Original Research Article

GISbasedmappingfora bettercropplanning forPerumpadappu block of Ponnani Kolelandsin Kerala

ABSTRACT

Kole lands are one of the biggest saline, humid tropical wetland ecosystems. It spreads across the Thrissur and Malappuram districts of Kerala state. They serve as a water storage structure during the rainy season. After rains, the stored water is dewatered and circulated in various Kolepadasekarams and channels to cultivate paddy. However, the problem is the lack of a proper water management plan resulting in crop loss. The current study is conducted in the Perumpadappu block of Ponnani Kole lands in the Malappuram districts. In this study, both GIS and Remote sensing has collaborated to plan the crop calendar. The cropping calendar of Ponnai Kole was developed mainly for 37 Kole padashekharams of Perumpadappu block. Data about elevation, transportation, irrigation, weather and soil were collected to arrive at the crop calendar. Together, by adopting participatory rural appraisal methods, local knowledge was also integrated. The final crop calendar was wetted with farmers and experts.

Keywords:- Kole lands, Padashekarams, Ponnani, Perumpaddapu

INTRODUCTION

Kole wetland is one of the most important areasthat come under the Central Asian-IndianFlyway (Anon, 1996). The Kole wetlands form one of the rice granaries of Kerala state. The“Kole”isaMalayalamwordwhichindicatesbumperyieldsofhighreturnsif the flooddoesnot damage the crops (Johnkutty and Venugopal, 1993). It forms a part of 13632 hectares ofthe Vembanad-Kole wetland ecosystem, which was designated as a Ramsar site in 2002. TheKolelands weregenerallyflat, shallowlagoons which slowlygot silted up.

Kole lands spread over Thrissur and Malappuram districts of Kerala state, extendingfrom the northern banks of the Chalakudy River to the southern banks of the Bharathapuzha Riverin the North (Panikkaveettil et al., 2020).It is located below mean sea level, i.e., 0.5m to 1m.The Kole area lies between $10^0$20’ and $10^0$40’N latitudes and $75^0$58’ and $76^0$11’E longitudes.Rice is the major crop cultivated in the Kole lands, which producesa fairly good yield due to the presence of high organic matter (Venugopal et al., 2019). A peculiar type of cultivation is practicingin Kole lands, especially from December to May (Sivaperuman and Jayson, 2000). The area isdivided into various padashekarams and is cultivated. From June to November, a majorportionof Kolelandis submerged in water.

Ponnani Kole lands extend from the Choondal panchayath in Thrissur district toTavanurpanchayathinMalappuramdistrict.Itconsistsoftwoblockpanchayats,i.e.,Perumpadappu block and Ponnani block of Malappuram districts. It consistsof an area of around3445ha(Srinivasan,2010; Rajasekharan and Sasidharan, 2019).ThePerumpadappublockconsistsoffiveKrishibhavans,whereas the Ponnani block consists of four Krishibhavans. Beneath each Krishibhavans, around 10 to 12padashekharasamithiswere functioning.

Padashekharasamithisaretheorganisationoffarmersinacommunityregisteredunderanylaw,now ineffectto encouragetheproductionof paddyandrelatedcrops. While taking an overview of Thrissur Kole lands, it had major and minor irrigation projects.Whereas in the case of Ponnani Kole lands, the irrigation projects are less. Also, the occurrences of flood and drought lead to consistent crop loss. Hence withthese backdrops, the present study aims to develop a crop calendar for the Perumpaddappublock of Ponnani Kole lands by assessing the features like location,soil, transportation,elevationand irrigation.

METHODOLOGY

Thepresentstudywas carriedoutin thePerumpadappublockofPonnaniKolelands inthe Malappuram district of Kerala state. A total of five Krishibhavans under the Perumbadappublock were taken for the study. They are Alamcode Krishibhavan, Maranchery Krishibhavan,Nanammukku Krishibhavan, Perumpadappu Krishibhavan and Veliyamkode Krishibhavan. Atotal of 37 Kole Padashekharams were present under the Perumpadappu block. The data wascollected from the Agriculture Officers and farmers of respective Padashekhara samithis through interview schedules and by conducting field visits and Participatory Rural Appraisal (PRA). The total sample size of 100 was selected purposively for the study. Inthisstudy,GeographicalInformationSystems(GIS)andRemoteSensinghave alsocollaboratedtodevelop the crop calendar (Fig.1).

