

## CURRENT WORKING TECHNOLOGIES FOR DRAFTING FOREST MANAGEMENT PLANS

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### ABSTRACT

**Keywords:** *time rule, production norm, forest management planning, forest management plans*

This paper identifies the technology and working methods used to develop drafts of forest management plans, with the required activities – executed using modern technologies and existing equipment – being indicated. Each operation in the drafting is described in detail, including the working technologies, organisation of the workplaces, training units, measurement units, instruments and equipment, working conditions with specific influence factors, and elements that contribute to the updating of working methodologies in the drafting and increase labour productivity.

### 1. INTRODUCTION

In the last three decades, major changes have been made in forest management planning that have been closely linked to developments recorded across several areas, especially calculation techniques, the theory of relational databases, database management systems, geographic information systems (GISs) and the evolution of equipment, software, etc.

The entire process of data collection and the development of forest management plans is part of a normal process of adapting to the realities of the moment and removing novel elements from various fields of activity.

For the processing of field data, specific software products have been developed and adapted in tandem with developments in computing techniques. In 1992, an informatics product – AS – Forest management plans version 3.3 – was developed, which carried out the computer-aided design of forest management on IBM PC-compatible computers. It was configured in MS-DOS version 4.1, which could be used on a

personal computer. This was a redesign of the previous version (3.2) that could be used on a Junimicrocomputer (Seceleanu, 1992).

This product was used as long as it was possible to operate using existing operating systems (from 1992 to 2005), up to the appearance of Windows 95. When the operating system became incompatible with the forest management planning software, the software had to be redesigned to be compatible with the operating systems existing after 2005. As a consequence, the informatics product AS2007 – Forest management plans was produced, developed for Visual Fox Pro. This was compatible with Windows 95 through Windows Vista (Lazar et al., 2009). The facilities provided by this new software enabled a developed database to be obtained, which could contain a greater number of reports, with the direct consequence of shortening the period of development of forestry management plans.

Also, GIS studies based on accumulated knowledge have, since 2001, enabled the archiving of GIS databases in forest management plans;

the first plan developed using GIS was in Brănești Forest District (FD). The forestry maps obtained using the GIS technique for the plan were made using digitisation in Autocad MAP, the topologies used ArcInfo Workstation and the GIS side using ArcView 3.1 C512 (Achim, 2013). The GIS database included spatial information taken from the maps used in forest management and descriptive information taken from the field.

The implementation of GIS in forest management planning has provided several benefits, including reducing the time needed to produce and update the maps, reducing the time involved in updating the database, obtaining accurate and standardised information and allowing quick access to information.

Based on these technology-influencing aspects, we here present the current working technology for developing forest management plans, which has replaced the classic technology used before the introduction of GIS techniques.

The need to identify the existing operations results from the need to update time and production norms, which have direct implications for increasing productivity in the management planning stage.

## **2. MATERIAL AND METHOD**

In order to identify the activities carried out by personnel during the drafting of forest management plans, and to study the work time in such a way that the recorded data would lead to the development of time and production norms for developing forest management plans, it was necessary to use appropriate technical methods. Thus, for the identification of activities related to this phase, observation and photography

of the working day were employed. The photography involved two steps – preparation and photograph-taking.

The preparation involved choosing the workers about whom the observations were to be made, and explaining to them the purpose and importance of the observations. They had to work at a normal pace, following their working methodology, and complete a working conditions sheet. The photography involved recording an entire activity being performed by the chosen worker during regular work hours.

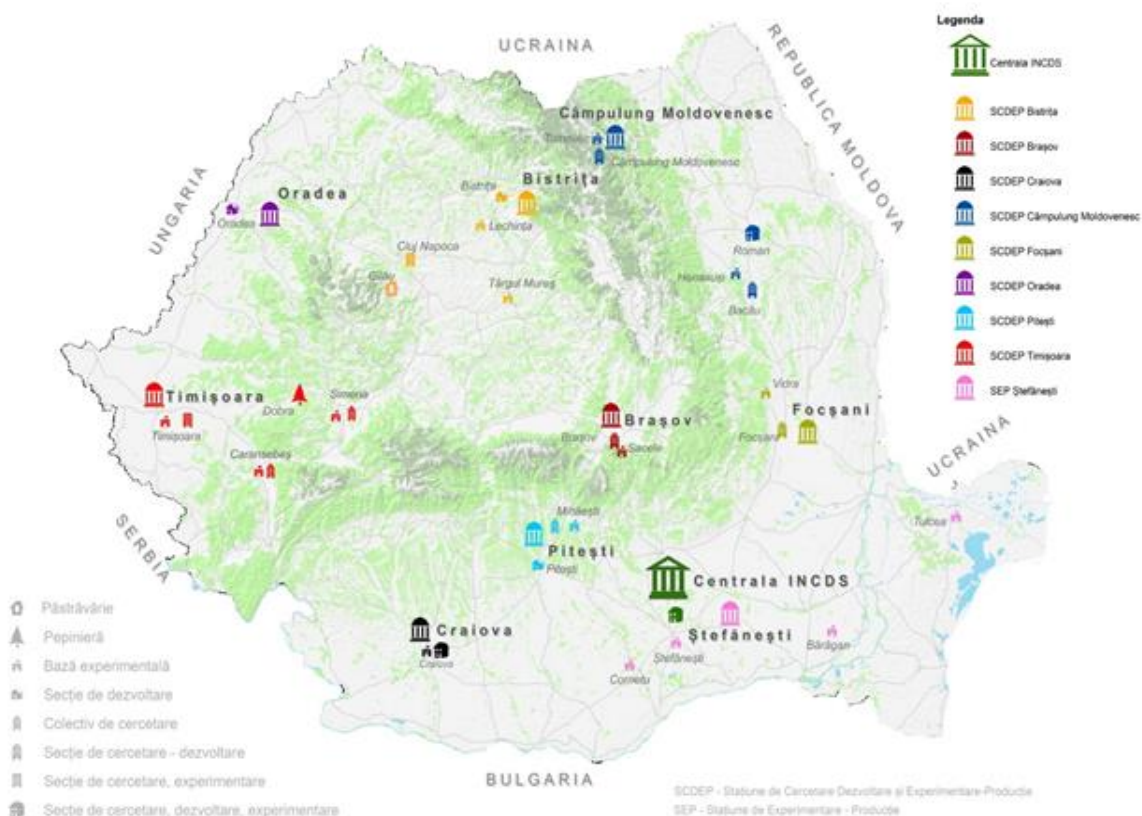
Each activity was recorded on photograph sheets, using a clock and a timer to record the times and duration of each work element.

