

Reclamation of Degraded Land at Regional Level and Conversion of Agricultural Land for Non-Agricultural Purposes

Monika Wasilewicz-Pszczółkowska, Adam Senetra, Agnieszka Szczepańska

University of Warmia and Mazury in Olsztyn, Poland

Abstract

Intensified anthropogenic pressures contribute to land degradation and devastation around the globe. Land degradation leads to a temporary or a permanent decline in the productive capacity of land. Degraded agricultural land is often converted to non-agricultural uses, as the result areas with natural land cover (arable land, meadows, pastures) are transformed into anthropogenic landscapes. The objective of this study was to analyze the changes in the area of degraded land in the Warmińsko-Mazurskie Voivodship based on the scope of implemented land reclamation measures. The area of land converted for non-agricultural purposes, the revenues generated from conversion fees and their distribution were also evaluated. The analyzed data covered the period of 2007–2012.

Keywords: agricultural land, land reclamation, land degradation, land conversion to non-agricultural uses

Introduction

Land degradation implies a partial loss, and land devastation—a complete loss of land's productive value. Growing levels of environmental degradation increase the area of degraded and devastated land. The severity of the problem is illustrated by the fact that 25% of the earth's land has been degraded in the past decades (Bai et al. 2008). Land degradation is observed at the local, regional and global level (Bajocco et al. 2012; Gisladottir and Stocking 2005; Jimoh et al. 2012), and it is one of the severest environmental issues in the world (Hanping and Wensheng 2003). Intensified anthropogenic pressures contribute to land degradation and devastation around the globe, leading to a temporary or a permanent decline in the productive capacity of land. The major causes of land degradation are biophysical and chemical factors (soil erosion, loss of plant cover, changes in albedo, climate changes, desertification, soil salinization, lowering of the groundwater table, acidification, decreased soil fertility, changes in land use and land management, including deforestation and tillage methods) as well as socio-economic and political factors (decreased production, economic loss, population movements, agriculture intensification, population growth, urban sprawl, industrial concentration, land tenure, marketing, institutional support, incomes and human health, incentives, political stability) (Bojorquez-Tapia, Cruz-Bello, and Luna-Gonzalez 2013; Castro Filho et al. 2001; Eswaran, Lal, and Reich 2001; Greinert and Greinert 1999; Lorent et al. 2008; Maciak 2003; Nkonya et al. 2011; Salvati and Zitti 2009; Siuta 2007; Stocking and Murnaghan 2001).

Land degradation results from the depletion of renewable resources (Salvati and Carlucci 2010), and it is characterized by different degrees of reversibility. According to some authors, land is a non-renewable resource on a human time-scale (Eswaran, Lal, and Reich 2001). Land can be reclaimed through efforts aiming to restore its productive capacity and natural characteristics

(Haigh 2007).¹ Reclaimed land can be used for various purposes. Subsequent land uses can include forestry, agriculture, water bodies, recreation, cultural, educational, natural, residential and commercial use (Ostreęga and Uberman 2010).

Land degradation is a composite term that describes how one or more of the existing land resources, mostly soil, have been negatively affected. It applies directly to natural resources such as climate, water, landform and vegetation. Soil degradation is generally recognized as the main aspect of land degradation. Land degradation is directly associated with land use (Stocking and Murnaghan 2001) because it is very often induced by human activities, including the conversion of agricultural land to non-farming uses, such as housing, industrial, recreational and commercial use.

In Poland, the process of converting agricultural land for non-agricultural purposes is regulated by the Act of 3 February 1995 on the protection of agricultural land and forests.² In the above act, land conversion is defined as “commencement of land use for purposes other than agriculture and forestry”. Wasteland and land with the lowest productive capacity is most amenable to conversion. Upon the receipt of a decision authorizing the conversion of agricultural land to non-agricultural use, the owner is required to pay a single conversion fee as well as annual duties (over a period of 10 years) the value of which is determined by soil quality. The owners of converted land may also be placed under the obligation of removing the humus layer and using it to improve the productive capacity of other soils. The above obligation generally applies to soils of high and very high quality as well as peatland.

1 Surveyed voivodship

The surveyed area was the Warmińsko-Mazurskie Voivodship in north-east Poland (map 1). The analyzed voivodship has an area of 24 173 km², it is inhabited by around 4% of the Polish population and has a low population density of 59 persons per km² (the Polish average is 122 persons). The voivodship comprises 21 counties, including two cities with county rights (*Raport z wyników. Narodowy Spis Powszechny Ludności...* 2012). Warmia and Mazury is a popular tourist destination on account of its diverse landform, high share of forests and extensive water bodies that cover 6% of the voivodship's territory. Forest cover in the voivodship is estimated at 30,9%, and it exceeds the national average (29,3%)³ (*Raport o stanie lasów...* 2012). Medium-quality crop land accounts for more than 50% of the land in the voivodship (*Raport z wyników – Powszechny Spis Rolny...* 2011). Conservation areas cover 1129458 ha and account for 46% of the voivodship's territory.⁴ In recent years, the share of areas with natural land cover has been growing steadily in the Warmińsko-Mazurskie Voivodship, which increases the demand for measures that offer effective protection against degradation processes.