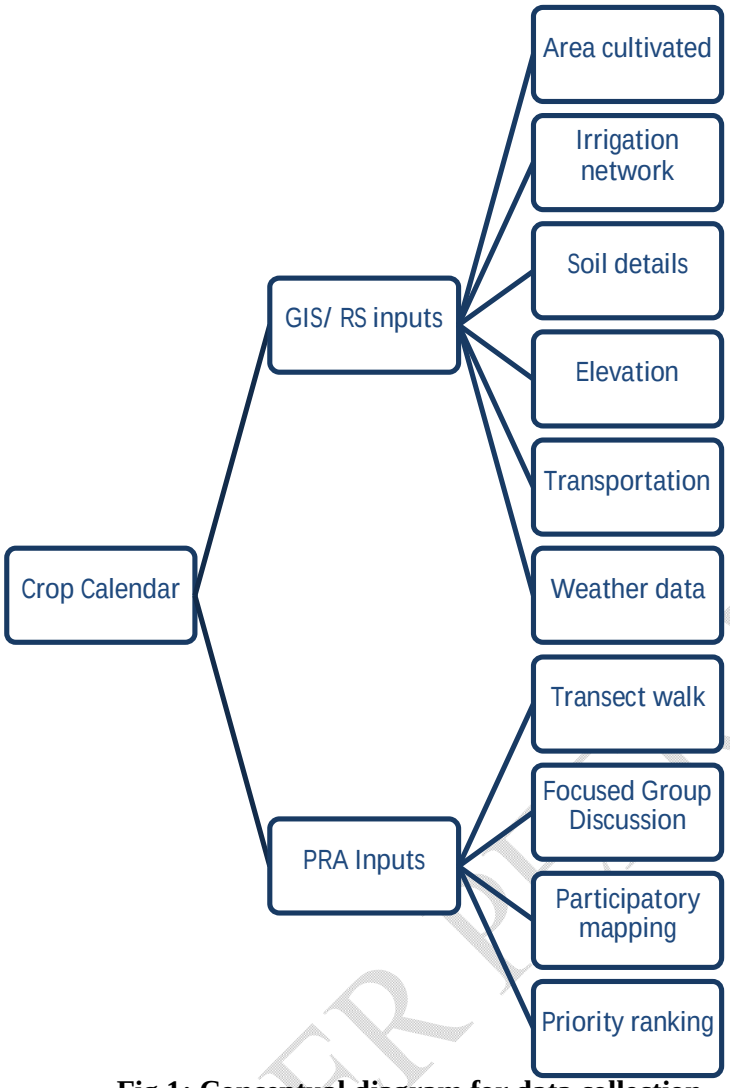

Fig.1: Conceptual diagram for data collection.

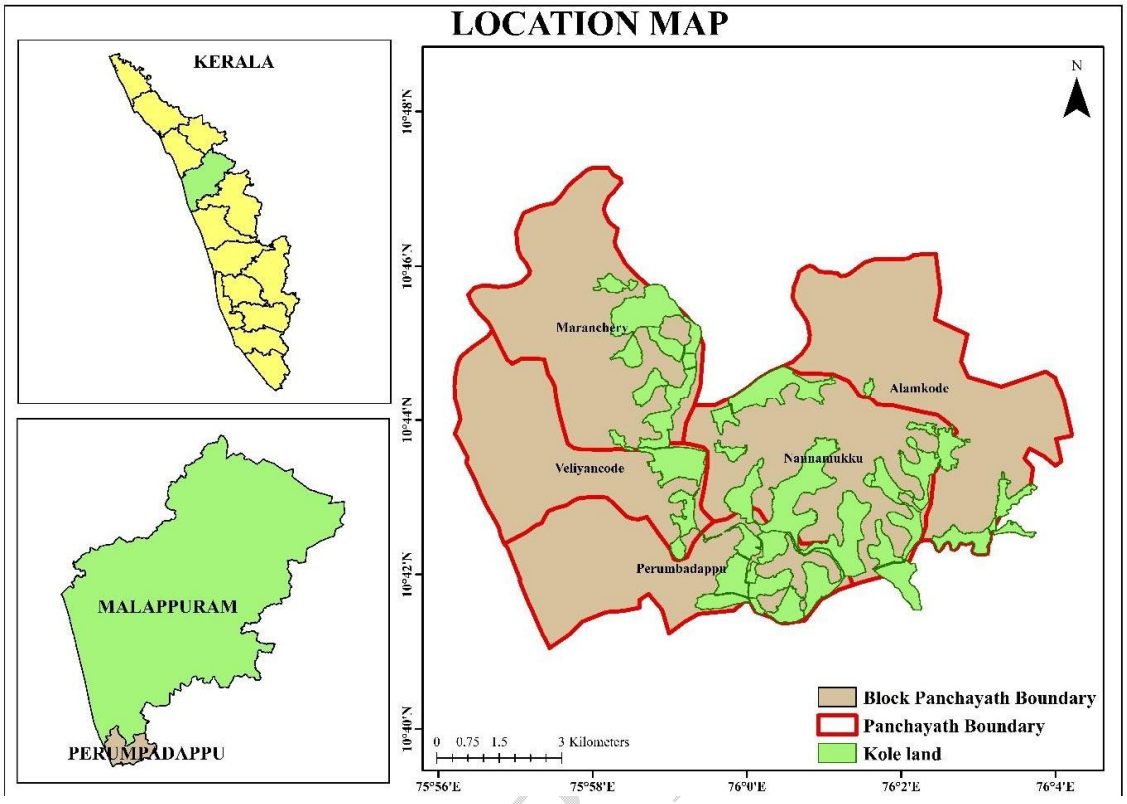

Fig 2: Location map of Perumpadappu block Kole lands

The criteria such as elevation, irrigation and transportation were collected, and inputmap layers for each criterion were prepared for analysis in a GIS environment. Now, these inputdata layers for the study were delineated by scanning, digitisation and registration throughGoogle earth pro and open-source Quantum Geographic Information System (QGIS). Thelayers were projected in Universal Transverse Mercator (UTM) projection system (WGS84/UTMZone43N)andfinallymadeintoa vectorformat.Thetotalareaofthe Perumpadappublockwascalculatedusingthe uniquevaluereporttoolin the QGISPlatformtofindoutthereacoveredineachclass.Essentialcriteriaconsideredforthestudy,sucha s irrigation, elevation, transportation, soil and Kole land locations from different sources, aresummarisedinTable 1.

