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An assessment of healthcare system accessibility of local communities in Yen Chau District, Son La Province

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Abstract. Son La Hydroelectric Project has designed the plant with the capacity of 2400 MW. It will provide electricity for not only the northwest region but also for the other regions of Vietnam. The project was approved by the Vietnam National Assembly on December 16th, 2002, in detail: Son La Hydroelectric Plant will be constructed mainly in Son La and Lai Chau provinces. It has water reservoir of 16 billion m3. Therefore, there are 13,656 households that have to resettle in new places. Healthcare facility is one of the very important public services for local communities, especially in the case of mountainous district as Yen Chau, Son La Province. Based on the AccessMod extension of ArcView software, we evaluated the mobility of local people as well as the capacities of healthcare system in the study area. The results of the study are showing that: there is only 77% of total population who can access the healthcare system in Yen Chau District. It means that the quality as well as the capacity of healthcare system did not meet the requirement of local people. On the other hand, accessibility is very useful method for assessing the quality of infrastructure system in rural area. It provided the important information of the real condition of public service system for local planners and managers.

Keywords: Son La Hydroelectric project; Accessibility; Resettlement; Healthcare facility; AccessMod.

1. Introduction

Son La Hydroelectric Project has designed the plant with the capacity of 2400 MW. It will provide electricity for not only the northwest region but also for the other regions of Vietnam. The project was approved by the Vietnam National Assembly on December 16th, 2002, in detail: Son La Hydroelectric Plant will be constructed mainly in Son La and Lai Chau provinces. It has water reservoir of 16 billion m^3. Therefore, there are 13,656 households that have to resettle in new places. There are three main methods for resettlement, such as: i) Roll up resettlement (in the other name as vertical resettlement). It means that the local people will move to higher position at the same site, it accounts for 20.1% of total people. ii) Mixing resettlement. It will move the local people to new places, where there is existing settlements. It takes 14.5% of total people. iii) The final method for resettlement is that the government will construct some new settlement sites for local

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people. It accounts for 65.4% of total people.

According to the Project of Resettlement, there are 10 districts of Son La Province, which will receive the people, including 83 communes and 218 resettlement sites. Yen Chau District, one of the districts of Son La Province, has suitable conditions for resettlement activities of Son La Hydroelectric Project. In order to resettle and rebuild the economic structure of the district, there are 16 resettlement sites in 7 communes are designed to receive the people with 750 households. Each household can get 1.0-1.5 ha of agricultural land and 2.0-2.5 ha of forestry land.

In fact, the resettlement activities in Yen Chau District are facing some difficulties, such as: 1) there are some resettlement sites, which are not suitable in terms of natural and socio-economic conditions; 2) in such resettlement sites, there are "native local people", who are living there along time. Therefore, there are some conflicts between the "old people" and the "new immigrants"; 3) the quality of infrastructure system in Yen Chau District is not good and it did not meet the requirements of local people. Such problems led the resettlement activities in the district as well as in Son La Province are unsuccessful as its designation.

Accessibility is a useful research method in order to evaluate the condition of infrastructure system in rural areas. The advantages of the method are: i) providing information about the quality of public services in specific region; ii) identifying the regions which local people can not access the public services; and iii) providing the necessary information for local planners and managers. Therefore, they can find the way to improve such services as well as infrastructure system.

The ultimate objectives of the paper are the followings: firstly, to analyze the characteristics of the study area, Yen Chau District, in both natural and socio-economic conditions; secondly, to evaluate the impacts of resettlement activities of the Son La Hydroelectric Project; thirdly, to analyze the healthcare system accessibility of local communities in the study area.

2. Study area and research methods

2.1. Study area

Yen Chau District is located in the southwest region of Son La Province. It situated at $21^{o}07'$-$21^{o}14'$N and $104^{o}10'$-$104^{o}14'$E between Son La and Moc Chau highland. The total area of Yen Chau District is 85,775 ha. The district has 14 communes and 1 town. In 2004, Yen Chau's population is 63,213 persons. In which, there are 80.8% of minorities, such as Thai, H'mong people. Agricultural land accounts for 76.13%, non-agricultural land is 20.38% and non-used land is 3.49% of total area. In general, socio-economic condition is not good as comparing with other districts. The local people get mainly benefit from agricultural activities. All of communes and town have healthcare infirmaries as well as post offices and so on. Nevertheless, their capacity is not good enough for the need of local people.

