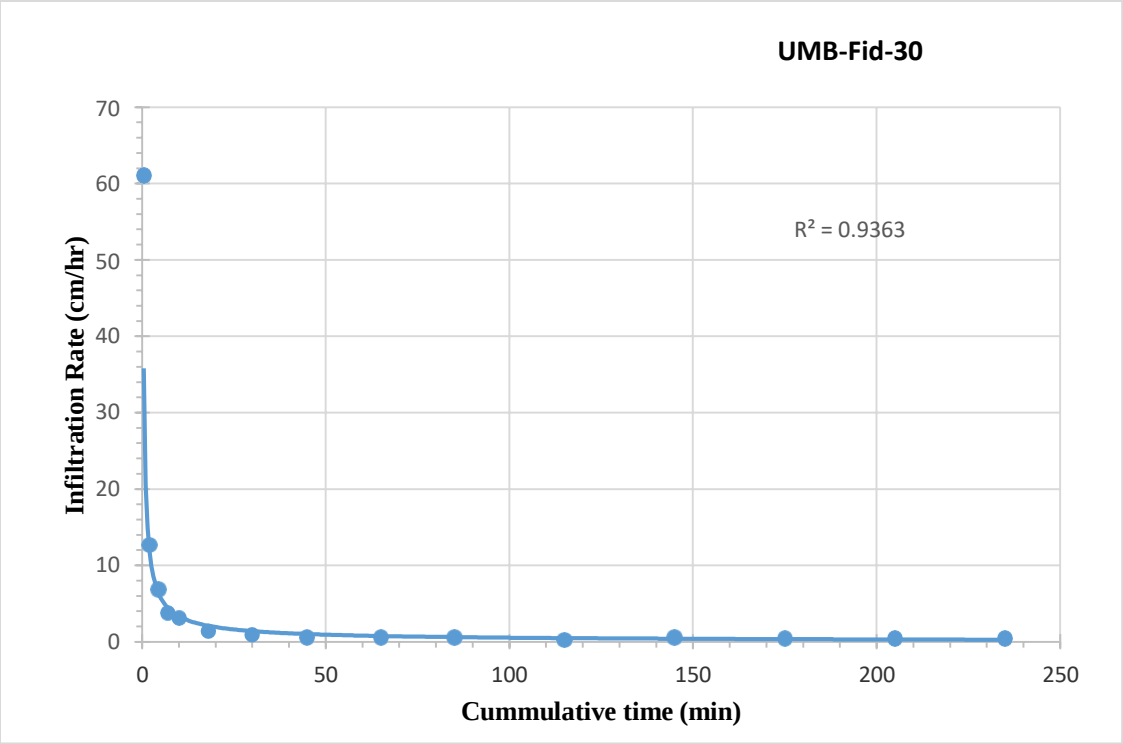

LB-Fid-16
R² = 0.7973
Infiltration Rate (cm/hr)
Cummulative time (min)
0
2
4
6
8
10
12
14
0
20
40
60
80
100
120
140
160


ULB-Fid-16
R² = 0.9285
Infiltration Rate (cm/hr)
Cummulative time (min)
0
10
20
30
40
50
60
70
80
90
0
20
40
60
80
100
120
140
160


LB-Fid-31
R² = 0.9254
Infiltration Rate (cm/hr)
Cummulative time (min)
0
5
10
15
20
25
30
35
40
45
50
0
20
40
60
80
100
120
140
160


ULB-Fid-31
R² = 0.8183
Infiltration Rate (cm/hr)
Cummulative time (min)
0
5
10
15
20
25
30
0
20
40
60
80
100
120
140
160
180


MB-Fid-30
R² = 0.9201
Infiltration Rate (cm/hr)
Cummulative time (min)
0
5
10
15
20
25
0
50
100
150
200
250


UMB-Fid-30
R² = 0.9363
Infiltration Rate (cm/hr)
Cummulative time (min)
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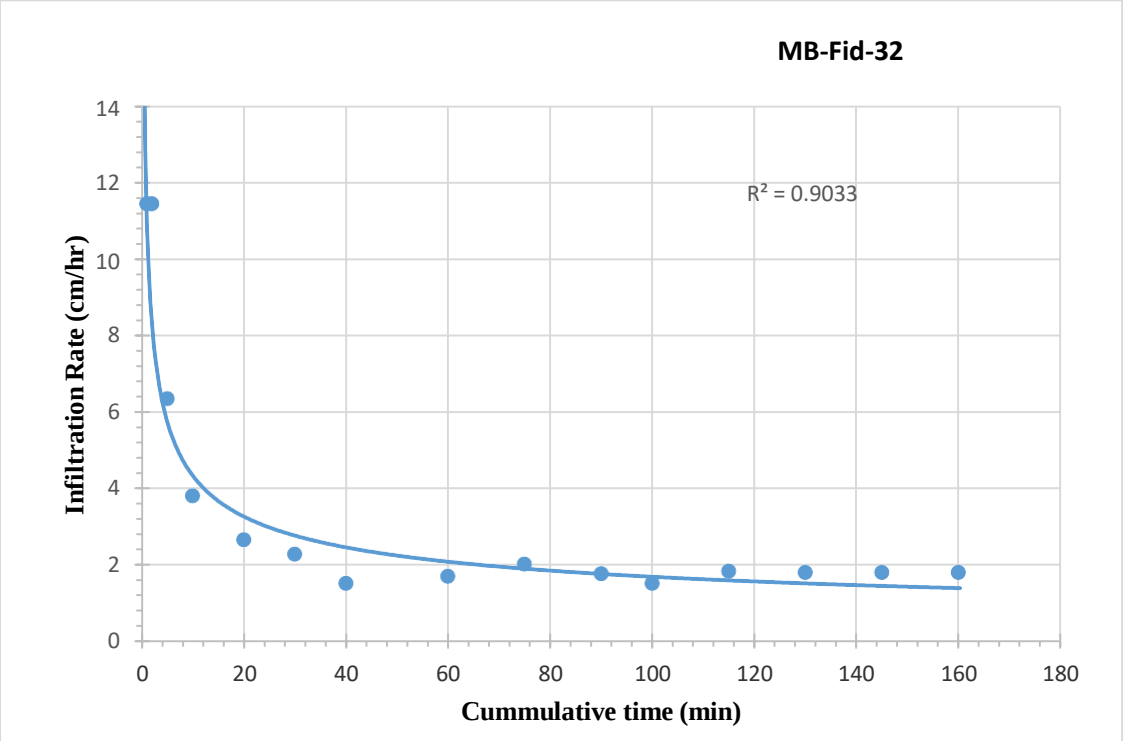
10
20
30
40
50
60
70
0
50
100
150
200
250