Table1:GISdatacollectionsourceanddescription

DataSets	Description	Sources
AsterDigitalElevation ModelResolution30m	Downloaded	USGSEarthExplorer (https://earthexplorer.usgs.gov)

Irrigation	Vectorline– ESRIShape file	Openstreetmap-QGIS platform
Transportation	Vectorline– ESRIShape file	Openstreetmap-QGIS platform
Elevation	DerivedfromDEM30m	DEM30m
Kolelandlocation	Digitised	Fielddata/GoogleEarth

RESULTANDDISCUSSIONS

ThefiveKrishibhavansunderPerumbadappublockweretakenforthestudy.TheywereAlamcodeKrishibhavan,MarancheryKrishibhavan,NanammukkuKrishibhavan,PerumpadappuKrishibhavanand VeliyamkodeKrishibhavan.Atotalof37KolePadashekharams were present under the Perumpadappu block.

CULTIVATED AREA

The cultivated area was calculated separately from GIS and Krishibhavan data. The list of Kole padasekarams underrespectivekrishibhavans with the area under cultivation is givenin thebelowTable 2 and Figure 3. From the data obtained, we can see that 25 per cent of the total area in these padasekarams in Perumbadappu block remains uncultivated. And when we take padasekaram wise data, it can be observed that out of 37 padasekarams, 4padasekarams have 50% or more areas uncultivated.Hence, bringing more area under cultivation is a necessary step to increase production.

