IN SEARCH OF SEAPLANES IN ANDHRA PRADESH: IN VIEW OF UDAN

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ABSTRACT

The present situation in India envisages that because of the surge in population and the economy, cities are expected to spill over to hinterland areas. The consumption-led factors such as land, labor, etc. will be boosted. Hence, there is a need for regional connectivity. There is enormous pressure upon the land; proving itself through the rise in traffic congestions, roads, and railway accidents. Air transport is practical, but due to the decrease of available land, this is not a wise solution. What with the introduction of seaplanes in the country; the vital asset in this world prior to Second World War. The Maldives has proved it. Seaplanes offer natural landing site and are time and cost-efficient. The government of India has taken an initiative to connect regions within the country through Regional Connectivity Scheme(RCS) namely, UDAN (Ude Desh ka Aam Naagrik). Seaplanes in accordance with UDAN is one of the solutions in linking various regions with other states. This research paper aims to discuss the viability of seaplanes and the potential sites in Andhra Pradesh, India. The standards are taken from the US Department of Transportation, Federal Aviation Administration for the analysis. The conflation of Seaplanes with UDAN offers an alternate mode of air connectivity, strengthens the transport network by simulation of connectivity to unserved and under-served areas and boost the nation's economy.

Keywords: connectivity, seaplanes, transport, UDAN

1 INTRODUCTION

Andhra Pradesh is rich in hydrology, with six major rivers flowing through it. The state also has the second largest coastline of 974km and 283 dams and reservoirs, ranking fourth in India. Out of the total dams and reservoirs, few are occasionally habited.

The road and rail infrastructure are adequate, but it struggles to keep pace with increasing footprint. This indirectly affects the development of tourism and economy, in general. This demands the need for an alternate mode of connectivity.

Better connectivity is also in line with an initiative by the Government of India namely UDAN (Ude Desh ka Aam Naagrik) [1], which aims to establish an integrated ecosystem that would lead to significant growth of civil aviation sector and balanced regional growth. However, many regions do not have sufficient appropriate area for airport construction. The conflation of UDAN with seaplanes becomes a good alternative.

Seaplanes offer natural landing sites providing the speed of an aircraft with the utilization of a boat with landing sites being the reservoirs. This will reduce the traveling time and stimulate connectivity to unserved and underserved areas as well, thereby decreasing pressure upon the land.

The purpose of this research is transport, with an emphasis upon Andhra Pradesh. The aim is to introduce new and appropriate transport solution with the use of seaplanes. The specific objective is to identify the potential sites which can be used for the infrastructure for seaplanes.

2 SCOPE AND LIMITATIONS

There is 30% growth in tourist arrivals in Andhra Pradesh since 2015. According to Indian census data,2011 [2]; there is a surge in the population density of 31 people per square kilometre since 2001. Beaches, Backwaters, pristine forest areas, resorts, amusement parks, pilgrimage destinations are major tourist attractions of the state. Because of the newly formed capital city in 2015 [3], the state will definitely attract a number of tourists. This provides an overview of the rise in the tourism sector in the near future. Hence, there is a need for an alternative connectivity to cater the rise in tourism. This determines the scope for connectivity through seaplanes.

Seaplanes can carry a limited number of passengers depending upon the type of seaplanes used and the landing area available. Difficulty in the availability of seaplanes in the country can become a limiting factor for the operations. While demand is difficult to forecast without a detailed market research, it can be presumed that demand should arise if the industry can offer a different service from large commercial airlines.

3 METHODOLOGY

Seaplanes are operated mostly in western countries like United States of America, Canada etc. The world's busiest seaplanes base is Lake Hood Seaplanes Base in The United States. The Indian Government has stated few site considerations, but seaplanes operations have not been started yet in the country.

The conflation of site considerations of Indian with The United States standards sets up strong guidelines for the site considerations.

3.1 THEORETICAL DETERMINANTS OF SITE SELECTION

Site selection plays a major role for seaplanes to operate. The site considerations in accordance with the Director General of Civil Aviation, India and U.S. Department of Transportation, Federal Aviation Administration are as follows: [4]

- Maritime movements in the location.
- The character of development within the surrounding areas.
- Available length of clear and safe water runway strip with respect to the size and type of aircraft intended to operate.
- Unobstructed approach and departure paths for the type of seaplanes to be accommodated.
- Current flow.
- Presence of annual water level.
- Wave height.
- Bird and wildlife hazards.
- Prevailing wind directions (under considerations of high and low wind velocity).
- The site should not fall under designated marine areas.
- The site should not be a fishing ground.
- The strip of water shall be free from large obstructing corals rubbles to a definite depth.
- Presence of other seaplanes bases and airports in the general area.
- Noise considerations.