The observations were made, using the subunits of the National Institute for Research and Development in Forestry 'Marin Drăcea', in Brașov, Craiova, Bistrița, Roman, Timisoara, Pitesti and Oradea (Fig. 1).

In all the subunits of the institute, there are specialised, collective workers who carry out forest planning, and it was intended that all of them would be involved in the implementation of the project. In this way, the representativeness of the results was ensured at the national level.

## **3. RESULTS AND DISCUSSIONS**

Eight operations were identified in the activity of drafting forest management plans, as compared to nine (according to the previous procedures that existed before implementing the GIS system) (Table 1).



**Fig. 1 Subunits of the National Institute for Research and Development in Forestry ‘Marin Drăcea’**

**Table 1**

Operations identified for drafting forest management plans (numbered points in the second column are referred to in the text below by their numbers)

Classic writing, work operations	Current writing, work operations	
Drafting forest management plans	Drafting forest management plans	Works using GIS techniques
1. Graphical reports, classic technology	1. Graphical reports, modern (digital) technology	
2. Cubic calculations, classic technology, manual calculations or dedicated software	2. Cubic calculations, modern technology, dedicated software	
3. Transposition the parcel and subparcel from the old plans to the new ones using photography or photocopying	3. Transposition the parcel and subparcel from the old plans to the new ones using scanning and vectorising	
4. Assemble reports on the basic plans using classic methodology	4. Assemble reports on the basic plans using modern (digital) methodology	

5. Classical method using a planimeter	-	Analytical determination of surfaces
6. Draw the old map, classically	-	Develop maps using GIS techniques
7. Automated data processing using the AS3 – Forestry software product	5. Automated data processing using the AS2009 –Forestry software product	
8. Draft the forest management plan on Yield Management Unit (YMU), write the manuscript	6. Preparation for the second Conference on Forest Planning	
	7. Draft the forest management plans on YMU, write on PC	
9. Guidance for, and reception and approval of, the forest management plan draft	8. Guidance for, and reception and approval of, the forest management plan draft	

Below are brief descriptions of each identified operation, and the differences between the classic technology and that used after the implementation of GIS.

**1. Graphical reports** are currently produced in the office by a technician or engineer, using GPS equipment, a PC computer and printer. The unit of measurement is 1000 reported points. In the classic system of drafting forest management plans, the graphical reports were produced by a designer or technical designer, using a spacer, a rapporteur, millimetre paper and calc paper, and the unit of measurement was also 1000 reported points (Ministry of Forest Waters and Environmental Protection - MFWEP, 1999). The current working technology is radically different and improved due to changes in field data collection equipment and the replacement of topographic compasses with GPS technology.

Observations for the graphical reports were made in 19 forestry

areas/experimental bases (Table 2), where:

- the production units (YMUs) had different surface sizes (from 935.3 ha to 6352.65 ha);
- the layout units had different surface sizes, to illustrate the diversity of situations;
- the YMUs in which a variable number of field measurements were carried out also captured the quantity of work performed per territorial unit;
- various specialised software packages, compatible with the GPS equipment, were used for the measurements;
- topographic measurements were made using Trimble and Garmin GPS devices.