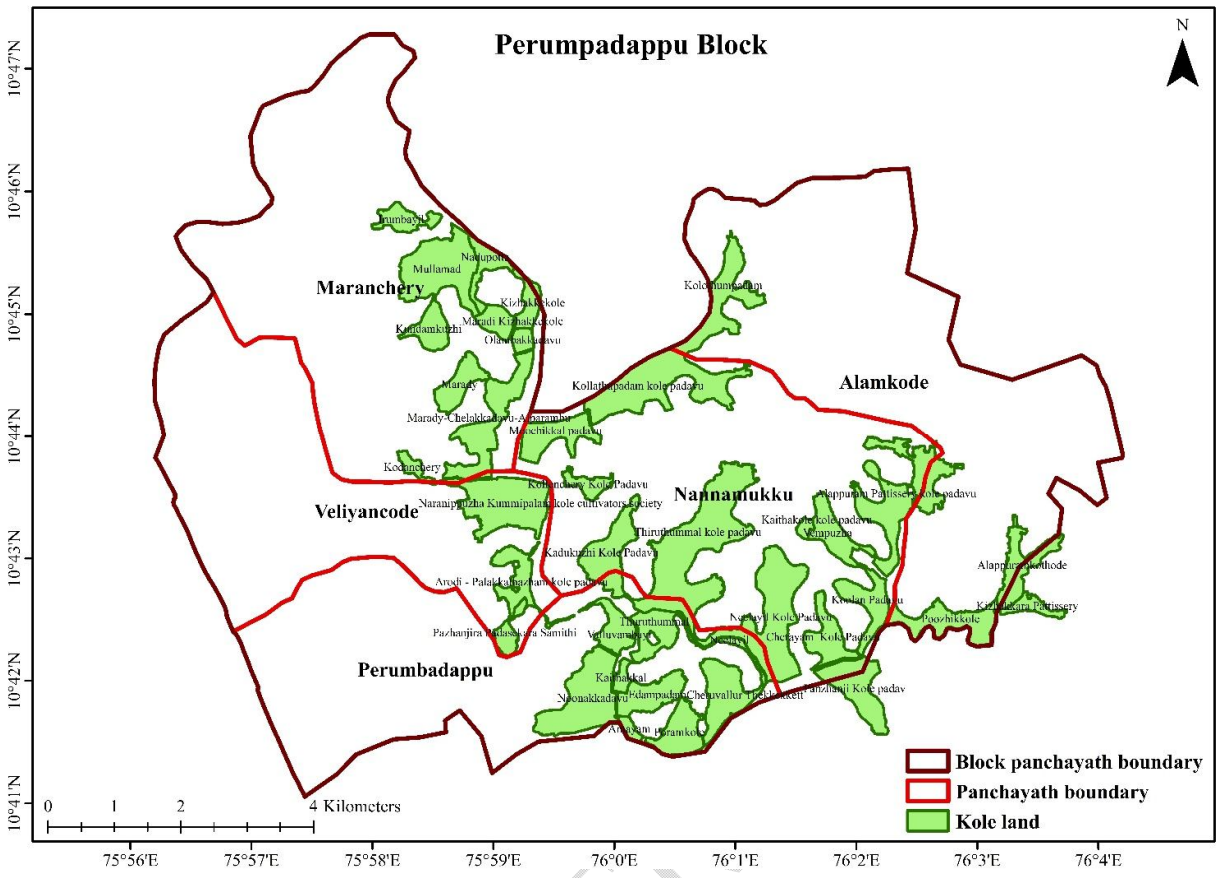

Fig 3: Map showing list of Kolepadashekharams in Perumpadappu block

Table2:ListofKolepadashekharamsinPerumpadappublock

Panchayath	Kole Padashekharams	Area as per GIS (Ha)	Area cultivated as per Krishibhavan data (Ha)	Uncultivated area (Ha)
Alamcode	Alappuramkothode	44.00	42.00	2.00
Alamcode	Kizhikkara Pattissery	15.00	14.00	1.00
Alamcode	Kolothupadam	63.00	54.00	9.00
Alamcode	PoozhikKole	54.00	46.00	8.00
Maranchery	Mullamad	93.00	90.00	3.00
Maranchery	Irumbayil	24.00	4.20	19.80
Maranchery	Kodanchery	10.00	10.00	0.00
Maranchery	Kundamkuzhi	29.00	24.00	5.00
Maranchery	Maradi KizhakkeKole	20.00	16.00	4.00
Maranchery	Marady	32.00	26.00	6.00

Maranchery	Marady-Chelakkadavu-Alparambu	77.00	20.00	57.00
Maranchery	Nadupotta	24.00	24.00	0.00
Maranchery	Olambakkadavu	10.00	10.00	0.00
Nanammukku	Alappuram Pattissery Kole padavu	109.00	60.00	49.00
Nanammukku	Cherayam Kole Padavu	38.00	37.00	1.00
Nanammukku	Kadukuzhi Kole Padavu	58.00	7.00	51.00
Nanammukku	KaithaKoleKole padavu	6.00	6.00	0.00
Nanammukku	Kollathupadam Kole padavu	115.00	54.00	61.00
Nanammukku	Kollenchery Kole Padavu	16.00	13.00	3.00
Nanammukku	Koolan Padavu	40.00	37.00	3.00
Nanammukku	Moochikkal padavu	47.00	24.00	23.00
Nanammukku	Neelayil Kole Padavu	119.00	92.00	27.00
Nanammukku	Panzhanji Kole padav	56.00	40.00	16.00
Nanammukku	Thiruthummal Kole padavu	176.00	141.00	35.00
Nanammukku	Vempuzha	38.00	37.00	1.00
Perumpadappu	Amayam Kadavath Kole	7.00	6.00	1.00
Perumpadappu	Cheravalloor PuramKole	41.00	36.00	5.00
Perumpadappu	Edampadam	42.00	34.00	8.00
Perumpadappu	Kaithakkal	9.00	4.00	5.00
Perumpadappu	Neelayil	10.00	6.70	3.30
Perumpadappu	Noonakkadav	93.00	87.00	6.00
Perumpadappu	Pazhanchira	17.00	14.50	2.50
Perumpadappu	Thekkekkett	56.00	48.00	8.00
Perumpadappu	Thuruthummal	36.00	33.60	2.40
Perumpadappu	Valluvambayi	31.00	20.00	11.00
Veliyamkode	Arodi - Palakkathazham Kole padavu	40.00	40.00	0.00
Veliyamkode	Naranippuzha Kummipalam Kole cultivators society	94.00	80.00	14.00
Total		**1789.00**	**1338.00**	**451.00**

Table 3: Uncultivated area of variousKole padashekarams of Perumpadappu block

Sl.no	Uncultivated area (%)	No. of Padashekharams
1	Less than 0%	6
2	0-10%	8
3	10-20%	13
4	20-30%	2
5	30-40%	2
6	40-50%	2
7	50-60%	1
8	60-70%	0
9	70-80%	1
10	80-90%	2
11	90-100%	0
12	100%	0
	Total	**37**

IRRIGATION

The Kole lands lie 0.5 to 3.0 m below the mean sea level. Nooradithodu and Beeyam Kayal are the major irrigation source in Ponnani Kole region. Themain tributaries that join the Nooradi thodu are Vettikkadavu thodu, Othallur sub canal,Panthavoor stream, Manoor thodu and Pothannur thodu.During the summer season, all thesetributaries get dried up. Hence, rice cultivation in the summer season is done by storing thewaterinNooradithoduwiththehelpofBeeyamregulator. Intheflood season,theinflowintothe riverbasin submerges all Kole lands. In this period, the canals in Kole lands act as drainage channels by channelising flood water to the Arabian Sea through Beeyam regulator.

After receiving the North East (Oct-Nov) monsoon, depending upon the water level in the Nooradi thodu,the Beeyam regulator will get closed. Hereafter, water from the padasekarams will be pumped to the Nooradi thodu, and the cultivation in the padasekarams starts. In the low-lying padasekarams, cultivation will begin only at the end. The problem observed in this area is the poorly developed bunds. Itoften results in the collapse of bunds and flooding of the fields at the time of sowing. This is noticed is 3 pasasekarams in the last year. Further out of the 37 padasekarams, only in six padasekarams, the traditional petti and para for water lifting are replaced with modern pumps. Hence, strengthening bunds and replacing the conventional petti and para with more efficient pumps is necessary.

