

Private forests in Poland – the results of the questionnaire surveys covering the network of test forest holdings

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ABSTRACT

The research on a nationwide sample of 1,112 agricultural holdings with forest conducted by Forest Research Institute in 2007 provided information on private forests in the ownership of farmers. The collected data show that, due to their small area, forests in agricultural holdings play basically the role of a timber warehouse used by farmers for the household needs. In the case of larger holdings, private forests are a source of small income, due to their high fragmentation. Farmers generate very low income from forest, do not invest in forestry production means (machines and equipment), and they usually do forest operations by themselves.

KEY WORDS

Forest area, income, private forests, timber harvesting

INTRODUCTION

By the end of 2007, private forests in Poland had occupied an area of 1,623 thousand ha (17.8% of total forest land) of which 94% (1,526 thousand ha) were the property of natural persons. According to the Agricultural Census 2002, 1,037 thousand ha of forests (67.9% of private forest area) were part of individual agricultural holdings. The remaining private forest land was in the ownership of land communities – 67 thousand ha, and production cooperatives – 7 thousand ha (Leśnictwo 2007).

Of approximately 2.9 million agricultural holdings in 2002, about 28% (841 thousand holdings) included forests of which 59.3% were holdings with a forest area of less than one ha and only 4.1% with more than five ha of forests. Since 2004, private forests

in Poland have been increasing their area at a rate of about 5–12 thousand ha annually as a result of afforestation of farmland excluded from agricultural production and waste land. Apart from the rationalization of the land-use structure, the State's financial support was an important factor increasing interest in land afforestation. The monetary equivalent paid for the afforestation of more than 19 thousand ha of land in the years 2002–2003 under the Act of 8 June 2001 on the allocation of land for afforestation (DzU No. 73, item. 764, with subsequent amendments) amounted to over 8.6 million EURO or about 455 EURO per ha of afforested land. In the years 2004–2006, afforestation works were carried out on more than 46 thousand ha of land, mainly farmland using the European Agricultural Guidance and Guarantee Fund. The total value of payments connected with afforestation amounted to

43.2 million EURO, or 945 EURO per ha of afforested land.

Changes in the private forestry sector in Poland also occur in the area of seeking the methods of increasing the economic effectiveness of small farm forestry. Currently, it is just the beginning of the way towards the popularization of the new forms of collective management by private forest owners, particularly by forming forest owners' associations. As of the end of 2009, there were only 10 registered associations incorporating 369 private owners carrying out management in an area of approximately 1,490 ha of forest (Gołos 2009).

Because of the high fragmentation of private forests in Poland, they are of little economic importance and never have therefore been embraced, as in the case of agriculture, by a coherent and regular public statistical research program. The existing data describing private forests come from the annual reports of the Central Statistical Office of general nature based on the reports from the County Governors' Offices exercising supervision over private forests, and supplemented by the results of the national agricultural programs taking account, only to a limited extent, of forestry aspects.

The above-described status of official statistics regarding private forests was the main reason for the Forest Research Institute in Warsaw (FRI) to take the initiative, following the solutions operating in Austria and Germany, to create a network of test holdings. The first research conducted by FRI on a nationwide sample of private forests owned by farmers was conducted in 2004 (Gołos 2008). In the project, 522 agricultural holdings with forests were surveyed. For objective reasons, the surveyed sample of private farmers was neither random nor representative. In 2007, questionnaire surveys were carried out on a nationwide representative random sample of 1,112 agricultural holdings with forests using for this purpose the Agricultural Census 2002 database obtained by courtesy of the Central Statistical Office. The results of the surveys are presented in this publication.

The results of the Central Statistical Office research (Forestry Management... 2001, 2005) and the above mentioned research conducted by FRI in 2004 are the reference point for the discussion with the research findings presented in other Publications (Gołos 2008).

AIM AND SCOPE OF THE RESEARCH

The aim of the research conducted in 2007 was to determine the specific socio-economic characteristics of private forest estates being part of an agricultural holding. The range of the data collected under questionnaire surveys and presented in this publication goes beyond the information available in the official statistics (Leśnictwo 2007) and in the system of Farm Accountancy Data Network – European system for collecting information about the activities of agricultural holdings and accounting records. The responses to the questionnaire were analysed by region (voivodship), size class of forest area and agricultural land area. Due to the vastness of the tabular specifications containing questionnaire responses the publication presents only the most important ones regarding size classes of a forest area, grouped in four sections, following the division of questions included in the questionnaire concerning:

- general characteristics of a surveyed forest estate,
- organization of the production process,
- economic aspects of forest management,
- supplementary information related to the issues of supervision, damage from animals, timber theft, as well as opinions concerning the possibilities of forest owners to associate.

RESEARCH METHODS

The Statistical Register of Agricultural and Forest Holdings being at the disposal of the Central Statistical Office was used as a sampling frame for agricultural holdings containing forests. It was created on the basis of the data from the Agricultural Census carried out in Poland in 2002. The population consisted of 795,224 agricultural holdings with forests with a total area of 1,040,766 ha. A sample of 1,200 holdings was drawn at random from the population, including 100 holdings with a forest area of more than 10 ha. Because of the high costs of questionnaire surveys, it was assumed that agricultural holdings with a forest area below 10 ha would be sampled in so-called clusters consisting of not less than 5 holdings. Prior to sampling, the population of holdings was divided into three groups:

- agricultural holdings with an area of more than 10 ha. This part of the population consisted of 6,968

agricultural holdings with a total area of 125,120 ha of forest;

- agricultural holdings with a forest area of less than 10 ha, which were combined into clusters at the village level (district), each cluster consisting of a minimum of 7 holdings. A total number of 24,414 clusters were created consisting of 721,529 holdings with a total area of 839,855 ha of forest;
- agricultural holdings with the forest area of less than 10 ha, which could not be combined into clusters at the village level, created clusters at the commune level. In such a case, 1,890 clusters were created consisting of 65,427 agricultural holdings with a total area of 74,274 ha of forest.

About 1,300 holdings with a total area of 1,517 ha of forest which could not be combined into clusters were eliminated from the population. More than 100 agricultural holdings were drawn for the basic sample and 100 holdings for the substituted sample from the population of holdings with a forest area exceeding 10 ha using an individual stratified sampling procedure. The structure of the two samples was identical which was due to the stratification by voivodship.

A sample of 220 clusters (each cluster consisting of 5 holdings from the basic sample and 2 from the substituted sample) was first broken down into groups 2 and 3 of the population. The division of the sample was made in proportion to the size of the forest area in these population groups. As a result, a sample of 202 clusters from group 2 and a sample of 18 clusters from group 3 were selected from the population.

Holdings from group 2 of the population were selected using a two-stage stratified sampling design with different probabilities in the first stage. Before sampling, the clusters were stratified according to voivodships. The number of clusters selected in various voivodships was proportional to the total forest area in the clusters. In turn, the probability of selecting a single cluster was proportional to the sum of forest areas included in a cluster. In cluster sampling, a Hartley-Rao procedure, *i.e.* systematic sampling was applied after the random ordering of clusters. Samples were drawn independently in each voivodship (stratum).