**Table 2**

**Elements of YMU characterisation observed for the graphical reports**

No	INCDS (NIRDF)	Observed data from forest district's forest management plans								
		Forest district/	Yield management unit (no.) (UP)	Surface of Yield management unit (ha)	No. forest management units (ua)/ Yield management unit (UP)	Surface of average forest management unit /PU	No. of measured and reported points	No. of measured ua' s	Tip of device used for measurement	Software
1	Braşov	Maneciu	IV	3274,18	321	10,2	1082	246	Garmin 64S	Softuri specializate
2	Braşov	Azuga	I	935,3	190	4,92	1300	152	Garmin 64S	Softuri specializate
3	Braşov	Fagaras	II	3115,09	365	8,53	1440	107	Garmin 78S	Softuri specializate
4	Bistriţa	Mălini	I	2951,52	209	14,12	1855	78	GPS Garmin	Softuri specializate
5	Bistriţa	Cluj	III	935,61	193	4,85	4260	132	GPS Garmin	Softuri specializate
6	Bistriţa	Dragomireşti	II	3696,78	624	5,92	6030	151	GPS Garmin	Softuri specializate
7	Craiova	Orşova	I	2245,88	254	8,84	1986	180	Garmin	Softuri specializate
8	Craiova	Orşova	V	4339,25	348	12,47	2294	210	Trimble	Softuri specializate
9	Craiova	Orşova	VI	3144,54	295	10,66	2302	190	Garmin	Softuri specializate
10	Craiova	Drăgăneşti Olt	I	1084,6	498	2,18	910	323	Trimble	Softuri specializate
11	Craiova	Drăgăneşti Olt	II	1323,91	455	2,91	956	315	Trimble	Softuri specializate
12	Oradea	Dobreşti	VI	1211,82	307	3,95	304	16	Garmin	Softuri specializate
13	Oradea	TârguLăpuş	I	2381,98	763	3,12	7928	426	Garmin	Softuri specializate
14	Oradea	Ilia	II	2665,93	617	4,32	1908	96	Garmin	Softuri specializate
15	Roman	Brăila	IX	704,2	132	5,33	728	32	GPS Garmin	Softuri specializate
16	Roman	Bârlad	I	1228,57	415	2,94	2200	88	GPS Garmin	Softuri specializate
17	Roman	Tomnatic	I	6352,65	728	8,75	5380	269	GPS Garmin	Softuri specializate
18	Timișoara	Păltiniş	I	2812,54	372	7,56	2423	372	Garmin Montana 650	Softuri specializate
19	Timișoara	Valea Mare	II	2290,98	288	7,95	3781	288	Garmin Montana 650	Softurispecializate
20	Pitesti	Rusca	XIII	1217,02	370	3,29	1225	185	GPS Montana	Softuri specializate
21	Pitesti	Amaradia	III	3647,26	689	5,29	1382	50	GPS Montana	Softuri specializate
22	Pitesti	Curtea de Arges	IV	1683,83	407	4,14	1123	47	GPS Montana	Softuri specializate
	<b>Total</b>			<b>43513,8</b>	<b>8840</b>		<b>52797</b>	<b>3953</b>		

**2. Cubic calculations** are performed in the office by a designer (technician or engineer) using a PC, specialised software, a field notebook, a notebook with the centralisation of the sheet points and a printer. The unit of measurement used is the number of development units. In the classic system of drafting forest management plans, cubic calculations were performed manually by a technician, using a field notebook, a notebook with the centralization of the sheet points and a

sheet of cubic calculations. The unit of measurement was also the number of development units (MFWEP,1999). The technology has been much improved by using specialised software.

Observations for the cubic calculations were made in 19 forestry areas/experimental bases (Table 3), and:

- the observations were made in 21 YMUs in different geomorphological areas of the country;

- the observations were carried out in forestry units where the trees were inventoried by statistical land integral procedures (wire by wire);
- the stands comprised a variable number (1–5) of species, so that the influencing factors having a significant impact on the calculation of the time and production norms could be identified, analysed and selected;
- forestry units made up of a variable number of trees were analysed;
- a single specialised software was used for the automated calculation of the volumes of the inventoried trees;
- observations were made on a total of 704 stands, with the total number above 420000 trees.

**Table 3**

Elements characterising the YMU observed for use in the cubic calculations

No	INCDS (NIRDF)	Observed data from forest district's forest management plans									No. of forest management units that were subject to observations (photographed)
		Forest district/	Yield management unit (no.) (UP)	Surface of Yield management unit (ha)	No. forest management units / Yield management unit	Average area of forest management unit (ha)	No. of inventoried stands / Yield management unit	No. tree species / inventoried forest management units and in which observations were made	No. trees / inventoried forest management units and in which observations were made	IT product (software) used for volume calculations	
1	Braşov	Azuga	VI	2070,7	205	10,1	13	1-2	40-500	Program cubaj specializat	13
2	Braşov	Maneciu	V	924,18	135	6,85	29	1-2	200-400	Program cubaj specializat	29
3	Braşov	Fagaras	II	3115,09	365	8,53	35	1-3	100-1200	Program cubaj specializat	35
4	Bistriţa	Mălini	I	2951,52	209	14,12	31	4	29820	Program cubaj specializat	31
5	Bistriţa	Cluj	III	935,61	193	4,85	16	9	18768	Program cubaj specializat	16
6	Bistriţa	Dragomireşti	II	3696,78	624	5,92	71	9	25970	Program cubaj specializat	71
7	Craiova	Orşova	III	3536,23	646	5,474	54	1	158	Program cubaj specializat	54
								2	8072		
								3	14568		
								4	18636		
								5	1443		
8	Craiova	Orşova	VII	3534,34	318	11,114	37	1	389	Program cubaj specializat	37
								2	5810		
								3	5588		
								4	13788		
								5	2518		
9	Craiova	Orşova	IX	5607,94	480	11,683	36	1	12667	Program cubaj specializat	36
								2	11383		
								3	5573		
								4	1984		
10	Craiova	Drăgăneşti Olt	II	1323,91	455	2,91	23	1	7430	Program cubaj	23
								2	1697		

