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REGIONAL TRANSPORT CONNECTIVITY FOR SUSTAINABLE DEVELOPMENT

(Background Paper for Plenary Session 2 of the Provisional Programme)

Final Draft

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1. Introduction

Connectivity refers to the property of being connected or the degree to which something has connections. Transport connectivity whether domestic or international is essential to facilitate movements of goods and people and plays a significant role in the social and economic development of countries and regions.

Regional, subregional, intraregional and interregional are forms of international connectivity whereas intercity, rural-urban, urban and rural connectivity can be considered domestic. Sometimes regional connectivity can be referred as domestic if considering a region within a country.

Currently connectivity is high on global and regional agenda. Many institutions and organizations have undertaken studies on this topic. The ADB/ADBI study on Infrastructure for a Seamless Asia[1] was the first to cover all sectors, ESCAP's Economic and Social Survey 2011 considered the issue of connectivity in the context of regional integration[2], ESCAP Theme Study 2012 included a chapter on seamless connectivity that incorporated all infrastructure sectors including transport[3], ASEAN-India connectivity[4] discussed ways to enhance connectivity between the two and the Master Plan on ASEAN Connectivity[5] considered physical, institutional and people to people connectivity, ADBI/ADB's Infrastructure for Asian Connectivity[6] includes all sectors and discusses and address demand, benefits, policies, institution and financing issues related to all regional infrastructure including transport, energy, logistics, transport and trade facilitation.

Asian countries have recognized the importance of connectivity and are initiating policies and implementing projects to improve regional connectivity. Development partners are also supporting countries in their efforts to improve transport networks and connectivity. ESCAP's regional initiatives such as an interconnected intermodal transport system, that incorporates sub-sector initiatives such as Asian Highway, Trans-Asian Railway and development of dry ports of international importance. In addition, ADB's subregional programmes include GMS, CAREC, SASEC, and UNDP's Greater Tumen Initiative are examples of regional and subregional frameworks and complement each other.

There is a need for a regional overview, that is a strategy with policies that looks towards the benefits of a sustainable approach to regional connectivity. This strategy should be based on the optimum use of different transport modes to maximize the benefits of each mode for maximizing efficiency and usefulness. The objective is to provide connectivity from farm gate, and manufacturing centres to consolidation depots – or dry ports, and then connecting on with long distance rail to seaports or transfer points to roads for final destinations.

Subregional organizations within ESCAP such as SAARC, BIMSTEC, ASEAN, SCO, and ECO also have transport programmes to improve connectivity within and among its members.

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[1] Asian Development Bank and Asian Development Bank Institute, 2009. *Infrastructure for a Seamless Asia*, A joint study of the Asian Development Bank (ADB) and the Asian Development Bank Institute.
[2] ESCAP, Economic and Social Survey 2011
[3] ESCAP, Growing Together: Economic Integration for an Inclusive and Sustainable Asia-pacific Century, 2012
[4] RIS, ASEAN-India Connectivity Report, 2011,
[5] ASEAN, Master Plan on ASEAN Connectivity, ASEAN Secretariat, Jakarta, 2010
[6] Bhattacharyay, B. N, Kawai, M, and Nag, R. M. (eds.), Infrastructure for Asian Connectivity, ADB and ADBI, 2012

Ongoing discussions are taking place to improve transport connectivity among these subregional groupings in Asia[7].

These efforts have resulted in significant improvements of physical connectivity. But there are still many physical barriers in terms of missing and substandard transport links, and non-physical and procedural barriers for cross-border transport. Also, transport connectivity and logistics performance are very important determinants of bilateral trade costs.[8] In the context of a renewed commitment expressed at Rio+20 summit there is now a growing need to enhance regional transport connectivity that considers the three pillars of sustainability-economic, social and environmental.

In this context, this paper reviews ongoing efforts in Asia, discusses issues and challenges for improving regional transport connectivity, provides some empirical evidence of socio-economic benefits of regional connectivity, and propose some policy initiatives for enhancing regional connectivity in a sustainable way. The paper treats the term 'regional' in an international context and focuses on land transport connectivity. The paper also discusses rural and intercity connectivity to a limited extent.

Following this introduction section 2 outlines status of transport connectivity in Asia, section and some selected initiatives and projects relating to regional connectivity, section 3 empirical evidences of socio-economic benefits of regional infrastructure and connectivity, section 4 discusses resilience, issues and challenges and policies for enhancing of regional connectivity are presented in section 5 followed by the conclusions and recommendations in section 6.

2. Status of transport connectivity in Asia

Intraregional export and import is increasing in Asia. More than half of Asia –Pacific trade is intraregional; the proportion of intraregional trade has increased to 54% in 2010 from 48% in 2000. Figure 1 shows the growth of merchandise export and import in selected direction in Asia. It can be seen that the trade between the People's Republic of China and ASEAN, and People's Republic of China and Central Asia is increasing substantially. The growth of intraregional trade as well as expected growth of trade among subregions clearly demonstrates the need to improve regional transport connectivity in Asia.

[7] Connecting subregional transport networks (E/ESCAP/MCT.2/11), 2011

[8] Arvis, J.-F, Duval, Y., Shepherd, B.and Utoktham, C., Trade Costs in the Developing World:1995 – 2010,.ARTNeT Working Paper, ESCAP, 2012

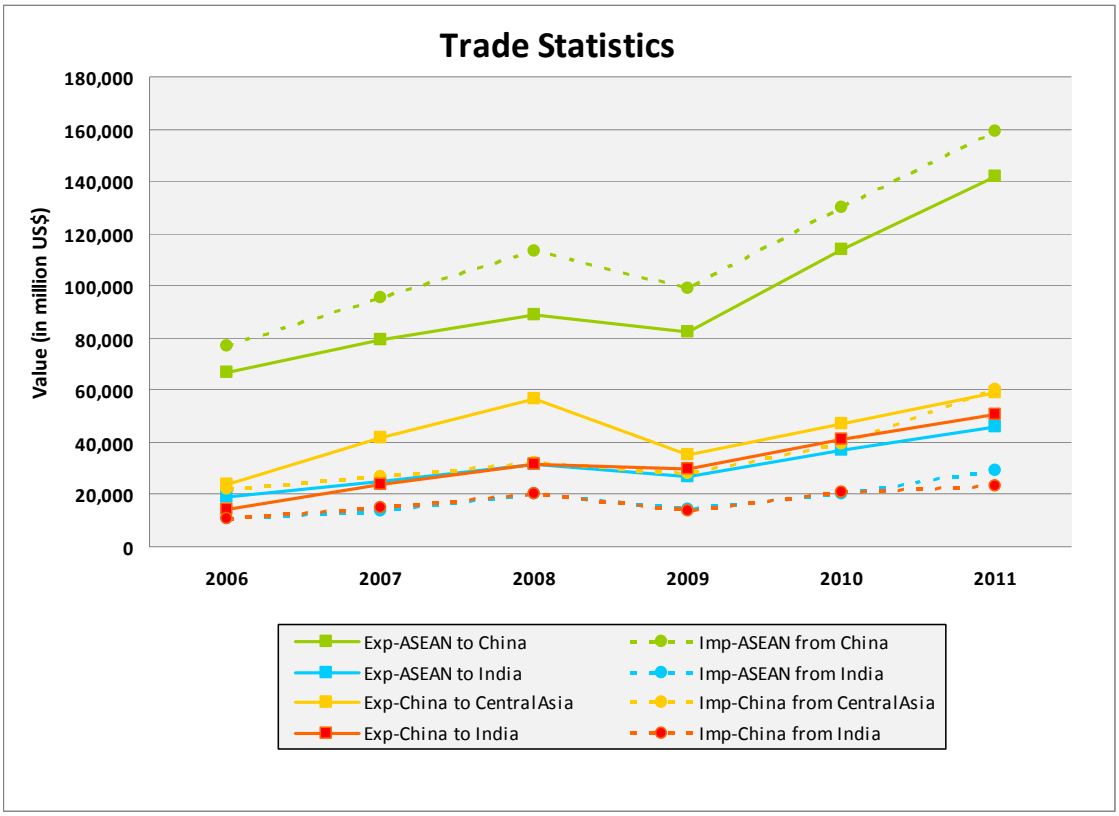

Figure 1: Trade along selected directions in Asia (Source: IMF DOTS, 2012)

Figure 2 shows road and rail density per population in selected Asian countries. It shows that the road density is far more than railway density. Japan and Russian Federation have high road density while Kazakhstan and Russian Federation have high railway density. Even though People's Republic of China and India have more length of road networks the density is low because of their high population.

