

Original Research Article

A Geographical Analysis of Challakere Amrit Mahal Kaval Grasslands: Using Remote Sensing and GIS Technologies

ABSTRACT

The Amrit Mahal Kaval grassland is a protected area dedicated to conservation of Amrit Mahal, an endangered breed of cattle that originated from the erstwhile state of Mysore in Karnataka. Nearly 14519 acres of grasslands is reserved which is enriched with biodiversity and grassland ecosystem as well and with over 450 years of history. Thus, such kind of research on grasslands is important and also inevitable. Another important point to be noticed is here that this area was portrayed as barren land and in the year 2007, a report was prepared and submitted to the state government and permitted Government Defense and other departments to use these eleven thousand four hundred acres of Amrit Mahal Kaval Grasslands which led to the severe impact on the biodiversity existed there. Thus, in order to study the impact on grasslands thereafter in terms of Social, Cultural, Economic and Environmental I have chosen the time period between 2009 to 2019 with the use of Remote Sensing and GIS technologies. A quick glance at the statistics of the Challakere Amrit Mahal Kaval grasslands, one can easily notice that the developmental work carried out here has led to the loss of 4.59% of the vegetation area, 0.29% of the water sources and 24.6% of the pastures. Study also focuses not only the impact on biodiversity but on the community life of people as well. Both Development and ecological balance is important in today's condition but at the same time it is really hazardous to overweigh development in comparison to ecology because replacing ecology in the place of development may not be dangerous but vice versa is proved to be inimical. So isn't it our responsibility to save the Amrit Mahal Kaval Grasslands for the sake of endangered breed. Amrit Mahal which has history of over 500 years and habitat of all the endangered mammals and birds habited with emotionally attached to it. But it should be overruled knowing the grasslands belongs to the critically endangered Great Indian Bustard.

Keywords: Amrit Mahal Grasslands; Communities; Biodiversity; Remote Sensing and GIS

1. INTRODUCTION

Human encroachment on the Grasslands is on the rise globally. Karnataka's population stands at 6,11,30,704 according to population census of 2011 (Primary Census abstract 2011). The population density stands at 319 per square kilometer of total geographical area of Karnataka[1]. On one side, it is difficult and impossible to meet man's supplies. The development of cities are putting tremendous pressure on natural resources directly. Today, increasing population has resulted in building huge cities encroaching grasslands, grazing pastures (Gomalas), forests, plantations, farmlands, ponds and lakes[2]–[4]. This impact is no different for Challakere Amrit Mahal Kaval grassland.

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Comment [d2]: Use 'here is that,' instead of is here

Comment [d3]: What are you referring to here? Check the statement.

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Since the time of Vijayanagara Empire, the hardy and draught resistant **Amrit Mahal** cattles have roamed free adapted to the heat of the open space and rough terrain of the hillocks[5]. The natural grassland areas specifically protected for grazing the Amrit Mahal breed gave them the name **Amrit Mahal Kaval**[6]. Probably, this is the only largest grassland devoted to the protection of a species of cattle anywhere in the world.

When the state of Karnataka was established, the Kaval grasslands spread over 4 Lakh acres. But now, it has reduced to just 60000 acres. That means, in 6 decades the reputation of destroying 3 Lakh acres of Kaval grasslands is on us[7], [8]. Especially, instead of protecting our proud Amrit Mahal Cattle, we are destroying its habitat. Mysore, Mandya, Tumkur, Chitradurga, Hassan, Chikmagalur and so on, spread in other several districts, we have made great strides in destroying the grasslands[9]. Forest Department, unaware of the importance of grasslands, has planted Eucalyptus over thousands of acres resulting in the destruction of Amrit Mahal Kaval grasslands[10]. Thus, amidst the pressure, the remaining 60000 acres of surviving grasslands has attracted the eyes of Central and State Governments along with land mafias[11].

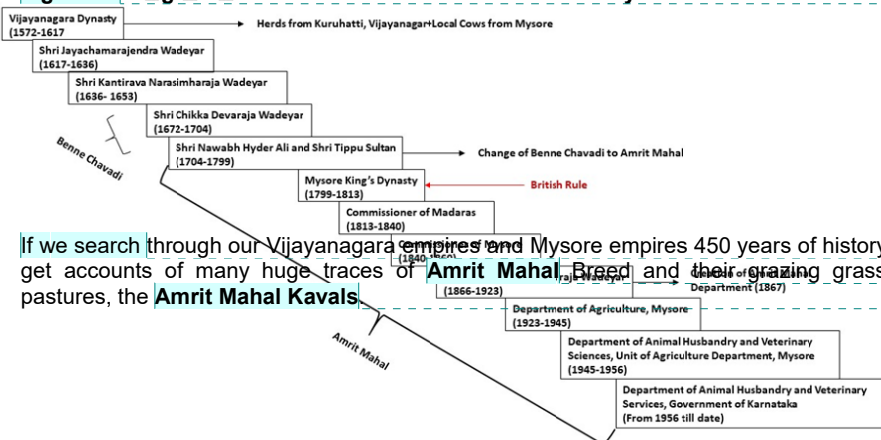
For example, in 2007 Chitradurga's Challakere Amrit Mahal Kaval Grassland areas respective State and Central Ministers wrote a letter to Ministry of Defense making them believe that grassland is a ruined place, a wasteland and is best suited to build airplanes. There is no question of alienating people here, land is infertile for agriculture practices so no need of paying compensation. Hence best suited place for a Defense Ministry setup. With the help of Member of Parliament, the District Commissioner prepared and submitted a plan to give away 10000 acres of Kaval grasslands which got approved from the State Government. Getting land in the name of safety of the country is very easy. Under this, other government departments and land mafia lobby joined hands[12].