								3	1828	specializat	
								4	4465		
								1	304		
								2	2269		
11	Oradea	Dobrești	VI	1211,82	307	3,95	60	3	13757	Program cubaj specializat	13
								4	5622		
								5	2393		
12	Oradea	Târgu Lăpuș	I	2381,98	763	3,12	90	1	1197		11
								2	963		
								3	2550	Program cubaj specializat	
13	Oradea	Iliia	II	2665,93	617	4,32	75	1	2404		15
								2	1335		
								3	2306		
								4	1607		
14	Roman	Brăila	IX	704,2	132	5,33	41	1-3	6017	Program cubaj specializat	41
15	Roman	Bărlad	I	1228,57	415	2,94	42	3-4	32874	Program cubaj specializat	42
16	Roman	Tomnatic	I	6352,65	728	8,75	126	2-3	127883	Program cubaj specializat	126
17	Timișoara	Păltiniș	I	2812,54	372	7,56	27	3	560	Program cubaj specializat	27
18	Timișoara	Valea Mare	II	2290,98	288	7,95	30	3	540	Program cubaj specializat	30
19	Pitești	Rusca	XIII	1217,02	370	3,29	20	1,2	2250	Program cubaj specializat	20
20	Pitești	Amaradia	III	3647,26	689	5,29	57	1,2,3	13575	Program cubaj specializat	16
21	Pitești	Curtea de Argeș	IV	1683,83	407	4,14	22	1,2,3,4	10245	Program cubaj specializat	18
	<b>Total</b>						<b>935</b>				<b>704</b>

**3. Transpositioning of the parcel and subparcel on the base map (change or create the base map)** is currently performed in the office by an engineer, using a PC, specialised software, the old 1:10,000 topographic plans, the forestry maps, orthophotomaps and a plotter, and the unit of measurement for the base map transposition is  $\text{dm}^2$ . In the classic system of drafting forest management plans, the transposition of parcels and subparcels from the old base maps to the new ones (change the base map) was performed by a worker and a technical designer. The work technology in the classical system was different, with the old plans being

transposed using photography or photocopying, at the same topographical scale as the new plans. The existing information from the new plans was copied onto calc paper and, using a special table to which the new plans were fixed, the contours of the existing parcels and subparcels were drawn using a pen. Then, the parcels and subparcels on the new plans were drawn onto the printed boundaries, and the information was completed with the number of parcels, subparcels and bourns. The unit of measurement was also  $\text{dm}^2$  (MFWEP, 1999).

Observations on the transposition of the parcel and subparcel to the base map

(change or create the base map) were performed in four forestry areas (Table 4), and included:

- five production units of different surface size (from 935 ha to 3697 ha) and with various areal sizes (from 5.9 ha to 11.8 ha);
- the areas transposed on the base planes ranged from 7 dm<sup>2</sup> to FDFăgăraș and 29 dm<sup>2</sup> to FDRâșca;

- the transposition of the parcel and subparcel to the base map was carried out on the topographic plans (scale 1:5000), as recommended by technical forest management norms;
- the observations were made for the 317 units transposed onto the topographic plans.

**Table 4**

Elements characterising the YMUs observed for use in the transposition of the parcel and subparcel

No	INCDS (NIRDF) station	Observed data from forest district's forest management plans							
		Forest district/ Experimental base	Yield management unit (no.) (UP)	Surface of Yield management unit (ha)	No. forest management units / Yield management unit	Average area of forest management unit (ha)	(dm <sup>2</sup> )	The scale of the assembled plan	No. of transposed forest management units
1	Brașov	Rasca	V	2790,7	237	11,78	29,17	1:5000	73
2	Brașov	Făgăras	II	3115,09	365	8,53	10,246	1:5000	35
3	Brașov	Făgăras	I	2117,12	362	5,85	7,07	1:5000	24
4	Bistrița	Cluj	III	935,61	193	4,85	18,4	1:5000	96
5	Bistrița	Dragomirești	II	3696,78	624	5,92	20,6	1:5000	89
<b>Total</b>				<b>12655,3</b>	<b>1781</b>				<b>317</b>

**4. Assembling reports and updating information on the basic plans** is now performed in the office by an engineer, using a PC, specialised software, the field reports on the subparcels measured electronically or printed out on hard support format, the orthophotoplanes and a plotter, the unit of measurement is the dm<sup>2</sup>. In the classical system, assembly of the reports on the basic plans was carried out by an engineer, using the kilometre as the unit of measurement. The work technology in the classic system is different, insofar as the graphical reports executed on calc paper overlapped on the base planes through connection points (bourns, roads, borders, valleys, peaks). After this overlapping, by pinching the reported points and then drawing the contour by joining the resulting signs, the base plan was assembled using the reported details (MFWEP, 1999).

Observations for assembling reports and updating information on the cartographic bases were made in 19

forestry areas/experimental bases (Table 5), and included:

- the geomorphology (wetland, plain, hill, mountain) constituted a potential influencing factor in the forestry area in determining time and production norms;
- YMUs with different surface sizes, from 704 ha in YMU IX from FD Braila to 6352 ha in YMU I from Experimental Base Tomnatic;
- report assembly for parcels and subparcels was carried out for both base planes at scales 1:5,000 and 1:10,000;
- observations on 4926 subparcels assembled on the base planes;
- subparcels assembled on basic measurements from the ground and graphical reports from the office, as well as on information from other sources (orthophotoplanes, the National Cadaster Agency NCAweb portal, etc).