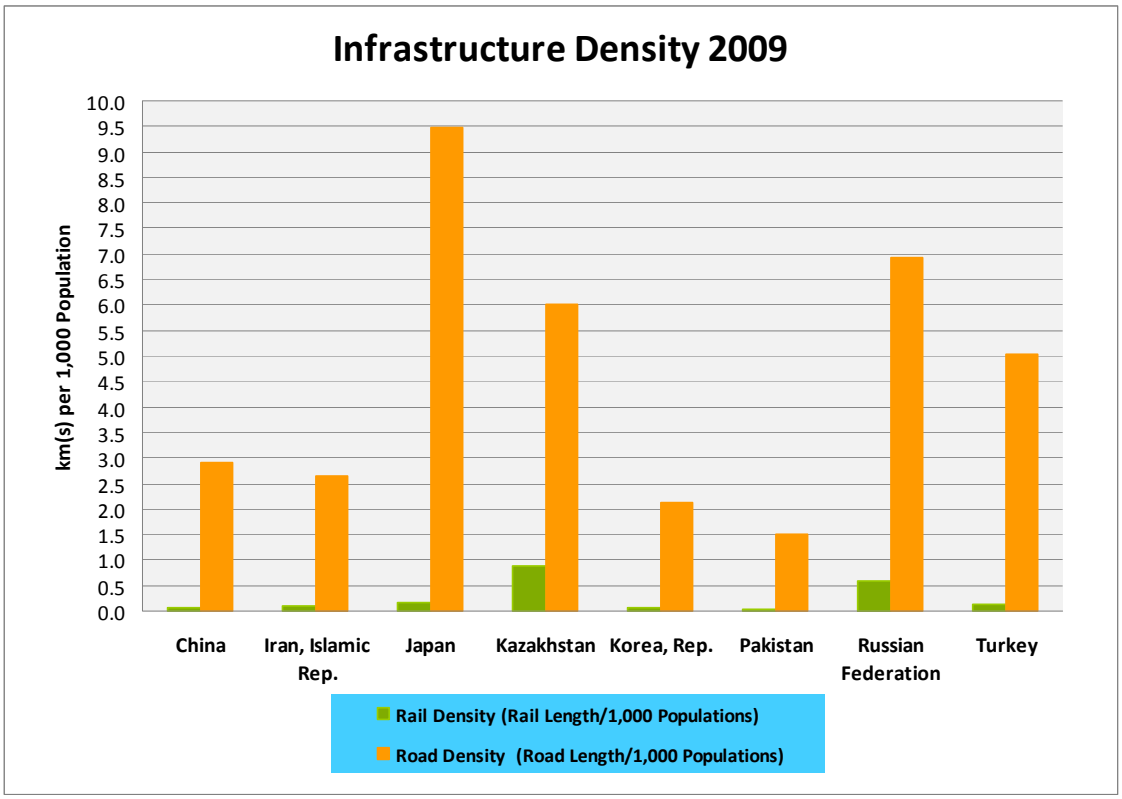

Figure 2: Density of road and rail in selected Asian countries

Figure 3 shows growth rate of land transport infrastructure and vehicle population in selected countries in Asia during 1990-2010.[9] It shows that growth of road provision is far more outpacing growth of railway. In terms of road development People's Republic of China, the Republic of Korea and Pakistan have high growth rate while for railway except for People's Republic of China and Iran the growth of railway is not that significant. Also the growth of vehicle population is outpacing the growth of road length. For example in People's Republic of China road is growing at a rate of 6.2% while the vehicle population is growing at 12.5%, in the Republic of Korea it is 3.1% and 6.3%; India it is 2% and 4% and in the Russian Federation 1.2% and 6.2% respectively.Many Asian countries are focusing on improving road connectivity compared to railway and water transport. The total road length in India, People's Republic of China, Japan and the Russian Federation is 4.1, 4, 1.2 and 1.14 million km respectively. This is also evident from the fact that about 75% of the transport investment made by the development banks goes to the highway sector followed by 7-15% to railways and 3-7% to inland water transport. The vast majority of transportation is by road and railway with limited use of inland water transport and coastal shipping in Asia.

[9] ESCAP, Review of Developments in Transport in Asia and the Pacific, 2011

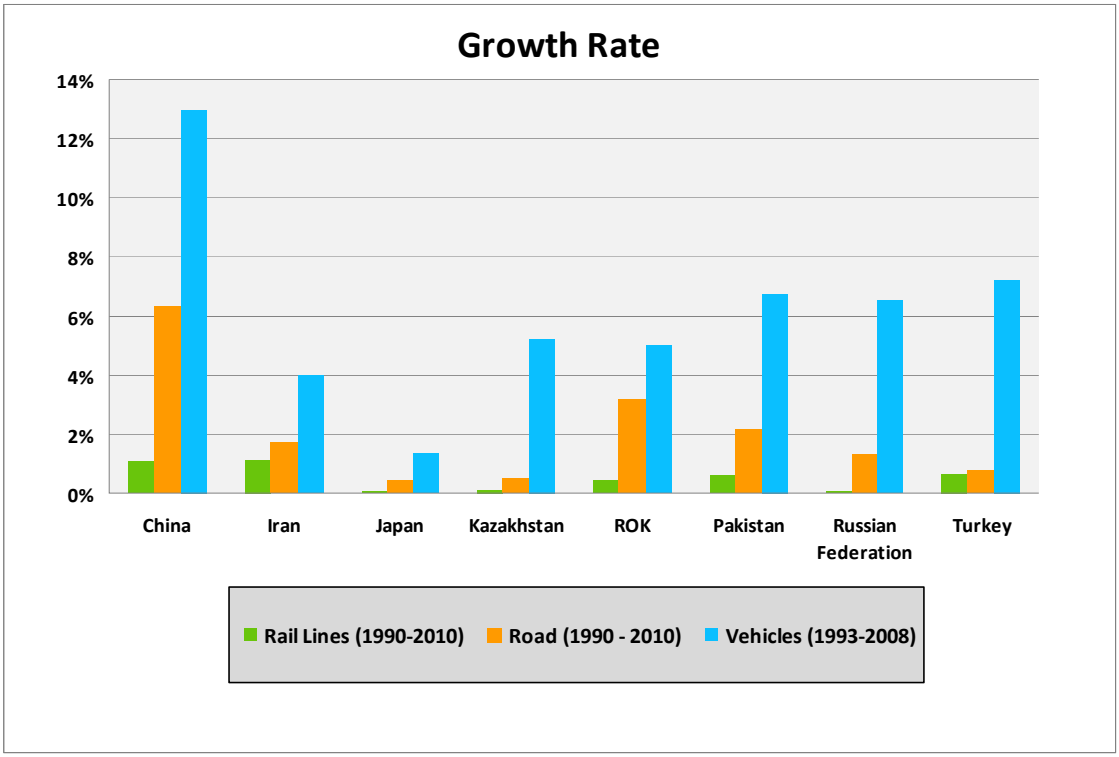

Figure 3: Growth of road and railway lines and vehicle population

People's Republic of China, Russian Federation and India have highest track length of railways 91,000 km, 85,000 km and 64,000 km of which 46%, 51% and 30% are electrified respectively. Asian countries use various railway gauges 1000 mm, 1067 mm, 1435 mm, 1520 mm and 1676 mm, which makes interoperability of railway transportation across borders difficult, where the neigbbouring countries use different type of railway gauge. The break of gauge is an operational issue for railways and requires transhipment and change of bogies at borders.