Also in group 3 of the population, a Hartley-Rao procedure was applied to draw a sample consisting of 18 commune-level clusters, but due to a small number of clusters in a sample, stratification by voivodship was not

employed. After that, 5 holdings each were drawn for the basic sample and 2 holdings for the substituted sample from all the selected clusters using a simple random sampling procedure. A set of selected holdings contained, in addition to the addresses, other information such as:

- sample allocation: 1 – main sample, 2 – substituted sample;
- holding no. (for holdings with an area of forest less than 10 ha, for others = 0);
- weight *i.e.* a generalization factor in summarizing the research results (the weight for the holding with forests is equal to the inverse probability of selection of this holding).

The questionnaire used in the survey research was tested during the pilot studies conducted in several dozen holdings of the Mazowieckie Voivodship. The basic research was carried out by trained students of the Faculty of Forestry, Warsaw University of Life Sciences in the form of personal interviews with farmers – the forest owners. The survey research was conducted in July–November 2007. The collected data refer mainly to 2006 or earlier years, and the selected questions maximally to the period 2004–2006. Prior to starting the research, it was assumed that only verbal responses of forest owners– farmers would be the source of information on forest estates, without verifying the truthfulness and correctness of their answers against documents. By adopting the above assumption it should be stated that, regardless of the appropriate selection of a sample, proper organization of field research, testing aimed at checking the correctness of the construction and design of questionnaire questions, the presented results provide only a rough picture of the state of forest management and private forests, as they may be affected by data submitted to an interviewer by farmers.

RESEARCH DATA FOR THE NETWORK OF TEST HOLDINGS

The survey research was carried out on a sample of 1,112 agricultural holdings, of which 83% (929) are the holdings from the basic sample. The replacement of the holdings from the basic sample with the holdings from the substituted sample is mostly due to:

- errors in the database related to the land-use records and owners (lack of forest land in the sam-

- pled holdings, land owner no longer alive, holding liquidated);
- refusal of the owner of a sampled holding to participate in an interview;
 - unsuccessful attempts to carry out an interview resulting from the difficulty in contacting the forest owner (the interviewer attempted to arrange an interview three times, when it was not possible he replaced the selected holding from the basic sample with a holding from the substituted sample).

GENERAL CHARACTERISTICS OF THE SURVEYED FOREST ESTATE

To complete the demographics data, the interviewers started interviews by asking questions referring to the socio-demographic features of the owner and his holding including address details, contact telephone number (checking on interviewers' work) and the date of birth of the forest owner. The data completion degree differed by region. The interviewers obtained valid contact telephone numbers for 823 holdings (74% of all surveyed holdings). This is a valuable information source, providing the possibility of quick and low-cost telephone interviews in the future.

The average age of owners of 1,003 forest estates (90.2% of surveyed farmers) ranges from 44 to 52 years and is highly correlated with the area of agricultural and forest land. The coefficient of correlation

between the average area of agricultural and forest land with age is -0.65 and -0.63 , respectively – the average age of the forest owner decreases with the increase in the average area of both agricultural and forest land.

In the land-use structure of the surveyed holdings, arable land prevailed, representing 57% of the total area (8.5 thousand ha) followed by meadows and pastures, which accounted for 23% of the area (3.4 thousand ha). The forest area was 2.9 thousand ha, or 20% of the total area of the surveyed holdings (Tab. 1). A detailed analysis shows that the share of small forest estates up to 1.5 ha accounts for more than 58% of all surveyed holdings, while the area of forests in these holdings represents only 15% of the total forest area. In the 72 largest holdings (with over 10 ha of forest – 6.5% of the surveyed holdings) the forest area was 1,228 ha (41% of the total forest area).

The average area of forest in an agricultural holding is 1.41 ha and is composed of two forest plots located about 2.4 km away from the place of residence of the owner. The farmers declared to carry out management on 2,886 forest plots of different sizes (on average 2.6 plots per holding). The largest group of holdings (43% of surveyed holdings) reached the area of approximately 0.88 ha and with approximately 6.40 ha agricultural land. An increase in the number of forest plots in the surveyed holdings from 1 to 7 plots and more does not mean a proportional increase in the average forest area from 0.88 ha to 3.00 ha (Tab. 2).

Tab. 1. Average age of owners of agricultural holdings with forest – Forest Research Institute study, 2007

Classes of forest area (ha)	Number of studied holdings	%	Forest area (ha)	%	Number of forest plots	%	Average age of forest owners (years)
0.01–0.50	276	24.82	79.38	2.68	381	13.20	52
0.51–1.00	216	19.42	165.83	5.59	407	14.10	51
1.01–1.50	159	14.3	198.46	6.69	422	14.62	50
1.51–2.00	97	8.72	174.08	5.87	263	9.11	48
2.01–3.00	127	11.42	316.99	10.69	445	15.42	47
3.01–4.00	68	6.12	240.85	8.12	274	9.49	47
4.01–5.00	39	3.51	176.49	5.95	154	5.34	47
5.01–10.00	57	5.13	384.35	12.96	238	8.25	53
10.01–15.00	48	4.32	571.64	19.28	202	7.00	44
> 15.00	25	2.25	656.98	22.16	100	3.47	44
Total	1,112	100.01	2,965.05	100.00	2,886	100.00	–

Tab. 2. Number of holdings with a specified number of forest plots – results of questionnaire study, Forest Research Institute, 2007

Number of forest plots	Number of holdings with a specified number of forest plots	Average area (ha)		Average volume of harvested timber (m ³) in a holding in 2004–2006
		forests	farmland	
1	482	0.88	6.40	11.95
2	228	1.45	7.93	17.78
3	160	2.14	12.47	24.57
4	76	2.29	9.88	19.83
5	64	2.40	9.78	28.35
6	35	2.54	8.09	25.66
> 7	65	3.00	9.24	33.09
not found	2	–	–	–
Total	1,112	–	–	–

Tab. 3. Characteristics of forest holdings with regard to the number of forest plots in area classes – results of questionnaire study, Forest Research Institute, 2007

Classes of forest area (ha)	Number of studied holdings	Forest area (ha)	Number of forest plots	Number of plots per holding	Average forest plot area (ha)	Volume of timber harvested from a single forest plot [m ³]
0.01–0.50	276	79.38	381	1.4	0.21	2.77
0.51–1.00	216	165.83	407	1.9	0.41	3.51
1.01–1.50	159	198.46	422	2.7	0.47	3.83
1.51–2.00	97	174.08	263	2.7	0.66	3.98
2.01–3.00	127	316.99	445	3.5	0.71	5.60
3.01–4.00	68	240.85	274	4.0	0.88	6.06
4.01–5.00	39	176.49	154	3.9	1.15	8.85
5.01–10.00	57	384.35	238	4.2	1.61	9.54
10.01–15.00	48	571.64	202	4.2	2.83	19.08
> 15.00	25	656.98	100	4.0	6.57	24.12
Total/Average	1,112	2,965.05	2,886	2.6	1.03	6.65

The number of plots increasing with the increase of forest area from 1.4 plots in the holdings with a forest area not exceeding 0.5 ha to 4 plots in the holdings where forests occupy more than 15 ha of land is a marked trend (Tab. 3). Also the average size of a single plot increases from 0.21 ha to 6.57 ha, respectively. The farmers also determined the size of forest plots, of which the largest group (42% of all plots whose size was described by the respondents) were plots with one side ranging from 51 to 100 m in length (average 87 m) and 39 m in width, *i.e.* plots with an area of approximately 0.35 ha (Tab. 4).

