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ASSESSMENT OF TEA AREA IN SRI LANKA

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The inconsistancy of existing tea areas in Sri Lanka often cause problems in proper planning and management of the industry. Therefore an attempt was made to assess the area using remote sensing techniques. The Landuse Mapping Project, linked with the National Landuse Mapping Programme of the Sri Lanka Survey Department produced district landuse map series, showing tea and other major landuse areas and their distribution. The tea areas thus computed were a close approximation of the real extent under tea.

INTRODUCTION

The accepted method of computing the area under tea cultivation is through records maintained by the Tea Commissioner's Division of the Sri Lanka Tea Board. It is a legal requirement under the Tea Commissioner's Act that all tea extents and their ownership are registered with the Tea Commissioner's Division which should also be kept notified of any changes in these in order to update information on the registered tea area. Even though the initial registration of tea plantations are normally done in order to obtain permits and licenses, to transport and sell green tea leaves to the manufacturer, the updating of this information is not done in practice. Further, a considerable hectarage of tea grown as small holdings on crown land and on plots with land disputes does not get registered at all. It is thus evident that the tea area statistics computed by the The Commissioner's Division will not reflect the correct position of the area under tea.

Figure 1 shows the pattern of tea production and variation in the area cultivated during the period 1960 to 1982. A three year running mean has been used in this figure to eliminate variations in production that occurred in any individual year due to weather and other factors like application or non-application of fertilizer. The figure clearly indicates the smooth co-ordination between area and production up to early 70's.

Despite the fact that there was a definite reduction of the area under tea plantations in mid '70s due to the diversification of vast areas of tea lands into other crops, especially in the mid country region, the statistics show a steady increase of the tea area from 1970's. The very attractive prices fetched for export crops like pepper, cloves, etc made the owners of small holdings to diversify from tea to these crops. Further a number of private plantations with extents of 20 to 40 ha (50 to 100 acres) taken over by the state and given to the National Agricultural Diversification and Settlement Authority (NADSA) were diversified from tea to other export crops. A fair number of small holdings registered as tea small holdings also opted to diversify. It must be pointed out that the