2.2. Database

The study used both kinds of data: spatial and non - spatial.

The spatial data include some digital maps of the district, such as: land use map in 2005, scale 1:25,000; map of existing forest in 2001, scale 1:25,000; topographic map in 2000, scale 1:25,000.

The non-spatial data include development reports of Yen Chau District in 2000 to 2005 as well as other related documents: reports of healthcare system (number of healthcare sites and their distribution); reports of existing population conditions,...

2.3. Research methods

Beside the traditional methods used in

geographical research, such as: field work, desk study, statistical analysis,... the study has applied the accessibility method as the new quantitative and core method.

Accessibility is the broad concept and it has a wide range of applications, in particular: urban studies (housing planning, social facilities planning and re-improvement [8]; public space planning [1]; market analysis [6]; rural studies (concepts and methodology of rural accessibility [2, 4, 7]; poverty and food [5]; rural accessibility [2, 7]).

In general, accessibility is known as: "*the amount of effort for a person to reach a destination*" or "*the number of activities which can be reached from a certain location*" [7]. An accessible location is considered as the site when the efforts to get there is acceptable to the target groups (local communities). Therefore, the concepts and the uses of accessibility are close related to the transportation system (length and quality,...), origins (local settlements) and destinations (public services).

According to Moseley, M.J., [7], there are three components of accessibility, including:

- People, who is living in the study area;
- Public services, which meet the need of local people;
- Transportation system or communication system play the role in order to connect local people to public services.

The size and structure of population are affected on the possibility of public service, when local people will identify the need of public services during their life in the particular period. The connections between three components show the travel cost and the efforts in order to travel from origins (their settlements) to destinations (public services). The public services component reflects the distribution of destinations and their quality in the study area (Fig. 1).

3. Healthcare system accessibility

3.1. Data processing

Based on the primary data as above-mentioned, we created three important maps for analysis process, including: Map of Origins (distribution of local settlements), Map of Destinations (distribution of healthcare sites), and Map of Transportation System (distribution and quality of transportation network). All of the three maps are presented in raster data format.

In order to create three maps, we used the AccessMod, the extension for ArcView software version 3.2. AccessMod is a module of World Health Organization (WHO). It is free for academic purposes. The extension uses both vector and raster data. The analysis tool for final purpose is using data in raster format.

3.1.1. Creating the map of origins

According to the data interpolation in AccessMod, map of origins contain information of population in each settlement. It uses the

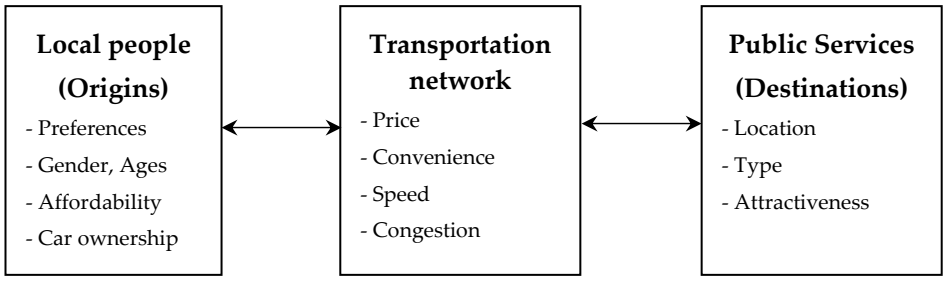

Fig. 1. The relationship between three main components of accessibility (source: Moseley [7]).

grid system to interpolate the population of settlement. It divides each origin into cells. Each cell contains a specific number of local people. We calculated the population of each settlement as the following:

$$C = \frac{P \times 400}{S},$$

where: C is the value of each cell; P is the population of each commune; and S is the total area of settlement.

According to the Regulation of the Government and the results of local people questionnaires processing, each household in average occupies an area of 400 m^2, we defined the size of a cell is 20x20 m. From the map of settlements (origins), which are in vector format, we rasterized this map to raster format. The result is showed in Fig. 2.