In the size classes of forest land, a clear dependence of the average plot size on the forest area is noted. In the

class of holdings where the forest area is below or equals 0.5 ha, the average plot size is 104 × 30 m, or approximately 0.31 ha. In the class of holdings with the forest area exceeding 15 ha, the average plot size is 1,520 × 70 meters or ca 10.64 ha (Tab. 5). The number of forest plots per ha of forest in the size classes of forest area is indicative of the degree of fragmentation of private forests in Poland (Tab. 6). In small forest estates with an area of 0.5 ha, there are nearly 5 forest plots on one ha of forest. This indicator decreases with the increase of forest area reaching 0.1 for the size class of forest area over 15 ha.

According to farmers, 65% of their forests are composed of coniferous and only 35% of deciduous species.

Tab. 4. Area of forest plot – results of questionnaire study, Forest Research Institute, 2007

Length class (m)	Average length (m)	Average width (m)	Number of plots	Average plot area (ha)	%
≤ 10	8.22	61.09	22	0.05	3.75
11–50	37.50	44.71	91	0.17	15.53
51–100	87.89	39.37	248	0.35	42.32
101–200	161.19	32.27	116	0.52	19.80
201–500	328.01	24.92	78	0.82	13.31
> 500	723.68	25.31	31	1.83	5.29
Total/Average	144.00	37.00	586	0.53	100.00

Tab. 5. Average size of a forest plot in agricultural holdings with forests – results of questionnaire study, Forest Research Institute, 2007

Classes of forest area (ha)	Number of studied holdings	Number of forest plots	Average dimensions of forest plot (m)	
			length	width
0.01–0.50	276	381	104	30
0.51–1.00	216	407	161	46
1.01–1.50	159	422	195	40
1.51–2.00	97	263	182	48
2.01–3.00	127	445	260	37
3.01–4.00	68	274	366	76
4.01–5.00	39	154	345	45
5.01–10.00	57	238	401	47
10.01–15.00	48	202	1100	29
> 15.00	25	100	1520	70
Total	1,112	2,886	–	–

Tab. 6. Average area of a forest plot and its distance from the place of farmer residence – results of questionnaire study, Forest Research Institute, 2007

Classes of forest area (ha)	Number of studied holdings	Number of forest plots	Forest area in studied holdings (ha)	Average size of forest plots and its distance from the place of residence of farmers		Single plot area (ha)	Number of plots per ha
				size (ha)	distance (km)		
0.01–0.50	276	381	79.38	0.28	2.94	0.21	4.8
0.51–1.00	216	407	165.83	0.47	2.77	0.41	2.5
1.01–1.50	159	422	198.46	0.77	2.32	0.47	2.1
1.51–2.00	97	263	174.08	0.67	1.86	0.66	1.5
2.01–3.00	127	445	316.99	0.74	2.28	0.71	1.4
3.01–4.00	68	274	240.85	1.18	2.31	0.88	1.1
4.01–5.00	39	154	176.49	1.15	2.44	1.15	0.9
5.01–10.00	57	238	384.35	1.80	2.90	1.61	0.6
10.01–15.00	48	202	571.64	3.40	3.46	2.83	0.3
> 15.00	25	100	656.98	6.72	1.83	6.57	0.1
Total/Average	1,112	2,886	2,965.05	–	–	1.03	1.0

Tab. 7. Species composition, age and standing volume of forests – results of questionnaire study, Forest Research Institute, 2007

Classes of forest area (ha)	Number of studied holdings	Stand species composition (%)		Stand age (%)		Standing volume	
		conifers	broadleaves	< 40 years	> 40 years	m ³ /ha	trees/ha
0.01–0.50	276	57.16	42.84	43.82	56.18	99	282
0.51–1.00	216	62.59	37.41	35.51	64.49	106	314
1.01–1.50	159	66.16	33.84	37.88	62.12	167	329
1.51–2.00	97	69.66	30.34	41.31	58.69	146	347
2.01–3.00	127	73.92	26.08	33.95	66.05	160	399
3.01–4.00	68	70.91	29.09	44.51	55.49	125	364
4.01–5.00	39	68.59	31.41	31.53	68.47	0	499
5.01–10.00	57	69.25	30.75	35.46	64.54	161	343
10.01–15.00	48	79.15	20.85	34.09	65.91	128	319
> 15.00	25	81.56	18.44	40.64	59.36	103	277
Total/Average	1,112	65.00	35.00	39.00	61.00	136	340

Their estimates differ from the results of the research conducted by FRI in 2004, when farmers declared that forest stands are made up of 74% of coniferous and 26% of deciduous species (Tab. 7). Similar data are presented by the Central Statistical Office (Leśnictwo 2007). On the other hand, the data collected in the Large Scale Forest Inventory (L-SFI) show that, in private forests, 65.8% are coniferous and 34.2% are deciduous species in terms of volume and 68.2% and 31.8% in terms of area, respectively. While comparing the FRI research results with the L-SFI data, it should be noted that the interviewed farmers very well estimated the proportion of deciduous and coniferous species in their forests.

As regards stand age, the farmers declared that 39% of their forests were younger than 40 years, while the remainder (61%) were forests older than 40 years (Table 7). This result is again different from that obtained in the 2004 research when the estimates given by the respondents were 54% of forests below 40 and 46% of forests over 40 years of age. The GUS data indicate that 55.3% are forest stands under 40 years, while the L-SFI data indicate that younger stands account for 34.1%. As in the case of stand composition by tree genera, the evaluation of the age structure by farmers is comparable to the L-SFI data.

The owners could assess their forest resources by volume in m³ or by the number of trees. In the first case, the average volume for 119 holdings amounted to 136 m³. As regards the number of trees, the average for 647 holdings was 340 trees (Tab. 7). It should be noted

that the average volume estimated by farmers in relation to the data collected in the 2004 research was lower (150 m³ in 2004), while the number of trees was higher (217 trees in 2004). Farmers underestimated the volume of their forests and results show that the volume of private forests is ca 209 m³/ha, *i.e.* similar to the volume of forests under the management of the State Forests – 262 m³/ha and is much higher compared to 118 m³/ha given in the official statistics.