In this article, it is stated, how Indian Institute of Science, Indian Space Research Organization, Nuclear Power Corporation of India along with Defense Ministry organizations and some private companies systematically destroy a micro ecosystem of great importance[13], [14].

Here the main objective of the study is to demarcate Challakere Amrit Mahal Kaval grassland boundary. To study, currently what kind of development is happening in grassland areas and analyzing ten years Land-Use and Land-Cover Change (LULCC) about past and present conditions. To analyze the affect on Environmental and social factors from unscientific development undertaken in encroached grassland and to study the disadvantages of development on biodiversity.

History

Figure: 1. Diagram of Amrit Mahal Kaval Grassland History in Karnataka



If we search through our Vijayanagara empires and Mysore empires 450 years of history, we get accounts of many huge traces of **Amrit Mahal Breed** and their grazing grassland pastures, the **Amrit Mahal Kavals**.

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Comment [d18]: Use 'Fig. 1.' and make sure the figure caption appear below the figure. And no figure should overlay texts.

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Since Vijayanagara Empire (1572) Karnataka's Amrit Mahal Kaval grasslands of dry regions are referred as "**Kuruhatti**". Later from 1617 to 1637 during Shri Jayachamarajendra Wodeyar VI, 1637 to 1638 Shri Raja Wodeyar II, 1638 to 1653 Shri Narasaraja Wodeyar I (Ranadheera Kanteerava) and 1654 to 1672 Shri Dodda Devaraja Wodeyar of Mysore Empire brought the native breed Amrit Mahal of Vijayanagara Empire to Mysore Empire. To graze the breeds, they identified the large tracts of grasslands in the Mysore Empire and preserved the same. These are called and referred as **Amrit Mahal Kaval** (Kaval Grassland Area). During 1672-1704 under Mysore Ruler Shri Chikkadevaraja Wodeyar, Amrit Mahal Kaval were developed. About 240 places in the empire over 4,13,529 acres of grasslands were identified and areas were called as "**Bennichavadi**"[15]. After Wodeyar's rule, during period of 1704 to 1799, **Hyder Ali and Tippu Sultan**, 60000 Amrit Mahal Cattle were there. During Tippu's rule "**Bennichavadi**" was renamed as "**Amrit Mahal**".

Cattle breed better empowered than Horses used by Tippu Sultan in war was also a reason for his victory. After Anglo-Mysore War IV (1798-1799) fought between Mysore Empire and East India Company, Amrit Mahal Kaval Grasslands came under East India Companies administration. During 1799-1813, under British rule, realizing the uniqueness of the breed, they set out to preserve it. In 1813 under the command of British Officer, Madras Commissioner **Captain Harvey**, a plan was implemented for the conservation of the breed[14]. And later during 1813-1860, the Madras and Mysore commissioners had a number of projects for Amrit Mahal livestock and the breed sustained. In 1867 Shri Mummudi Krishnaraja Wodeyar created a new department called "**Amrit Mahal Department**", there were 5395 Amrit Mahal cattles[16]. Joint District Collector of Mysore and Superintendent of Amrit Mahal Department gave away 69,007 acres out of a total of 3,95,062 acres Amrit Mahal grasslands to farmers at Darakast in 1915-16 at the behest of the Government. Of government order, in 1918, 1,24,903.35 acres were handed over to the Revenue Department. Then from 1923-1945, the Mysore State Department of Agriculture looked after the Amrit Mahal Kaval and Livestock. From 1945-1956, the Department of Animal Husbandry and Veterinary Medicine of Mysore State was also involved. In 1956, the government ordered to distribute 92,801 acres of land over 1,65,000 acres to land farmers and other development activities. From 1956 to present, under Karnataka Government's animal husbandry and veterinary science departments, 65,925.36 acres of Amrit Mahal Kaval is distributed amongst 6 districts and 62 places of Chikkamagaluru, Chitradurga, Hassan, Tumkur, Mandya and Davanagere. The present article is about Amrit Mahal Kaval Grassland of Challakere of Chitradurga[9].

2. MATERIAL AND METHODS

2.1 Study Area

Figure: 2. Location map of Challakere Amrit Mahal Kaval Grasslands

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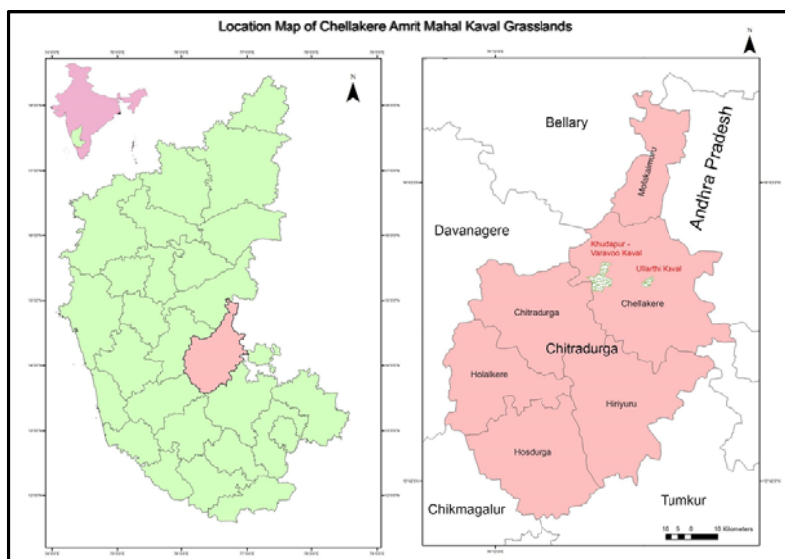
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Challakere Amrit Mahal Kaval Grassland area comes under Chitradurga District's Challakere Taluk. This area falls under Central Dry Zone. The study area has Latitude of 14° 27' 30" N to 14° 20' 30" N and 76° 30' 30" E to 76° 44' 30" E Longitude.