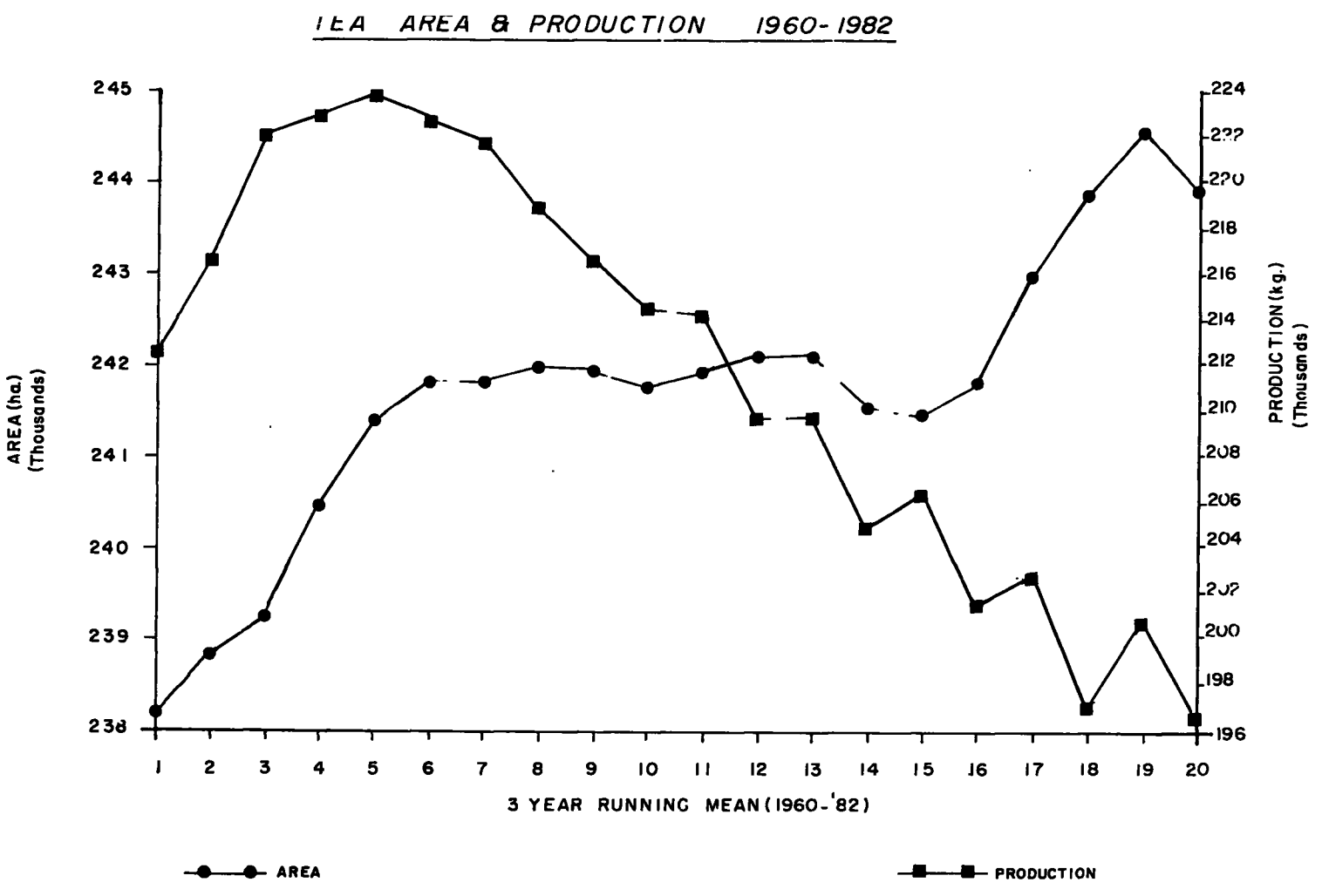

Fig. 1 – *Tea area and production* (1960 - 1982)

highest number of tea small holdings are in the mid elevation category and more than 61,000 tea small holdings are registered in the Tea Commissioner's Division. It must also be noted that some tea lands which come under the Land Reforms Commission (L.R.C.) that enacts the Land Ceiling Law, were allocated for village expansion schemes and for new settlements.

It should be stated that the area and production figures used for Fig. 1 were obtained from the records of the Tea Commissioner's Division. Even the production trend shown in Fig. 1 suggests that the available records of the area under tea cultivation are questionable. Despite the fact that there is a continuous increase of the area under high yielding clonal tea which replaces most uneconomical seedling tea areas there is a 6 % reduction in production from 1960-1970 compared to 1970-1980's. However, in actual fact, the production should have increased when the clonal plantations started bearing provided the area remained more or less constant throughout this period.

Such erroneous tea area computations not only give misleading statistics but also wrongly interpret national tea yield production and hence the general performance of the tea industry. Correct estimates for fertilizer and agro-chemicals are also not possible as only approximations could be made with the available statistics produced by the Tea Commissioner's Division.

It was thus imperative that the existing tea area was computed in a more rational manner. The Landuse Unit of the Tea Research Institute undertook to do this exercise using aerial photographs and other Remote Sensing data and techniques under the Landuse Mapping Project. This project operated as a co-project of the National Landuse Mapping Programme carried out by the Center for Remote Sensing (C.R.S.) of the Survey Department. Technical advice and some of the material aid for the project were given by the Sri Lanka/Swiss Remote Sensing Project under the Swiss Directorate for Development Co-operation.

METHODOLOGY

Remote Sensing

The field of Remote Sensing may be defined very broadly to include techniques that obtain reliable information about the properties of surfaces and objects from a distance. This may be accomplished by measuring 1) electro magnetic radiation emitted by or reflected from the surfaces or objects, 2) other force fields such as gravity or magnetic created or modified by them, or 3) mechanical, echostics, seismic vibrations or waves emanating from, being transmitted through or reflected from them (Humbel, 1982).