3.1.2. Creating the map of travel time

Travel time is known as the necessary and minimum time for people in order to move from origin to destination. In fact, the travel time is calculated as the total time to pass all of relief units from origin to destination (river, stream, hill, mountain,...) with the specific speed of each type of transportation (go on foot, bike, motorbike, car,...).

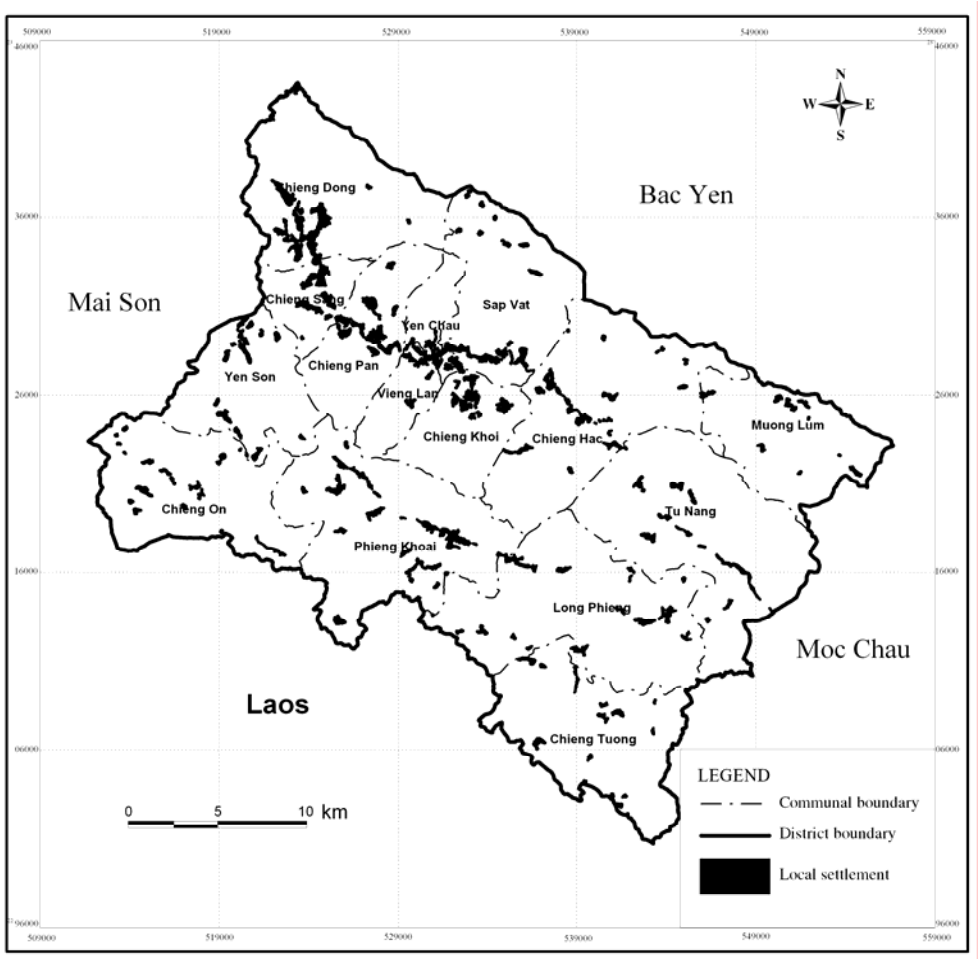

Fig. 2. The map of origins with their population data in Yen Chau District.

Map of travel time is the result of overlaying all layers with the specific attribute such as speed of transportation methods throughout all of relief units in the study area. In this step, we used digital elevation model (DEM) as the main information source to calculate the time to travel through all of relief units.

According to the questionnaires for local people as well as other related documents, the average speed of some main transportation types are shown in Table 1.

In the condition of Yen Chau District, we evaluated the average speed of transportation types throughout the relief unit, which based on the DEM. According to the Tobler's formula, this showed the relation between slope and other topographic conditions.

Table 1. Average speed in the specific land use type.

Land use type		Average speed
Road	National	45 km/h
	Provincal	30 km/h
	Distric	15 km/h
	Commune	10 km/h
River, stream		0,06 km/h
Agricultural land		6 km/h
Forest		3 km/h

3.1.3. The distribution of destination

In the study, destinations are healthcare facilities, including infirmaries and district hospital. There are two important attributes in this step: capacity of healthcare site and maximum threshold of travel time.