Following 3 Amrit Mahal Kaval Grasslands can be identified on the basis of the neighboring villages it shares its boundaries with:

1. Khudapur Kaval - 2971 acres
2. Varavoo Kaval - 9370 acres
3. Ullarthi Kaval - 2178 acres

The total area of these three Kavals is about 14519 acres.

2.2 Materials and Methods

The two sets of remote sensing data used for this study include: LANDSAT_5 (The Thematic Mapper sensor) and LANDSAT_8 (Operational Land Imager_ Thermal Infrared Sensor) and other materials used are Land Use and Land Cover changes. The details of the data used are given in **table-1**.

1. Preliminary information gathered from villagers living around the Amrit Mahal Kaval Grasslands.
2. 1:50,000 Toposheets collected from the Geological Survey of India, Koramangala, Bengaluru.
3. Landsat Satellite Images collected from USGS website.

Table 1. Information of the satellite images used for the preparation of land use and land cover maps.

Sl.No.	Data type	Date of	Path-Row	Resolution	Number	Source
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Comment [d31]: You can re-write these in single sentence/paragraph and merge with the remaining above. Amrit Mahal Kaval Grassland consists of three (3) neighboring villages namely: Khudapur Kaval with a total of 2971 acres, Varavoo Kaval with 9370 acres and Ullarthi Kaval with 2178 acres..... In the study area location, add the country to which the study area belong.

Comment [d32]: Separate Material from Methods as it the same as section '2.'

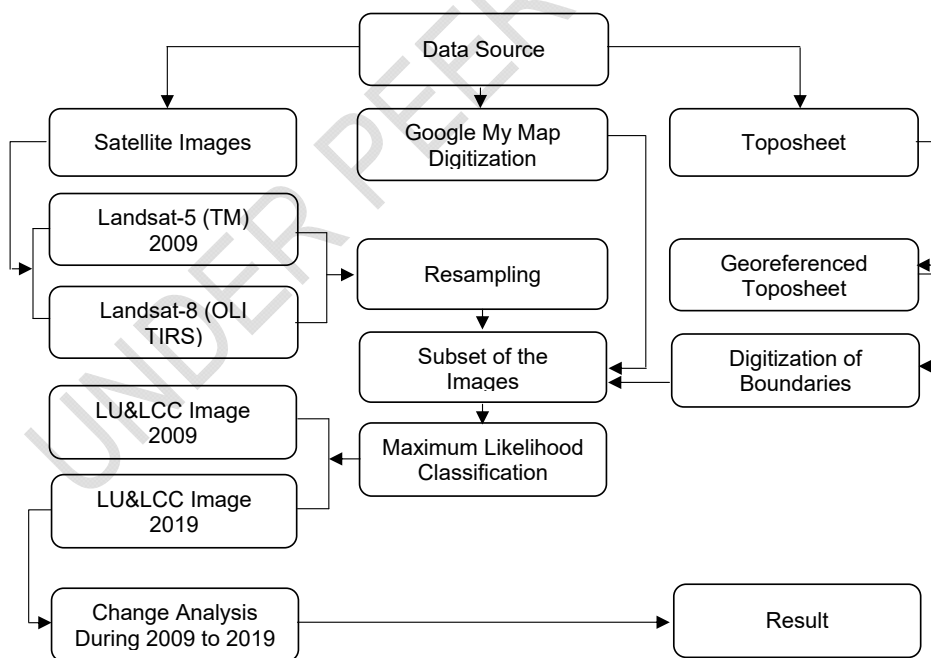
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		acquisition	(m)	of bands	
1	LANDSAT_5 (TM)	03-01-2009	145/050	30	7 USGS
2	LANDSAT_8 (OLI_TIRS)	16-02-2019	145/050	30	11 USGS

OLI: Operational Land Imager; TM: Thematic Mapper; USGS: United States Geological Survey.

The following methodology was used for land use and land cover change detection over the specified years 2009 and 2019. Maps of survey of India, toposheets, multi-temporal satellite dataset observed by LANDSAT_5 (The Thematic Mapper sensor) and LANDSAT_8 (Operational Land Imager_ Thermal Infrared Sensor) were used in the study[17]. The scale of the study area map used for the analysis was drawn on 1:50000 ratio. The image resolution was 30 meters for pixel, land use and land cover classification were carried out by using the supervised classification following maximum likelihood method. Based on the preliminary information gathered from ground truth points and villagers living around the Amrit Mahal Kaval Grasslands were used to perform the classification the land use and land cover of the study area and satellite images were prepared using ArcGIS, the land use and land cover include classes, namely vegetation, water bodies, grassland, solar area, runway, buildings, roads, boundary walls and disturbed area. Using GPS around a total of 18 points were collected on various land types as ground truth data, based on this, finally the accuracy assessment has been carried out to know the accuracy[18].

Figure-3: Flowchart of methodologies for LU & LCC mapping



Comment [d34]: What did you use each of these items for? You should be able to mention what you use them for.

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3. RESULTS AND DISCUSSION

14,500 acres of Protected Area (PA), a unique grassland ecosystem harboring vast biodiversity, is preserved over centuries specifically for the World's most endangered special breed of cattle, the Amrit Mahal.