For the purposes of this study however the above definition will be restricted to the measurement of electro-magnetic radiation reflected or emitted by subjects on the earth's surface from a distance of at least a few hundred metres. Such measurements will be used to learn about the earth's resources in order to manage them better.

A Remote Sensing system consists mainly of two essential parts. They are the PLATFORM which brings the system to the required location and controls its position,

and the radiation measuring device called the SENSOR. Sensors must be able to measure the spectral, spatial and/or temporal variations of electro-magnetic radiation. Passive imaging sensors which concentrates on the measurements of the spectral variations of reflected sunlight and thermal emission are the most important and widely used type of sensors.

The final qualities of any remote sensing data are determined by both the chosen platform and the sensor. Probably the oldest and the most common combination is the aircraft equipped with the photographic camera, which for Sri Lanka is also a long approved and a very reliable tool.

Area Assessment by Remote Sensing

The Landuse Mapping Project which used the Remote Sensing techniques to obtain the area under tea cultivation accurately and rapidly, produced district landuse maps to the scale of 1:100,000 with major landuse categories including tea. In the district landuse map the distribution and extent of each landuse category under each Assistant Government Agent's (AGA's) division of the district is given. This is now a universally accepted method of producing maps. Most of the developing countries including China, India, Indonesia, Pakistan and Thailand obtain their area assessments of agricultural crops from maps produced using Remote Sensing techniques. Landuse extents of these maps are measured electronically to obtain numerical statistics (Humbel, Liyanage and Mendis, 1984). This method gives more accurate information than that of the statistics obtained from other sources and the area figures are therefore a close approximation of the real extent under tea cultivation.

Aerial Surveys in Sri Lanka

It was in 1956 that Sri Lanka first acquired aerial photographs. Under a project with Huntings Aerial Surveys Limited, U. K., the whole country was covered with 1:40,000 Black and white panchromatic photography. The first landuse survey using these aerial photographs was done during 1956 to 1959 and according to this survey the tea area in Sri Lanka was 246,890 ha. This figure was however higher than the registered tea area for the same period (1956-1958). But according to the registered records, the tea area in Sri Lanka increased steadily since 1956 and was 242,333 ha in 1968. This figure remained rather static from 1968 to 1977 and followed an unrealistic pattern thereafter (Fig. 1).

The aerial survey done by the Landuse Unit, TRI with the assistance of the Center for Remote Sensing using the aerial photographs obtained between 1980 and 1983 reveals that the tea area in Sri Lanka is 201,630 ha. In comparison with the previous aerial survey there is a reduction of over 45,000 ha or 18% (see Fig. 2).