MB-Fid-32
R² = 0.9033
Infiltration Rate (cm/hr)
Cummulative time (min)
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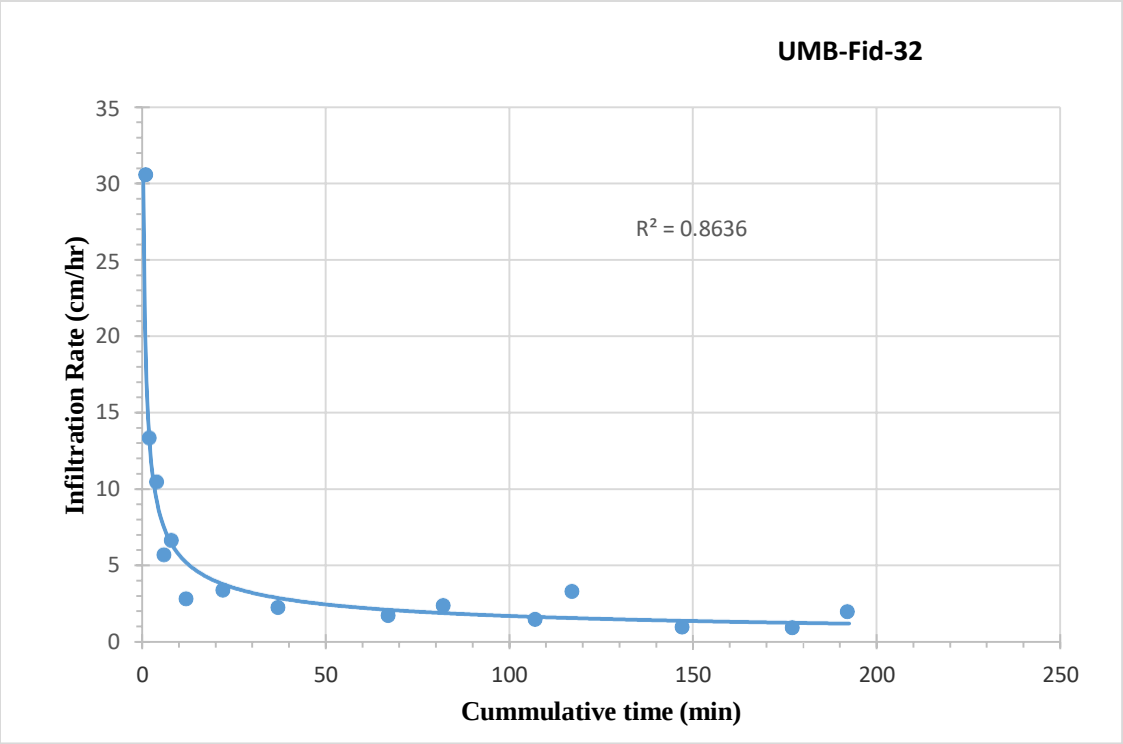
4
6
8
10
12
14
0
20
40
60
80
100
120
140
160
180