In the following tables, (Table: 2) has info on which organizations have been allocated how much area and for what purposes. Given that it can be seen in detail.

In **Khudapur Kaval**: Indian Institute of Science (IISC) 1557 acres, Talent Development Centre (TDC) 290 acres, Bhabha Atomic Research Centre (BARC) 402 acres, Defence Research and Development Organization (DRDO) 224 acres, Karnataka Housing Board (KHB) 110 acres, Indian Space Research Organization (ISRO) 100 acres, Industrial Park 147 acres of area has been allocated. In total, out of 2971 acres, 2830 acres have been allocated. Only 141 acre remains.

In **Varavoo Kaval**: Out of 9366 acres, Defence Research and Development Organization (DRDO) 4028 acres, Sagitaur Ventures India Pvt.Ltd. (Solar Park) 1003 acres, National Aerospace Laboratories (NAL) 583 acres, Upper Bhadra Project 877 acres. In total, out of 9370 acres, 6491 acres have been allocated. Only 2879 acre remains.

In **Ullarathi Kaval**: Indian Space Research Organization (ISRO) 464 acres, Bhabha Atomic Research Centre (BARC) 1420 acres, Karnataka State Small Industries Development Corporation Ltd. (KSSIDC) 276 acres, Goshale 3 acres. In total, out of 2178 acres, 2163 acres have been allocated. Only 15 acre remains.

In 2007 State and Central Governments have donated a total of 11484 acres of geographical area to the above institutions for Defence, Industrial, Infrastructure, Institutional and Commercial purposes[19], [20].

Comment [d40]: Reframe the text, info should be written in full. Also, only one Table is referring to and not more than one Table. If you are referring to one or more table, say it as Table 2 &

Comment [d41]: Use '[19, 20]' instead.

Table: 2. In this tables Kaval wise which organizations have been allocated how much area and for what purpose. Given that it can be seen in detail.

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Khudapura Kaval					
Sl. No	Organisation	Village Name	Sy. No.	Extent of land in acres	Purpose
1	IISC	Khudapura	47	1557	Synchrotron, Energy Research Centre and Advanced Aerospace Research Centre.
2	BARC	Khudapura	47	402	BARC Guest House with Special Material Enrichment Facility (Uranium).
3	DRDO	Khudapura	47	224	Aeronautical Test Range (ATR) DRDO Guest House.
4	TDC (2 Campus, 106 and 184 respectively)	Khudapura	NA	290	Talent Development Centre (TDC) Guest House and Teachers Training Program Centre.
5	KHB	Khudapura		110	Karnataka Housing Board.
6	ISRO	Khudapura	47	100	Spacecraft Technologies & Spacecraft Tech Research.
7	Industrial Park	Khudapura	NA*	147	NA*
8	Remaining land	Khudapura	NA*	141	NA*
Total Area				2971	

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Varavoo Kaval					
Sl. No	Overlapped Organisations	Village Name	Sy. No.	Extent of land in acres	Purpose
1	DRDO	Varavoo Kaval	343	4028	Advanced Research and Development (R&D) complex, a 3.5 kilometre Runway and Test-Centre for long-endurance (48-72 hours) Unmanned Aerial Vehicles (UAVs) and Unmanned Combat Aerial Vehicles (UCAVs).
2	Solar Park	Varavoo Kaval	NA*	1003	Integrated Solar Park Development along with Grid Connected 25 MW Solar PV Power Project.
3	NAL	Varavoo Kaval	NA*	583	Proposed for NAL.
4	Upper Bhadra	Varavoo Kaval	NA*	877	Proposed for Upper Bhadra.
5	Remaining Land	Varavoo Kaval	NA*	815+2064=2879	NA*
Total Area				9370	

Ullarthi Kaval					
Sl. No	Overlapped Organisations	Village Name	Sy. No.	Extent of land in acres	Purpose
1	ISRO	Ullarthi Kaval	1	464	Spacecraft Technologies
2	BARC	Ullarthi Kaval	1	1420	Special Material Enrichment Facility (Uranium)
3	KSSIDC	Ullarthi Kaval	1	276	Various industrial ancillary units
4	GOSHALE	Ullarthi Kaval	1	3	Public Cowshed (Goshale)
5	Remaining Land	Ullarthi Kaval	NA*	15	NA*
Total Area				2178	

* Not Available

3.1 Land Use and Land Cover Change (LULCC)

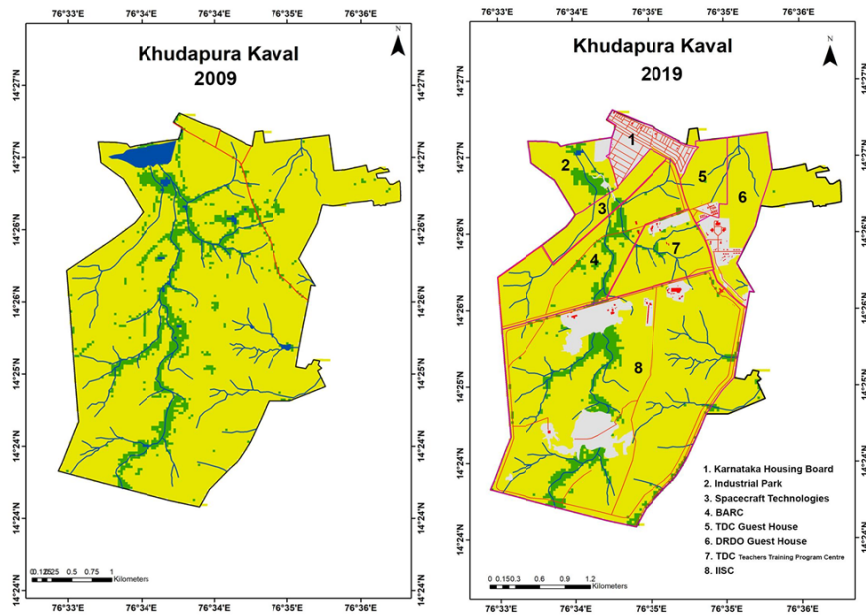
In my study with the use of Landsat satellite images and GIS technology, Challakere Amrit Mahal Kaval grassland's detailed ten-year land-use and land-cover, Past Condition and Present Conditions aspects can be found.