The World Bank has developed a measure called the Logistics Performance Index (LPI) that demonstrates comparative performance of countries.[10] Figure 4 shows the LPI score and quality of infrastructure in selected Asian countries. While developed countries such Singapore and Japan have high LPI score and high quality of infrastructure, other developing and landlocked countries have low LPI score as well as low quality of infrastructure. The figure also shows that the LPI and quality of infrastructure for most of the countries shown are lower than three and hover around midway indicating there is much scope to improve the quality of infrastructure as well as other factors that constitute LPI.

[10] Logistics Performance Index (LPI) is the weighted average of the country scores on the six key dimensions: Efficiency of the clearance process (i.e. speed, simplicity and predictability of formalities) by border control agencies, including Customs; Quality of trade and transport related infrastructure (e.g. ports, railroads, roads, information technology); Ease of arranging competitively priced shipments; Competence and quality of logistics services (e.g., transport operators, customs brokers); Ability to track and trace consignments; Timeliness of shipments in reaching destination within the scheduled or expected delivery time. The scorecards demonstrate *comparative performance* - the dimensions show on a scale from 1 to 5 relevant to the possible comparison groups – all countries (World), region and income groups.

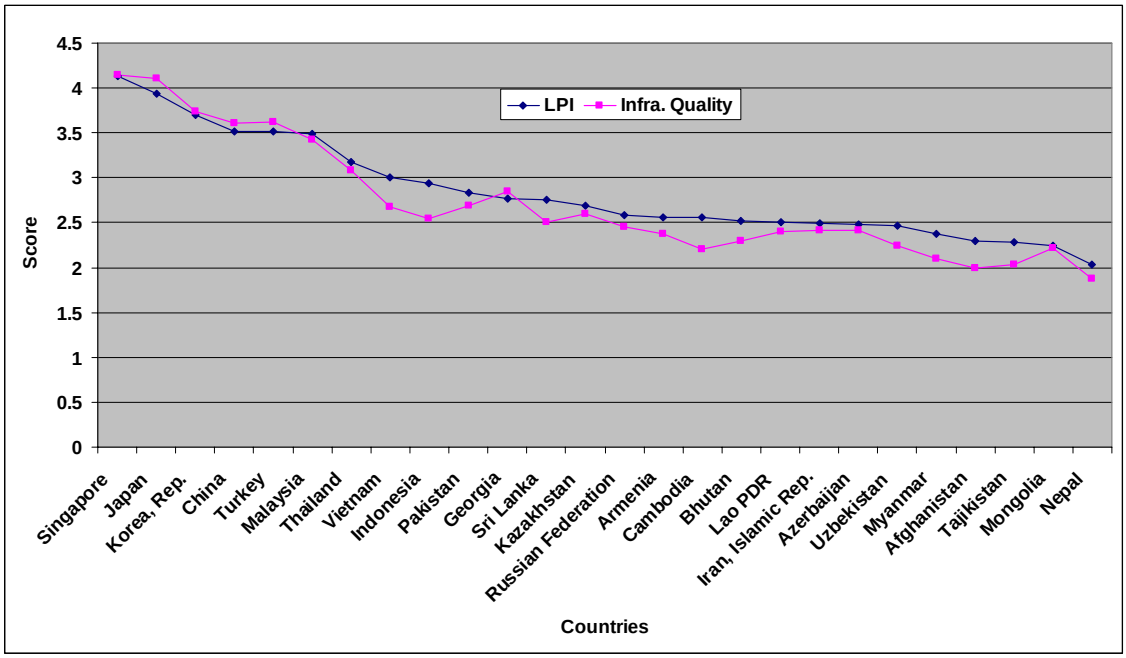

Figure 4: LPI Score 2012 and quality of Infrastructure (Source: World Bank)

2.1 Regional connectivity

In many countries the main focus of the growth on land transport development has been aimed to improve domestic connectivity and to improve the connectivity of the main production and population centres with their main sea ports. As a result, inter-country land transport linkages have not been well developed.

In the recent years, along with the improvement of domestic connectivity, countries have also considered various initiatives to improve their land transport connectivity with the neighbours. Significant progress can be seen, for example, in the ongoing development in Asian Highway routes and other roads of national importance; major expansion of rail networks and growth of freight transportation by rail (particularly in People's Republic of China, India, Islamic Republic of Iran, Indonesia, and the Russian Federation); limited investment in intermodal facilities such as dry ports and container terminals; and investment in the improvement of rural transport infrastructure.

Asian Highway Network comprises of 143,000 km of highways in 32 countries (see Figure 5 - AH routes). Recent data on the status of AH routes shows that between 2006 and 2010, there has been some progress to improve quality of Asian highway routes, the proportion of the roads under class III fell to 7% of the total network, or 11,500 km. As of the end of 2011, Primary and Class I standard AH routes cover about 32% of the network, while Class II and III type routes account for 60% of the network. In order to upgrade 11,500 km of the substandard sections of the Asian Highway an investment of about US $ 18 billion will be required.

