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Priority Areas for Sustainable Developmental Activities in Geo-dynamically Restless Arunachal Pradesh

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INTRODUCTION

The land of dawn lit mountains and the land of biodiversity – Arunachal Pradesh - is a paradise on the extreme north-eastern tip of India. The State of Arunachal Pradesh with its unique natural treasure of picturesque rolling lofty mountains, snow-clad shining peaks, fascinating hill slopes and deep valleys, numerous crisscross turbulent streams, roaring rivers, beautiful landscape, luxuriant lush evergreen forests, and diverse flora and fauna attracts not only the tourists but also the professionals. Its climate varies from sub-tropical in the south to alpine in the north. The State is proud of having more than five hundred rare species of orchids and a large varieties of natural resources. Arunachal Pradesh is one of the most splendid, variegated and multilingual tribal areas of the world, which are reflected in combination of their dresses, houses, festivals, etc. Every tribe has its own dialect.

Arunachal Pradesh stands at the biological and cultural cross roads of Asia, meeting point of floral and faunal assemblages and cultures of the Indian sub-continent, Malaya

/ Myanmar peninsula and Tibet. As the State falls at the junction of the Pale Arctic and 'Indo-Chinese', Indo-Malayan' and 'Indian' sub region of Oriental region, it harbours the pale arctic and oriental elements of biodiversity. The geographical contiguity with Indo-Malayan and Indo-Chinese belt marks the State as one of the main corridor for eastern entrant of 'Indian' sub region and, thus, it is largely responsible for more regional diversity of bio-resources, which makes the State of Arunachal Pradesh to be recognized as one of the 25 hotspots of the world for its rich biological diversity. Its indigenous people belonging to 25 major tribes and 110 sub-tribes distinguish themselves with their diverse culture. The State is known for its verdant rainforest and rich vegetation with unique ecosystem ranging from tropical belt to the snow clad alpine mountains.

Although rich in natural and biological resources, the State is yet backwards in terms of economic development. On the other hand, needs of the increasing population pressure have influenced the natural resources and ecosystem of the State. As a result imbalance in developmental processes and unsteady growth can be observed causing environment degradation. The fast increasing interference of human activity in natural environmental system for their economic up-gradation has already reached to an alarming stage. For example, mushroom growth of settlement in the capital towns and elsewhere is disturbing the hill slopes. Likewise, construction of road network without geological considerations has initiated and also re-activated several dormant landslides. Above all, the State falls under the high seismic zone, i.e. Zone V of the Seismic Zoning of India.

Yet, developmental plans are necessary to continue and, thus, an integrated approach of ecological preservation is necessary for the socio-economic activities.

THE DEVELOPMENT EFFORTS

Unlike other states, which have been evolved out of a process of metamorphosis of ancient kingdom or part of activity administered by British Raj, Arunachal Pradesh remains the same as it was created by nature. Its indigenous people remained a part of the endemic traditional society.

Arunachal Pradesh joined the planning process much later than most other states of the country. It suffered geo-political isolation for quite long. Partition of India isolated it further by disrupting its socio-economic ties with Bhutan, Tibet, China, and Myanmar. Hostile terrain and impenetrable jungle further made infrastructure development a difficult task. The developmental activities in the State started from scratch after independence. It may be evidenced from the fact that there were only two primary schools and three jeepable roads aggregating to a length of 168 km at the dawn of independence.

Being remote and inaccessible, the social fabric of Arunachal kept developing with a relatively slow pace in an isolated manner as an oasis of its own. After being declared as an independent State of the Indian Union, development activities and modernization processes started accelerating in the erstwhile inaccessible State. Over the years Arunachal Pradesh joined the national mainstream programs.

At present, the processes of development of various activities towards urbanisation, on one hand, are gaining momentum steadily, and on the other hand, most of land in the State is still untouched or underdeveloped, largely due to the geographical location, terrain conditions, thick virgin forests, etc.

RESOURCE POTENTIALS

Arunachal has vast natural resources, most of which have yet to be explored to its full potential. These natural resources may broadly be divided into three categories, viz., land resources, hydro resources and bio resources.

i) Land Resources

The predominant land resources include soil, minerals, building material, etc. Other than these, the terrain itself is a resource, which can be used in its natural form for various purposes, particularly water harvesting structures, nature's scenic beauty, etc.