- Public accessibility.
- Area geography.
- The distance of water aerodrome from servicing resorts and islands.
- Presence of navigable airspace.

3.2 STANDARDS FOR SEAPLANES OPERATION

There are no Indian standards for the construction of seaplanes base. So, the standards are from Advisory Circular by U.S. Department of Transportation, Federal Aviation Administration.

Table 1: Considerations [5] and Standards [6]

No.	Site considerations	Standards
1.	Maritime movements in the location.	-
2.	Character of development within the surrounding areas.	-
3.	Available length of clear and safe water runway strip with respect to the size and type of aircraft intended to operate.	Minimum width: 200 feet. Minimum depth: 6 feet. Wingtip to wingtip clearance for passing seaplanes: 50 feet
4.	Unobstructed approach and departure paths for the type of aircraft intended to operate.	Restricted sea-lanes under 200 feet in width, both ends of such restricted sea-lanes should have turning basin of minimum 60m.
5.	Current flow.	Water current should not exceed 6 knots.
6.	Presence of annual water level.	If water level exceeds 18 inches- requirement of floating structures. If water level exceeds 6 feet- extended developments to be made.
7.	Wave height.	Water should be moderately disturbed, having ripples or waves approximately 3-6 inch in height. 3000-15000 pounds- 2 feet.
9.	Bird and wildlife hazards.	-
10.	Prevailing wind directions	Not necessary to consider winds of 3 miles / hour or less.
11.	The site should not fall under designated marine areas.	-
12.	The site should not be a fishing ground.	-
13.	The strip should be free from large obstructing coral rubbles to a definite depth.	-

14.	Presence of other seaplanes bases and airports in the general area.	-
15.	Noise considerations.	-
16.	Public accessibility.	-
17.	Area geography.	-
18..	Distance of water aerodrome from servicing resorts and islands.	-
19.	Presence of navigable airspace.	-
20.	Aircraft intended to use	Twin Engine LET-410 Aircraft, Twin Otter (DHC-6 series 400)

Table 2: List of Dams in Andhra Pradesh considered for landing of seaplanes.

No.	District
1.	Anantapur • PABR Dam • MPR Dam • Jeedipalli
2.	Chittoor • Kalyani Dam Reservoir
3.	East Godavari • Dornakayi Dam • Haritha Beach Resort, Kakinada
4.	Guntur • Nagarjuna Sagar Tail pond • Dhyanabuddha Ghat • NTR Mansarovaram
5.	Kadapa • Galeru Nagari • Brahamamsagar • Mylavaram Dam • Gandikota Reservoir • Veligallu Dam Reservoir • Cheyyeru Reservoir
6.	Krishna • Krishna River, Near Prakasam Barrage
7.	Kurnool • Srisailam dam • Srisailam Tail Pond • Owk • Gorakallu • Sunkesula • Velugodu Balancing Reservoir • Alaganoor

	• Handri-Neeva • Rajolibanda
8.	Nellore • Pulicat Lake • Somasila Dam • Kandaleru Dam • Gandipalem Reservoir
9.	Prakasam • Veligoda • Gundlakamma Reservoir
10.	Srikakulam • Madduvalasa Reservoir • Narayanapuram Project
11.	Visakhapatnam • Jalaput • Thandava Dam • UpperSileru Dam • Kanithi
12.	Vizianagram • Thatipudi Reservoir • Jhanjavati Reservoir • Thotapalli Barrage
13.	West Godavari • Kolleru Lake • Polavaram Project

3.3 FINDING POTENTIAL SITES

A checklist has been made according to the criteria mentioned above. Since the reservoirs in Andhra Pradesh are occasionally habited, most reservoirs are taken into consideration.

Table 3: List of compatible dams for landing of seaplanes as per Table 1

No.	District	Reservoir
1.	Anantapur	PABR Dam
2.	Chittoor	Kalyani Dam Reservoir
3.	East Godavari	Haritha Beach Resorts, Kakinada
4.	Guntur	-
5.	Kadapa	Mylavaram Dam
6.	Krishna	Krishna River, Near Prakasam Barrage

7.	Kurnool	Velugodu Balancing Reservoir, Owk Reservoir
8.	Nellore	Kandaleru Dam
9.	Prakasam	Gundlakamma Reservoir
10.	Srikakulam	Madduvalasa Reservoir
11.	Visakhapatnam	Kanithi Balancing Reservoir
12.	Vizianagaram	Thatipudi Reservoir
13.	West Godavari	-

3.4 ROUTE DURATION ANALYSIS

Exiting duration has been compared with the duration if seaplanes are used as shown in the table below.