Since Challakere Amrit Mahal Kaval has been divided into 3 areas, I would like to sort, present and explain separately amongst Khudapur Kaval, Varavoo Kaval and Ullarthi Kaval.

Comment [d45]: Avoid the use of 'my' as the reader already know that the work is yours. Therefore, use in 'the' or 'this'

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Figure: 4. Land Use and land Cover Classification in Challakere Amrit Mahal Kaval grassland from 2009 to 2019



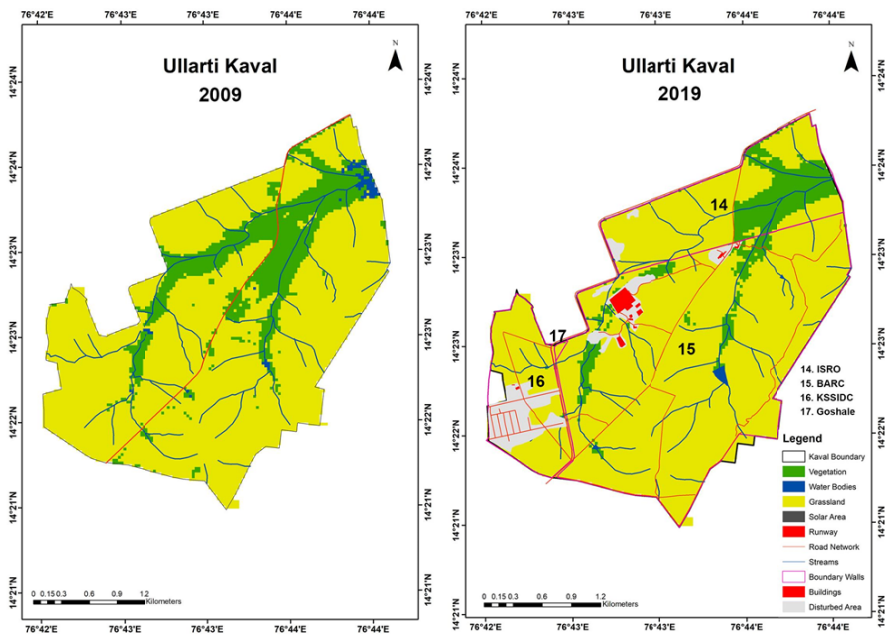
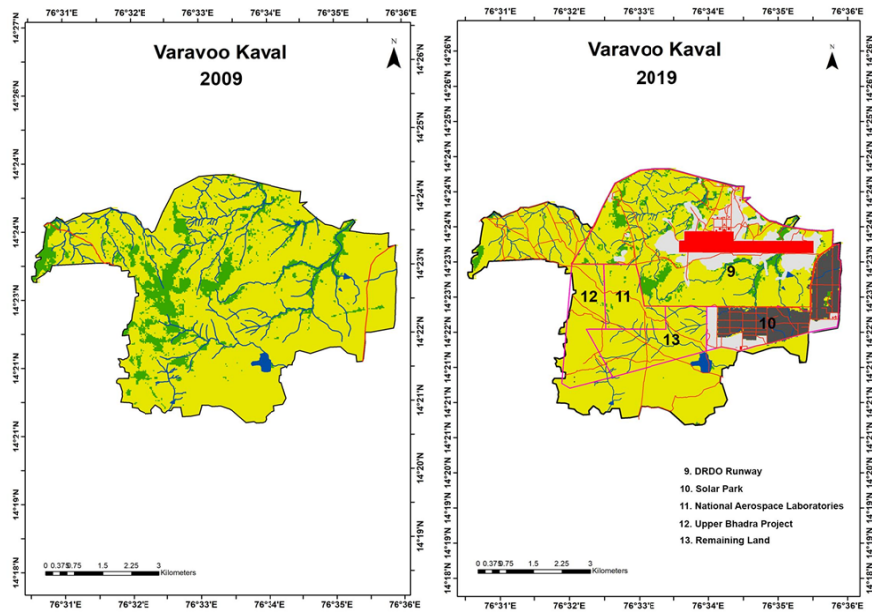


Table: 3. Layers of various classes shows their extent in the LULCC map of 2009 and 2019.

Comment [d47]: Remove ':' from the Table caption

Khudapura Kaval							
Sl.No	Classified	2009		2019		Change	
		Area (Acre)	In %	Area (Acre)	In %	Area (Acre)	In %
1	Vegetation	308.24	10.37	197.08	6.63	-111.16	-3.74
2	Water Bodies	8.67	0.29	1.11	0.04	-7.56	-0.25
3	Grassland	2647.37	89.12	2322.52	78.17	-324.85	-10.95
4	Buildings	0	0	10.82	0.36	10.82	0.36
5	Road Network	6.72	0.22	80.59	2.71	73.87	2.49
6	Boundary Walls	0	0	4.12	0.14	4.12	0.14
7	Disturbed Area	0	0	354.76	11.95	534.76	11.95
Total Area		2971	100	2971	100		

Comment [d48]: Why not 'Area (%)' and apply to others.