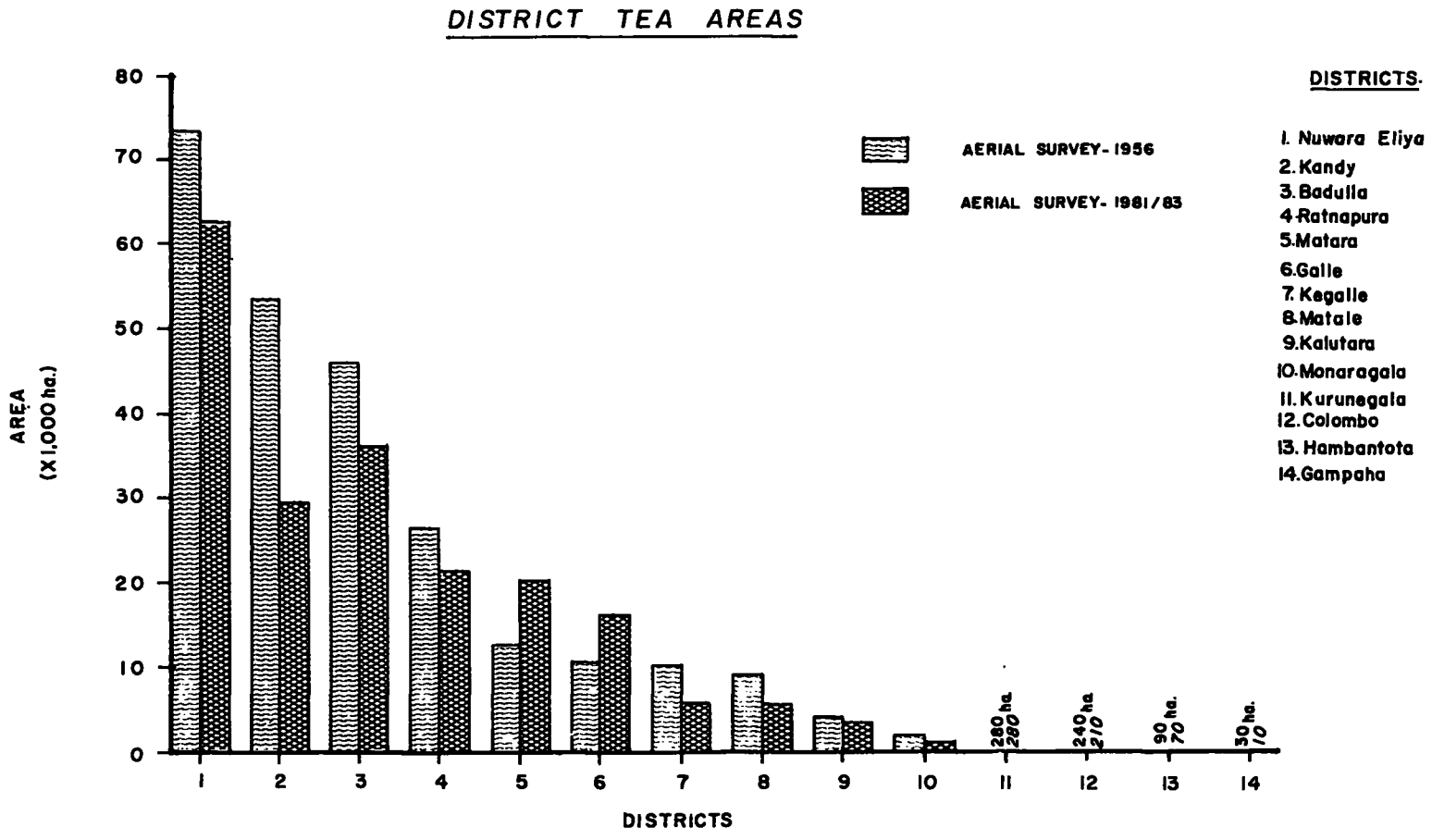

Fig. 2 – *District tea areas*

Note: For the districts 11 through 14 the actual hectarages are indicated

Landuse Mapping Procedure

A series of Landuse Maps showing the present land utilization in Sri Lanka has been published as a result of the aerial survey done using the aerial photographs of 1980-1983. These maps have been published as district maps to facilitate the district administration and planning. In keeping with international standards of landuse classification systems, 24 different landuse categories have been identified and the classification grouped into 3 levels (Perera, 1989).

A comparably simple procedure has been adopted in the preparation of these maps. Once the most recent aerial photographs are obtained covering a district the following sequence of steps are followed:

1. All aerial photographs are viewed under the stereoscope to gain a general understanding of the landuse pattern and the distribution within the district. If any unfamiliar landuse patterns appear on the photographs their locations are marked on the relevant topographic map.

2. A reconnaissance field survey is done throughout the district giving special emphasis to locations where unusual landuse patterns were visible on the aerial photographs.

3. A careful systematic interpretation of the landuse units are done on a transparent overlay using a mirror stereoscope. Units are demarcated according to the landuse legend given in Table 1. All the uncertain units are marked with a question mark, to be checked in the field subsequently.

4. All question marks on aerial photo interpretation sheets are checked in the field and necessary corrections are done on the sheets accordingly.

5. Each aerial photograph used is then individually scaled to obtain the accurate reduction factor to reduce the interpretation data to the scale of 1:100,000.