UMB-Fid-32
R² = 0.8636
Infiltration Rate (cm/hr)
Cummulative time (min)
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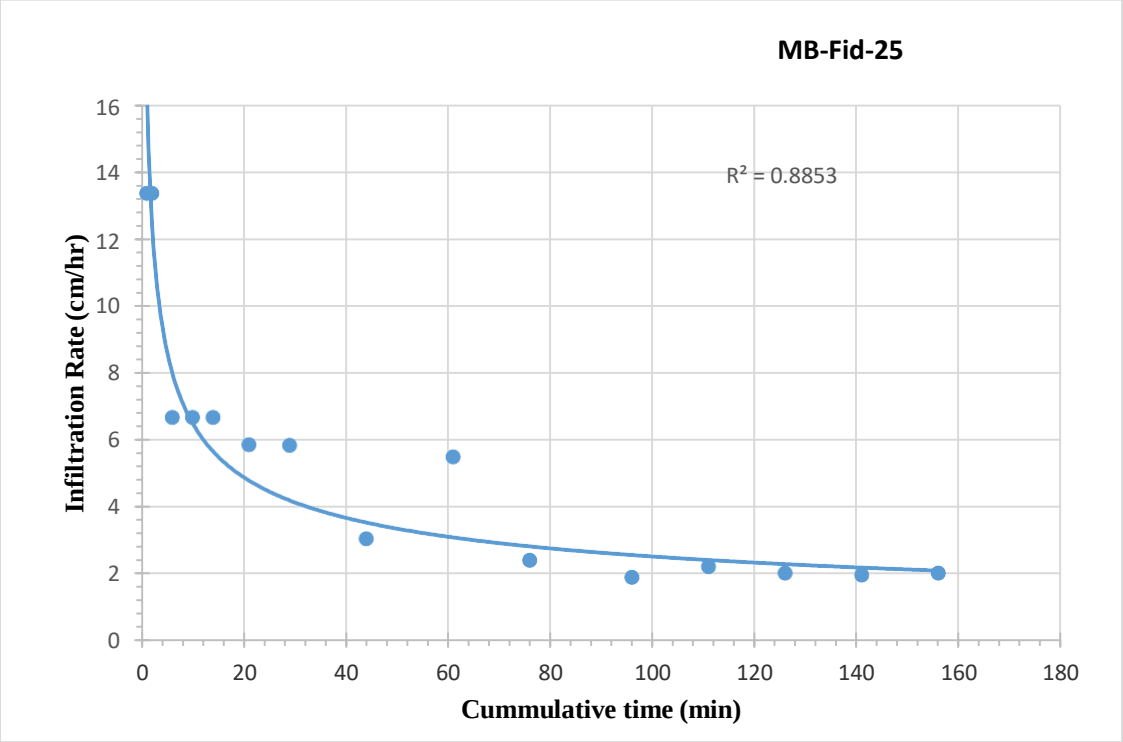
5
10
15
20
25
30
35
0
50
100
150
200
250


MB-Fid-25
R² = 0.8853
Infiltration Rate (cm/hr)
Cummulative time (min)
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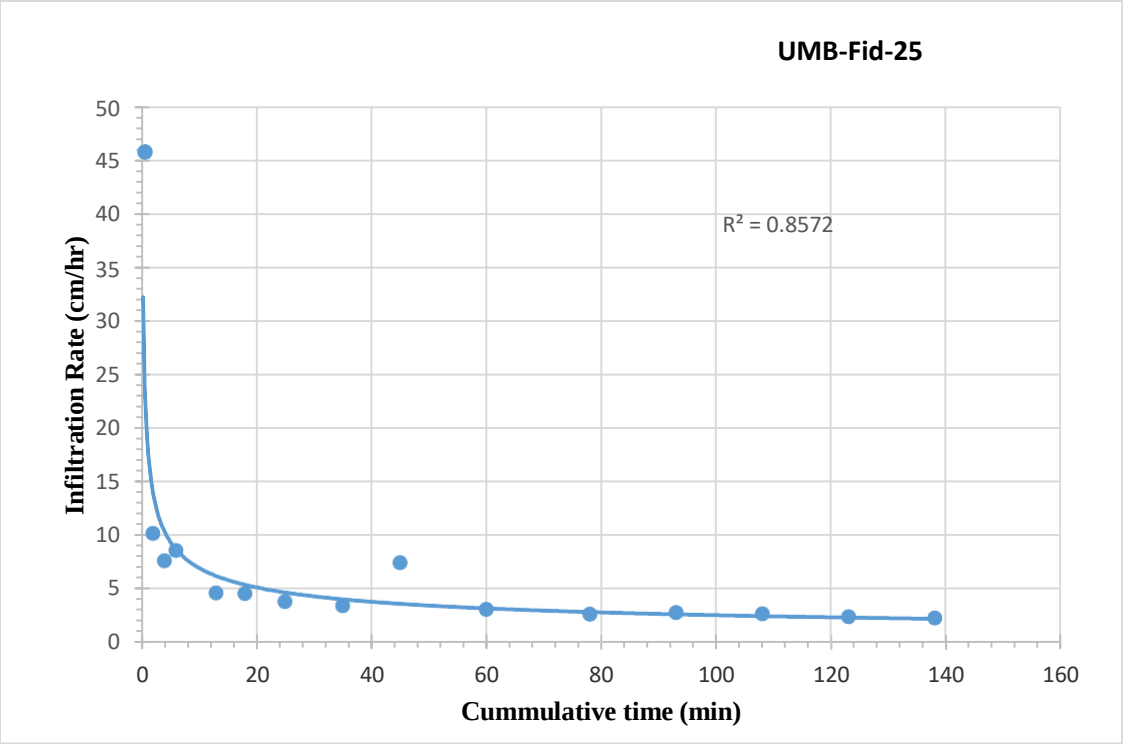
2
4
6
8
10
12
14
16
0
20
40
60
80
100
120
140
160
180