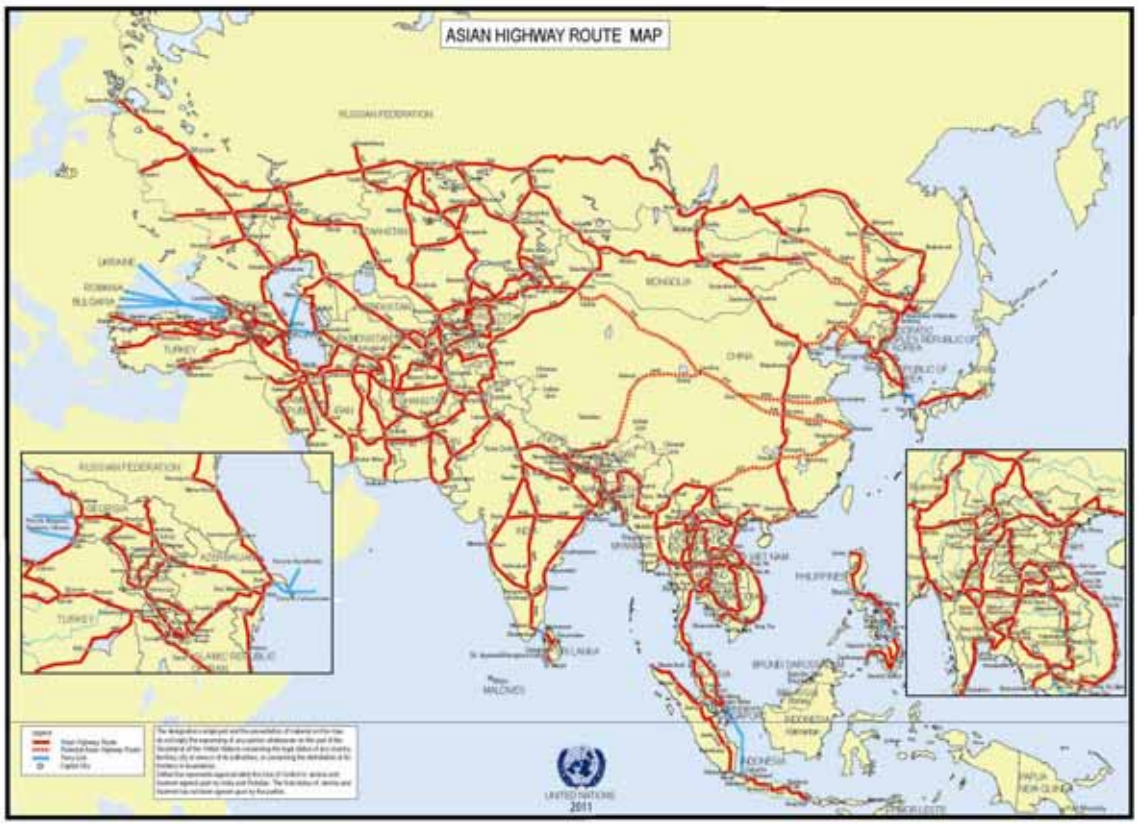

Figure 5: Asian Highway routes

The Trans-Asian Railway Network comprises of 114,000 km of railway lines in 28 member States 2009.[11] There are number of missing links in the railway network (Figure 6) most of which are concentrated in South and South-East Asia. Total investment needs for their development is around US $ 25 billion. There is much scope to improve transport connectivity in North-East Asia[12]. Major infrastructure projects in Asia are to trade with one other and develop the benefit for all and bind Asia closer together.[13]

[11] There are now 29 parties to the Intergovernmental Agreement on the Asian Highway Network and 16 parties to the Intergovernmental Agreement on the Trans-Asian Railway Network.

[12] Greater Tumen Initiative, Integrated Transport Infrastructure and Cross-Border facilitation Study for the Trans-GTR Transport Corridors: Regional Summery Report, 2013

[13] Jaswant Singh, Infrastructure key to Asian Unity, Bangkok Post, 25 February 2013

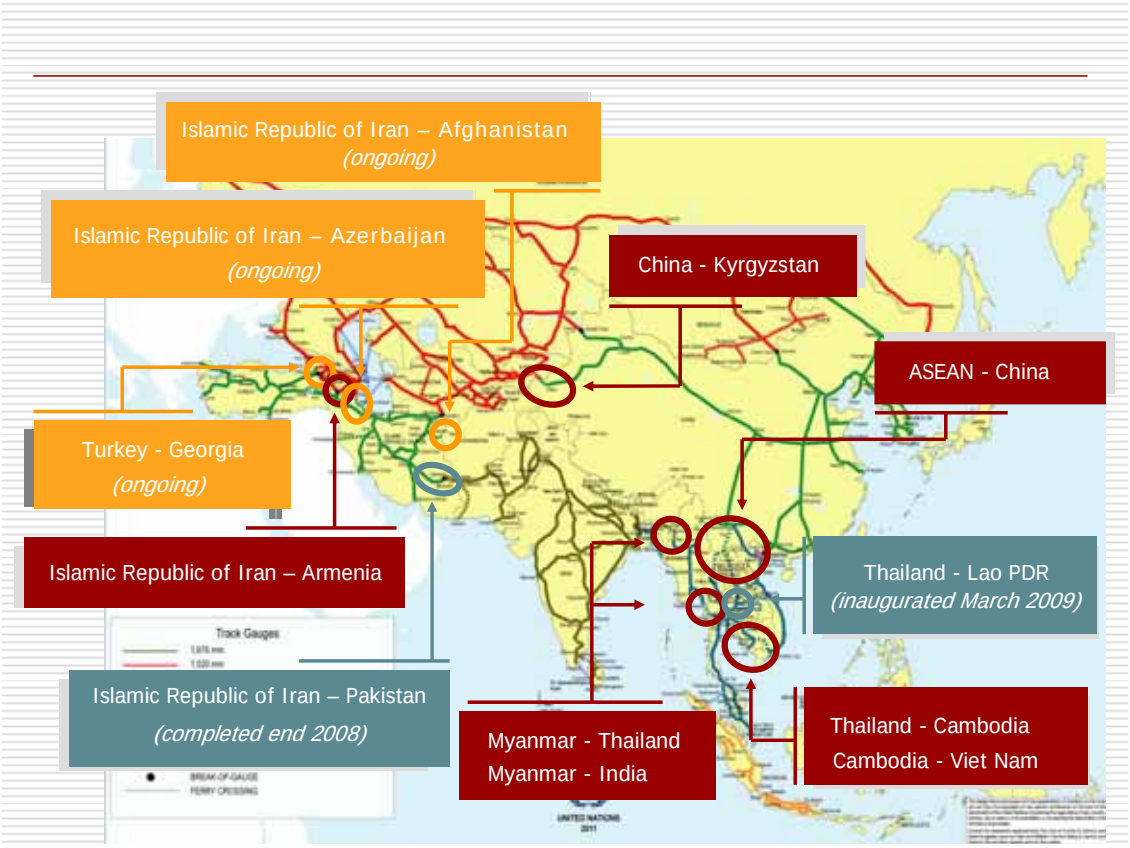

Figure 6- Missing links in the Trans-Asian Railway

The Intergovernmental Agreements on the Asian Highway and Trans-Asian Railway Networks serve as catalysts for encouraging governments to prioritize and upgrade cross-boundary highways and construct missing links of railway lines.

While considerable efforts have been made by countries to address relevant issues, land infrastructure networks are still under pressure to accommodate rising transport demand. The land transport networks of most developing countries are not yet capable of handling the increase in intra-Asian overland trade.

Maintenance and asset management of transport infrastructure is also an important issue where improvements would lead to more sustainable outcomes. Countries need to prioritize maintenance of transport infrastructure to preserve the value of existing infrastructure assets. There are many policy initiatives in place to ensure sustainable funding for road maintenance; however, in spite of these efforts Asia is still to witness some success stories on sustainable road maintenance.

With a vision of integrating regional highways and railway lines and provide intermodal connections ESCAP along with its members has been working to develop an intergovernmental agreement on dry ports. The main objective of the proposed intergovernmental agreement is to improve the efficient movement of goods through (i) promoting the development of dry ports of international importance; (ii) facilitating recognition of dry ports and investment; (iii) improving operational efficiency of intermodal freight; (iv) enhancing environmental sustainability of freight transport through a modal shift.

The second session of the Committee on Transport held in October 2012 has approved the finalized text of the agreement. The agreement will be considered by the 69th session of the Commission to be held from 25 April-1 May 2013 in Bangkok for adoption through a resolution. If adopted, the agreement will be open for signature by member countries during the second session of the Forum of Asian Minister of Transport to be held in Bangkok, 4-8 November 2013.

In its current forms the main body includes legal provision relating to administration of the agreement, Annex I lists the dry ports of international importance and Annex II includes basic guiding principles for development and operation of dry ports.

Total 240 dry ports have been identified as the dry ports of international importance (Figure 7) nominated by member countries of which 110 have been identified as having a potential to develop into future dry ports. Considerable investment will be required to upgrade existing dry ports and construct dry ports at the potential locations. ESCAP has a plan to undertake priority investment needs for development of these dry ports.