Varavoo Kaval							
Sl.No	Classified	2009		2019		Changes	
		Area (Acres)	In %	Area (Acres)	In %	Area (Acres)	In %
1	Vegetation	1325.51	14.14	883.7	9.43	-441.81	-4.71
2	Water Bodies	50.89	0.54	41.26	0.44	-9.63	-0.1
3	Grassland	7981.16	85.18	4736.46	50.54	-3244.7	-34.64
4	Solar Area	0	0	1003	10.7	1003	10.7
5	Runway	0	0	348.4	3.72	348.4	3.72
6	Buildings	0	0	12.81	0.13	12.81	0.13
7	Road Network	13.04	0.14	205.39	2.2	192.35	2.06
8	Boundary Walls	0	0	13.66	0.14	13.66	0.14
9	Disturbed Area	0	0	2125.92	22.7	2125.92	22.7
Total Area		9370.6	100	9370.6	100		

Ullarti Kaval							
Sl.No	Classified	2009		2019		Changes	
		Area (Acre)	In %	Area (Acre)	In %	Area (Acres)	In %
1	Vegetation	383.4	17.6	215.72	9.9	-167.68	-7.7
2	Water Bodies	29.84	1.36	4.79	0.21	-25.05	-1.15
3	Grassland	1756.41	80.64	1755.33	80.62	-1.08	-0.02
4	Buildings	0	0	14.13	0.64	14.13	0.64
5	Road Network	8.7	0.4	41.15	1.88	32.45	1.48
6	Boundary Walls	0	0	5.5	0.25	5.5	0.25
7	Disturbed Area	0	0	141.73	6.5	141.73	6.5
Total Area		2178.35	100	2178.35	100		

3.1.1 Khudapur Kaval

Comment [d49]: Remove the underline

Having an area of 2971 acres, Khudapur Amrit Mahal Kaval comes between Nayakahatti and Challakere road. In a decade between 2009-2019 one can observe lots of changes in Land-use and Land-cover.

In 2009, Khudapur Amrit Mahal Kaval grasslands covered an area of 2647.37 acres (89.12%), at present in 2019 2322.52 acres (78.17%). It indicates 10.95% reduction in grasslands. Vegetation reduced from 308.24 acres (10.37%) to 197.08 acres (6.63%) indicating 3.74% reduction. Water Bodies reduced from 8.67 acres (0.29%) to 1.11 acres (0.04%) indicating 0.25% reduction. Currently, in these areas construction of buildings take up to 10.82 acres (0.36%), roads take up to 80.59 acres (2.71%), Boundary walls take up 4.12 acres (0.14%). And with disturbed Area of 354.76 acres (11.95%), natural area has been destroyed. Overall, about 443.57 Acres (14.94%) of the area is under development, destroying the original grassland and the area is still under development.

3.1.2 Varavoo Kaval

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If we consider Varavoo Kaval, it has a geographical area of about 9370 acres and it is the largest grassland area compared of the three Kavals. Varavoo Kaval is near to Neralagunte Village. In 2009, Varavoo Kaval grasslands covered an area of 7981.16 acres (85.18%), at present in 2019, 4736.46 acres (50.54%). It indicates 34.64% reduction in grasslands. Vegetation reduced from 1325.51 acres (14.14%) to 883.7 acres (9.43%) indicating 4.71% reduction. Water Bodies reduced from 50.89 acres (0.54%) to 41.26 acres (0.44%) indicating 0.1% reduction in water bodies. Sagitaur Ventures Pvt.Ltd company destroyed grasslands in Varavoo Kaval and built Solar power plant units on an area of 1003 acres (10.7%)[21][22]. Defense Research and Development Organization (DRDO), a government of India agency built Runway in 348.4 acres (3.72%) with various proposed buildings and construction in 12.81 acres (0.13%), construction of roads in 205.39 acres (2.2%). The Defense Research and Development Organization (DRDO), Solar Power Plant Unit, National Aerospace Laboratories (NAL) and Upper Bhadra Project has built a compound wall of 54km in about 13.66 acres (0.14%) of area (Fig-5). With a disturbed Area of 2125.92 acres (22.7%), natural habitat has been destroyed and development is still in progress (Fig-8). And overall, about 3696.14 Acres (39.45%) of the area is under development, destroying the original grassland and the area is still under development.

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3.1.3 Ullarti Kaval

Comment [d53]: Remove the underline

Around 25kms far from Khudapur Amrit Mahal Kaval, near Dodda Ullarti village, 2178 acres of grassland has been sanctioned to Indian Space Research Organization (ISRO), Bhabha Atomic Research Centre (BARC)(Fig-6), and Karnataka State Small Industries Development Corporation (KSSIDC). Even here in 2009, grassland covered 1756.41acres (80.64%), at present in 2019, 1755.33 acres (80.62%). It indicates 0.02% reduction in grasslands. Vegetation reduced from 383.4 acres (17.6%) to 215.72 acres (9.9%) indicating 7.7% reduction. Water Bodies reduced from 29.84 acres (1.36%) to 4.79 acres (0.21%) indicating 1.15 % reduction in water bodies. 14.13 acres (0.64%) of land for various purpose buildings, construction of roads in 41.15 acres (1.88%, with disturbed Area of 5.5 acres (0.25%), 141.73 acres (6.5%) of grassland area have been destroyed and development is still in progress. Then overall, about 19381 Acres (8.84%) of the area is under development, destroying the original grassland and the area is still under development.