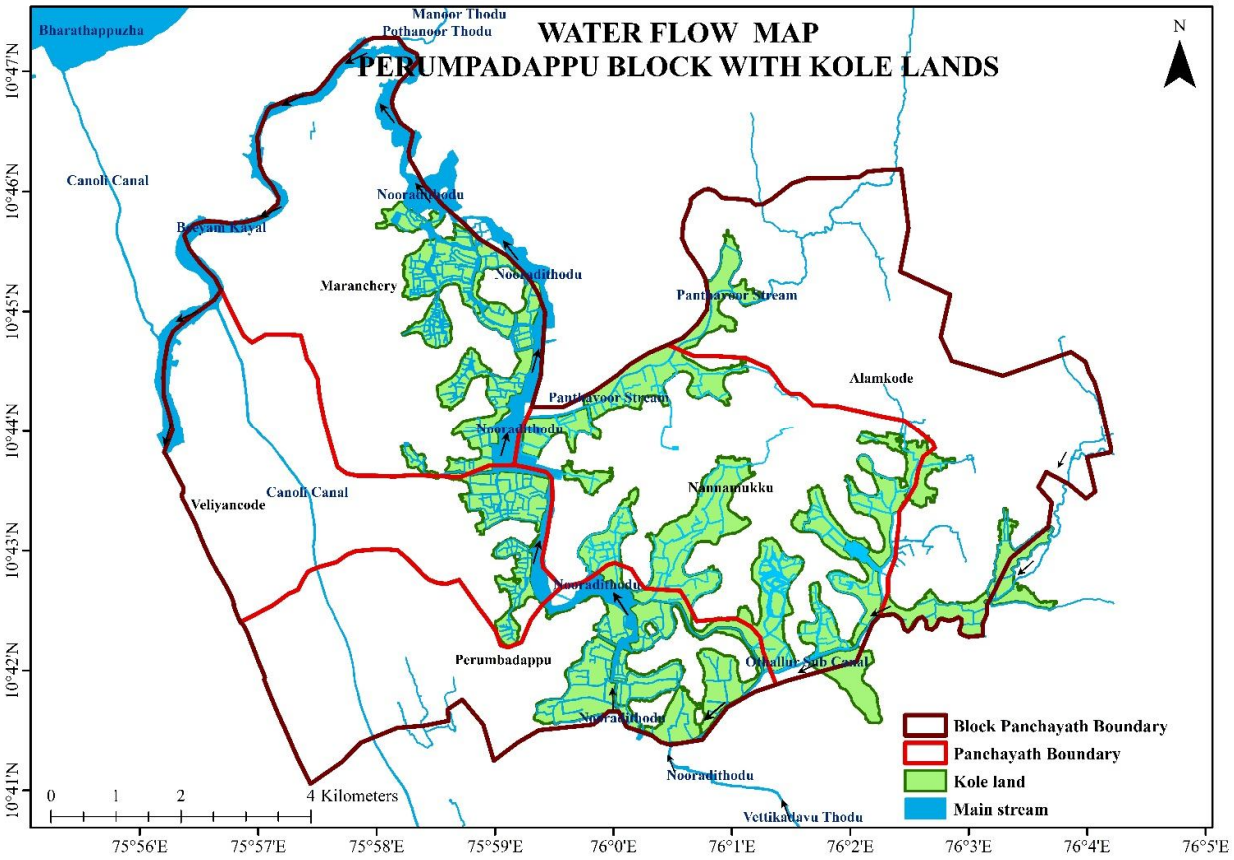

Fig 4: Irrigation map of the Kole padashekharams in Perumpadappu block

SOIL

Kolesoilsaretheproductsofweatheringofriveralluvialdepositsandcolluvium.Thesedepos its are having clayey texture in nature and inhabits the flood plain. The flood plain is adeposition basin lying below the sea level, and vulnerable to floods. The dominating factorsinfluenced the soil formation in the Kole area were parent material and relief. The Kole soils are potential acid sulphates soil (100-150 cm) deep, similar to that of Kuttanad soils (Venugopal *etal.*, 2019).

Kole landssubsurfaceshows finesandydeposits of sedimentaryorigin.Thepercentageof claycontent onthe surface of these soils were high, also the ill drained situations and continuous deposition of sedimentshave arrested the development of soil profile. The below Table 3 shows the soil fertility statusofdifferent panchayathsof Perumpadappu block (Venugopal *et al.*, 2019).

Table4:Soilfertilitystatusofdifferentpanchayathsof Perumpadappublock

Panchayth	pH	OC	K	P	Ca	Mg	S	B	Cu	Zn

Alamcode	5.1-7.3	M	L	A	A	A	A	A	A	A
Maranchery	5.6-7.30	L	L	A	A	D	A	D	A	A
Perumpadappu	4.5-7.30	M	L	A	A	D	A	D	A	A
Nannamukku	4.5-7.30	M	M	A	A	D	A	D	A	A
Veliyamcode	5.1-7.3	M	A	A	A	D	A	D	A	A

Red– Low/Deficient, Yellow –Medium, Green – High/ Adequate

From the above Table 3, it is understood that Maranchery panchayath is having high pH and low Organic Carbon, whereas in Alamcode, Maranchery and Perumpadappu panchayath Potassium element is low or deficient in soil and in Maranchery, Perumpadappu, Nannamukku and Veliyamcode panchayth Magnesium and Boron element is very low or deficient in soil.