In 2006, the tending treatments carried out in the surveyed holdings covered an area of nearly 274 ha of plantations, representing 9.2% of the total forest area (Tab. 8). The assumed share of the area of tended plantation is similar to the data collected by Central Statistical Office in 2004 for the Podkarpackie (South-West part of Poland) and Wielkopolskie (West part of Poland) Voivodships – 10.1% and 8.6% of forest area, respectively although much lower than the data collected by FRI in 2004 when farmers declared to have performed tending treatments in an area representing 28% of the total forest area in the surveyed holdings (Gołos *et al.* 2006, Gołos 2008). The share of forest areas subjected to tending treatments in the state-owned forests in 2006 amounted to 2.8% (197,244 ha) of the territory administered by the State Forests.

As regards thinning, it was performed on 648 ha, representing nearly 22% of the forest area (Tab. 8) which is the value considerably lower compared to the data collected by Central Statistical Office for the Podkarpackie (14.8%) and Podlaskie (East part of Poland)

Tab. 8. The extent of economic tasks in forests depending on their area – results of questionnaire study, Forest Research Institute, 2007

Classes of forest area (ha)	Number of studied holdings	Forest land not reclassified to forest land (ha)	Silvicultural operations (ha)	
			tending of plantations	thinning
0.01–0.50	276	11.06	13.24	19.33
0.51–1.00	216	29.79	26.89	41.22
1.01–1.50	159	18.08	16.29	43.33
1.51–2.00	97	10.82	17.35	37.33
2.01–3.00	127	24.38	32.41	85.21
3.01–4.00	68	7.59	27.74	64.67
4.01–5.00	39	5.99	13.95	47.52
5.01–10.00	57	47.81	22.00	67.40
10.01–15.00	48	18.62	77.55	89.06
> 15.00	25	10.50	26.57	152.92
Total	1,112	184.64	273.99	647.99

(18.6%) Voivodships. In the research conducted by the FRI in 2004, the share of forest area covered by thinning treatments was 31% of the total forest area. The share of area covered by tending treatments in the state-owned forests in 2006 amounted to 6.8% of the forest land within the State Forests. It is notable that the category of sanitation and incidental cuts whose performance in forests managed by the State Forests significantly reduces the share of thinned areas does not exist in the minds of private forest owners.

Interesting are the data concerning over 184 ha of land still having the status of agricultural land in the land register which, due to the way of their utilization, should be reclassified into forest land. The area of such land constitutes 6.2% of forest area in the surveyed holdings. This value is close to the result of the research conducted by FRI in 2004 (7.2%) and higher than the Central Statistical Office data from 2004 where this share in the Podkarpackie, Podlaskie and Wielkopolskie Voivodships was 2.17%, 0.98% and 1.27%, respectively. The obtained result shows that the area of private forests given in the official statistics (Central Statistical Office) may actually be higher by about 300 thousand ha and amount to about 1.8 million ha. The estimated area of forest from natural regeneration not included in the land register, established on the basis of FRI and Central Statistical Office data is comparable to the data published in 2010, according to which it is an area of 400 thousand ha (Chrempińska 2010).

ORGANIZATION OF THE PRODUCTION PROCESS

The volume of timber harvested in years 2004–2006 in the surveyed holdings exceeded 19 thousand m³ – an average of about 6.4 thousand m³ annually (5.7 m³/holding and 2.1 m³/ha). The whole-tree method was the dominant harvest method – 6.2 thousand m³ (32.7% of the total volume of harvested timber) (Tab. 9). This volume is comparable with the FRI research results of 2004, according to which 34.7% of the total volume was harvested using this method (Gołos *et al.* 2006, Gołos 2008). Interestingly, the interviewed farmers assured that forest condition and sanitary aspects were the basis for selecting trees for cutting in the first place. 58% of respondents indicated that these two elements were decisive for timber harvest.

The next largest volume of timber was harvested in thinning operations, nearly 5.7 thousand m³ of timber, or 29.6% of volume (the volume of timber obtained in thinning operations within the State Forests in 2006 accounted for 43.5% of volume). This figure is lower compared to the data collected by FRI in 2004 when timber volume from thinning accounted for nearly 39%. The volume harvested from clear-cuts was 1.4 thousand m³ of timber (7.3%) which is lower compared to the findings of the FRI research in 2004 – 9.8% of the total timber volume.

The average timber harvest for all the surveyed holdings was about 2.2 m³/ha/year. This figure is close to the

Tab. 9. Different methods of timber harvest in forests depending on their area – results of questionnaire study, Forest Research Institute, 2007

Classes of forest area (ha)	Number of studied holdings	Number of holdings in which timber was harvested	Timber harvested in 2004–2006 (m ³)						
			cutting area	thinning	whole trees	other	total	m ³ /holding	m ³ /ha of forest
0.01–0.50	276	104	–	335	378	344	1057	3.83	13.32
0.51–1.00	216	112	–	434	593	402	1429	6.61	8.61
1.01–1.50	159	96	29	422	498	668	1617	10.17	8.15
1.51–2.00	97	62	31	177	434	407	1048	10.80	6.02
2.01–3.00	127	97	226	641	851	776	2494	19.64	7.87
3.01–4.00	68	54	–	478	650	534	1661	24.43	6.90
4.01–5.00	39	34	100	421	489	353	1363	34.94	7.72
5.01–10.00	57	49	120	819	833	499	2271	39.84	5.91
10.01–15.00	48	37	587	1360	588	1319	3854	80.30	6.74
> 15.00	25	21	302	602	964	544	2412	96.48	3.67
Total/Average	1,112	666	1,395	5,689	6,278	5,844	19,206	17.27	6.48

average harvest estimated on the basis of the FRI research in 2004 (2.3 m³/ha/year) and lower than the volume estimated in the Central Statistical Office survey conducted in 2004 in three Voivodships: Podkarpackie, Podlaskie and Wielkopolskie amounting to 2.66, 2.89 and 3.29 m³/ha/year, respectively. The official statistics show that in 2006, approximately 1.1 million m³, or 0.68 m³/ha was harvested in private forests. The research results indicate that the actual harvest of timber in private forests is about 3 million m³. Even if we assume that the results can be burdened with some error, the difference between the actual harvest level and the official data indicates that approximately 2 million m³ of the harvested timber is not registered off record.

The vast majority of harvested timber is used by farmers for domestic and household purposes as firewood and utility wood. In 2004, over 94% of timber was used by farmers for their own purposes, and only 5% was sold (Gołos *et al.* 2006, Gołos 2008). The data collected in 2007 are also comparable to the data collected by GUS in 2004 for three Voivodships: Podkarpackie, Podlaskie and Wielkopolskie where the use of timber harvested by private owners accounted for 89.5%, 89.7% and 83.5%, respectively. Interestingly, the largest share of the sold softwood is in the voivodships where the area of private forests is small, but the average size of forest estates is much larger than the country average. A trend is also observed towards an increase

of the share of timber for sale with the increase in the area of forests from approximately 1% of the volume of harvested timber for the holdings up to one ha to nearly 19% of the volume in the holdings with forest cover from 10 to 15 ha (Tab. 10).