Comment [d54]: Put space inbetween and use 'Fig. 6'

Figure: 5. Left side image: The compound wall built in the Challakere Amrit Mahal Kaval grasslands. **Figure: 6.** On right side: Bhabha Atomic Research Centre (BARC) agency encroached the village road.

Comment [d55]: Use 'Fig. 5.' Instead of Figure: 5.

Comment [d56]: Use 'Fig. 6.' Instead of Figure: 6.

Figure:7. Left side image: People weave blankets in the villages around the Amrit Mahal Kaval grassland for their livelihood. **Figure: 8.** On right side: Natural area has been destroyed and development is in progress.

Comment [d57]: Use 'Fig. 7.' Instead of Figure: 7. And make sure that the Figure caption appears below

Comment [d58]: Use 'Fig. 8.' Instead of Figure: 8. And make sure that the Figure caption appears below

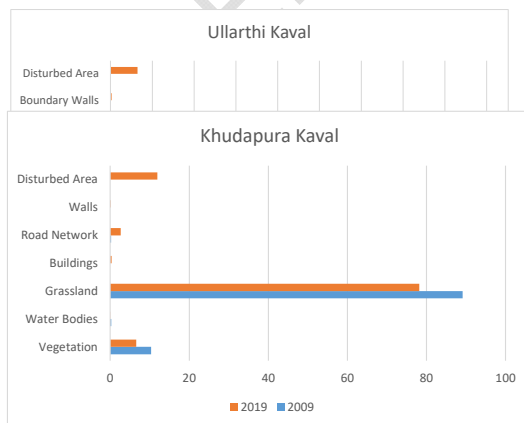
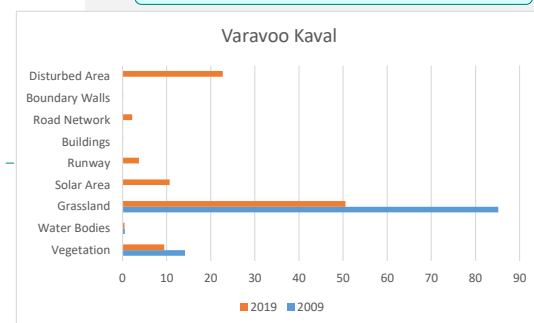


Figure: 9. Spatial Distribution of Various Categories in Challakere Amrit Mahal Kaval.



3.2 Consequences on Social, Cultural and Economic factors:

Unscientific development undertaken in the sensitive grassland impacted on Social, cultural and economic rights as described below. According to the 2011 census, Challakere Amrit Mahal Kaval has a population of 85,908 out of a total of 43 villages within the five-kilometer Buffer Zone boundary of Kaval grasslands[23]. Almost all of them here are below the poverty line and belong to the backward classes, whose roots are in farming, dairy and cottage industries.

Challakere area mainly consists of the Amrit Mahal Kaval grassland, and this grassland area absorbs the rainfall as a sponge and increases the water levels of streams, lakes and groundwater levels of bore-wells. But this area of grassland is getting destroyed for the construction of buildings, roads and compound walls (Table-3, Fig-5). People from 43 villages resorting to water for drinking purposes and also for irrigation purposes for agriculture are facing problems. Cattle, other animals and birds in the grassland are facing the troubles for drinking water.

Uranium Concentration from Baba Atomic Research Center spread over 1822 acres of grasslands in Ullarti and Khudapur Kaval is disposing the waste into ponds and lakes of surrounding area, negatively impacting the health of people living in and around due to radiation. There is a fear that the pollution could result in the displacement of people from the communities. Defense Research and Development Organization manufactures armed drones and conducts tests as well. To prevent internal opposition over driverless aircraft, warplanes are manufactured too, which in turn causes trouble to people and biodiversity in the surrounding area. An Unmanned Aerial Vehicle (UAV) crashed during testing and landed over farmers land can be seen in Figure10 & 11.



Figure: 10. Left side image: DRDO's UAV crash-lands in Challakere farmland (Photo courtesy of Times of India). **Figure: 11.** On right side: The drone which crashed near Nayakanahatti in Challakere taluk of Chitradurga district (Photo courtesy of Deccan Herald).

People have been doing dairy farming such as cattle, sheep, goat and buffalo for over hundreds of years. Dairy farming is still their livelihood. We all know Challakere Sheep wool Blanket (Sheep Rug) were famous all over India and were supplied to Indian Soldiers as well. So the livelihood and economic system of most people depends on sheep grazing. People buy sheep wool in Challakere travelling from distant towns like Davangere and Shimoga. They weave and sell sheep blankets in villages (Fig: 7). People also sell meat, milk and milk products locally. Importantly, thousands of families depend mainly on the grasslands for livelihood[24].

Comment [d60]: Change this to (Table 3, Fig. 5) and unbold

Comment [d61]: Change it to (Fig. 10 & 11) and unbold

Comment [d62]: Use 'Fig. 10.' Instead of Figure: 10. And make sure that the Figure caption appears below

Comment [d63]: Use 'Fig. 11.' Instead of Figure: 11. And make sure that the Figure caption appears below

Comment [d64]: Change it to 'Fig. 7'

At present, the walls are restricting the villagers to herd cattle to graze in the grasslands spread over hundreds of acres, forcing them to sell their livestock. There have been instances of migration forcing them to move hundreds of kilometers away. People from the Lambani community, making a living out of weaving baskets, are facing the shortage of Indian Date palm trees and are forced to buy raw materials, travelling to neighboring Andhra Pradesh state. The abundant and fresh medicinal plants growing in grassland were used to solve health issues amongst the people and their cattle. Now, even the medicinal plants are not available.