ELEVATION

Elevation is one of the most important edaphic factors required for assessing croppingpattern. It also influences the water management and runoff. Therefore, elevation is one of themajor aspects in developing the cropping pattern. Elevation for Kole land was determined fromAdvancedSpaceborneThermalEmissionandReflectionRadiometer(ASTER)DigitalElevation Model (DEM) data of resolution 30 metres. The elevation range of the Perumpadappu Kole lands lies between0 to -3 m. Hence, this factor must be considered while preparing a crop calendar.

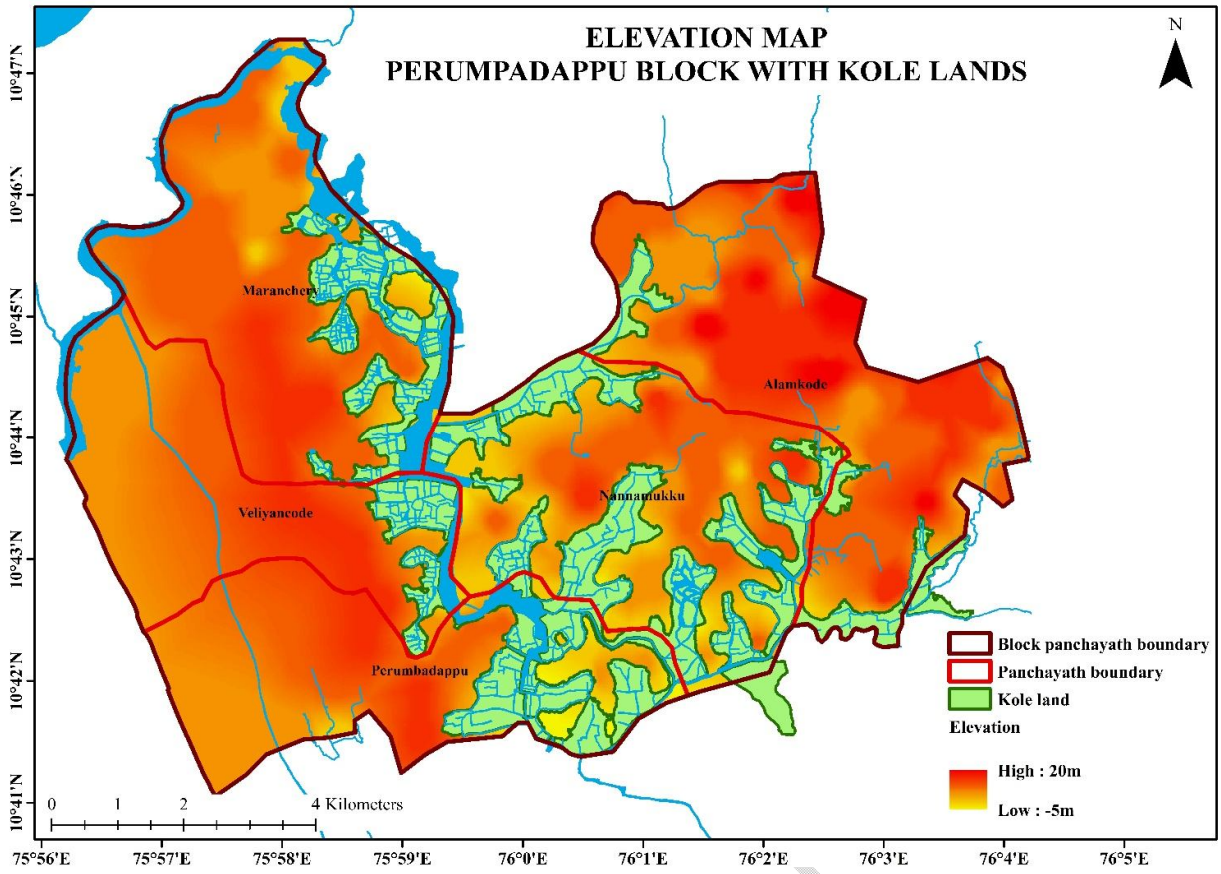

Fig 5: Elevation map for Perumpadappu Kole lands

TRANSPORTATION

Kole lands have a well-connected transport system (Fig.6). Major roadways connectingthe Ponnani Kole lands are Thrissur Kunnamkulam road, Guruvayoor Althara Ponnani road,VelliyankodeMarancheryroad,ChangaramkulamChelakkadavuroad,KololambuThekkethalaroad,KundukadavuVeliancoderoadandCheravalloorPerumpadappubundroad. So transportation of materials into and from Kole land is not a problem.