2 Materials and Methods

Changes in the area of degraded land and reclaimed land were analyzed in the surveyed voivodship. The area of land converted for non-agricultural purposes and the revenues generated from conversion fees were evaluated. The analyzed changes were directly related to anthropogenic activities. The analyzed data covered the period of 2007–2012.

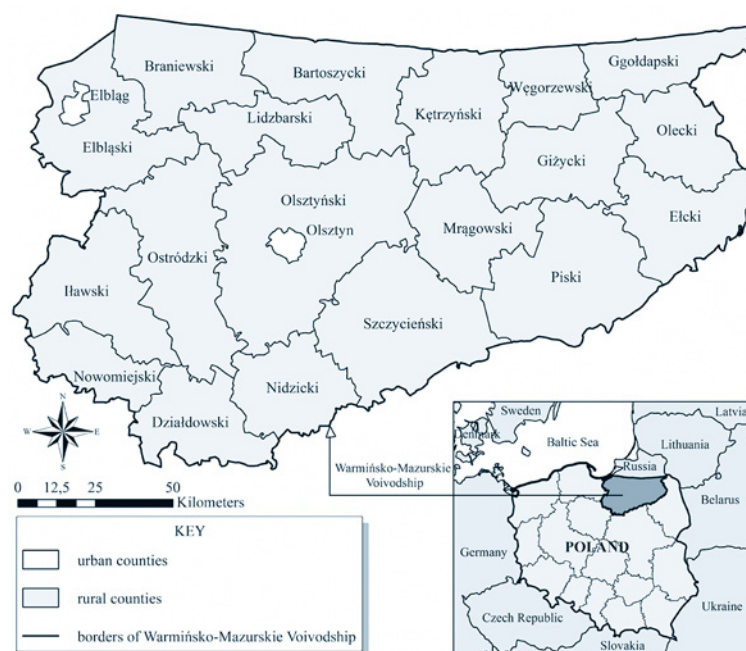
The analysis was conducted based on data from reports RRW-11 and RRW-12. Report RRW-11 outlines the progress made in the implementation of the provisions of the Act of 3 February 1995 on the protection of agricultural land and forests regarding the conversion of agricultural land for non-agricultural purposes, land reclamation, land and resource management, and peat extraction.

1. See also: Obwieszczenie Marszałka Sejmu Rzeczypospolitej Polskiej z dnia 18 lipca 2013 r. w sprawie ogłoszenia jednolitego tekstu ustawy o ochronie gruntów rolnych i leśnych, DzU z 2013 r. poz. 1205.

2. Ibid.

3. [In the journal (in both Polish and English texts) European practice of number notation is followed—for example, 36 333,33 (European style) = 36 333.33 (Canadian style) = 36,333.33 (US and British style). Furthermore in the International System of Units (SI units), fixed spaces rather than commas are used to mark off groups of three digits, both to the left and to the right of the decimal point.—Ed.]

4. Information published at <http://stat.gov.pl/> in February 2014.

Map 1. Geographic location of the surveyed voivodship

Report RRW-12 details the progress made in the implementation of the above legal provisions concerning the collection of conversion fees, annual duties and the relevant statutory payments and the distribution of the resulting funds. The locally competent county administrator is responsible for reporting on the area of land converted to non-agricultural use and developed land. The Department of Infrastructure and Geodesy of the Marshal's Office of the Warmińsko-Mazurskie Voivodship forwards the reports to the Department of Land Management of the Ministry of Agriculture and Rural Development.