UMB-Fid-25
R² = 0.8572
Infiltration Rate (cm/hr)
Cummulative time (min)
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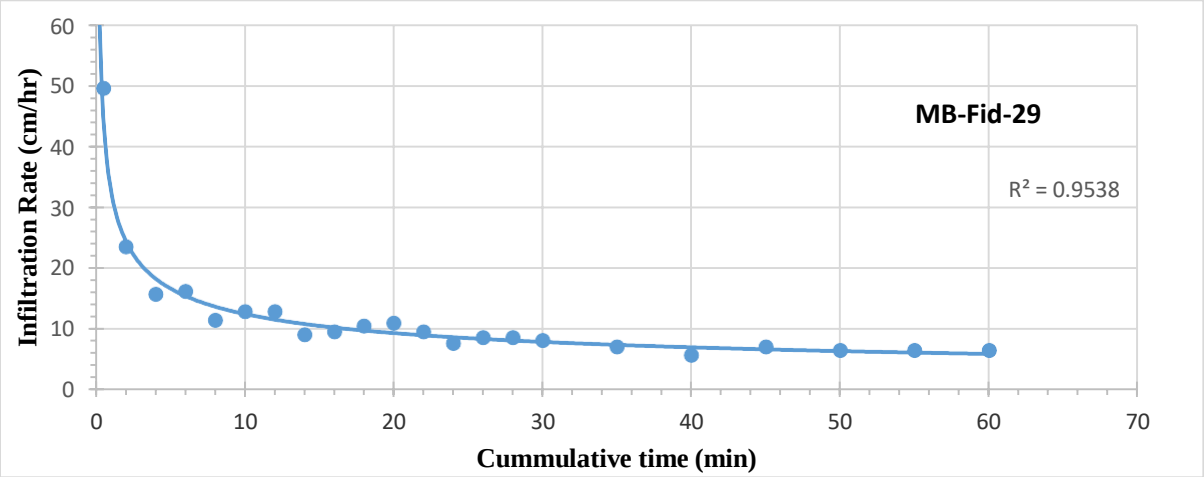
5
10
15
20
25
30
35
40
45
50
0
20
40
60
80
100
120
140
160


MB-Fid-29
R² = 0.9538
Infiltration Rate (cm/hr)
Cummulative time (min)
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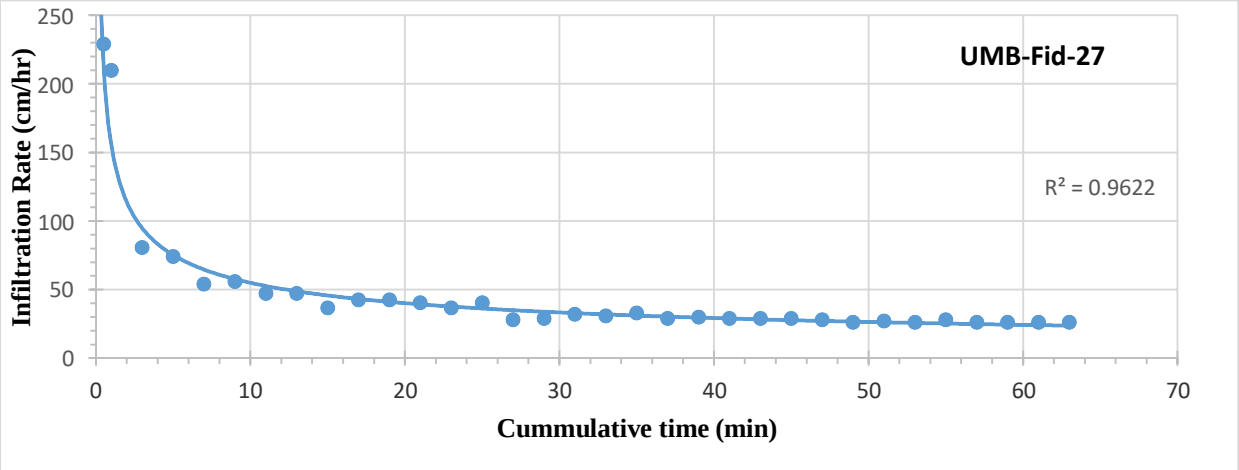
10
20
30
40
50
60
0
10
20
30
40
50
60
70


UMB-Fid-27
R² = 0.9622
Infiltration Rate (cm/hr)
Cummulative time (min)
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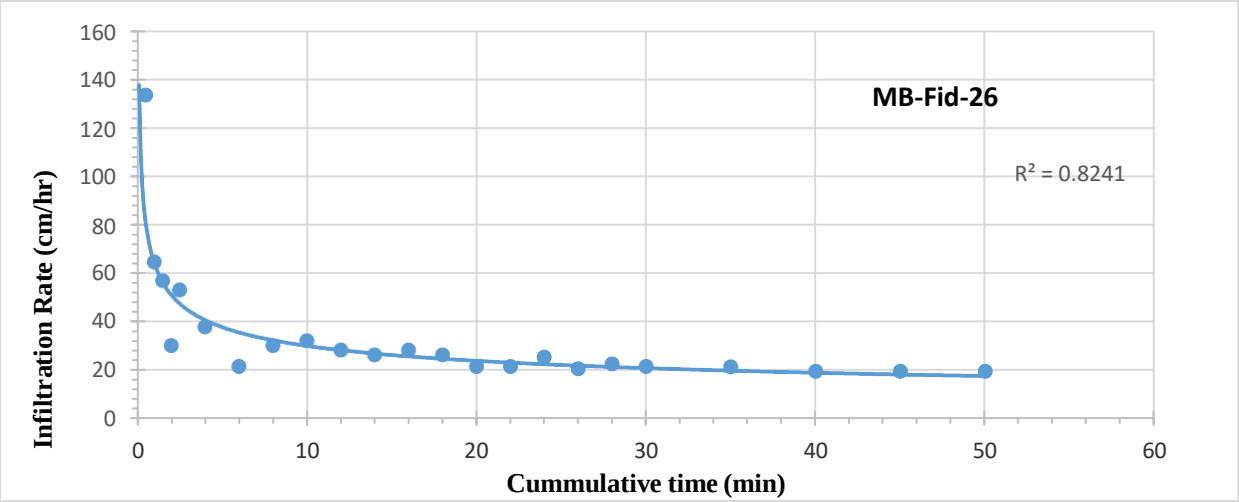
50
100
150
200
250
0
10
20
30
40
50
60
70