The lack of significant revenues from forests, and thus the low effectiveness of forest management causes that the owners of even relatively large, under the Polish conditions, forest estates (over 10 ha) do not invest in the means of forestry production. In forestry operations such as timber extraction, transport, site preparation for forest renewal and afforestation, farmers use their own technical equipment necessary to run a holding (tractors, trailers, ploughs). The majority of work the forest owners do themselves. According to the respondents, 60% of logging and 59% of transport operations farmers carry out themselves.

A chain saw is the only forest tool commonly used in agricultural holdings with forests. Over 74% of the interviewed farmers declared to have had it. These are mostly the chainsaws of the Scandinavian make, mainly of two producers – Husqvarna and Sthil. A large part of the surveyed holdings also have a tractor which has replaced horses suitable for work in difficult forest conditions (especially in the mountains) not long ago widely used in Poland. Nearly 69% of the interviewed farmers confirmed to have had a tractor in their holdings, while only every tenth – a horse. In the comparable FRI re-

Tab. 10. Purpose and method of use of harvested timber – results of questionnaire study, Forest Research Institute, 2007

Classes of forest area (ha)	Number of studied holdings	Harvest (m ³)		Utilization structure of softwood (%)			Use structure of hardwood (%)		
		softwood	hardwood	needs	firewood	sale	needs	firewood	sale
0.01–0.50	276	365.80	234.50	13.42	86.58	–	9.35	88.48	2.17
0.51–1.00	216	464.65	225.60	20.61	78.28	1.11	17.17	82.83	–
1.01–1.50	159	385.50	233.00	16.93	82.59	0.48	14.29	82.96	2.76
1.51–2.00	97	326.50	124.50	20.98	79.02	–	20.00	78.89	1.11
2.01–3.00	127	851.50	352.50	17.75	78.88	3.37	12.40	87.60	–
3.01–4.00	68	378.80	162.50	16.15	80.38	3.46	18.67	78.67	2.67
4.01–5.00	39	421.00	247.50	25.69	71.55	2.76	11.76	88.24	–
5.01–10.00	57	569.00	338.00	14.65	79.77	5.58	14.44	85.56	–
10.01–15.00	48	1351.35	487.94	29.62	51.46	18.92	13.89	67.94	18.17
> 15.00	25	809.00	153.00	10.33	74.14	15.52	6.25	93.75	–
Total/Average	1,112	5,923.10	2,559.04	18.34	78.20	3.46	14.37	83.61	2.02

Tab. 11. The structure of factors deciding about the selection of trees for cutting – results of questionnaire study, Forest Research Institute, 2007

Classes of forest area (ha)	Number of studied holdings	The reasons for the tree selection for cutting (%)				
		forest condition	own needs	best trees	dead trees	other
0.01–0.50	276	29.09	3.64	1.82	62.73	2.73
0.51–1.00	216	25.19	10.69	3.05	60.31	0.76
1.01–1.50	159	25.22	18.26	0.87	54.78	0.87
1.51–2.00	97	15.07	16.44	1.37	65.75	1.37
2.01–3.00	127	29.13	6.80	0.97	62.14	0.97
3.01–4.00	68	26.79	10.71	1.79	60.71	0.00
4.01–5.00	39	15.38	10.26	2.56	69.23	2.56
5.01–10.00	57	17.54	10.53	5.26	64.91	1.75
10.01–15.00	48	23.81	16.67	0.00	52.38	7.14
> 15.00	25	44.00	12.00	0.00	36.00	8.00
Total/Average	1,112	24.93	11.08	1.85	60.29	1.85

search conducted in 2004, 74% of the respondents declared to have had a chain saw, 37% a tractor and only 6% a horse (Tab. 12).

In 2006, the interviewed farmers, their families and other persons carrying management on 2,965 ha of forest worked for 67 thousand hours in the forest harvesting at that time 7,593 m³ of timber. In a single holding, the forest owner spent, on the average, nearly 44 hours in the forest annually. In terms of volume calculated per m³ of harvested timber and per ha of forest, the time they worked in the forest was, on the average, nearly

9 hours and over 23 hours, respectively (Tab. 13). The data indicate that the number of hours farmers worked in the forest calculated per unit area decreases with the increase of forest area – from 56 hours/ha in small holdings with up to 0.5 ha of forest to 11 hours/ha in large holdings with more than 15 ha of forest. Based on FRI research in 2007, the employment indicator (assuming 220 eight-hour working days in a year) shall be 13 persons/thousand ha of forest (based on the FRI research in 2004, it was 17 people per each every thousand ha of forest). In the State Forests, this indicator is 3.4 persons/

Tab. 12. Equipment used in timber harvesting – results of questionnaire study, Forest Research Institute, 2007

Classes of forest area (ha)	Number of studied holdings	Chain saw		Tractor		Horse	
		items	%	items	%	items	%
0.01–0.50	276	167	61	145	53	20	7
0.51–1.00	216	140	65	132	61	24	11
1.01–1.50	159	123	77	114	72	21	13
1.51–2.00	97	72	74	71	73	9	9
2.01–3.00	127	113	89	105	83	17	13
3.01–4.00	68	57	84	57	84	5	7
4.01–5.00	39	36	92	35	90	3	8
5.01–10.00	57	52	91	46	81	5	9
10.01–15.00	48	42	88	41	85	6	13
> 15.00	25	22	88	21	84	3	12
Total/Average	1,112	824	74	767	69	113	10

Tab. 13. Number of work hours of the owner, family members and other persons spent in the forest – results of questionnaire study, Forest Research Institute, 2007

Classes of forest area (ha)	Number of studied holdings	Number of work hours spent in the forest in 2006				Number of hours per	
		owner	family members	other persons	total	ha	m ³ of timber
0.01–0.50	276	2,563	1,772	81	4,416	56	11
0.51–1.00	216	4,299	2,447	539	7,285	44	12
1.01–1.50	159	4,538	2,849	121	7,508	38	12
1.51–2.00	97	3,236	2,236	90	5,562	32	13
2.01–3.00	127	5,184	3,162	308	8,654	27	10
3.01–4.00	68	3,057	2,291	120	5,468	23	10
4.01–5.00	39	2,393	1,808	70	4,271	24	7
5.01–10.00	57	4,248	3,328	1,036	8,612	22	10
10.01–15.00	48	5,112	2,688	120	7,920	14	4
> 15.00	25	3,700	3,132	480	7,312	11	8
Total/Average	1,112	38,330	25,713	2,965	67,008	23	9

thousand ha of forest (taking into consideration only administrative staff, excluding the private sector staff providing services for forestry).