Indigenous communities have been using and guarding these grasslands around the Kaval for centuries. There are many temples of various tribes and communities of peoples who live around the grasslands. Annual fairs are organized for these temples cultural importance. Clay statue is made from Amrit Mahal Grassland and decorated. Devotion (Bhakti), Sobaane (Pada), Parade (Meravanige) and Fasting (Upavaasa) are conducted displaying bhakti. The Clay idol is immersed in water at the end of the Fair in devotion[25]. With the grasslands destroyed, right to perform such cultural activities is also taken away.

3.3 Factors affecting Biodiversity and Environment:

Challakere Amrit Mahal Kaval grassland system is the most extensive and the last remaining micro biological landscape in the state. Most endangered birds like Great Indian Bustard, Lesser Florican. Mammals like Black buck, Wolves and Fox are thriving in the grassland and they need extensive grasslands to survive. With the destruction of their habitat, critically endangered creatures are pushed into The IUCN Red List of Threatened Species[24].

In India only 150 individual Great Indian Bustards are surviving. Rajasthan's Jaisalmer has 100, Gujarat's Kutch has 25, Karnataka has 6, Andhra Pradesh has 6 and only 1 in Maharashtra. We need to give the same importance to these critically endangered animals as we give to National Animal of India, the Bengal Tiger. It is miserable to see an endangered birds habitat is used and destroyed for development purposes while the same development can be carried out in un protected and barren lands of lesser environmental importance spread across the Deccan Plateau. Development in Chitradurga's Challakere Amrit Mahal Kaval grasslands had a bad effect on Critically Endangered Great Indian Bustards. These birds are seen only in Karnataka's Ballari, Ranibennur, Challakere, Gujarat, Rajasthan and Andhra Pradesh. The Great Indian Bustard bird needs to be protected under first schedule of Wildlife Protection Act of 1972.

4. CONCLUSION

Population growth is putting enormous pressure on natural resources, grasslands are not exempted. Social, cultural, economic and environmental impacts due to the same puts a doubt about the survival of humans, their livelihoods, cultures and heritage. Once you look at the statistics of the above three grasslands (**Table 3**), the development work here reduced the area of vegetation by 4.59%, water sources by 0.29% and 24.6% of the grassland is lost. If the common people had done the same kind of damage to these one of a kind, environmentally and culturally important grasslands, reserved and protected for a special breed of cattle of National importance, the law would have brought them to justice, punished them and the land would have been acquired back, but here it's different. Local communities did go from Local Panchyath level to the Hon'ble High Court and the Prestigious Supreme Court but the justice was denied. Sad thing is developmental activities kept continuing even after anti-environmental complaints were lodged at the National Green Tribunal (Southern Zone Bench). On Challakere Amrit Mahal Kaval grassland encroachment issues, an organization supporting Environment Support Group is fighting legally with application numbers as 6/2013 and 12/2013 in National Green bench[26]. Various citations can be seen in the context of the submission to the National Green bench, work is being carried out by violating the Environment (Conservation) Act 1986, Environmental Impact Assessment

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Notification 2006, Water (Prevention and Control of Pollution) Act 1974, The Air (Prevention and Control of Pollution) Act 1981, Forest Protection Act 1980, Factories Act 1948, The Karnataka Town and Country Planning Act 1961, The Airline Act 1934, The 74th Amendment enacts regulations for the municipal or urban local authority (municipalities). This demonstrates, Justice is different for the masses and the government. Development is very important. But my question is, Why does development work be necessarily carried out in ecologically important grasslands, destroying the landscape, uprooting the cultures and forcing the true protectors of the land to move out. Isn't it our responsibility to save the Amrit Mahal Kaval Grasslands for the endangered breed Amrit Mahal which has history of 500 years and all the endangered mammals and birds? Emotional feelings can make it wrong to question the land provided for the defense forces of one's Nation. But, it should be overruled knowing the grasslands belongs to the critically endangered Great Indian Bustard[27].

4.1 Suggestions

- It is very important to retain the grasslands by clearing the encroachments and save the Amrit Mahal Kaval Grasslands.
- It is important to protect Amrit Mahal cattle breed which has history of about 500 years and save Amrit Mahal Kaval grasslands reserved for the breed, which is one of its kind in the World.
- Separate law must be created in India for the protection of the grasslands and the endangered flora fauna of the grasslands.

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Comment [d66]: Remove the bracket and let it be 1. Anil Kumar STK.
Apply the same to all other references listed as surname will come first and initial after without '.' inbetween. Justify each reference

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Note, in all the references listed 1-27, remove the bracket and make it 1. to 27. Also, it should be for example Anil Kumar STK. and not S. T. K. Anil Kumar. It should be Surname first follow by the initial. Remove the appostrophe in the reference title in the references listed above.

Use the below as example;

Anil Kumar, STK. CENSUS OF INDIA 2011 Primary Census Abstract Data Highlights KARNATAKA Series 30 Directorate of Census Operations, Karnataka Data Product Code : 29-007-2011-PCA Data Highlights Primary Census Abstract-Data Highlights, Bangalore, 2011. [Online]. Available: [http://censuskarnataka.gov.in/Data High lights-Karnataka-PCA-2011.pdf](http://censuskarnataka.gov.in/Data%20Highlights-Karnataka-PCA-2011.pdf).