**Table 5**

**Elements characterising the YMUs observed for use in assembling reports and updating information on basic plans**

No	INCDS (NIRDF) station	Observed data from forest district's forest management plans									No. of assembled forest management units that have been photographed (observed)
		Forest district/ Experimental base	Yield management unit (no.) (UP)	Surface of Yield management unit (ha)	No. forest management units / Yield management unit	Average area of forest management unit (ha)	(dm <sup>2</sup> )	The scale of the assembled plan	No. of forest management units assembled using plotting (measurements)	No. of forest management units with updated boundaries (limits) based on informations other than made measurements	
1	Brașov	Maneciu	IV	3274,18	321	10,20	93,00	1:5000	246	0	246
2	Brașov	Azuga	I	935,3	190	4,92	14,73	1:5000	152	0	152
3	Brașov	Faga-ras	II	3115,09	365	8,53	10,28	1:5000	107	0	107
4	Bistrița	Mălini	I	2951,52	209	14,12	118,06	1:5000	78	35	113
5	Bistrița	Cluj	III	935,61	193	4,85	37,42	1:5000	132	97	229
6	Bistrița	Dragomirești	II	3696,78	624	5,92	24,51	1:5000	354	0	354
7	Craiova	Orșova	II	3501,99	620	5,65	140,08	1:5000	471	85	556
8	Craiova	Orșova	IV	5479,68	633	8,66	21,19	1:5000	450	80	530
9	Craiova	Orșova	X	1620,29	188	8,62	64,81	1:5000	96	25	121
10	Craiova	Drăgănești Olt	II	1323,91	455	2,91	52,96	1:5000	315	35	105
11	Oradea	Dobrești	VI	1211,82	307	3,95	48,45	1:5000	16	30	116
12	Oradea	Târgu Lăpuș	I	2381,98	763	3,12	95,49	1:5000	426	34	139
13	Oradea	Ilia	II	2665,93	617	4,32	108,27	1:5000	96	29	129
14	Roman	Brăila	IX	704,2	132	5,33	28,17	1:5000	32	100	20
15	Roman	Bârlad	I	1228,57	415	2,94	47,75	1:5000	415	0	415
16	Roman	Tomnatic	I	6352,65	728	8,75	306,75	1:5000	735	735	735
17	Timișoara	Păltiniș	I	2812,54	372	7,56	28,13	1:10.000	372	372	372
18	Timișoara	Valea Mare	II	2290,98	288	7,95	91,64	1:5.000	288	288	288
19	Pitești	Rusca	X	2405,48	512	4,70	24,05	10000	74	95	102
20	Pitești	Amara-dia	III	3647,26	689	5,29	9,11	5000	103	23	50
21	Pitești	Curtea de Arges	IV	1683,83	407	4,14	4,20	5000	133	27	47
	<b>Total</b>			<b>54219,6</b>					<b>5091</b>	<b>2090</b>	<b>4926</b>

**5. Automated data processing** is performed at the office, by an engineer/technician or programming analyst, using a PC, specialised software, field notebooks, an ecotypical scheme and a printer. The unit of measurement used is the number of YMUs. In the classic system, automated data processing was performing by a worker,

and the the unit of measurement used was forest area, YMU and the FD. The working technology in the current system is the same as in the classic one. The current software is AS2009 –Forest management plans, which replaced the previous AS -Forest management plans, version 3.3.

The observations for the automated data processing with specialised software were made in 19 forest areas/experimental bases (Table 6):

- the geomorphology (wetland, plain, hill, mountain) constituted a potential influencing factor in the forestry area in determining time and production norms;
- the production units had different surface sizes, from 704 ha in YMU IX from FD Braila to 6352 ha in YMU I from Experimental Base Tomnatic;

- the time taken to enter data on forest type (with one-two stand components, three, four stand components or more) on parcellar description sheets influenced the duration of these operations;
- the parcellar description sheets contain a description of the land with special designated areas, which involves a small amount of data and information; the time taken to input these into the forest planning software is variable.

**Table 6**

Elements characterising the YMUs observed for use in automated data processing

No	INCDS (NIRDF) station	Observed data from forest district's forest management plans								
		Forest district/ Experimental base	Yield management unit (no.) (UP)	Surface of Yield management unit (ha)	No. forest management units / Yield management unit	Average area of forest management unit (ha)	Forest management units with:			Special designated areas (TDS)
						1-2 stand component (s)	3 stand components	4 stand components		
1	Braşov	Rasca	IV	2255,23	229	9,85	40	62	85	42
2	Braşov	Maneciu	III	1691	107	15,80	31	49	13	14
3	Braşov	Azuga	I	935,3	190	4,92	50	31	54	55
4	Bistriţa	Mălini	I	2951,52	209	14,12	61	71	43	34
5	Bistriţa	Cluj	III	935,61	193	4,85	93	37	43	20
6	Bistriţa	Dragomireşti	II	3696,78	624	5,92	296	157	45	126
7	Craiova	Orşova	II	3501,99	620	5,65	210	163	175	72
8	Craiova	Orsova	IV	5479,68	633	8,66	201	180	193	57
9	Craiova	Drăgăneşti Olt	I	1084,6	498	2,18	364	86	48	124
10	Craiova	Drăgăneşti Olt	II	1323,91	455	2,91	405	18	32	106
11	Craiova	Drăgăneşti Olt	III	1228,86	613	2,00	499	65	49	38
12	Oradea	Dobreşti	VI	1211,82	307	3,95	42	10	8	24
13	Oradea	Târgu Lăpuş	I	2381,98	763	3,12	17	67	6	49
14	Oradea	Iliia	II	2662,93	617	4,32	32	33	30	44
15	Roman	Brăila	IX	704,2	132	5,33	109	9	1	13
16	Roman	Bârlad	I	1228,57	415	2,94	272	47	46	50
17	Roman	B.E.Tomnatic	I	6352,65	728	8,75	76	25	25	84
18	Timișoara	Păltiniș	I	2812,54	372	7,56	153	83	69	67
19	Timișoara	Valea Mare	II	2290,98	288	7,95	43	84	129	35
20	Pitești	Rusca	X	2405,48	512	4,70	409	66	37	95
21	Pitești	Amaradia	III	3647,26	689	5,29	23	274	392	51
22	Pitești	Curtea de Argeș	IV	1683,83	407	4,14	78	302	27	71
	<b>Total</b>			<b>52466,72</b>	<b>9601</b>		<b>3504</b>	<b>1919</b>	<b>1550</b>	<b>1271</b>