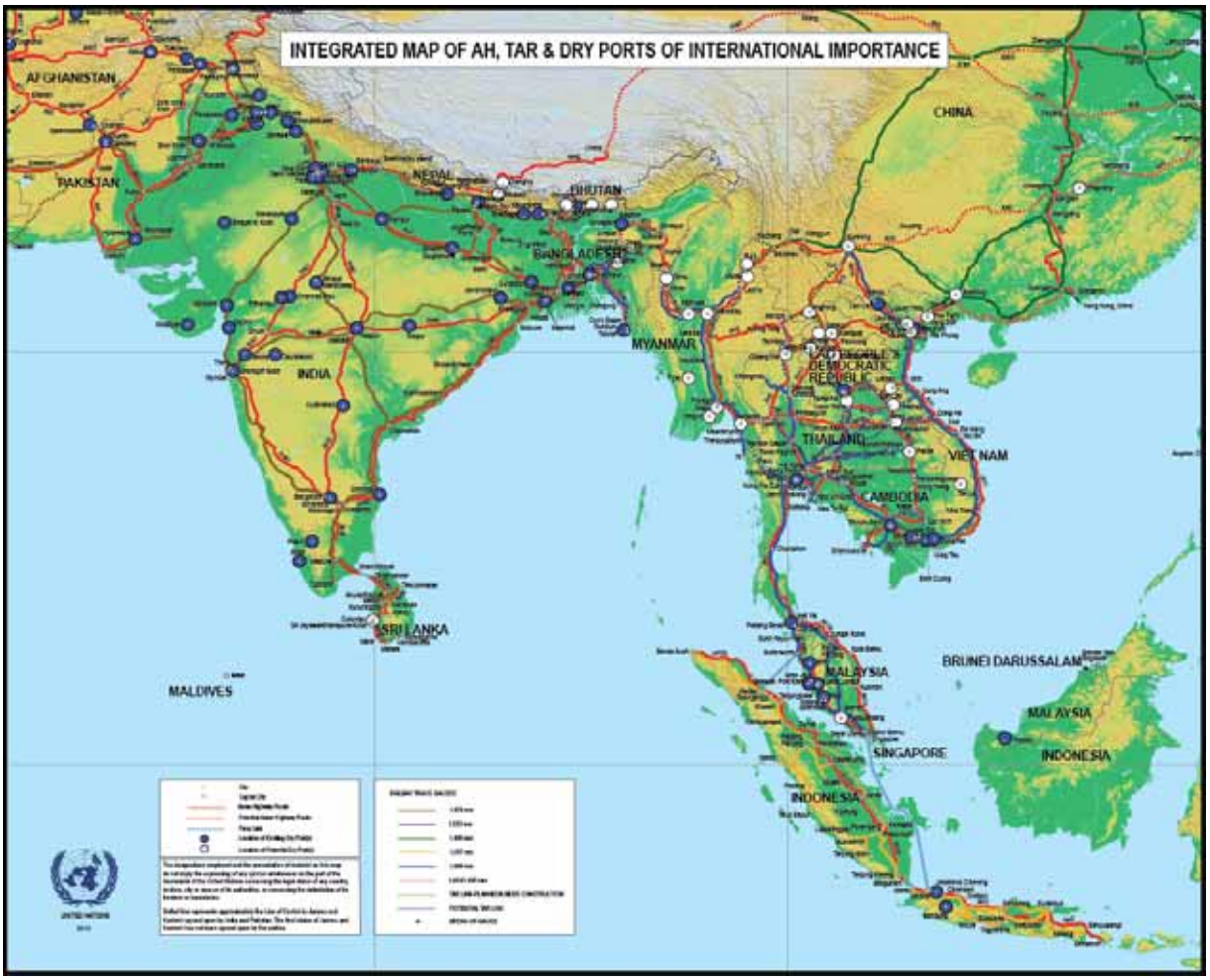

Figure 7: Dry ports of international importance

Bhattacharyay (2012) estimates the need for US $ 176.3 billion from 2010 to 2020 for regional transport infrastructure. That includes US $ 17.4 billion for AH, US $107.5 billion

for TAR and US $ 51.4 billion for 765 container ports around Asia. As there is a separate session on financing issues during the EST Forum, the investment needs and financing is not further discussed in this paper.

Inland water transport and coastal shipping

The emission factors of various modes show that there are clear benefits of moving freight from road to non-road mode. Inland water transport has advantages of being more energy efficient than railway for per tonne-km, but there are limited inland water transport (IWT) routes available in Asia. Navigable Rivers such as Mekong, Ganga, and Padma are not utilized for freight transport in a substantial way; mostly IWTs are being used for traditional passenger transport. The revival of water transport could take some share from road transport and reduce emissions to a significant extent. Use of coastal shipping and trucks instead of distribution by trucks alone led to 60% less emissions resulting from efficiency of coastal shipping[14]. Revival and improvements of canals and rivers routes through channelling, dredging, widening to increase capacity, and the addition of river ports are some of improvements required. Maritime transport has already taken major share of international transport. There is further potential of modal shift through coastal shipping.

2.2 Subregional and inter-sbregional connectivity

There have been efforts by ADB to promote subregional development and transport is a major sector of development within these programmes such as GMS, SASEC, and CAREC. Other subregional organizations such as ASEAN, SAARC, BIMSTEC, SCO, and ECO also have transport development programmes within their members. ESCAP has also now established four subregional offices in the Pacific, North and North-East Asia, South and South-West Asia and North and Central Asia, with a mandate to look at subregional dimension of regional cooperation and development. Whilst the issues of transport connectivity in the Pacific are mainly related to air and maritime transport, for other subregions the land transport connectivity is a major focus. The connectivity within and among the subregions need to be improved. Connectivity is being increasingly addressed by subregional cooperation programmes and projects of these subregional organizations, there remains a need to have renewed focus to improve inter-subregional connectivity.

One of the approaches taken by ADB's subregional programmes is corridor based approach. These programmes have made substantial progress in improving physical connectivity, but however despite various activities focusing on facilitation issues through development of framework agreements, single window system – cross-border movement of traffic is not encouraging as anticipated. This is the area where much policy attention and collaborative efforts of countries will be required.

2.3 Easing cross-border movement

Another important aspect of regional transport is the operation of the network as provision of, and development of, transport infrastructure is only one side of the story. The main objective of developing this infrastructure is increasing economic activity whilst at the same time

[14] Liao, C.H., P.H. Tseng, and C.S. Lu, Comparing carbon dioxide emissions of trucking and intermodal container transport in Taiwan Province of China, Transportation Research Part D, 14(7) (2009) 493-496.

maximizing its usefulness in ensuring that it is sustainable. This infrastructure provision needs to be coordinated with solving the issues related to legal and regulatory barriers to transport across borders and increase use of ICT and other technologies for the facilitation of international road or rail transport. Improving transport operations sectors in cooperation with the logistics industry in order to bring down transport costs.

Improving regional transport connectivity involves more efficient use of border crossing points. Usually these border crossing points pose a threat to the smooth flow of goods and people. The level of smoothness of transport operation can vary widely depending on the location of borders and the cooperation of the neighbouring country, existing agreements, and on origin and destination and type of cargoes. The border clearance process can also vary along the transport routes. Some of the commonly found non-physical barriers are:

(i). Inconsistent and time consuming, costly border crossing formalities and procedures;
(ii). Restriction/limitation on entry of vehicles;
(iii). Transshipment needed at the border;
(iv). Different standards of vehicles and drivers;
(v). Restrictive visa requirement;
(vi). Difficult and different process for transit traffic;
(vii). Differential/reciprocal tariffs/charges;
(viii). Incompatible working hours at borders;
(ix). Coordination among various stake holders; and
(x). Excessive security checks.