6. A transparent original is reproduced from the original 1" to a mile topographic map sheet to the scale of 1:100,000 for orientation support.

7. Geometrically corrected false colour satellite images obtained from LANDSAT 3 satellite are prepared for each topographic sheet area to the scale of 1:100,000 on a hard copy. This image is used as a base for transferring the landuse data.

8. Once the landuse data is transferred on to 1:100,000 scale overlays they are compiled together to get the entire district coverage.

9. Blue prints obtained from the compiled data sheets are then colour checked.Colour checking is a simple but sure method of detecting all errors of the maps as all open boundaries and units without symbols could be detected. All the errors found during colour checking will be corrected on the original data sheet.

10. The district sheet is then printed on a scribing sheet. All lines on the scribe sheet is then manually scribed.

11. Photographically processed peel coats are prepared for each landuse category, which will be used to produce colour plates, and special black and white transparent sheets to calculate the area under each landuse category.

12. Area measurements are done using an electronic area meter.

13. After completing various other standard cartographic and photographic steps the final maps are printed on six colour webb offset press.

RESULTS AND DISCUSSION

The area statistics obtained from the district landuse maps are compiled under each AGA's division of the district. Thus the tea areas in all the tea growing districts under their respective AGA's divisions can be obtained from these landuse maps.

It is also an important exercise to compile tea areas under each elevation category, as tea in Sri Lanka is categorized into three major elevation groups, viz,

a. Low country, below 610 m. b. Mid country, between 610 m to 1220m, c. Up country, above 1200 m.

As the contour boundary lines demarcating the above three categories are across AGA's divisions and districts it is not possible to assign any particular AGA's division to any of the above categories. However taking the average elevation of the tea plantations of each AGA's division a fairly accurate assessment of the tea areas under each elevation category could be made. Results of this assessment is given in Tables 1 to 3.

However it should be noted that due to limitations in resolution of the district landuse map which is at the scale of 1:100,000, small tea stands (<4 ha.) could not be mapped under the category "tea" but are included under "homesteads". When tea is interplanted with cocoa, coffee or pepper in the mid-country areas and with coconut, rubber and bananas in low-country districts, such areas are being mapped under "Mixed Tree and other Perennial Crops". This may have resulted in a reduction of the extents of tea shown in the landuse maps but this is negligible in relation to the total national tea area.

Periodical Monitoring.

The district landuse map, based on a satellite image in the initial stages of its production, can now be updated periodically using recent satellite image data in areas where considerable changes in the landuse pattern occurs due to various factors. The land under the Mahaveli Development Project is such an area where dynamic changes have and are taking place even at present.

The upper catchment development work of the Mahaveli Development Project made considerable changes in the landuse pattern in certain areas of Kandy and Nuwara Eliya Districts, especially the five AGA's Divisions where construction of Kotmale and Victoria reserviors and connected development work took place.

It is significant to note that these two districts together account for more than 45% of the total tea area in Sri Lanka consisting of almost all the Up country (southern

TABLE 1 – *Tea area statistics in up-country (elevation over 1220 m)*

District	AGA's Division	Area (ha)
Nuwara Eliya	Ambagamuwa Korale	16,130
	Nuwara Eliya	20,060
	Kotmale	5,335
	Uda Hewaheta	3,470
	Walapane	6,870
		51,865
Badulla	Passara	7,630
	Uva Paranagama	1,340
	Welimada	1,160
	Haputale	1,580
	Bandarawela	1,970
	Ella	4,210
	Haldummulla	4,650
		22,540
Monaragala	Bibile	90
	Kandukara Korale	1,040
		1,130
Up country total tea area		75,535