**6. Preparation for the second Conference on Forest Planning** is now performed in the office by an forester (engineer/subengineer), using a PC,

specialised software, field notebooks, an ecotypical scheme, previous forest management plans, a design theme, the minutes of the acceptance of the

fieldwork, the minutes of the first conference, correspondence from within the forest district, and a printer. The unit of measurement used is the YMU. Previously, the working technology was included in the drafting of the forest management plans per YMU.

The second Conference on Forest Planning is a necessary milestone for anticipating forest management solutions and so, taking into account the work volume involved in the preparation for this, as well as the technical process of drafting the forest management plans, this has been separated out as a discrete operation. Compared to the work items evaluated by the work norms in 1999, the

current situation is distinct. After the year 2000, once the low no. 1/2000 and subsequently the low no. 247/2005, as well as with other forestry or environmental regulations, the categories of data to be analysed have increased significantly (including the situation of the stands included in the catalogue of seed stand reserves and forest genetic resources, the status of stands included in natural protected areas, the status of virgin and quasi-virgin stands).

Observations on the forest management plan for preparing for the second Conference on Forest Planning were made in 19 FDs/experimental bases (Table 7), and include:

**Table 7**  
Elements characterising the YMUs observed for use in preparing for the Second Conference on Forest Planning

No	INCDS (NIRDF) station	Observed data from forest district's forest management plans							
		Forest district/ Experimental base	Yield management unit (no. and name) (UP)	No of Yield management units/ Forest district	Forest district's managed area (ha)	YMU surface	Average area of forest management unit (ha)	No. of inventoried forest management units/ Yield management unit	No. of positions in 1E table
1	2	3	4	5	6	7	8	9	10
1	Braşov	Maneciu	VII Zaganu	9	18737	1086	7,8	38	3
2	Braşov	Rasca	II Ghizinoia	5	13519	2757	12	43	2
3	Braşov	Fagaras	II Fagaras	2	5232	3115	8,5	35	12
4	Bistriţa	Mălini	I Suha Mare	5	18342	209	14	31	76
5	Bistriţa	Cluj	III Săvădisla	4	5325	193	4,9	16	109
6	Bistriţa	Dragomireşti	II Baicu	7	10401	624	5,9	71	196
7	Craiova	Orsova	I Eliseva	10	35326	254	8,8	37	58
8	Craiova	Orsova	IV Prisaca	10	35326	633	8,7	68	127
9	Craiova	Orsova	VII Corbu	10	35326	318	11	39	64
10	Craiova	Drăgăneşti Olt	III Brebeni	3	3637	613	2	38	110
11	Oradea	Dobreşti	VI Răcaş	4	5498	307	4	60	5
12	Oradea	Târgu Lăpuş	I Valea Mare	6	7307	763	3,1	90	1505
13	Oradea	Ilia	II Burjuc	6	13108	617	4,3	75	149
14	Roman	Brăila	IX Bran	11	9405	132	5,3	41	48
15	Roman	Bârlad	I Bârlad	6	9785	415	2,9	42	203
16	Roman	Tomnatic	I Demăcuşa	2	6813	728	8,8	126	44
17	Timișoara	Păltiniș	I Goleț	6	10772	372	7,6	27	2
18	Timișoara	Valea Mare	II Groși	3	5696	288	8	30	3
19	Pitești	Rusca	X Uzlina	7	10083	12	4,7	12	3
20	Pitești	Amaradia	III Balota	4	7291	57	5,3	57	3
21	Pitești	C de Arges	IV Zigoneni	4	8084	18	4,1	18	5
	<b>Total</b>				<b>275015</b>				<b>2727</b>

- the geomorphology (wetland, plain, hill, mountain) constituted a potential influencing factor in the forestry area in determining time and production norms;
- the YMUs were of different surface sizes, from 704 ha in YMU IX from FD Braila to 6352

- ha in YMU I from Experimental Base Tomnatic;
- the YMUs with average forestry units had variable areas, from 2 ha in YMU III Brebeni from FDDraganesti Olt to 14.12 ha in YMU I Suha Mare from FDMalini;

- the YMUs where the inventory number was variable influenced the duration of the analysis of

the calculated volumes and their entry into the database;