ECONOMIC ASPECTS OF FORESTRY MANAGEMENT

The total costs related to forest management in the holdings surveyed in 2006 amounted to more than 103 thousand EURO (34 EURO/ha of forests and 13 EURO/m³ of harvested timber). The costs of purchase of machin-

ery and equipment (35.43%), materials and energy (30.01%), taxes and charges (18.39%) were the main items in the total cost structure. The average cost per household stood at a level of 92 EURO/year.

The per household costs increase in the size classes of both agricultural land and forest area. In the first case, they grow from 39 (agricultural land of less than 5 ha) to 460 EURO (in the class of over 50 ha of agricultural land) and from 23 EURO (in the class of up to 0.5 ha of forest) to 636 EURO (in the holding with more than 15 ha of forests) (Tab. 14). In 2006, the total

Tab. 14. Costs incurred on forest holdings – results of questionnaire study, Forest Research Institute, 2007

Classes of forest area (ha)	Number of studied holdings	Costs (EURO)		
		forest area (ha)	m ³ of harvested timber	forest holding
0.01–0.50	276	87.40	17.99	25.19
0.51–1.00	216	49.87	13.88	38.30
1.01–1.50	159	31.88	10.28	39.59
1.51–2.00	97	39.33	16.45	70.69
2.01–3.00	127	36.50	13.62	91.00
3.01–4.00	68	14.65	6.17	52.19
4.01–5.00	39	14.91	4.63	67.61
5.01–10.00	57	53.73	24.42	362.98
10.01–15.00	48	35.73	11.57	425.71
> 15.00	25	24.16	16.45	636.76
Total/Average	1,112	34.70	13.62	92.80

Tab. 15. Income from forest holdings – results of questionnaire study, Forest Research Institute, 2007

Classes of forest area (ha)	Number of studied holdings	Income (EURO)				Forest area (ha)	Timber harvest in 2006 (m ³)	Income	
		sale	needs	equivalent	total			EURO/ha	EURO/m ³
0.01–0.50	276	180	7,403	0	7,583	79	388	96	20
0.51–1.00	216	1,028	21,916	4,010	26,954	166	593	162	46
1.01–1.50	159	77	13,410	0	13,487	198	612	68	22
1.51–2.00	97	3,96	7,887	370	8,653	174	417	50	21
2.01–3.00	127	4,571	18,247	0	22,817	317	854	72	27
3.01–4.00	68	540	11,671	1,542	13,753	241	573	57	24
4.01–5.00	39	0	13,668	0	13,668	176	572	77	24
5.01–10.00	57	514	18,111	6,710	25,334	384	844	66	30
10.01–15.00	48	26,185	31,288	0	57,473	572	1,775	101	32
> 15.00	25	17,558	9,512	4,010	31,080	657	967	47	32
Total/Average	1,112	51,049	153,111	16,643	220,803	2,965	7,594	75	29

income from forests generated by the surveyed holdings was over 220 thousand EURO, *i.e.* 74 EURO/ha which is higher than the figure arrived at during the research conducted by FRI in 2004 (62 EURO) and by Central Statistical Office in 2004 for the Wielkopolskie (60 EURO) and Podlaskie (63 EURO) Voivodships, but lower for the Podkarpackie Voivodship (99 EURO). Assuming that an average income is 70 EURO/ha of private forests, the total income of private forest owners in Poland in 2006 can be estimated at approximately 112 million EURO (Tab. 15).

The estimated revenues from the use of harvested timber for agricultural and domestic purposes of farmers (determined on the basis of the average timber price) were highest in the income structure. They accounted for 69% of the total income. This figure is higher than that shown in the Central Statistical Office data for the Wielkopolskie Voivodship (62.3%) and lower for the Podkarpackie (85.6%) and Podlaskie (85.2%) Voivodships. The research conducted by the FRI in 2007 shows that the share of the revenues from the timber used in the holding is also lower than that shown in the com-

Tab. 16. Income structure of agricultural holdings with forests – results of questionnaire study, Forest Research Institute, 2007

Classes of forest area (ha)	Number of studied holdings	Income structure (%)				
		running a agricultural holding	sale of timber from own forest	sale of processed timber from own forest	hired labour, pension. Invalidity pension	other sources
0.01–0.50	276	37	0	0	46	17
0.51–1.00	216	42	0	0	38	20
1.01–1.50	159	49	0	0	30	22
1.51–2.00	97	51	0	0	34	15
2.01–3.00	127	58	1	0	23	19
3.01–4.00	68	68	2	0	17	13
4.01–5.00	39	57	0	0	22	21
5.01–10.00	57	62	0	0	28	10
10.01–15.00	48	79	5	0	8	8
> 15.00	25	63	6	0	16	15
Total/Average	1,112	49	1	0	33	17

Tab. 17. Opinion about the supervision of private forests – results of questionnaire study, Forest Research Institute, 2007

Classes of forest area (ha)	Number of studied holdings	Opinion				Average evaluation index value
		very well	well	bad	no opinion	
0.01–0.50	276	6.37	42.32	8.61	42.70	2.92
0.51–1.00	216	8.02	46.23	6.13	39.62	3.06
1.01–1.50	159	7.59	53.80	6.33	32.28	3.04
1.51–2.00	97	10.42	48.96	8.33	32.29	3.06
2.01–3.00	127	6.67	49.17	8.33	35.83	2.95
3.01–4.00	68	13.43	43.28	8.96	34.33	3.14
4.01–5.00	39	10.53	47.37	7.89	34.21	3.08
5.01–10.00	57	10.53	49.12	10.53	29.82	3.00
10.01–15.00	48	14.89	59.57	6.38	19.15	3.21
> 15.00	25	12.00	64.00	4.00	20.00	3.20
Total/Average	1,112	8.56	47.93	7.64	35.88	3.03

parable FRI research conducted in 2004 in which this value was 81%.

The value of timber sold was more than 50,889 EURO representing 23% of the total income and was higher than that shown in the research results of Central Statistical Office (Podkarpackie – 6.1%, Podlaskie – 5.1% and Wielkopolskie – 17.9%) and of FRI in 2004 (15.4%).

The average income per holding is almost four times higher (198 EURO) compared to the research re-

sults of FRI in 2004 (55 EURO) and significantly higher compared to the GUS data from 2004 in which the income in the Carpathian, Podlaskie and Wielkopolskie Voivodships was 118, 168 and 134 EURO/household, respectively. The income calculated per m³ of harvested timber – 29 EURO/m³ (Tab. 15) was slightly higher compared to the FRI research conducted in 2004 (27.5 EURO/m³).

Farming is the main source of income for the surveyed farmers representing on the average nearly 49%

of their total household income. Due to the low profitability of forest management and small area of forest land, revenues from the forest did not exceed 1% of the income structure of surveyed holdings in any of the voivodships. On the average they accounted for 0.25% of the revenues from the sale of timber and 0.02% from the sale of processed wood (Tab. 16).