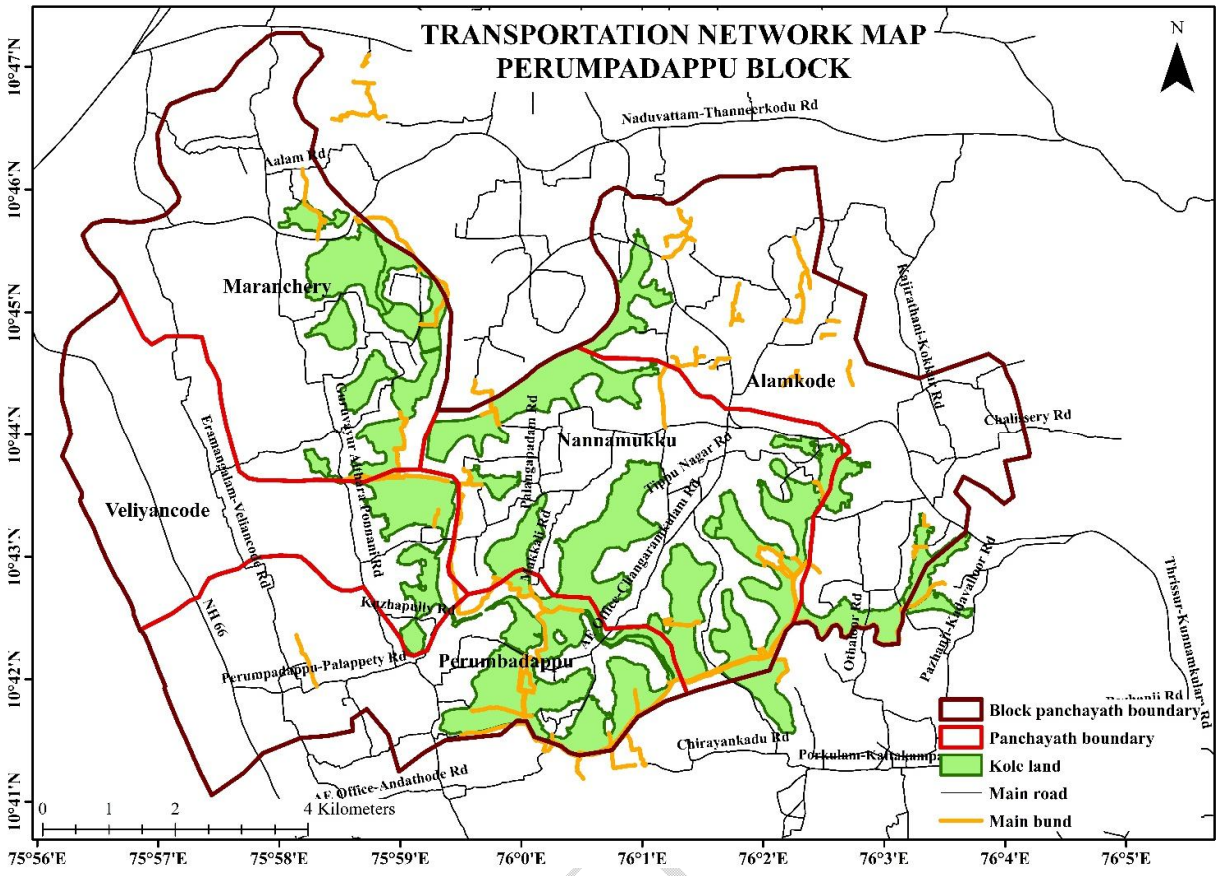

Fig 6: Transportation map of Kole padashekharams in Perumpadappu block.

WEATHER

The daily weather data of the Perumpadappu block of Ponanni Kole lands were collected from NASA power data access. Hereafter, the data were analysed to understand the North-East monsoon pattern in the study area. From the analysis, it was found that an average of 399 mm of rain was there from Oct to Dec in the area during the last forty years.

From the data presented in Fig. 6, it was also found that 50% of the North-East monsoon came on Oct 26th. Further analysis found that the average last 150 mm of rainfall was on Oct 31st. Hence, after discussion with the group members, it was decided to start the cultivation on Nov 1stof every year. It will avoid flooding of fields and resultant crop loss.