Soil : Soil is the basic natural resource to support living beings on the Earth. Soil is formed by a long term processes of complex interaction of climate, topographic relief,

flora, fauna, micro-organism, parent rocks and time. Soil erosion and depletion are the major threats to soil as a resource. It is estimated that it takes 500 to 1,000 years to form one inch of soil, hence, it very important to conserve this resource to its full potential with proper protection, particularly from depletion and erosion, to maintain high productivity for ever increasing human needs.

This important resource need proper attention by the planners and conservators in Arunachal Pradesh, as such detailed soil mapping on 1:50,000 scale at district level and 1:5,000 scale for location specific may be carried out in the State.

Minerals : The State has quite a large number of economic minerals, both metallic and non-metallic. These include Limestone, Dolomite, Graphite, Lead, Zinc, Coal, Marble, Gold, Cobalt, Nickel, Copper, Pyrite, Chalcopyrite, Magnetite, Hematite, other platinoid group of minerals, and Oil & Natural Gas. Unfortunately, most of these occurrences are not exploitable, either because of poor survey, or lack of detail information, or not economically viable for extraction. Need of the day is to study economic feasibility of various minerals for exploration, because mineral resources form the basis of industrial development and backbone of the State.

Terrain : The State has quite a few places where the natural terrain can be developed as water storage structures, waste disposal structures, tourist spots, etc. The State has 'veritable treasure house of nature' with its diverse variety of nature's scenic beauty in form of snow peaks, cliffs, river valleys, gorges, waterfalls, natural springs, lakes, enchantingly beautiful landscape, luxuriant forest, fascinating national parks and wildlife sanctuaries, etc., which can be developed as tourist spots.

These unique features coupled with heritage/pilgrimage places, such as Tawang Monastery, Malinithan, Bhismanagar, Parasuram Kund, World War – II cemetery, and many other places, provide a valuable natural resource that can be utilized for developing Leisure-time Tourism, Adventure Tourism, Eco Tourism, Wildlife Tourism, Historical Tourism, etc., which can fetch a sound economy in the State.

The only requirement is to disseminate information to the potential tourist and to create a good infra-structure in the form of accommodation, transportation, communication and

trained man-power in the hospitality trade by adopting a scientific and professional approach to this valuable resource, which is merely untapped till date.

ii) Hydro Resources

With the presence of large river system with numerous turbulent streams, roaring rivers, and the structure of the landforms provide optimum as well ideal conditions to the State to generate tremendous amount of electricity. According to various estimates, Arunachal Pradesh has the power potential to the extent of 1/3 of the country total power potential, hence the State could be called the 'Power House of India'.

The vast hydro-power potential may be tapped in the best interest of socio-economic development of the nation, in general, and the State, in particular. However, general apprehension is the environmental and disaster impacts. These can, however, be taken care through proper planning, design, construction, operation and maintenance, which are adequately recognized, investigated, interpreted and implemented.

Another important sector, which can be developed through this hydro resources is the Inland Water Transport System. With the limitation of land development, infra-structure and difficulties due to hilly terrain, Inland Water Transport may stand the viable mode of cheap transportation at least in some parts of the State.

iii) Bio Resources

Arunachal is blessed with rich and vast bio-resources, which forms the backbone of the State's economy and fabric of life, lore, and culture.

Forest : The State has a large variety of forests ranging from deciduous, ever green to alpine, with abundance of bamboo, cane, orchids, and various economically important tree species. These forests are broadly divided into four climatic categories with a secondary classification of six categories, viz., i) Tropical forests, ii) Sub-tropical forests, iii) Pine forests, iv) Temperate forests, v) Alpine forests, and vi) Secondary forests including Degraded forests, Bamboo forests, and Grasslands.

The State forests harbour timber yielding plants, medicinal plants, and wild ornamental plants. Like elsewhere, traditionally forests have been main source of existence and subsistence of tribal communities in Arunachal. The State has a unique distinction of having virgin forest even today.