Many of above soft issues can be improved through accession and implementation of related international transport conventions or concluding agreements among the countries. ESCAP Resolution 48/11 recommends member countries for accession to and implementation of seven international transport conventions.

Many other studies such as the CAREC's Transport and Trade Facilitation Strategy[15] and the World Bank study on Trade and Transport Facilitation in Central Asia[16] has recognized the above barriers to trade and among others recommended enhancing cooperation, improvement of border crossings, establishment of single-window at inland borders, improvement of trade corridors, and introduction of pilot demonstration runs of container trains.

2.4 Intercity connectivity

Asian countries are implementing projects and programme to enhance intercity connectivity, connect major production and distribution centres and linking to sea ports. People's Republic of China's expressway development programme has now constructed more than 98,000 km, India's National Highway Development Project is being implemented to increase capacity of 49,000 kms national highways in different phases[17], construction of dedicated railway freight corridors in India, modernization of railway in the Russian Federation, restructuring and strengthening of railways in Turkey, construction of a new railway lines in Afghanistan,

[15] CAREC Transport and Trade Facilitation Strategy, Volume 1: Main Report, ADB, 2008
[16] Trade and Transport Facilitation in Central Asia: Reducing the Economic Distances to Market (final draft), The World Bank, 2005
[17] http://www.nhai.org/WHATITIS.asp

high-speed rail construction in People's Republic of China, and plans for construction of high speed rail in South-East Asia are few notable initiatives.

Connectivity is clearly in ASEAN agenda in order to realization of ASEAN's goal of becoming ASEAN Economic Community in 2015. ASEAN countries are planning major investment projects to improve transport infrastructure. In addition to the construction of subway system in Bangkok, Thailand is planning major high-speed[18] railway projects to improve connectivity among major cities within the country as well as with neighbouring countries. The planned high-speed rail lines link Bangkok with Pattaya, Phitsanulok, Nakhon Ratchashima and Hua Hin by 2018 and extend high-speed rail links to other cities Rayong, Chiang Mai, Nong Khai and Hat Yai by 2022. In addition some existing tracks will be upgraded to dual tracks and three new sea ports at Chumphon, Pak Bara and Sonkhla are planned. The government 2-trillion baht infrastructure investment programme that includes rail expansion, new roads and ports improvements was approved by the parliament[19]. The implementation of this plan would make Thailand a regional transport and production hub.

Lao PDR and Viet Nam 220 km are also planning high-speed rail link costing US $ 5 billion.[20] The People's Republic of China is funding rail link to Vientiane, Laos PDR from southern China at a cost of US$ 7 billion. Singapore and Malaysia recently agreed to revive 400 km high speed Singapore-Kuala Lumpur rail link costing about approximately USD 3-5 billion that will shorten the travel time to 90 minutes.

In People's Republic of China, a major drive is underway to ensure that rail can continue to assist the country's future economic development. China has the world's largest high-speed rail network with a length of over 9,300 kilometers. It plans to put 18,000 kilometers of high-speed rail network in operation by 2015. The current long-term development plan being implemented by Chinese Railways aims to bring the network to 120,000 km by 2020, of which 50 per cent will be double-track and 60 per cent electrified.

India is developing two dedicated freight corridors in India. The "Eastern corridor" will connect Ludhiana to Sonnagar over a distance of 1,760 km and the "Western corridor" will connect Tughlakabad ICD to JNP/Mumbai over a distance of 1,485 km. Both corridors are designed for the operation of long and heavy trains of up to 1.5 km, with a loading gauge suitable for double-stack operation and an axle-load of 30 tons.

Due to high reliance on road transport, many countries have recognized the deficiencies in transport and logistics infrastructure that are required to seize global market and remain competitive. Therefore, as seen above there are initiatives to improve railway connectivity. If operated on green electricity – the railway transport offers environmental friendly freight transport for long hauls.

2.5 Rural connectivity

While initiatives are being implemented in countries of the region, physical access, especially in rural areas, remains a general problem. In some countries, 30 to 40 per cent of villages are without all-weather road access and a minority have no road access at all. In other countries, many road connections between the capital city and provincial capitals are unpaved and large

[18] High-speed refers to having a higher speed than conventional railways.
[19] Bangkok Post, 30 March 2013, Infrastructure bill sails through
[20] Bangkok Post, 25 February 2013

percentages of provincial roads remain unpaved and may be impassable during the rainy season.

The Rural Accessibility Index (RAI) measures the share of the rural population living within two kilometers of a road that is passable in all weather.

Countries are implementing programmes to improve rural connectivity. Some major rural road development initiatives have been implemented in many countries of the region Nepal is implementing rural access programme to connect mountainous districts by road. India is implementing the Bharat Nirman programme within which earlier Pradhan Mantri Gramin Sadak Yojana is incorporated which aims to connect all 1,000-plus habitations in rural areas (500-plus in hilly and tribal areas) with rural roads.[21] People's Republic of China is also investing heavily on construction and maintenance of rural road. During 2006-2010 about 1.9 million km of rural road were built and repaired including 527,000 km of new rural road with an investment of RMB197.8 billion. It further plans to construct 450,000 km new rural by 2015 and rural transportation service will be available in all towns and 90% of administrative villages[22]. The Gama Neguma programme in Sri Lanka is designed to achieve island-wide economic development through the creation of economically prosperous villages. The programme was launched in 2006 in 119 Grama Niladhari divisions and will ultimately cover all of the 14,034 divisions. Under the programme, 3,354 km of roads and bridges were built in 2008 at a cost of 7,058 million Sri Lanka rupees.[23] Bhutan has constructed eight priority feeder roads in five districts, where isolated rural communities had to walk for one to three days to reach all-weather roads or markets, schools, health clinics, hospitals and district headquarters.[24] As a result of these projects and initiatives, there has been significant progress in improving access for rural communities and improvement in the rural logistics and supply chain.

All too often rural roads gets are not properly engineered and once the construction is complete their maintenance is usually neglected. Some rural roads are unpaved and only accessible in dryer seasons. Depending on the geology and topography of the location sections of roads could be damaged by soil erosion, obstructed by landslides, subsidence of tracks and pot holes could be seen. As these rural roads are lifelines of communities and they should be properly engineered and low cost all weather pavement options should be considered that utilizes adaptation of local materials and engage local people on the design, construction and maintenance. The capacity of local bodies could be enhanced for maintenance planning and implementation.

3. Socio-economic benefits of regional transport infrastructure and connectivity

Reduction in travel time and transportation costs are immediate benefits of transport projects. There is broad understanding that developing national and regional transport infrastructure would significantly contribute to the socio-economic development of the country and the region by facilitating trade, enhancing its competitiveness through improved connectivity and access to new or existing markets. There are many studies showing clear benefits from

[21] Government of India, "Bharat Nirman: A Business Plan for Rural Infrastructure", accessed from www.bharatnirman.gov.in

[22] http://www.researchinchina.com/Htmls/Report/2011/6053.html

[23] Government of Sri Lanka, *Annual Report 2008*, Ministry of Finance and Planning, available at www.treasury.gov.lk/FPPFM/fpd/annualreports.htm.

