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著者(和文)	OdchimarAnita II Alvarez
Author(English)	Anita II Odchimar
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報告番号	乙 第　　号	氏　名	Anita II Alvarez Odchimar

（要　旨）

For archipelagic regions, physical isolation is a development challenge. Especially for developing countries where uneven progress among the islands occurs, communities in small islands with small trade sizes and situated far from large cities would pay more to have access to needed goods. The challenge therefore is to build the region's infrastructure to be efficient in distributing goods and commodities using economies of density, while not aggravating other current problems the region is facing.

The Philippines is a developing country with archipelagic characteristics that could benefit from a seamless spoke-hub transport network design. An intermodal road–Roll-on Roll-off (RoRo) transport has been in use and promoted by the government to provide seamless transport; while, the use of hub-and spoke has been advocated by the private sector. While the country's capital city's port has the highest cargo throughput, it is not ideal to be a transport hub since the additional cargo traffic will increase the truck presence in the already congested roads of the metropolitan. Therefore, this study i) presents the current position of intermodal road-RoRo transport in the Philippines, ii) develops a hub-and-spoke network model suitable for an archipelagic region, and iii) explores the use of hub-and-spoke network while shifting cargo from Manila to adjacent port of Batangas to lessen the presence of trucks that contributes to road congestion in the capital.

The intermodal transport of the Philippines is unique from the motorways of the sea of other regions (e.g. Europe) since the self-powered cargo carrying vehicle traverses chains of islands and seas by RoRo vessels. As starting point, this study clarifies the current position of intermodal transport in the country by conducting a questionnaire survey with freight forwarders as respondents. The survey tackles the shares of the following domestic cargo transport modes i) container vessel transport, ii) intermodal road–RoRo transport and iii) air transport; and the attributes that affect shippers' mode preferences. Survey results show that the top influential attributes to the choice of intermodal road-RoRo transport are transport time, transport cost, frequency of vessels and reliability in terms of delay. Transport times and transport costs are estimated for several origin-destinations for both intermodal road-RoRo and container vessel transport choices. The following could be drawn from the results: i) dominance of intermodal transport for destinations along the western seaboard from Manila could be attributed to lower transport time, transport cost, and high frequency of vessels; ii) lower container transport costs for distances 600km away and the daily regular container vessel trips to some destinations could led the higher share of inter-island container vessel; and iii) estimated transport cost and transport time for intermodal transport are lower for Manila to Tacloban in the eastern seaboard but the higher share of container vessel transport could be due to the poor quality of road.

Next, a hub-and-spoke network suitable for archipelagic setting is developed incorporating intermodality of land mode (truck) and sea modes (container vessel and RoRo vessel modes), and the properties of multiple allocations, non-restrictive networking policy and general hub network topology; all of which have not been tackled simultaneously in one network model by other studies. The model here allows direct origin-destination calls without going through hubs thus coined as “mixed-network”. The Philippine scenario is considered for the numerical data and the large network problem of 25 nodes and up to 6 hubs cases is solved using Lagrangian relaxation heuristic. The model is able to locate hub ports where cases of intermodal road-RoRo and container transport could transship and be used complementarily. The proposed mixed-network model results in considerable total network transport cost savings compared with only direct transport case.

Lastly, a mixed hub-and-spoke network is modeled taking Batangas, Cebu and Bacolod as locations for hub ports. With this strategy, 11 to 23% of cargoes intended for Manila port would be shifted to Batangas port while there would be transport costs saving by shippers, as well as shipping costs reduction by shipping lines when operation is restructured from multi-port calling to direct calls within hub-to-hub. Shift in cargoes entails that the presence of trucks in the metropolitan area adjacent to the ports would be lessened and thus help decongest the roads in the area. From the results, policy suggestions are drawn such as improvement of port facilities for quick operations of multimodal transport and providing incentives in using Batangas port in the form of discounts or port fees elimination.

This study therefore contributes (i) knowledge on intermodal road-RoRo transport for archipelagic geography and its choice basis, (ii) on the development a hub-and-spoke network suitable for an archipelagic setting, and (iii) on the feasibility utilization of a hub-and-spoke network and cargo shifting in reducing the number of trucks intended for Manila port and, thus, lessen the presence of trucks in the capital that contribute to road congestion.