Route	Minimum time taken via drive.	Distance	Approximate aerial Distance	Approximate duration through seaplanes (minutes)
Anantapur - Chittoor	5h 58min	269km	233.4km	46
Anantapur- East Godavari	13h 52min	700km	503.1km	88
Anantapur - Guntur	8h 25min	439km	461.3km	78
Anantapur- Kadapa	3h 28min	162km	296.2km	52
Anantapur- Krishna	9h 28min	493km	400.8km	72
Anantapur- Kurnool	2h 5min	148km	139.2km	31
Anantapur - Nellore	6h 31min	311km	288.1km	55
Anantapur-Prakasam	6h 7min	314km	231.2km	46
Anantapur - Srikakulam	17h 33min	928km	786.4km	132
Anantapur - Visakhapatnam	15h 42min	823km	663.1lm	113
Anantapur- Vizianagaram	16h 42min	871km	711.2km	121
Anantapur- West Godavari	10h 59min	573km	465.5km	72.6
Chittoor -East Godavari	13h 8min	701km	557.9km	97

Chittoor - Guntur	7h 40min	441km	388.5km	70
Chittoor- Kadapa	3h 39min	164km	159.2km	34
Chittoor- Krishna	8h 38min	495km	460.6km	81
Chittoor – Kurnool	6h 57min	362km	355.8km	65
Chittoor- Nellore	3h 51min	201km	221km	44
Chittoor - Prakasam	6h 21min	334km	260.3km	50
Chittoor - Srikakulam	16h 38min	930km	806.7km	136
Chittoor- Visakhapatnam	14h 29min	824km	696.6km	118
Chittoor- Vizianagaram	15h 43min	872km	782.5km	131
Chittoor- West Godavari	9h 8min	575km	530.5km	92
East Godavari – Guntur	5h 44min	262km	181.5km	38
East Godavari- Kadapa	11h 30min	595km	419.6km	75
East Godavari – Krishna	4h 57min	217km	108.5km	26
East Godavari – Kurnool	12h	567km	444km	79
East Godavari – Nellore	9h 10min	504km	345.8km	64
East Godavari - Prakasam	8h 56min	438km	314km	59
East Godavari - Srikakulam	6h	289km	278.8km	35
East Godavari - Visakhapatnam	3h 43min	183km	154.1km	34
East Godavari - Vizianagaram	4h 59min	231km	183.7km	38
East Godavari – West Godavari	3h 6min	120km	52.07km	17
Guntur – Kadapa	5h 50min	335km	241.7km	47
Guntur – Krishna	1h 33min	54.6km	74.59km	21
Guntur – Kurnool	6h 28min	297km	284.5km	54
Guntur - Nellore	3h 45min	244km	196.5	40
Guntur – Prakasam	3h 30min	178km	133.46	30
Guntur – Srikakulam	9h 56min	489.4km	456.4km	81
Guntur- Visakhapatnam	7h 35min	384km	333.51km	62

Guntur – Vizianagaram	8h 57min	432km	362.11	66.4
Guntur- West Godavari	3h 1min	135km	144.4km	22.2
Kadapa-Krishna	6h 53min	389km	315.99km	60
Kadapa-Kurnool	3h 39min	201km	225.91	45
Kadapa-Nellore	3h 23min	170km	137.37km	30
Kadapa-Prakasam	3h 7min	182km	107.5km	26
Kadapa-Srikakulam	15h 18min	823km	684.11km	112
Kadapa-Visakhapatnam	13h 11min	718km	566.27	98.2
Kadapa-Vizianagaram	14h 24min	766km	592.66km	100
Kadapa-West Godavari	8h 29min	469km	385.6km	70
Krishna-Kurnool	7h 39min	360km	341km	62
Krishna-Nellore	4h 52min	298km	259.18	50
Krishna-Prakasam	4h 34min	232km	208.86	42
Krishna-Srikakulam	9h 4min	449km	385.57	70
Krishna-Visakhapatnam	6h 49min	344km	261.24	50
Krishna-Vizianagaram	8h 5min	392km	290.73	55
Krishna-West Godavari	2h 12min	94.2km	68.66km	20
Kurnool- Nellore	5h 53min	328km	331.26km	60
Kurnool-Prakasam	4h 45min	233km	219.01km	44
Kurnool-Srikakulam	16h 4min	795km	722.25	112.8
Kurnool-Visakhapatnam	13h 48min	690km	596.61	103
Kurnool-Vizianagaram	15h 4min	742km	627.45	108
Kurnool-West Godavari	9h 16min	440km	394.2km	70
Nellore-Prakasam	2h 50min	153km	120.55	28
Nellore-Srikakulam	13h 11min	732km	584.47	100
Nellore-Visakhapatnam	11h 1min	627km	475.92	84
Nellore-Vizianagaram	12h 16min	675km	498.56	87
Nellore-West Godavari	6h 26min	377km	326.6km	60