The capacity of healthcare site is defined as the number of local people is served by the particular healthcare site. According to Doherty [4], the capacity of healthcare site is calculated by the following formula:

$$C = \frac{Hw \times D \times \overline{P}_d}{P_y / P_{op}},$$

in which:

C : capacity of infirmary;

Hw : number of medical officer;

D : number of working day;

$\overline{P}_d$: number of average patient;

P_y : total patient in a year;

P_{op} : population of commune;

and for a hospital:

$$C = \frac{B \times R_b \times D}{(P / P_{op}) \times t}$$

in which:

C : capacity of local hospital;

B : number of hospital bed;

R_b : proportion of using hospital bed (%);

D : number of working day;

P : total patient in a year;

P_{op} : population of the district;

t : average time for treatment.

Maximum travel time is defined as the travel time of local people in order to travel from origin to destination. As it was mentioned in some documents, average maximum travel time is 60 minutes.

In Yen Chau District, there are two kinds of healthcare sites, such as: local infirmary (*Tram y te)* and local hospital (*Benh vien huyen*). Based on the fieldwork documents and the two above formulas, we created the map of healthcare system of Yen Chau District with their capacities (Fig. 3).

3.2. Healthcare system accessibility in Yen Chau District

The core method of the accessibility assessment process is the *Cost Distance interpolation*. In detail, the *Cost Distance* is calculated as follows: firstly, we started from destinations (healthcare sites). The service area of each healthcare site will be larger than the threshold of the maximum travel time as 1/4, 1/2, 3/4, and 1. Then, we overlaid its service area with the layer of distribution of origins. Finally, we checked when the capacity of healthcare site is over with four above-mentioned thresholds of the maximum travel time. There are two possibilities of the capacity

of healthcare sites: 1) The service area is over the maximum travel time but its capacity is not over. It means that this healthcare site has more potential capacity than the real condition. In this case, this healthcare site is in good condition. 2) On the other hand, when the service area could not be over the maximum travel time but the capacity is over. It means that this healthcare site is over in terms of the capacity.

The final results of this process show that:

- The service area of each healthcare site in Yen Chau District is showed in the Figure 5. Their service areas were combined into the bigger area in the direction of northwest – southeast. This shape contains the same direction of the main transportation network (national and provincial roads) of the study area. It is also suitable for the relief condition of Yen Chau District (according to the DEM model). Therefore, the service areas are located on the small valleys between mountain ranges.