In the case of size classes of forest area, the revenues oscillated from 162 EURO /ha and 45 EURO/m³ of harvested timber in the class 0.51 – 1 ha of forest to 47 EURO /ha in the class of over 15 ha of forest and 21 EURO /m³ of timber in the class 1.51 – 2.00 ha of forest. Supplementary information concerning supervision, damage from wild animals, timber theft and official opinions about the possibility of forming associations by forest owners.

In 2006, 147 farmers (13%) applied to the authorities exercising supervision over forests for assistance in various matters relating to private forests. Most of the farmers applied to Subdistrict Forest Managers or Forest Districts for assistance or execution of actions related to supervision, 58% and 33%, respectively. Acting in accordance with the binding law, farmers usually applied for the execution of actions related to the legalization of the harvested timber *i.e.* for a permission to cut trees and register the harvested timber accounting for 24% and 18% of all permissions, respectively. In

the third place, farmers mentioned the need to obtain a certificate of legality of timber origin (12%) and, subsequently, afforestation issues (10%).

The rating of supervision as “very good” differed by region ranging from 1% in the Mazowieckie Voivodship to 20% in the Kujawsko-Pomorskie, Lubuskie and Wielkopolskie Voivodships. Using the 5-point grading scale with 5 points for “very good”, 3 points for “good” and 1 point for “bad” performance, the highest average rating (3.62 points) was assigned by farmers to the supervision services in the Wielkopolska Voivodship and the lowest (2.51 points) to the supervision services in the Lubelskie Voivodship (East part of Poland) where, interestingly, supervision was mostly exercised by the County Governor’s services.

The data contained in Tab. 17 indicate that farmers of large holdings evaluate supervision much higher; with nearly 15% of respondents rating it as “very good” in the class of holdings with 10–15 ha of forests, while only about 7% of respondents rated it as “very good” in the classes of holdings with 0.01 to 3 ha of forest.

In the years 2004–2006 timber theft occurred in 251 (22.6%) surveyed holdings. More than 3.2 thousand m³ of timber was stolen in three years, which represents 16% of the volume of timber harvested at the time (Tab. 18). More than 50% of the volume of stolen timber (almost 1,600 m³) was in the Mazowieckie

Tab. 18. Volume of stolen timber in the period 2004–2006 in agricultural holdings with forest – results of questionnaire study, Forest Research Institute, 2007

Classes of forest area (ha)	Number of studied holdings	Number of agricultural – forest holdings	Volume of stolen timber in 2004–2006 (m ³)	%	Volume of stolen timber in m ³ per		
					holding	ha of forest	m ³ of harvested timber
0.01–0.50	276	51	460.8	14.75	1.67	5.80	0.44
0.51–1.00	216	41	328	10.50	1.52	1.98	0.23
1.01–1.50	159	40	427	13.67	2.69	2.15	0.26
1.51–2.00	97	25	178.45	5.71	1.84	1.03	0.17
2.01–3.00	127	27	596.5	19.09	4.70	1.88	0.24
3.01–4.00	68	24	250	8.00	3.68	1.04	0.15
4.01–5.00	39	14	273	8.74	7.00	1.55	0.20
5.01–10.00	57	11	310	9.92	5.44	0.81	0.14
10.01–15.00	48	13	245	7.84	5.10	0.43	0.06
> 15.00	25	5	56	1.79	2.24	0.09	0.02
Total/Average	1,112	251	3,124.75	100.00	2.81	1.05	0.16

Voivodship (Central part of Poland). The average volume of stolen timber is 2.8 m³ per surveyed holding, this value being regionally differentiated. The average volume of stolen timber calculated per ha of forest is more than 1 m³, while that calculated per cubic metre of harvested timber is about 0.16 m³ of timber (Tab. 18).

Analyzing the level of theft in respect of size classes of agricultural holdings, nearly 90% of the volume of stolen timber comes from the holdings with less than 20 ha of agricultural land. Also the largest quantities of timber calculated per ha of forest land (from 2 m³ to 0.86 m³) and per cubic meter of harvested timber (from 0.32 m³ to 0.13 m³) are stolen from this size class of holdings (approximately 3 m³). An analysis of responses to the questionnaire concerning size classes of forest area shows that over 19% of timber was stolen from the holdings with 2 to 3 ha of forest. Adding up the quantities of stolen timber in the smallest holdings in which the area of forests is less than 5 ha, it appears that the volume of stolen timber in such holdings accounts for about 80%. The owners of small holdings who carry out management on 0.5 ha of forest suffer the biggest loss from the theft of timber. In such holdings, nearly 6 m³ of timber calculated per ha of forests was stolen and in terms of harvested volume it was almost 0.5 m³ per each m³ of the harvested timber.

In 2006–2007, damage from wild animals occurred in 268 holdings – 24% (which is slightly less than shown in the FRI research in 2004 when such damage occurred in 35% of the surveyed holdings). The total area of land where wild animals caused damage covered more than 280 ha of which 94% was agricultural land. The value of compensation payments amounted to almost 22 thousand PLN of which 63% was a compensation for damage to agricultural land.

Irrespective of the area of forest estates, farmers – the forest owners need sometimes to purchase wood from the State Forests. Basing on the research conducted by FRI in 2007, the amount of wood purchased by the respondents in 2006 was nearly 2.5 thousand m³.

Forestry Associations are one of the best proven forms of collective management in private forests. In the questionnaire surveys, farmers were asked whether they would see the need for and benefit from belonging to this type of local government organizations. Only a small group of 166 farmers (15% of respondents) gave an affirmative answer to that question. Among the

benefits arising from forming associations, the farmers (percentage of farmers who gave affirmative answers) pointed to:

- collective management to reduce the cost of forest management – 54%,
- joint timber sale – 49%,
- active participation in determining forest tax – 35%,
- economic initiatives related to wood processing – 23%,
- attempts to obtain a common certificate for private forests – 22%.

In the subsequent question in the questionnaire farmers were asked to specify what assistance they would expect from the institutions exercising supervision over private forests – County Governors' Offices or Forest District Inspectorates. Of the five proposed areas of assistance, the farmers pointed to:

- consulting in the area of forest management – 52.87%,
- assistance in the preparation of documents (afforestation, harvesting) – 35.91%,
- access to important information related to forests – 27.69%,
- legal assistance – 24.64%,
- training for forest owners – 22.93%.

SUMMARY AND CONCLUSIONS

The implementation of the project allowed for the first time to collect data in questionnaire surveys conducted on a nationwide representative random sample of agricultural holdings with forest. Questionnaire surveys have so far been conducted as pilot studies in selected regions in Poland or nationwide surveys using a sample that could not be considered representative due to its selection method (FRI research in 2004).

The research on a nationwide sample of 1,112 agricultural holdings with forest conducted by FRI in 2007 provided valuable, previously unavailable information on private forests in the ownership of farmers whose generalization to the population of agricultural holdings with forests allowed to assess the status, direction and prospects for the development of forests in this ownership category (natural persons, farmers). The FRI network of forest estates selected by Central Statistical Office with the use of the data of the Ag-

gricultural Census 2002 should be established in the field, and then updated on the basis of the Agricultural Census 2010.