Prakasam-Srikakulam	12h 58min	666km	582.5	100
Praksam-Visakhapatnam	10h 43min	561km	462.71	82
Prakasam-Vizianagaram	11h 58min	609km	490.05	86
Prakasam-West Godavari	6h 8min	311km	278.5km	53
Srikakulam-Visakhapatnam	2h 37min	115km	125.64	29
Srikakulam-Vizianagaram	1h 27min	66.2km	95.02	25
Srikakulam-West Godavari	7h 18min	347km	327.4km	61
Vizianagaram-Visakhapatnam	1h 39min	59.7km	31.06km	15
Vizianagaram-West Godavari	6h 16min	291km	232.4km	46
Visakhapatnam-West Godavari	5h 5min	243km	202km	40

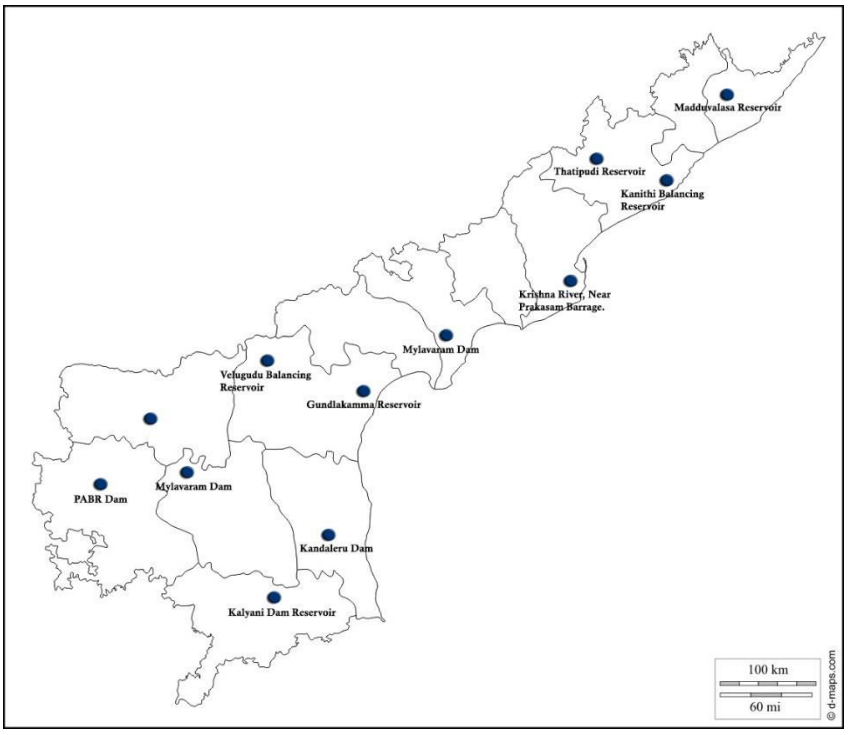

Figure 1: Map showing potential reservoirs where seaplanes can land.

4 RESULTS

4.1 SPEED CALCULATION

Twin otter seaplanes series manufactured in Canada has been considered for operation as of now. The specifications are as follows:

- Speed: 384km/h
- Wingspan: 19.81m
- Range: 1296km
- Empty Weight: 3363kg
- Max. take-off weight: 5650kg
- Wingspan: 19.81m
- Length: 15.77m
- Height: 5.94m

The Formula for calculation of Time taken is mentioned below.

$$\text{Time} = \text{Distance} / \text{Speed} \quad (1)$$

Here, speed is considered as 348 kilometres per hour and the distances are mentioned in the table above,

Considering Anantapur-Chittoor,

Distance = 269km

Speed, as mentioned above, is: 384km

Hence, to calculate the time taken, formula (1) has been considered.

$$\text{Time} = 269 \text{ km} / 384 \text{ km/h}$$
$$= 0.7 \text{ hour}$$
$$= 42\text{min}$$

Thereby, there is a reduction in time of 85% with the use of seaplanes.

The total coastline of the Andhra Pradesh is 974km, making it the state with second longest coastline in India. Also, six major rivers in India flow through the state and hence there are many dams built across the rivers.

Connectivity within the state and accessibility to remote areas will be achieved through seaplanes connectivity. Eventually, this will boost tourism industry and improve passenger accessibility.

The development of seaplanes is desirable and necessary. It is an attractive tourist offer. The implementation of hydro connection via air promotes overall development in various sectors.

This paper suggests the possibility of enhancing growth which from an environmental and economic point of view has a good development potential.

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