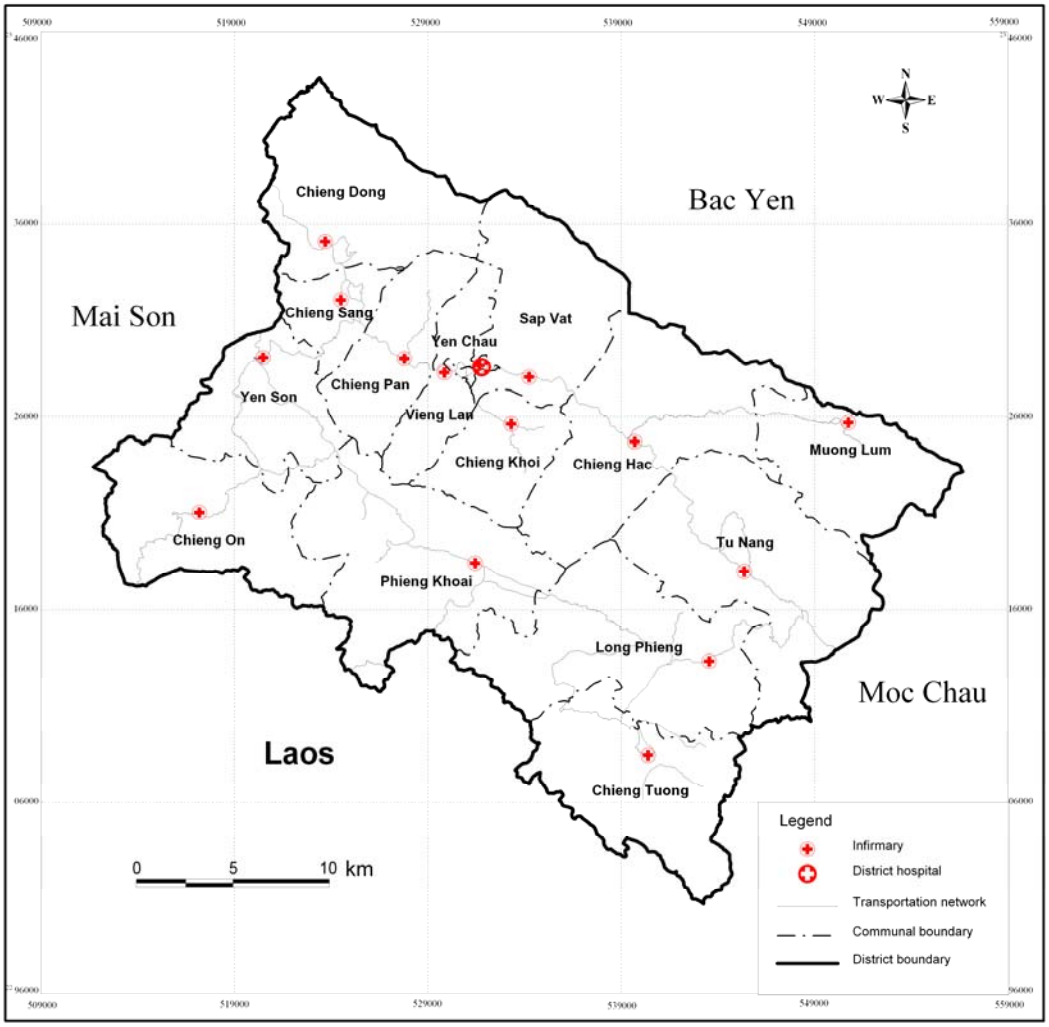

Fig. 3. The map of healthcare system of Yen Chau District.

Attributes of Hf.shp

Shape	Id	Tencosxa	Capacity	Traveltime	Accessmod	Cellpop	Catchpop	Coefpop	Calcff
Point	1	Chieng Dong	6465	60	3	0	2451	2451	60
Point	2	Chieng Sang	3591	60	9	0	2	2	60
Point	3	Yen Son	3637	60	8	1	1861	1861	60
Point	4	Chieng On	3967	60	6	0	3017	3017	60
Point	5	Chieng Pan	3507	60	10	0	184	184	60
Point	6	Vieng Lan	2023	60	16	0	0	0	60
Point	16	Benh vien huyen Yen Chau	25454	60	1	0	25716	25454	40
Point	10	Sap Vat	3452	60	11	0	34	34	60
Point	9	Chieng Khoi	2597	60	14	0	0	0	60
Point	8	Phieng Khoai	7793	60	2	1	6585	6585	60
Point	11	Chieng Hac	4070	60	5	0	377	377	60
Point	12	Muong Lum	2105	60	15	0	1098	1098	60
Point	13	Tu Nang	6291	60	4	0	5920	5920	60
Point	14	Long Phieng	3793	60	7	0	219	219	60
Point	15	Chieng Tuong	3268	60	13	0	1424	1424	60
Point	7	Thi Tran Yen Chau	3295	60	12	0	62	62	60

Fig. 4. The output results of healthcare accessibility in Yen Chau District.