The forests are rich in non-timber forest produces (NTFPs), which are extracted from the roots, stems, flowering panicles, fruits, leaves, etc. Based on the end products, the NTFPs of economic importance can be classified into the following categories :

- i) Bamboos, Cane and Grasses
- ii) Resins, Waxes, Gums and Oleo-resins
- iii) Spices, edible plants, drug, etc.
- iv) Tans and dyes
- v) Distillation and extraction products including grass oil
- vi) Oil seeds, etc.
- vii) Fibre and flosses
- viii) Miscellaneous products – Broom stick, Toko leaves, Jeng leaves,

Wild-life : There is one biosphere reserve, two national parks, nine wildlife sanctuaries and one orchid sanctuary in the State to protect and conserve wild-life resources.

Human population is another bio-resource in terms of trained man-power. Mere human being does not constitute human resource, which otherwise means human with variety of abilities and skills that may be capable to raise their socio-economic status. Accordingly, a suitable network of infrastructure must be developed not only to bring all children to schools but also to create in them higher skills of science, technology and management.

In the present education scenario, the State has one University, two technical institutions, seven colleges, seventy one higher secondary schools, besides several secondary, middle and primary schools. In general, awareness about the importance of education has increased among the local people. This has created a fleet of technically educated man power over the years in terms of engineers, doctors, lawyers, architects,

agriculture scientists, horticulturists, veterinary doctors, etc. and the situation has even reached to the extent of unemployment of such technical persons in Arunachal.

However, there is an **important field of education which has not been taken care or rather ignored in the State is the subject of GEOLOGY**. This subject is most important for the State of Arunachal Pradesh, particularly in view of the on-going rapid development of infra-structure, hydropower, geo-resources, etc., which needs geotechnical studies in view of the fact that the State falls under the high seismic zone. It not only needs attention of the State Government, but also needs awareness among the students and the people of Arunachal.

A lot of technical man-power in the field of Geology is required in Arunachal Pradesh, but unfortunately, there is not a single college in the State providing education in the subject of Geology. The State is dependent upon the other States for technical man-power in this field. This indicates that there is a lack of awareness about this subject amongst the students as well as government officials. It is pertinent to note that the adjoining State, Assam, has the full-fledged department of Earth Sciences (Geology) in Gauhati University and Dibrugarh University, and the subject of Geology is taught even at college level in Sibsagar and Silchar. Other States in the NE Region that has the Geology Department are Meghalaya, Nagaland, Manipur, and Tripura.

There is a strong need for capacity building in terms of its own man-power to tackle the geological issues in the State. Considering vast scope of geological studies, it is important to impart this education and develop the professional skill in the people of Arunachal.

IMPACT ON SOCIO-ECONOMIC DEVELOPMENT

The pace of development and processes of economic growth depend upon the availability and the extent & intensity of niche resources utilization, which largely depends on the skills of the local inhabitants.

As already mentioned above, the State has tremendous potential of natural resources for its socio-economic development to become one of the most developed State in the

country. However, lack of reliable data on uniform pattern for making policy and plan is the biggest hindrance in exploitation of these resources for its optimal use. It is, therefore, important to know the distribution of resources over space and to have location specific plans and strategies at micro-level, which should be well coordinated at State level macro planning. There is a strong need to establish a **sound multi-sectoral spatial database** in the State with suitably designed data structure under the GIS environment.

As mentioned above, it is the human attitude that makes a nation to become developed country, rather than the availability of resource as such. For example, Japan is poor in natural resource base, but is the only nation in Asia having the status of developed country, in spite of the fact that it has a small geographical area, large population, hilly terrain, and above all it falls under high seismic zone. African countries, on the other hand, are full of natural resources, but economically they are poor, reason being poor human attitudes.

Therefore, pre-condition towards economic growth is **generation of skilled man-power**. Even the contractor-ship business, particularly in mega projects, is not possible without technical qualification. At present technical man-power in the State is poor, and as such the projects come under conflict from the local population because they require jobs in the projects, whereas the project authorities require technically trained man-power to complete the project successfully on time.