**Table 7 (continuation)**

Observed data from forest district's forest management plans								
No. of Seed Stands	No. of forest management units that are situated within protected areas	No. of natural protected areas	No. of forest management units considered in the virgin and quasi-virgin stand categories	No. of functional categories/ Yield management unit	No. of working circles (SUP's)	The working circle's assigned code (SUP)	No. of the printed lists	Average area of forest management unit/ Forest district (ha)
11	12	13	14	15	16	17	18	19
1	140	1	12	9	5	A, E, G, K, M	16	10,39
0	0	0	0	6	3	A, K, M	16	9,78
1	349	3	93	14	4	A, E, K, M	16	7,2
1	4	1	2	8	4	A, E, K, M	15	13,06
0	1	1	0	6	2	A, M	15	4,7
0	84	2	0	4	3	A,E,M	15	8,9
0	197	3	0	10	3	A,M,E	12	8,91
0	576	4	0	11	3	A,M,E	12	8,91
0	55	3	0	8	3	A,M,E	12	8,91
0	0	0	0	3	3	A, Q, M	21	2,32
5	290	2	-	11	4	A, M,E, K	16	5,07
0	99	2	-	11	3	A, E, M	16	3,82
0	300	3	-	8	5	A, E, M, O, Q	16	5,5
0	132	3	0	4	5	E,M,X,Y,Z	45	3,18
3	167	4	0	8	6	A,E,K,M,O,Q	47	4,66
18	709	2	7	11	5	A,B,K,M,E	47	8,14
0	0	0	0	5	2	A, M	13	6,69
0	288	3	0	3	2	A, M	13	7,67
3	402	3	0	7	4	K,M,X,Z	104	3,96
3	0	0	0	5	3	A,K,M	62	4,2
2	0	0	0	5	3	A,K,M	62	5,51
<b>37</b>	<b>3793</b>	<b>40</b>	<b>114</b>	<b>157</b>			<b>591</b>	

- the forest management plans of the YMUs where the data volumes were recorded in Stand Component Table (EL) tables, regarding the movement of surfaces during the period of application, significantly influenced the development of the forestry plan;
- other elements influenced the time taken, including the number of seed stand reserves, the number of stands included in natural protected areas, the number of virgin and quasi-virgin stands, the number of management subunits the stands were assigned to for their differentiated management, according to the ecological, economic and social objectives of the forests;
- the number of lists/reports calculated by the specialised

software for data processing that need to be introduced into the forest planning projects.

### 7. Drafting forest management plans for the YMU

is currently performed in the office by an engineer/subengineer, using a PC, specialised software, field notebooks, an ecotypical scheme, previous forest management plans, a design theme, the minutes of the acceptance of the fieldwork, the minutes of the approval of the fieldwork, the minutes of the First Conference of Forest Planning, the minutes of the Second Conference on Forest Planning, the correspondence within the forest district, and a printer. The unit of measurement used is the YMU. Classically, the system for drafting the forest management plans for the YMU involved writing a manuscript.

Observations for drafting the forest management plans on the YMU were

made in 19 FDs/experimental bases (Table 8):

- the geomorphology (wetland, plain, hill, mountain) constituted a potential influencing factor in the forestry area in determining time and production norms;
- the YMU's had different surface sizes, from 704 ha in YMU IX from FD Braila to 6352 ha in YMU I from Experimental Base Tomnatic;
- the YMU's with average forestry units had variable areas, from 2

ha in YMU III Brebeni from FD DraganestiOlt to 14.12 ha in YMU I Suha Mare from FDMalini.

- the YMU's where the number of protected natural areas varied influenced the duration of the analysis of the protected objectives of the management measures from the management plans, and their implementation in the forest management plans;

**Table 8**  
Elements characterising the YMU's observed for use in drafting forest management plans for YMU's

No	INCDS (NIRDF) station	Observed data from forest district's forest management plans										
		Forest district/ Experimental base	Yield management unit (no. and name) (UP)	No of Yield management units/ Forest district	Forest district' s managed area (ha)	No. of forest management units/ Yield management unit	Average area of forest management unit (ha)	No. of natural protected areas	No. of forest management units considered in the virgin and quasi-virgin stand categories	No. of functional categories/ Yield management unit	No. of working circles (SUP' s)	The working cirlee' s assigned code (SUP)
1	Braşov	Fagaras	II Fagaras	2	5232,21	365	8,53	3	93	14	4	A, E, K, M
2	Braşov	Azuga	VI Obarsia Azugii	3	4204,49	205	10,1	1	13	8	3	A, E, M
3	Braşov	Maneciu	VII Zaganu	9	18736,54	140	7,76	1	12	9	5	A, E, G, K, M
4	Bistriţa	Măliini	I Suha Mare	5	18341,78	209	14,12	1	2	8	4	A, E, K, M
5	Bistriţa	Cluj	III Săvădisla	4	5325,49	193	4,85	1	0	6	2	A, M
6	Bistriţa	Dragomireşti	II Baicu	7	10401,04	624	5,29	2	4	7	3	A,E, M
7	Craiova	Orsova	III BaiaNoua	10	35326,16	646	5,47	4	0	10	3	A, M, E
8	Craiova	Orsova	VI Radu	10	35326,16	295	10,66	3	0	7	2	A, M
9	Craiova	Orsova	IV Prisaca	10	35326,16	633	8,66	4	0	11	3	A, M, E
10	Craiova	DrăgăneştiOlt	III Brebeni	3	3637,37	613	2	0	0	3	3	A,Q, M
11	Oradea	Dobreşti	VI Răcaş	4	5493,12	307	3,95	2	0	11	4	A, M,E, K
12	Oradea	TârguLăpuş	I Valea Mare	6	7307,33	763	3,12	2	0	11	3	A, E, M
13	Oradea	Ilia	II Burjuc	6	13108,4	617	4,32	1	0	8	5	A, E, M, O, Q
14	Roman	Brăila	IX Bran	11	9404,51	132	5,33	3	0	4	5	E,M,X, Y,Z
15	Roman	Bârlad	I Bârlad	6	9784,81	415	2,94	4	0	8	6	A,E,K,M,O,Q
16	Roman	B.E.Tomnatic	I Demăcuşa	2	6812,92	728	8,75	2	7	11	5	A,B,K,M,E
17	Timișoara	Păltiniş	I Goleţ	6	10772,24	372	7,56	0	0	5	2	A, M
18	Timișoara	Valea Mare	II Groşi	3	5696,26	288	7,95	3	0	3	2	A, M
19	Pitești	Rusca	X Uzliina	7	10083,3	12	4,7	3	0	7	4	K,M,X,Z
20	Pitești	Amaradia	III Balota	4	7291,33	57	5,29	0	0	5	3	A,K,M
21	Pitești	Curtea de Arges	IV Zigoneni	4	8084,05	18	4,14	0	0	5	3	A,K,M
	<b>Total</b>				<b>265695,7</b>	<b>7632</b>		<b>40</b>	<b>131</b>	<b>161</b>		