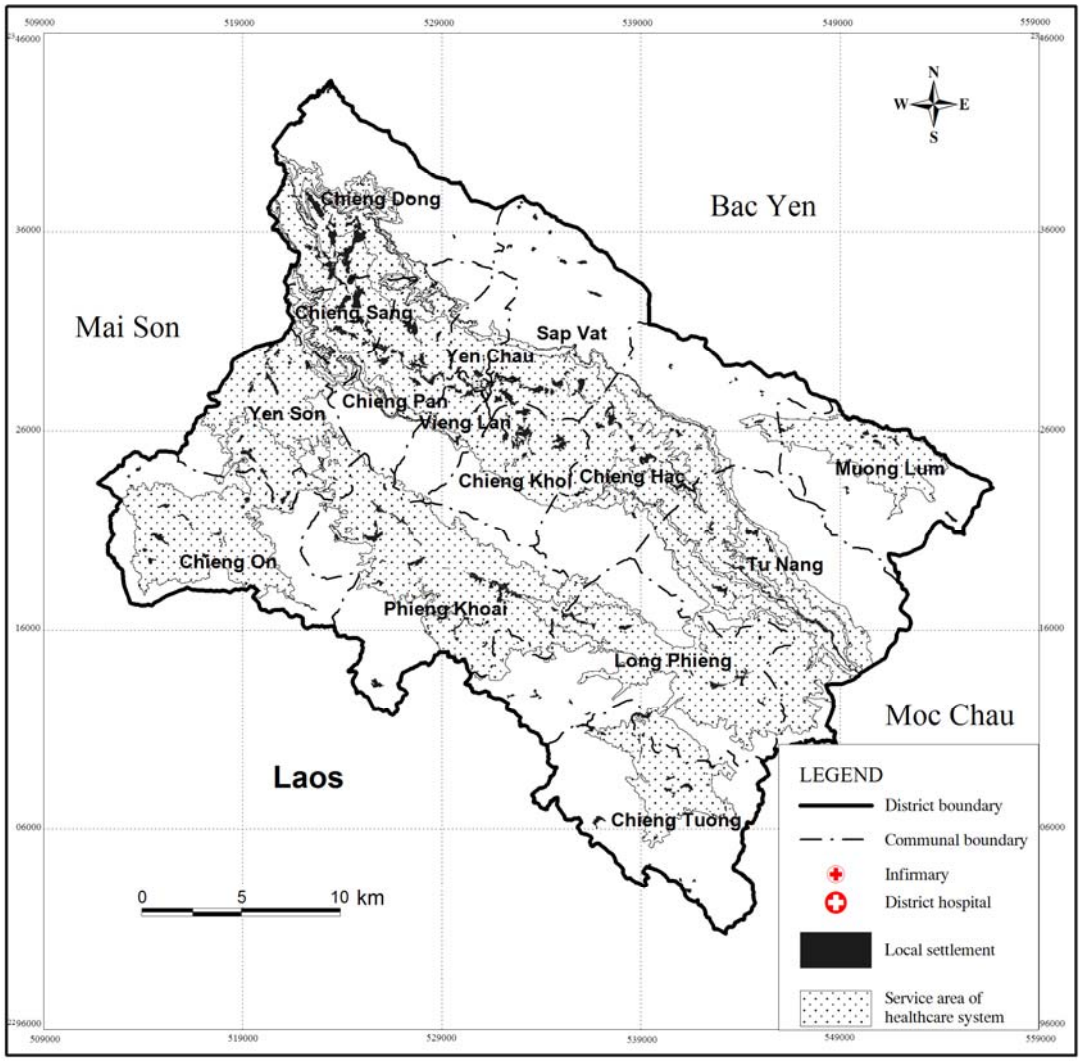

Fig. 5. Healthcare system accessibility of local communities in Yen Chau District.

- The second result is the table, which contains the detail and important data in the specific data fields: total population in the service area of each healthcare site (*Catchpop* field); the maximum travel time (*Calctt* field),... The table shows that: there is only 77% of total population of Yen Chau District who can access the healthcare sites easily. It is also showing that the capacities of healthcare sites are from the low to very low level. It means that the healthcare system of Yen Chau District did not meet the requirement of local people (Fig. 4).

4. Conclusions

Based on the distribution of healthcare system and the resettlement sites in Yen Chau District, we identified and classified that where is the good healthcare infirmary for local people. It means that local communities can access the public services as easy as they need. Therefore, the results of the study provided important information for planners and manager in terms of rural planning for specific objectives. It is more valuable for Son La Hydroelectric Project in order to resettle local people.

The infrastructure of Yen Chau District can be assessed by accessibility method. The case study in assessment of healthcare system accessibility provided important information for planning process of the district. Based on the results of the research, we can identify the needs for improving healthcare sites for local people.

Furthermore, the research showed the real condition of healthcare facilities of Yen Chau District, and we can identify which commune has difficulties to access the healthcare facility. Therefore, we can serve and improve the better facility for local people. On the other hand, GIS is very useful tool for this kind of research. Based on the spatial analysis advantages, we can easily identify the serving region of each healthcare infirmary as well as district hospital. The results of the research are showing clearly on the maps, which are helpful and attractive for local planners and managers.

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