MB-Fid-26
R² = 0.8241
Infiltration Rate (cm/hr)
Cummulative time (min)
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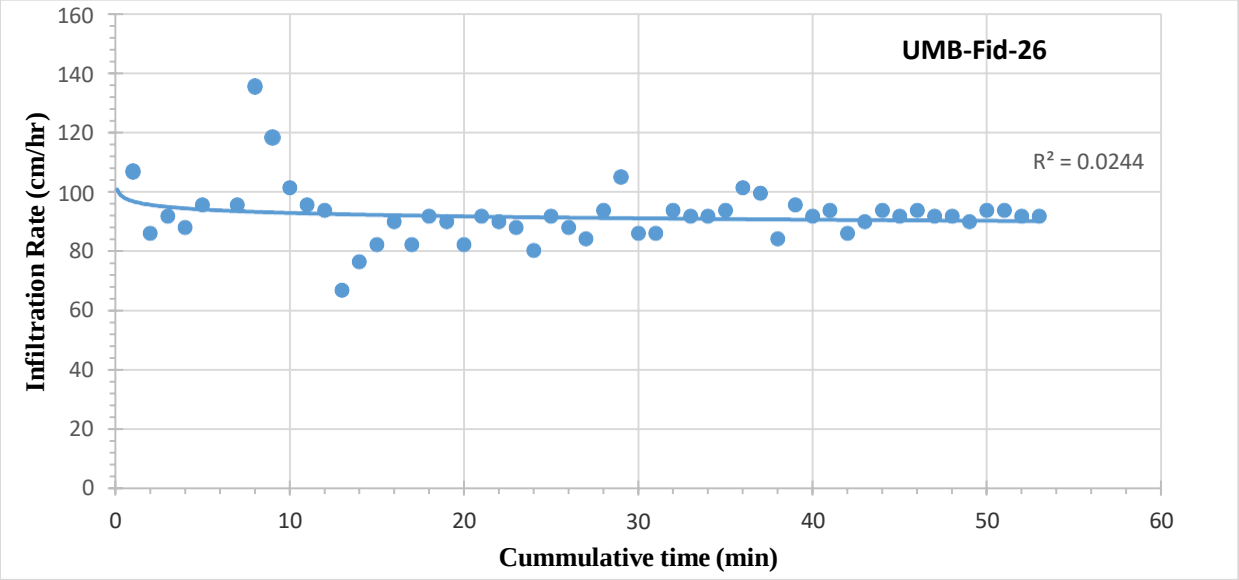
40
60
80
100
120
140
160
0
10
20
30
40
50
60


UMB-Fid-26
R² = 0.0244
Infiltration Rate (cm/hr)
Cummulative time (min)
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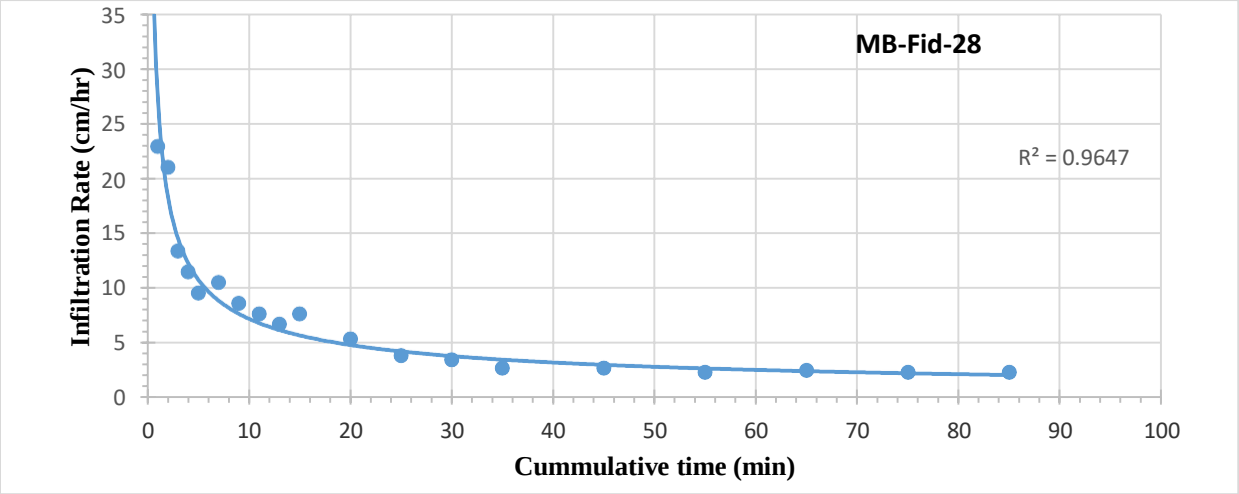
20
40
60
80
100
120
140
160
0
10
20
30
40
50
60