The periodically inspected forest estates included in the network would provide valuable information useful in formulating policies for the largest portion of private forests. The monitoring of changes and developmental trends taking place in private forests owned by farmers should become an important element of rural development strategies, especially for the plans related to the future EU budget for the years 2014–2020.

The collected data show that, due to their small area, forests in agricultural holdings play basically the role of a timber warehouse used by farmers for the household needs (fuel and utility wood). In the case of larger holdings, private forests are a source of small income, although due to their high fragmentation and the way economic activity is organized in them (low effectiveness of forest management) the economic importance of the private forestry sector, both for the country and for the owners, is small. Farmers practically generate no income from forest, do not invest in forestry production means (machines and equipment), and they usually do forest operations by themselves, with the assistance of family members or neighbours, and using the means of agricultural production.

The FRI and Central Statistical Office studies, as well as data describing private forests allow for the following conclusions:

- In the land-use structure of the surveyed agricultural holdings, arable land prevailed, representing 57% of the total area. Forest area accounted for 20% of the total area of the surveyed holdings.
- The total area of nearly 3 thousand ha of forests in the surveyed holdings consisted of 2,886 plots of forest land of different sizes. In the average agricultural holding with forests there are two small plots of forest land with a total average area of 1.41 ha located about 2.4 km away from the owner's place of residence. The largest group of forest estates are those in which there is a forest plot with an average area of approximately 0.88 ha and approximately 6.40 ha of agricultural land.
- Thinning treatments in forest plantations in the holdings surveyed in 2006 were performed on nearly 274 ha, representing 9.2% of the total forest area.

This result is similar to the results of the Central Statistical Office survey in 2004. The result is significantly lower than the data obtained in the FRI research in 2004, when thinning treatments covered an area of 28% of the total forest area in the surveyed holdings.

- In the case of thinning, it was performed on 648 ha, representing nearly 22% of forest area which is the value considerably lower compared to the results of the Central Statistical Office survey for the Podkarpackie (14.8%) and Podlaskie (18.6%) Voivodships. In the research conducted by FRI in 2004, the share of forest area covered by thinning treatments was 31% of the total area of forests.
- In the research conducted by FRI in 2007, the interviewed farmers declared that they had in their holdings over 184 ha of land which, because of the way of utilization, should be reclassified to forest land. The share of such land in relation to forest area was 6.2% which is the result similar to that obtained in the FRI research of 2004. The area of the mentioned land (about 300 thousand ha) may indicate that the real, not cadastral area estimated for private forests is about 1,800 thousand ha.
- The volume of timber harvested in 2004–2006 in the surveyed holdings exceeded 19 thousand m³. The greatest volume of timber was obtained by cutting whole trees (6.2 thousand m³), representing 32.7% of the total volume of harvested timber. These data are comparable with the data of the research conducted by FRI in 2004 according to which 34.7% of the total volume was obtained in this way. The next largest volume was harvested in thinning operations in which almost 5.7 thousand m³ of wood (29.6% of volume) was harvested. This figure is slightly lower compared to the research results from 2004 when nearly 39% of timber volume came from thinning. Only 1.4 thousand m³ of timber (7.3%) was harvested in clear-cuts which is a slightly lower value compared to the results from 2004 – 9.8% of the total timber volume.
- It should be assumed that in the period under review (2004–2006), the average harvested volume per holding amounted to nearly 6 m³ of timber annually, while calculated per ha of forest area it was slightly over 2 m³/ha. In comparable studies carried out by FRI in 2004, the average volume was

similar to that presented above, and amounted to nearly 7 m³/holding and 2 m³/ha of forest area. These figures are much higher than the official Central Statistical Office data which show that the average volume per ha of private forests was about 0.6 m³/ha. Assuming that the results obtained are reliable, it turns out that in 2006 about 3.2 million m³ of timber was harvested in private forests which indicates that about 2.1 million m³ of timber was harvested off record.

- The vast majority of harvested timber is used by farmers for domestic and household purposes as firewood and utility wood. A comparison of the data collected in 2007 with the FRI data collected in 2004 shows that the method of timber utilization did not change. In 2004, over 94% of timber was used by farmers, and only 5% was sold. The results of the 2007 research are also comparable with the Central Statistical Office data collected in 2004 for three voivodships: Podkarpackie, Podlaskie and Wielkopolskie, according to which the use of wood in agricultural holdings amounted to 89.5, 89.7 and 83.5%, respectively.
- A chain saw is the only forest tool commonly used in agricultural holdings with forests. Over 74% of the interviewed farmers declared to have had it. These are mostly the chain saws made in Scandinavia, mainly by two producers – Husqvarna and Stihl.
- The total costs related to forest management in the holdings surveyed in 2006 amounted to more than 103 thousand EURO (34 EURO/ha of forests and 13 EURO/m³ of harvested timber). The costs of purchase of machinery and equipment (35.43%), materials and energy (30.01%), taxes and fees (18.39%) were the main items in the total cost structure. The average cost per holding stood at a level of 92 EURO /year.
- In 2006, the interviewed farmers, their families and other persons managing 2,965 ha of forest worked for 67 thousand hours in the forest harvesting at that time 7,593 m³ of timber. In a single holding, the forest owner spent on the average, nearly 44 hours in the forest annually. In terms of volume calculated per m³ of harvested timber and per ha of forest, the time they worked in the forest amounted, on the average, to nearly 9 hours and

over 23 hours, respectively. The obtained research results concerning the time farmers worked in the forest (2,259 hours/100 ha) are different from the Central Statistical Office data from 2004 when the number of hours per 100 ha of forest for the Podkarpackie Voivodship was 5,615 hours/100 ha, Podlaskie Voivodship – 2,330 hours/100 ha and Wielkopolskie Voivodship – 3,309 hours/100 ha. In the research conducted by FRI in 2004, this figure was 3,062 hours/100 ha.

- In 2006, the total income from forest generated by the surveyed holdings was over 74 EURO/ha which is a higher result than the result of the research conducted by FRI in 2004 (62 EURO/ha) and by GUS in 2004 for the Wielkopolskie (60 EURO/ha) and Podlaskie (63 EURO/ha) Voivodships, but lower than the income generated by the holdings in the Podkarpackie Voivodship (99 EURO/ha).
- In the period 2004–2006, timber theft occurred in 251 (22.6%) surveyed holdings. Within three years, over 3.2 thousand m³ of timber was stolen which represents 16% of the volume of timber harvested at the time (Tab. 18). More than 50% of the volume of stolen timber (almost 1,600 m³) was in the Mazowieckie Voivodship. The average volume of stolen timber is 2.8 m³ per surveyed holding, this value being regionally differentiated. The average volume of stolen timber calculated per ha of forest is more than 1 m³, while calculated per cubic meter of harvested timber it is about 0.16 m³ of timber.

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