[24] International Development Association, "Transport: Improving services for the poor" (Washington, D.C., World Bank, Sept. 2008) p. 16, available from http://siteresources.worldbank.org/INTSD NETWORK/Resources/IDA_Transport.pdf .

improvements of roads, facilitation of cross border transport and trade would bring more substantial benefits to the project area. The roads are making great contribution to subregional cooperation, cultural exchanges with direct impact to economic and social development. There are also examples of projects for improving rural connectivity contributing to employment generation and reducing the incidence of poverty. How much impact an investment in regional transport infrastructure can make is largely based on the size of the economy and pattern and direction of trade.

Zhai (2012)[25] used a global computable general equilibrium (CGE) model to simulate effects of investment in regional infrastructure development in Asia. The global gains in real income would be US $ 1081.8 billion and around 90% of which would be captured by Asian Developing economies. People's Republic of China, India, Indonesia, Thailand and Malaysia would be the major beneficiaries of investment in transport. It would also boost both global and regional trade; global export would expand by 21%. The investment in regional transport, communications and energy infrastructure would increase the share of intra-regional trade in Asia from 47.5% in baseline to 54.7% in 2020. The study also predicts that the share of intra-Asian trade to be larger than extra-Asian trade. The analysis further shows that the export and imports would both increase in countries with low-level of foreign trade and low quality transport infrastructure such as- India, Bangladesh, Indonesia and Thailand.

ESCAP (2012)[26] also used CGE model to look at the impacts of investment in Asian Highways on economic growth. The modelling analysis showed that the investments in the Asian Highway can have large net positive gains and favourable distributional effects.

A World Bank[27] study has shown strong correlation between reduction in incidence of poverty and improved rural access. For example in Viet Nam, rural access improved significantly from an average of 76% to 84 % at the provincial level during 2002 to 2004 and the incidence of poverty also dropped significantly from an average of 41% in 1999 to 24% in 2004 at the provincial level. A study on road development, economic growth and poverty reduction in People's Republic of China concluded that that low-quality rural roads have benefit-cost ratios for national GDP that are approximately four times larger than the benefit-cost ratios for high-quality roads.[28]

The contribution of transport to GDP varies from 4 to 10% in GMS countries. Transport sector's contribution to GDP was 4.07% and 10.13% in Viet Nam and Thailand respectively in 2008.[29] The construction of 2nd Mekong Bridge led to 8% increase in tourists visiting to Lao PDR in first two months of opening in 2007.[30] A study of roads and poverty in rural Lao PDR has concluded that between 1997-8 and 2002-3, rural poverty incidence in Lao PDR declined by 9.5% of the rural population and about 13% of this decline can be attributed to the improved road access.[31]

[25] Zhai, F., Benefits of infrastructure investment; an empirical analysis In Bhattacharyay BN, Kawai, M, and Nag RM (eds) Infrastructure for Asian Connectivity, 2012
[26] ESCAP, 2012, Growing Together, pp 72
[27] http://www.worldbank.org/transport/transportresults/headline/rural-access.html
[28] Shenggen Fan and Connie Chan-Kang, "Road Development, Economic Growth, and Poverty Reduction in China", International Food Policy Research Institute, Research Report 138 (Washington, D.C., 2005), p. 46, accessed from www.ifpri.org/sites/default/files/publications/rr138.pdf
[29] ESCAP, 2009, Enhancing the Policy Impact of Transport Investment Analysis (E/ESCAP/FAMT/SGO/3)
[30] Asian Development Bank Institute, 2009, Transport Infrastructure and Trade Facilitation in the GMS
[31] Warr, Peter, 2010, Roads and Poverty in Rural Laos: An Economic Analysis, Pacific Economic Review, 15: 1 (2010)

4. Making transport connectivity resilient

Transport connectivity is also of primary importance when disasters occur and relief aid needs to be transported to victims of floods, droughts, tsunamis and earthquakes. The ability to respond to disasters requires not only the adoption of risk mitigation strategies, including the development of contingency transport and logistics plans, but also the adaptation of the design and alignment of infrastructure so that it is resilient to such disasters. Experience shows that more attention needs to be paid to these mitigation and adaptation strategies in the transport and logistics sectors. Policies could involve, for instances strengthening priority routes.

Recent disasters have caused tremendous damage to transport infrastructure and operations. The Thailand floods in 2012 submerged many roads while the 2011 Japan earthquake damaged roads, railways and airports. Transport can also be interrupted: in coastal areas of Bangladesh, the Maldives, the Pacific islands and Viet Nam, transportation systems will be highly vulnerable to rises in sea levels.

Transport systems and in particularly, vital elements can be designed to be more resilient to the impacts of climate change and disasters. Generally, this will mean enhancing the capacity of officials on the planning process by incorporating higher design standards, using innovating construction technology and sustainable materials. Some of the policies and strategies required for development of resilient and sustainable transport infrastructure in Asia include increasing awareness and enhancing coordination among stakeholders, integrating potential impacts of extreme events and disasters into planning process and reviewing and incorporating higher design standards for structural elements, considering life cycle cost and enhancing capacity of planning and implementing officials.[32] This would also increase the serviceability and life of costly structures.[33] [34] For example, in the US after Hurricane Katrina, the clearance height of bridges was increased[35] and in Canada the design of the Confederation Bridge allows for a one-metre sea level rise.[36]

Coastal sections of roads and railways can be moved to higher ground or given protective walls or embankments. During the 2011 Japan earthquake and the subsequent tsunami the embankment section of the expressway along the coast protected the inland side from inundation. It also offered an evacuation space, saving many lives. The reconstruction project envisages evacuation stairs for the embankment slopes. A study in Bangladesh found that it was economically viable to raise road embankments from 0.5 to 1.0 metres to protect the roads from floods.[37]

[32] Regmi, M.B., Hanaoka, S., 2011, A survey on impacts of climate change on road transport infrastructure and adaptation strategies in Asia, Environmental Economics and Policy Studies, 13, 21-41.
[33] Wooller, S. (2003). The changing climate: its impact on the Department for Transport. London, United Kingdom, Department for Transport
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[37] Tanner, T. M., A Hassan, KMN Islam, D Conway, R Mechler, AU Ahmed, and M Alam (2007). ORCHID: Piloting Climate Risk Screening in DFID Bangladesh. Summary Research Report, Institute of Development Studies, University of Sussex, UK

In mountainous areas, roadside slopes can be made more stable through bio-engineering using living plants, as in Nepal. Combined with civil engineering measures these can provide cost effective and environmentally friendly solutions.[38] Drains can also be built with extra capacity to cater for surges in water flow. The Bipartisan Policy Center offers a list of options.[39]

It is important to keep transport connectivity and links open for disaster relief operations. For this purpose, transport planners should incorporate some redundancy – building extra routes in case one is damaged. They can also consider multi-modal networks so that traffic is distributed among different options – such as railways, roads, and water routes. Planning should also reflect the functional hierarchy of transport networks, such as primary trunk roads, national highways, feeder and district roads, and rural roads. Nepal for example, accords priority for upgrading and maintenance of strategic road networks which include important national highways and feeder roads.

5. Enhancing sustainability through use of long haul intermodal transport

In order to enhance sustainability of regional connectivity, there should be more emphasis on long haul freight transport using railway. The development of intermodal nodes with logistics facilities such as inland container depots and dry ports that integrate various transport modes can offer modal shift opportunities with long haul railway routes to seaports. Therefore, now the focus should be to develop inland dry ports to provide intermodal connectivity. As Asia is home to 12 of the world's landlocked countries, the development of dry ports could play a major role in promoting intermodal transport. It could also contribute to improved transshipment and distribution of goods in wider inland areas by improving operational efficiency.