MB-Fid-28
R² = 0.9647
Infiltration Rate (cm/hr)
Cummulative time (min)
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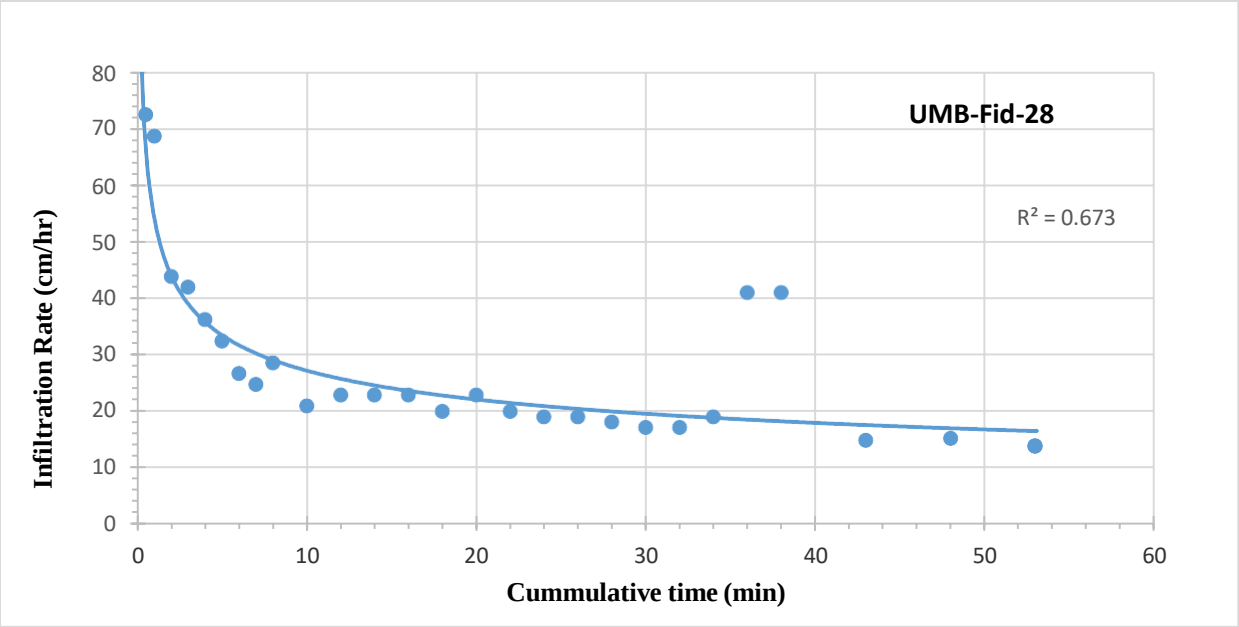
5
10
15
20
25
30
35
0
10
20
30
40
50
60
70
80
90
100


UMB-Fid-28
R² = 0.673
Infiltration Rate (cm/hr)
Cummulative time (min)
0
10
20
30
40
50
60
70
80

Annexure: III

Burned Polygon Covered

Sl. No.	Poly-ID	Forest Type Group	Severity	Area	FCM	Altitude	Slope	Aspect	District	Division	Range	Beat	Forest_ Block	Compt_ No	Longitude	Latitude	Date For Survey
1	1552	Tropical Dry Deciduous Forests	Low Burnt	42.80	MDF	0-900	0-3	South	Haridwar	Hardwar Forest Division	Chiriyapur Range	Kotawali Beat	Kotawali	10	78^{0}18' 46.505" E	29^{0}48' 19.676" N	05.12.2020
2	4007	Sub-Tropical Pine Forests	Low Burnt	202.4	MDF	900-1800	18-36	North	Dehradun	Chakrata Forest Division	Bawar Range	Daragad Beat	Daragad	0	77^0 50' 50.844" E	30^0 51' 49.153" N	02.2020
3	386	Sub tropical Pine Forests	Low Burnt	9.251	MDF	0-900	18-36	West	Dehradun	Civil & Soyam Kalsi Division	Langha Range	Batoli-Ii Beat	Batoli Block	5	77^0 56' 41.129" E	30^0 27' 16.965" N	04.12.2020
4	4002	Sub Tropical Pine Forests	Low Burnt	537.1	MDF	900-1800	18-36	South	Uttarkashi	Tons Forest Division	Purola Range	Purola Beat	Purola	0	78^0 4' 26.879" E	30^0 54' 5.968" N	03.12.2020
5	336	Himalayan Moist Temperate Forests	Moderately Burnt	105.04	MDF	900-1800	18-36	North	Tehri	Tehri H Forest Division	Balganga RANGE	Syansu	Jhatuliya	Jhatuliya	78^0 22' 15.605" E	30^0 29'472.502" N	19.10.2020
6	397	Himalayan Moist Temperate Forests	Moderately Burnt	11.04	Scrub	900-1800	18-36	North	Tehri	Tehri H Forest Division	Tehri Range	Nailbagi BEAT	Devtadanada	Devtadanada	78^0 24' 58.015" E	30^0 27' 18.711" N	18.10.2020
7	548	Sub Tropical Pine Forests	Moderately Burnt	15.76	MDF	900-1800	18-36	South	Tehri	Tehri Forest Division	Tehri RANGE	Maniyar Beat	Maniyar	9	78^0 24' 47.699" E	30^0 21' 55.652" N	17.10.2020
8	367	Himalayan Moist Temperate Forests	Moderately Burnt	8.6	MDF	900-1800	18-36	East	Tehri	Tehri H Forest Division	Balganga RANGE	Naolbagi Beat	Argad Beat	1	78^0 36' 31.352" E	30^0 29' 2.953" N	20.10.2020
9	1783	Sub Tropical Pine Forests	Moderately Burnt	99.50	MDF	900-1800	11-18	South	Almora	Almora Forest Division	Almora Range	Gananath Central Beat	Gananath	11	79^{0}40' 11.121" E	29^{0}45' 43.611" N	21.01.2021
10	2201	Sub Tropical Pine Forests	Moderately Burnt	19.99	MDF	2200-2500	11-18	East	Almora	Almora Forest Division	Ranikhet Range	Ganiadeoli Beat	Ganiadeoli	5	79^{0}25' 4.289" E	29^{0}37' 24.238" N	23.01.2021
11	4603	Sub Tropical Pine Forests	Moderately Burnt	391.271	MDF	900-1800	11-18	South	Almora	Almora Forest Division	Someshwar Range	Punarkot Beat	Punarkot	7	79^{0}35' 51.256" E	29^{0}42' 3.441" N	22.01.2021
12	1238	Sub Tropical Pine Forests	Moderately Burnt	138.9	MDF	900-1800	18-36	North	Almora	Almora Forest Division	Jaurasi Range	Nagar Beat	Nagar	7	79^{0}19' 26.797" E	29^{0}54' 1.084" N	24.01.2021