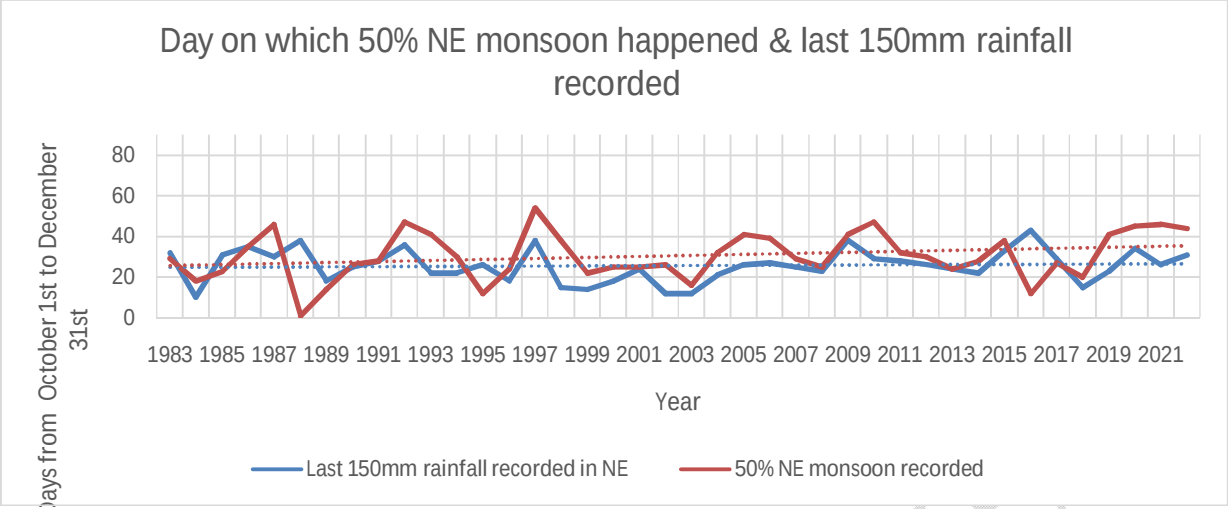

Fig 7: Rainfall Data of Perumpadappu block Kole lands

PREPARATION OF CROP CALENDAR

After considering the factors mentioned above, like the area under cultivation, the elevation of the padasekarams, weather data and the irrigation network present, the individual padasekarams were classified into five major groups. The group discussion with the members and officials of the padasekara samithis also added input into this classification. The planting dates were arrived after considering the weather data, field area and distance from major water sources (Table 5). The final crop calendar thus prepared was vetted with the farmer and official group.

The widely recommended variety for the padasekaram is Uma from Kerala Agricultural University with a duration of 120 days. The second recommended variety is Jyothi, with a duration of 110 days; the third is Manurathna, with 100 days. The decision to cultivate a particular variety should be taken considering the weather and other conditions.

Table 5: Crop Calendar for Kole padashekharams of Perumpadappu block

Sl. No	Major grouping	Name of Panchayath	Name of Padashekaram	Proposed date of planting
1	Group 1	Alamcode	Alappuramkothode	1/11
2	Group 1	Alamcode	Kizhikkara Pattissery	1/11
3	Group 1	Alamcode	Kolothupadam	1/11
4	Group 1	Alamcode	PoozhikKole	1/11
5	Group 5	Maranchery	Mullamad	29/11
6	Group 5	Maranchery	Irumbayil	29/11
7	Group 4	Maranchery	Kodanchery	22/11

8	Group 5	Maranchery	Kudamkuzhi	29/11
9	Group 5	Maranchery	Maradi Kizhakke Kole	29/11
10	Group 4	Maranchery	Marady	22/11
11	Group 4	Maranchery	Marady Chelakkadavu Alparambu	22/11
12	Group 5	Maranchery	Nadupotta	29/11
13	Group 5	Maranchery	Olambakkadavu	29/11
14	Group 2	Nanammukku	Alappuram Pattissery Kole Padavu	8/11
15	Group 2	Nanammukku	Cherayam Kole Padavu	8/11
16	Group 3	Nanammukku	Kadukuzhi Kole Padavu	15/11
17	Group 2	Nanammukku	KaithaKoleKole Padavu	8/11
18	Group 1	Nanammukku	Kollathupadam Kole Padavu	1/11
19	Group 4	Nanammukku	Kollencherry Kole Padavu	22/11
20	Group 2	Nanammukku	Koolan Padavu	8/11
21	Group 4	Nanammukku	Moochikkal Padavu	22/11
22	Group 2	Nanammukku	Neelayil Kole Padavu	8/11
23	Group 2	Nanammukku	Pazhanji Kole Padavu	8/11
24	Group 2	Nanammukku	Thiruthummal Kole Padavu	8/11
25	Group 2	Nanammukku	Vempuzha	8/11
26	Group 3	Perumpadappu	Amayam Kadavath Kole	15/11
27	Group 3	Perumpadappu	Cheravalloor PuramKole	15/11
28	Group 3	Perumpadappu	Edampadam	15/11
29	Group 3	Perumpadappu	Kaithakkal	15/11
30	Group 2	Perumpadappu	Neelayil	8/11
31	Group 3	Perumpadappu	Noonakkadav	15/11
32	Group 4	Perumpadappu	Pazhanchira	22/11
33	Group 3	Perumpadappu	Thekkekkett	15/11
34	Group 3	Perumpadappu	Thuruthummal	15/11
35	Group 3	Perumpadappu	Valluvambayi	15/11
36	Group 4	Arodi Palakkathazham Kole padavu	Veliyamkode	22/11

37	Group 4	Naranippuzha Kummipalam Kole cultivators society	Veliyamkode	22/11

CONCLUSION

Kole lands are considered as the rice bowl of Thrissur and Malappuram districts. Even though the land is highly fertile, the potential yield is not achieved for the majority of the farmers because of frequent crop loss. The major reason for crop loss was identified and poor water management plan. A proper water management plan for the Kole lands can happen only with a holistic approach, as several factors are linkedto each other.

As part of the study, various factors like area under cultivation, irrigation system, elevation details, weather details, transport network and soil fertility details were thoroughly analysed. The result shows ways to improve the area under cultivation, increase the water use efficiency and better management of the area to get maximum yield. The use of GIS tools makes the study more comprehensive.

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