- other elements influenced the time taken, including the number of virgin and quasi-virgin stands, the number of

management subunits assigned to the stands for their differentiated management, framed in relation to the

ecological, economic and social objectives of the forests, and the number of functional categories in which the trees were classified.

#### **8. Guidance, reception and approval of the forest management plan draft**

is now performed in the office by the project manager and a Technical Committee for Project Approval's expert, using a PC, specialised software, field notebooks, an ecotypical scheme, previous forest management plans, a design theme, the minutes of the receipt of the fieldwork, the minutes of the approval of the fieldwork, the minutes of the first conference, the correspondence within the forest district, and a printer. The unit of measurement used is the YMU.

Observations for guidance and approval activities specific to drafting the forest management plans per YMU were made in 19 FDs/experimental bases, and included:

- the geomorphology (wetland, plain, hill, mountain) constituted a potential influencing factor in the forestry area in determining time and production norms;
- the YMU had different surface sizes, from 704 ha in YMU IX from FD Braila to 6352 ha in YMU I from Experimental Base Tomnatic;
- the YMUs where the forestry management unit had variable areas from 2 ha in YMU III Brebeni from FD Draganesti Olt to 14.12 ha in YMU I Suha Mare from FD Malini;
- the YMUs where the number of protected natural areas varied influenced the duration of the analysis of the protected objectives of the management measures from the management plans, and their implementation in the forest management plans;
- other elements influenced the time taken for developing the

forestry management plans, including the number of virgin and quasi-virgin stands, the number of management subunits assigned to the stands for their differentiated management, framed in relation to the ecological, economic and social objectives of the forests, and the number of functional categories in which the stands were classified.

Comments on the context of the activities included in the drafting of the forest management plans were noted and essential operations were individualised. On this basis, the classic method for drafting forest management plans was compared with the new methodology, as described in the Working Norms for Forestry Management Plans (1999 edition).

The differences in technology between the current and classic drafting methods result from:

- emergence of the modern equipment used in forestry management planning (GPS devices) that has led to new methods for field measurements;
- the development of new information products for cubic calculations, which allow the automation of operations for calculating the volumes of exploitable and inventoried trees;
- the emergence of specialised software (AutoCad, ArcEditor 9.x, Autodesk Map 3D 2007, Arc View, Arc Publisher, VP Raster, extension for 3D Analyst) for GIS, which allows its implementation in forest management planning databases, changing the classic procedures for transpositioning parcels and subparcels and assembling graphical reports;

- the creation of a new software (AS2007 – Forest management plans) for processing data and obtaining results for forest management planning, allowing a reduction in the work time needed for drafting plans as a result of the additional amount of data and information that can be processed; and
- the use of PCs and the available software by all performers, allowing direct editing without a hand-written manuscript phase.

The current drafting of forest management plans involves taking information from GIS projects to determine areas values and make forestry maps, and the classic planimetric operations (classic or digital planimetry) and hand-drawing of draft maps is no longer done. GIS analytically determines the topography and creates forestry maps directly on a PC. This technological change has improved the precision in determining the area occupied by national forest and the accuracy of the thematic maps.

GPS equipment has changed the method of measuring the boundaries of the national forest, leading to improved accuracy of boundary (which is related to the performance of the device) and reducing the amount of work involved. This depends on the availability of the satellite signal and the number of available satellites.

The creation of a new software product (AS2007 – Forest management plans) has allowed a greater amount of information to be obtained and processed, with direct consequences for time reduction in developing forest management plans.

In summary, all the classic operations involved in the drafting of forest management plans have been transformed and adapted to incorporate new technologies, the positive effects of

which are evident in the work of forest planning.

#### 4. CONCLUSIONS

The operations involved in drafting forest management plans were identified and validated, using modern technology and equipment that already exists in forest management. For each operation, the work items, job organisation, work formations, measurement units, tools and equipment, working conditions, and factors that contribute to updating the work methodologies were identified.

The observations made by all the working groups from the subunits of the National Institute for Research and Development in Forestry 'Marin Dracea' were used to develop the time and production norms for the work of drafting forest management plans, and are characterised by a uniformity of norms at the national level. Observations were made on 19 FDs, in 21 YMUs, located in various geomorphological conditions (plain, wetland, hill, mountain). These had a diverse number of characteristic elements – elements that constituted potential factors of influence over the calculation of time and production norms.

The observations used for drafting forest management plans were made based on an existing work methodology.

The experimental data obtained will be interpreted and analysed statistically, allowing it to be interpreted on a scientific basis, and will be used for the calculation of time and production norms in a forest management plan.

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