13	2179	Sub Tropical Pine Forests	Moderately Burnt	10.37	MDF	1800-2200	18-36	North	Almora	Almora Forest Division	Almora Range	Badechina Beat	Pharkanauli	1	79^{0} 44' 44.937" E	29^{0} 38' 4.057" N	20.01.2021
14	2045	Sub Tropical Pine Forests	Moderately Burnt	9.99410	VDF	900-1800	18-36	West	Almora	Binsar Wildlife Sanctuary Division	Binsar Wildlife Sanctuary Range	Dhaulchina Beat	Binsar North	4	79^{0} 48' 9.708" E	29^{0} 41' 7.735" N	25.01.2021
15	2041	Sub Tropical Pine Forests	Moderately Burnt	261.23	MDF	900-1800	18-36	North	Almora	Civil Soyam Almora Division	Kanarichina Range	Charchali Beat	Panuwanaula_East	18	79^{0} 54' 28.466" E	29^{0} 40' 56.511" N	26.01.2021
16	2374	Sub Tropical Pine Forests	Moderately Burnt	15.05	OF	1800-2200	11-18	East	Nainital	Nainital Forest Division	North Gola Range	Kapleshwar Beat	Kapleshwar Block	6	79^{0} 39' 8.091" E	29^{0} 31' 10.753" N	28.01.2021
17	2655	TOF/Plantations	Low Burnt	36.84	MDF	0-900	0-3	South	Nainital	Tarai West Division	South Jaspur Range	Tumaria Beat	Jaspur Block	39	78^{0} 55'45.193" E	29^{0} 22' 2.906" N	30.01.2021
18	1008	Tropical Moist Deciduous Forests	Low Burnt	45.00	MDF	0-900	0-3	South	Haridwar	Rajaji National Park Division	Haridwar Range	Kharkhari North Beat	Kharkhari Block	0	78^{0} 10' 1.027" E	29^{0} 59' 12.042" N	23.12.2020
19	1020	Tropical Dry Deciduous Forests	Low Burnt	331.3	MDF	0-900	11-18	South	Haridwar	Rajaji National Park Division	Haridwar Range	Ranipur East Beat	Ranipur Block	0	78^{0} 8' 36.240" E	29^{0}57' 35.779" N	22.12.2020
20	1430	Himalayan Moist Temparate Forest	Moderate burnt	26.154	VDF	900-1800	18-36	West	Pithoragarh	Pithoragarh Forest Division	Didihat Range	Nawlara	Jarapani	1	80°10'3.694" E	29°51'50.855" N	20.02.2021
21	1867	Sub Tropical Pine Forests	Moderate burnt	29.22	MDF	1800-2200	5-11	West	Pithoragarh	Pithoragarh Forest Division	Didihat Range	Ogla Beat	Devchula Block	1	80°17'5.215" E	29°45'3.182" N	23.02.2021
22	4446	Sub Tropical Pine Forests	Moderate burnt	225.8	MDF	900-1800	18-36	South	Pithoragarh	Pithoragarh Forest Division	Askot Range	South Daphia Beat	Daphia Block	3	80°21'19.271" E	29°52'7.755" N	22.02.2021