Earlier models for transport development have taken a unimodal approach in which road and rail were planned and constructed separately without much consideration given to integration between them. In some cases, following similar routes and appearing to be in competition with each other. In order to promote a modal shift, the existing transport system needs to offer a choice of modes depending upon distance, geography and demand capacity. The three essential components of an intermodal transport system are the transport network, intermodal nodes, and provision of transport services. Therefore, policies and interventions that are conducive to encourage a modal shift in freight transport and use of railways are necessary. Dry ports offer facilities provided by seaports in inland areas. The most essential requirements of dry ports are connectivity to a seaport, preferably rail, customs clearance services, freight distribution and intermodal transshipment facilities.

Road transport is the most flexible transport mode and is operated and managed usually by the private sector and public sector subsidiaries in some limited cases. Most railway route operations in Asia are still handled by public sector railway companies under overall government control. Quality is the single most significant problem in railway freight operations. In order to attract a greater share of freight, therefore, the quality of service and reliability must be improved whilst offering price attraction, and the punctuality of freight service maintained.

[38] John Howell, 1999, Roadside Bio-Engineering, Department of Roads, Nepal
[39] Transportation Adaptation to Global Climate Change, Bipartisan Policy Center, 2009, Washington, DC

In order to provide door-to-door service, railways must be integrated with existing logistical networks. Interfaces between railways and other transport modes are essential to encourage modal shift. It is suggested that government policies can help to increase rail freight share by developing rail freight as a business, encouraging a level playing field, private sector involvement and competition, and removing barriers at borders.

Rail-based intermodal freight transport is more environmentally friendly than truck-only transport, particularly in terms of CO_2 emissions and other pollutants when hauling over long-distances[40]. Rail is considered an ideal connection between seaports and dry ports[41].

Replacing truck haul from a seaport to dry port with railway in Sweden led to a 25% reduction in CO_2 emissions and helped to reduce port congestion as well[42]. Dry port and logistics centres can act as freight consolidation centers also have the potential to reduce empty truck trips. For example, 12-30% of trucks run empty in Pakistan and 43% in People's Republic of China[43]. A study of freight emissions in London revealed that establishment of consolidation and distribution centers led to combined 25.7% emissions reduction[44].

The promotion and development of intermodal transport and the modal shift to rail transport can help reduce emissions and environmental impact. Freight carried by rail emits much less CO_2 than freight transported by heavy goods vehicles. For example, in the UK, average CO_2 emission per ton/km measure 28.3 g for rail freight, 118.6 g for heavy good vehicle[45]. Use of cleaner and greener fuels/energy in transport and improvement of efficiency of transport operation through route and logistics planning can help reduce emissions. Improved logistics organization, coordination, and route planning could reduce up to 10-20% of CO_2 emissions[46].

However, we must be clear that inland intermodal long haul freight transport cannot be made emissions free, but efforts should be directed towards making intermodal transport more sustainable. It certainly is more sustainable than road freight transport.

6. Conclusion and recommendations

Asian countries with the support of their development partners have made substantial progress in developing regional and domestic transport infrastructure to enhance connectivity. However, still there are many substandard sections; missing links and bridges above all non-physical barriers are limiting their optimum utilization. Many sections of the Asian Highway and Trans-Asian Railway networks have been improved; upgrading and some portion of missing links have been planned. Now in order to better utilized these vast regional transport networks and offer intermodal transfer opportunities it is necessary that dry ports and intermodal transfer facilities need to be developed in key strategic locations.

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[40] Kim, N. S. and B. V. Wee, Assessment of CO_2 emissions for truck-only and rail-based intermodal freight systems in Europe, Transportation Planning and Technology, 32(4) (2009) 313-333

[41] Roso, V., J. Woxenius and K. Lumsden, The dry port concept: connecting container seaports with the hinterland, Journal of Transport Geography, 17(5) (2009) 338-345.

[42] Roso, V., Evaluation of dry port concept from an environmental perspective: A note, Transportation Research Part D, 12(7) (2007) 523-527

[43] Londono-Kent, P., Freight Transport for Development Toolkit: Road Freight, World Bank, Washington DC, 2009

[44] Zanni, A. M. and A. L. Bristow, Emissions of CO_2 from road freight transport in London: Trends and policies for long run reductions, Energy Policy, 38(4) (2009) 1774-1786.

[45] Department for Environment, Food and Rural Affairs of UK, 2009 Guidelines to Defra/DECC's GHG Conversion Factors for Company Reporting: Methodology Paper for Emission Factors, London, 2009

[46] OECD, Globalization, Transport and the Environment, Paris, 2010.

Improving regional, intercity and rural connectivity and bridging the infrastructure gap is a complex and challenging task that will continue to require the active involvement of all the stakeholders and a strong political commitment and collective efforts.

Based on the review of the progresses achieved and the challenges and opportunities linked to improve connectivity and develop regional transport infrastructure in Asia, the following recommendations are proposed for consideration:

(a) Utilize existing infrastructure and facilitate cross-border connectivity

One of the important concepts of developing regional transport connectivity is to utilize existing infrastructure as far as possible. Where physical connectivity exists these should be used for international trade by eliminating or reducing non-physical barrier at borders. This would need rational policy shifts and conducive policy environment, regulatory reform and administrative arrangements. It may be right time to call the next decade of regional connectivity for barrier free trade.

(b) Promote regional intermodal transport

Countries need to actively engage in developing and upgrading regional transport infrastructure. Having made progress in development of regular highway and railway routes, countries need to focus attention on developing dry ports of international importance as indentified in the intergovernmental agreement on dry ports. Work should be accelerated on enhancing the capacity of railway lines and initiate the development of long haul intermodal freight services that would be sustainable compared to road only modes.

Initially group of countries could identify feasible intermodal corridors and initiate freight services and gradually extend services to other corridors. This would contribute to the realization of an interconnected intermodal transport and logistic system.

Support commercial initiatives promoting the use of inland transport services for international trade, in particular rail transport, as a competitive alternative to maritime transport and back activities targeting the emergence of quality driven logistics services.

(c) Prioritize maintenance of transport infrastructure

Although the concept of asset management, road and rural road maintenance and management initiatives is being implemented in majority of Asian countries, many transport infrastructure and assets are not yet adequately managed and maintained in many developing countries and transition economies in Asia. Countries need to initiate policies to revitalize the asset management and adequately allocate resources for maintenance of transport asset including rural roads and enhance capacity of officials and communities. Review and adopt best regional practices as regards infrastructure maintenance institutional framework in order to preserve the value of the existing assets and as such reduce future financing needs.

(d) Revive inland waterways and using coastal shipping

Inland water transport (IWT) and coastal shipping being environmental friendlier options than other modes, countries may consider reviving informal IWT, improving river and sea port and initiate feasible IWT and coastal short shipping routes.

(e) Plan for resilient infrastructure

Integrate sustainable, inclusive and climate and disaster-resilient development considerations into planning and construction of transport infrastructure. Consider innovative design and use of construction materials to reduce carbon foot print and environmental impacts.

(f) Invest in railways

Despite its environmental superiority and efficiency, the share of railway investment is around 7-15% of total transport investment, therefore countries needs to consider policies to attract investment and mobilize resources for railway development. The news coming from People's Republic of China, India, Russian Federation and South-East Asia to further invest in high-speed inter-city railways, modernization of railways, and development of dedicated freight corridors is very encouraging.