TABLE 2 – *Tea area statistics in mid-country (elevation 610 - 1220 m)*

District	AGA's Division	Area (ha)	
Nuwara Eliya	Ambagamuwa Korale	5,380	
	Kotmale	5,335	
			10,715
Badulla	Badulla	4,200	
	Kandaketiya	400	
	Meegahakiwla	550	
	Soranatota	950	
	Uva Paranagama	1,340	
	Hali Ela	4,880	
	Welimada	1,160	
			13,480
Kandy	Harispattuwa	1,460	
	Tumpane	40	
	Yatinuwara	770	
	Udunuwara	280	
	Kandy	480	
	Kundasale	450	
	Panwila	4,260	
	Meda Dumbara	3,740	
	Uda Dumbara	390	
	Pata Dumbara	7,490	
	Uda Palata	7,490	
	Ganga Ihala Korale	3,430	
	Pasbage Korale	3,650	
			29,340
Kurunegala	Ridigama	20	
	Kurunegala	190	
	Mawatagama	70	
			280
Matale	Matale	700	
	Rattota	2,200	
	Ambanganga Korale	870	
	Ukuwela	1,610	
	Naula	120	
			5,500
Ratnapura	Imbulpe	2,780	
	Balangoda	2,620	
	Kolonne	1,430	
			6,830
Mid country total tea area		66,145	

TABLE 3 – *Tea area statistics in law-coountry (elevation below 610 m)*

District	AGA's Division	Area (ha)	
Ratnapura	Eheliyagoda	140	
	Kuruwita	810	
	Ayagama	560	
	Nivitigala	1,510	
	Pelmadulla	1,950	
	Ratnapura	3,020	
	Weligepola	720	
	Atakalanpanna	2,130	
	Kalawana	3,630	
			14,470
Matara	Morawak Korale West	9,870	
	Weligam Korale North	3,200	
	Weligam Korale West	880	
	Weligam Korale South	460	
	Gangaboda Pattuwa South	10	
	Wellaboda Pattuwa West	10	
	Gangaboda Pattuwa North	410	
	Kandaboda Pattuwa East	90	
	Kandaboda Pattuwa West	1,790	
	Morawak Korale East	3,410	
			20,130
Kegalle	Rambukkana	10	
	Warakapola	40	
	Galigamuwa/Ambanpitiya	160	
	Kegalle	150	
	Mawanella	130	
	Aranayaka	260	
	Yatiyantota	2,800	
	Dehiowita	690	
	Deraniyagala	1,420	
			5,660
Kalutara	Raigam Korale West	20	
	Dodangoda	40	
	Pasdun Korale West	300	
	Pasdun Korale South	650	
	Pasdun Korale East	730	
	Gangaboda Pattuwa	1,010	
	Raigam Korale East	630	
			3,380

TABLE 3 – (*Contd.*)

District	AGA's Division	Area (ha)	
Galle	Wellaboda Pattuwa East	620	
	Wellaboda Pattuwa North	70	
	Wellaboda Pattuwa South	20	
	Gangaboda Pattuwa South	2,080	
	Bope-Poddala	60	
	Galle Four Gravets	20	
	Wellaboda Pattuwa West	1,270	
	Talpe Pattuwa South	800	
	Talpe Pattuwa North	2,910	
	Gangaboda Pattuwa North	1,920	
	Bentota Walallawita Korale East	690	
	Bentota Walallawita Korale South	640	
	Hinidum Pattuwa South	3,200	
	Hinidum Pattuwa North	1,700	
			16,000
Gampaha	Attanagalla	10	
Hambantota	Katuwana	70	
Colombo	Avissawella	210	
Low country total tea area		59,930	

sector) and most of the Mid country tea fields. Thus the activities taking place in these two districts could result in significant landuse changes and consequently have a direct effect in the production and management of tea land.

Periodical updating of maps in such areas will provide the industry with useful information for future planning purposes.

CONCLUSIONS

An important feature in landuse map statistics is that the area figures are detailed into AGA's divisions of the district. An advantage in the use of district landuse maps is that it is possible to obtain tea areas under each AGA's division of a district as well as the spatial distribution of the plantations within the district. The fact that the landuse map gives information on other landuse categories in the areas as well makes the map not merely a data source but a vital planning tool for the tea industry in Sri Lanka.

The ability to update the landuse data on these maps using remote sensing methods also enhances the usefulness of the landuse maps.

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