Another aspect of the socio-economic development is the two paradoxical situations with reference to the utilization of the geo-resources, where certain areas are suffering through the problems of over exploitation, and some areas are either not been able to utilize or under-utilizing the resources. Arunachal is no exception of it, where the forest resources are over utilized leading to environmental and ecological problems owing to which the Supreme Court intervention was found necessary, and on the other hand, a variety of mineral and water resources are either dormant or under-utilized.

Precaution, however, must be taken to **avoid over exploitation**, particularly in exploring the bio-resources because certain varieties are endangered or nearly at the

verge of extinction. In case of mining and other exploratory activities, **geo-environmental studies** should be undertaken to avoid ecological and environmental hazards.

URBANIZATION PATTERN

There has been an increase in population in the last four decades, which is more than three times taking 1950 as the base. Urbanization on an unprecedented scale is being experienced in the State of Arunachal Pradesh that resulted into not only the setting up of new towns but also overcrowding of land with building. It caused in-adequacies urban amenities and services in almost all the towns of the State.

The point of concern is not just increasing population, but also urban characterization in the delicate eco-system, which is proneness to natural hazards. The people are crazy for constructing multi-storey concrete buildings on hill slopes, most of which are without engineering design, thus disturbing natural slope and making these prone to landslides.

For instance, Itanagar Capital Complex has experienced rapid growth rate within a short span of time, where unplanned developmental activities, particularly concrete structures to adopt modern lifestyle, are increasing day by day without assessing their vulnerability to the earthquakes. The capital and urban towns have reached beyond the critical level of their bearing capacity. Population pressure is forcing people to construct their houses by making table land on hill slope, which are disturbing the natural slope. In the process of unregulated constructions, people have even started occupying natural drain area for construction of buildings, thereby, misusing modern construction technology by creating tunnel passage over natural drain without considering the volume of rainfall water in its catchment area. Slope cutting and using natural drains in unscientific manner are causing serious threat to the hill slopes and settlements.

The situation has become vulnerable to disaster, and thus, there is a strong need for proper planning to ensure sustainable urban development, which is possible through a long-term program for natural hazards assessment and mitigation using an integrated

approach with participation of the society, scientific community and governmental agencies. In this context, hazard-resilient land-use planning is the basic requirement, which should be integrated with the administrative protocols of building codes and bye-laws enforcement. It is suggested that :

- ⇒ Building codes and bye-laws should strictly be enforced.
- ⇒ Geotechnical studies of the urban towns be taken up.
- ⇒ Geotechnical studies must be carried out before initiating any major infra-structure project, such as hydro-power, new roads or widening of existing roads, bridges, large buildings, etc.
- ⇒ Hazards micro-zonation maps of the State may be prepared.

GEOLOGICAL CHALLENGES AND CONSTRAINTS

The sprawling mountainous territory of Arunachal Pradesh has a unique set up, where three different mountain systems of different origin occur in juxtaposition. These are : i) the Himalayan Ranges, ii) the Mishmi Hill Ranges, and iii) the Naga-Patkai-Arakan Ranges.

The Himalayan Ranges in Arunachal forms a continuation of that in Darjeeling, Sikkim and Bhutan in its western part and continue up to the eastern part in Upper and East Siang districts and partly in Dibang Valley and Lohit districts. Geologically, the Himalayan Ranges in Arunachal are divisible into three domains : Outer Himalaya, Lesser Himalaya and Higher Himalaya. **The Mishmi Hill Ranges**, which form a part of the Shan-Malaysia Plate, abut against the Himalayan Ranges along the Tuting-Tidding Suture Zone and are mostly present in the Dibang Valley and Lohit districts. **The Naga-Patkai-Arakan Ranges** that abut against the Himalayan and Mishmi Hill ranges are present in Changlang and Tirap districts. These are represented by the Schuppean Belt of Upper Tertiary sequence.