Control Polygon

Poly_Id	Forest Type Group	Severity	Area	Fcm	Altitude	Slope	Aspect	District	Division	Range	Beat	Forest_Blo	Compt_ No	Longitude	Latitude	Date For Survey
1552	Tropical Dry Deciduous Forests	Low Burnt	42.80	Mdf	0-900	0-3	South	Haridwar	Hardwar Forest Division	Chiriyapur Range	Kotawali Beat	Kotawali	10	78°18’22.9 ” E	29°47’19.6 ” N	05.12.2020
4007	Sub-Tropical Pine Forests	Low Burnt	202.4	Mdf	900-1800	18-36	North	Dehradun	Chakrata Forest Division	Bawar Range	Daragad Beat	Daragad	0	77°50’15.4 ” E	30°51’53.9 ” N	02.12.2020
386	Sub Tropical Pine Forests	Low Burnt	9.251	Mdf	0-900	18-36	West	Dehradun	Civil & Soyam Kalsi Division	Langha Range	Batoli-Ii Beat	Batoli Block	5	77°56’50.9 ” E	30°27’18.4 ” N	04.12.2020
4002	Sub Tropical Pine Forests	Low Burnt	537.1	Mdf	900-1800	18-36	South	Uttarkashi	Tons Forest Division	Purola Range	Purola Beat	Purola	0	78°04’33.6 ” E	30°54’14.1 ” N	03.12.2020
336	Himalayan Moist Temperate Forests	Moderately Burnt	105.04	Mdf	900-1800	18-36	North	Tehri	Tehri H Forest Division	Balganga Range	Syansu	Jhatuliya	Jhatuliya	78^0 22' 10.512" E	30^0 29'72.720" N	19.10.2020
397	Himalayan Moist Temperate Forests	Moderately Burnt	11.04	Scrub	900-1800	18-36	North	Tehri	Tehri H Forest Division	Tehri Range	Nailbagi Beat	Devtadanada	Devtadanada	78^0 25' 02.25" E	30^0 27' 09.93" N	18.10.2020
548	Sub Tropical Pine Forests	Moderately Burnt	15.76	Mdf	900-1800	18-36	South	Tehri	Tehri Forest Division	Tehri Range	Maniyar Beat	Maniyar	9	78^0 24' 37.934" E	30^0 21' 59.678" N	17.10.2020
367	Himalayan Moist Temperate Forests	Moderately Burnt	8.6	Mdf	900-1800	18-36	East	Tehri	Tehri H Forest Division	Balganga Range	Naolbagi Beat	Argad Beat	1	78^0 36' 32.862" E	30^0 28' 54.872" N	20.10.2020
1783	Sub Tropical Pine Forests	Moderately Burnt	99.50	Mdf	900-1800	11-18	South	Almora	Almora Forest Division	Almora Range	Gananath Central Beat	Gananath	11	79^0 40' 11.1" E	29^0 245' 43.6" N	21.01.2021
2201	Sub Tropical Pine Forests	Moderately Burnt	19.99	Mdf	2200-2500	11-18	East	Almora	Almora Forest Division	Ranikhet Range	Ganiadeoli Beat	Ganiadeoli	5	79^0 24' 55.715" E	29^0 37' 25.373" N	23.01.2021
4603	Sub Tropical Pine Forests	Moderately Burnt	391.271	Mdf	900-1800	11-18	South	Almora	Almora Forest Division	Someshwar Range	Punarkot Beat	Punarkot	7	79^0 35' 54.14" E	29^0 42' 12.15" N	22.01.2021
1238	Sub Tropical Pine Forests	Moderately Burnt	138.9	Mdf	900-1800	18-36	North	Almora	Almora Forest Division	Jaurasi Range	Nagar Beat	Nagar	7	79^0 19' 06.60" E	29^0 54' 09.30" N	24.01.2021

2179	Sub Tropical Pine Forests	Moderately Burnt	10.37	Mdf	1800-2200	18-36	North	Almora	Almora Forest Division	Almora Range	Badechina Beat	Pharkanauli	1	79^0 44' 53.292" E	29^0 38' 16.098" N	20.01.2021
2045	Sub Tropical Pine Forests	Moderately Burnt	9.99410	Vdf	900-1800	18-36	West	Almora	Binsar Wildlife Sanctuary Division	Binsar Wildlife Sanctuary Range	Dhaulchina Beat	Binsar North	4	79^0 47' 54.833" E	29^0 40' 45.401" N	25.01.2021
2041	Sub Tropical Pine Forests	Moderately Burnt	261.23	Mdf	900-1800	18-36	North	Almora	Civil Soyam Almora Division	Kanarichina Range	Charchali Beat	Panuwanaula_ East	18	79^0 55' 05.663" E	29^0 41' 11.873" N	26.01.2021
2374	Sub Tropical Pine Forests	Moderately Burnt	15.05	Of	1800-2200	11-18	East	Nainital	Nainital Forest Division	North Gola Range	Kapleshwar Beat	Kapleshwar Block	6	79^0 39' 23.753" E	29^0 31' 22.140" N	28.01.2021
2655	Tof/Plantations	Low Burnt	36.84	Mdf	0-900	0-3	South	Nainital	Tarai West Division	South Jaspur Range	Tumaria Beat	Jaspur Block	39	78^0 55' 29.256" E	29^0 21' 49.637" N	30.01.2021
1008	Tropical Moist Deciduous Forests	Low Burnt	45.00	Mdf	0-900	0-3	South	Haridwar	Rajaji National Park Division	Haridwar Range	Kharkhari North Beat	Kharkhari Block	0	78^0 10' 03.6" E	$29^0$59' 09.8" N	23.12.2020
1020	Tropical Dry Deciduous Forests	Low Burnt	331.3	Mdf	0-900	11-18	South	Haridwar	Rajaji National Park Division	Haridwar Range	Ranipur East Beat	Ranipur Block	0	78^0 08' 42.2" E	$29^0$57' 30.5" N	22.12.2020
1430	Himalayan Moist Temparate Forest	Moderate Burnt	26.154	Vdf	900-1800	18-36	West	Pithoragarh	Pithoragarh Forest Division	Didihat Range	Nawlara	Jarapani	1	80°09'29.6" E	29°51'23.0" N	20.02.2021
1867	Sub Tropical Pine Forests	Moderate Burnt	29.22	Mdf	1800-2200	5-11	West	Pithoragarh	Pithoragarh Forest Division	Didihat Range	Ogla Beat	Devchula Block	1	80°17'08.7" E	29°44'58.8" N	23.02.2021
4446	Sub Tropical Pine Forests	Moderate Burnt	225.8	Mdf	900-1800	18-36	South	Pithoragarh	Pithoragarh Forest Division	Askot Range	South Daphia Beat	Daphia Block	3	80°21'31.2" E	29°51'50.4" N	22.02.2021