The geological, structural, seismic and gravity anomaly data indicate that the above-mentioned three mountain systems are geodynamically active, which are causing geo-environmental hazards. The Arunachal Himalaya is being pressed by the northward moving Indian shield, and consequently the land of Assam is sliding northwards under

the Arunachal Himalaya. The Naga-Patkai-Arakan Ranges, on the other hand, links up with the Andaman-Nicobar Islands Arc, which is an active zone where Indian Ocean floor is descending under the Malaysian Plate. In Arunachal, several tectonic lineaments, faults and thrusts, particularly Himalayan Frontal Fault, Main Boundary Thrust, Main Central Thrust, Bame Fault, Lohit Thrust, Mishmi Thrust and several smaller faults represent weak zones, which are seismically active. As such seismicity is very common, and the State experiences earthquake tremors frequently and on regular basis, and quite a large part of the region is being affected by frequent landslides.

It is because of this reason **Arunachal Pradesh has remained geo-dynamically restless and falls under the high seismic zone, i.e. Zone V.** The State is, thus, under constant geo-environmental threat in terms of earthquakes, landslides, flash floods, soil erosion, etc. Excess rainfall, shifting cultivation, unplanned developmental activities further aggravates the natural disasters. As such the State is fragile both ecologically and geologically, and geo-environmental threat will remain hanging as a sword on head under the active geo-dynamic condition of the State. Therefore, proper care has to be taken for proper mitigation to minimize the adverse effect of these natural disasters, while exploring various resources or undertaking developmental activities for the sustainable development of the State.

PRIORITY AREAS OF RESOURCE UTILIZATION

Considering the above discussion, it is high time to identify the priorities in terms of resource utilization in Arunachal. The broad sectors of development identified on priority basis are suggested below :

1. Human Resource (Skill) Development
2. Connectivity in terms of Road Network and Information Technology
3. Hydro-power
4. Agri-, Horti-, Flori-culture
5. Commercial Forestry
6. Non-timber Forest Products
7. Mineral and building material

8. Tourism
9. Food Processing Technology

It is also worth setting up of pharmaceutical industries through the local entrepreneurs. Amongst the mineral potential oil, coal, limestone, dolomite and graphite may generate a sound economy. The most important is the documentation of Indigenous Traditional Knowledge in context of the Intellectual Property Right regime.

The following industries are suggested that may be set up in the State based on the above mentioned mineral potential :

- i) Fertilizer plants, refractory units based on dolomite.
- ii) Calcium carbide manufacturing units and cement plants based on limestone.
- iii) Coking plants and gasification based on coal.
- iv) Refractory, pencil, abrasive-manufacturing units based on graphite.
- v) Cutting and Polishing units of decorative and building stones.

CONCLUSIONS

Arunachal Pradesh has vast potential of natural resources, which either have remained untapped or being exploited unscientifically and unsystematically. These natural resources are diminishing rapidly not only due to the increasing pressure of growing population but also by their ruthless exploitation with passage of time. Therefore, the management of these resources and the socio-economic upliftment of the local inhabitants need attention. The need of the time is also to bring awareness amongst the people to conserve resources and involve them in resource management. A **sound multi-sectoral spatial database** is required to be established in the State with suitably designed data structure under the GIS environment.

Generation of skilled man-power is the pre-requisite for economic growth. It may not only increase awareness about mountain ecosystems but also develop peace and harmony in the State. It may further help to utilize the resources without destroying the

fragile environment upon which survival inevitably depends, and maintaining socio-economic equilibrium.

On the other hand, Arunachal Pradesh falls under the high seismic zone and consequently the geo-environment is under threat. Thus, it is also important to maintain the Himalayan ecosystem, which is possible through better understanding of hazardous areas that are most vulnerable to landslides, flash floods, erosion, snow avalanches, earthquakes and other hazards. It is possible through **preparation of hazards micro-zonation maps** of the State.

In view of the expected geo-hazards, it is necessary to obtain quantitative and qualitative **geotechnical information**, so as to take care of various geologic factors which are affecting construction, operation and maintenance of the projects in these tectonically active State. Adequate investigations, interpretation and analyses of geological parameters of the site hold the key for success of the projects in terms of economy and its durability.

It is high time to improve basic understanding of the social, environmental and economic risks so as to strengthen the abilities to cope with them, and to address risk management necessary for appropriate policy and decision making for sustainable development in the State of Arunachal Pradesh.