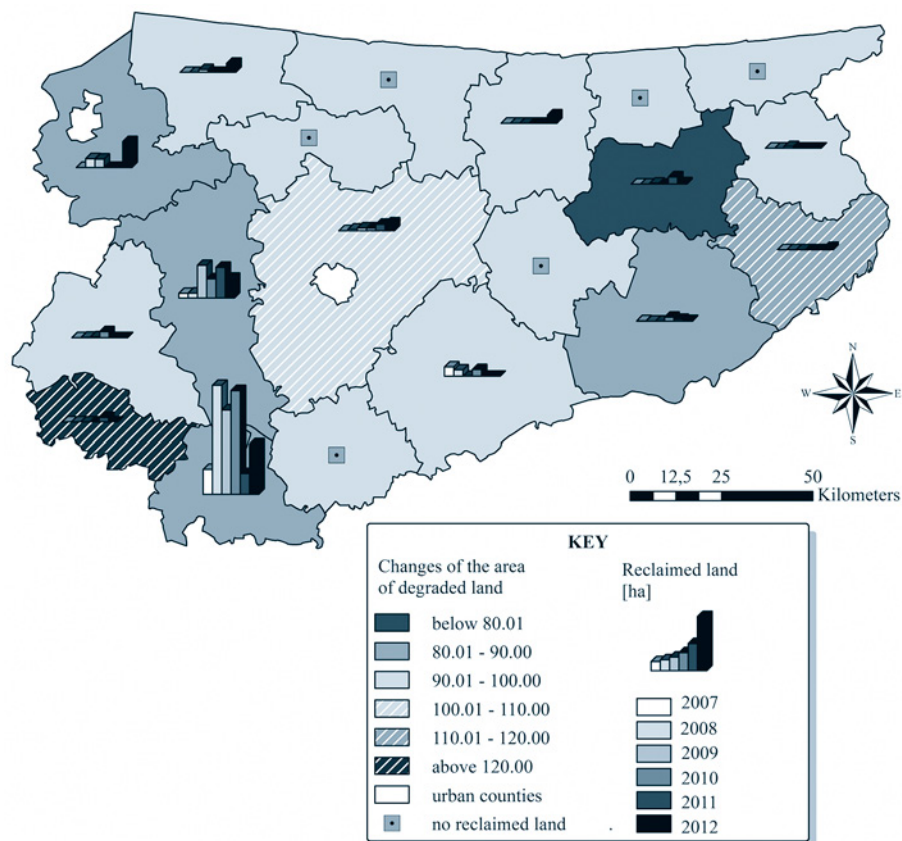
The study comprised the following research stages:

- a digital map of the Warmińsko-Mazurskie Voivodship with a division into 19 rural counties and 2 urban counties, the principal research sites, was developed
- a database was developed for analyzing the rates of change in the area of degraded land and agricultural land converted to non-agricultural uses in 2007–2012
- relative fixed-base percent changes in the area of degraded land and converted land in the counties of Warmińsko-Mazurskie Voivodship were calculated; the values of relative fixed-base percent changes were referenced to the level of 100% (no change)
- a spatial analysis of the rates of change in the area of the degraded land and converted land was performed in the surveyed sites
- the results of the analysis were presented in the form of cartograms and cartodiagrams; the percentage rates of the analyzed processes were presented in separate intervals for greater convenience

3 Results and Discussion

The changes in the area of degraded land and reclaimed land in each county of the analyzed voivodship are presented in map 2. The greatest changes in the area of degraded land were observed in the Nowomiejski county, Ełcki county and Olsztyński county, but the area of land reclaimed in the above counties in the surveyed period remained fairly low. The most extensive land reclamation measures were conducted in the Działdowski county (highest change rate in the voivodship), Ostródzki county and Elbląski county, which were characterized by the smallest changes in the area of degraded land. Six counties, including four counties situated in the northern part of the voivodship—Braniewski, Węgorzewski, Bartoszycki, Góldapski, as well as the Nidzicki county

Map 2. Changes in the area of degraded land in the Warmińsko-Mazurskie Voivodship in 2007–2012. The area of land reclaimed in the Warmińsko-Mazurskie Voivodship in 2007–2012



and Mrągowski county, failed to initiate any land reclamation measures in the analyzed period, which gives serious cause for concern.

The total area of degraded land and reclaimed land in Warmińsko-Mazurskie Voivodship is shown in figure 1, and it points to low levels of land reclamation in the analyzed voivodship. Approximately 5000 ha of land requires reclamation each year, and due to infrequent reclamation programs, only a minor decrease was noted in the area of degraded land. The area of degraded land did not increase significantly in the analyzed period, which somewhat alleviates the problem.

Table 1 shows the area of agricultural land converted for non-agricultural purposes in each year of the analyzed period, and it illustrates the extent of the relevant measures in the counties of the surveyed voivodship. The most extensive land conversion (accounting for more than 71% of total conversions in the analyzed voivodship) was noted in counties with well-developed urban centers—Działdowski, Elbląski and Olsztyński. Moderate land conversion was observed in the Elcki

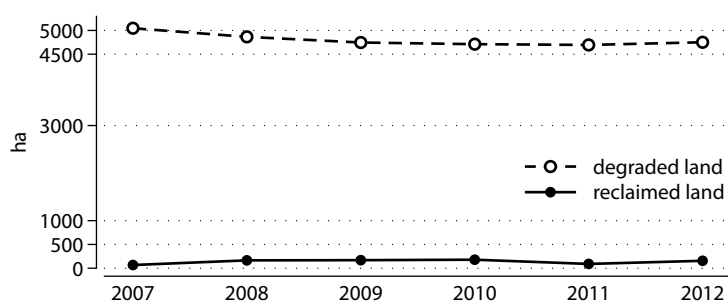


Fig. 1. Area of degraded land and reclaimed land in the Warmińsko-Mazurskie Voivodship in 2007–2012

Source: own study based on GUS data

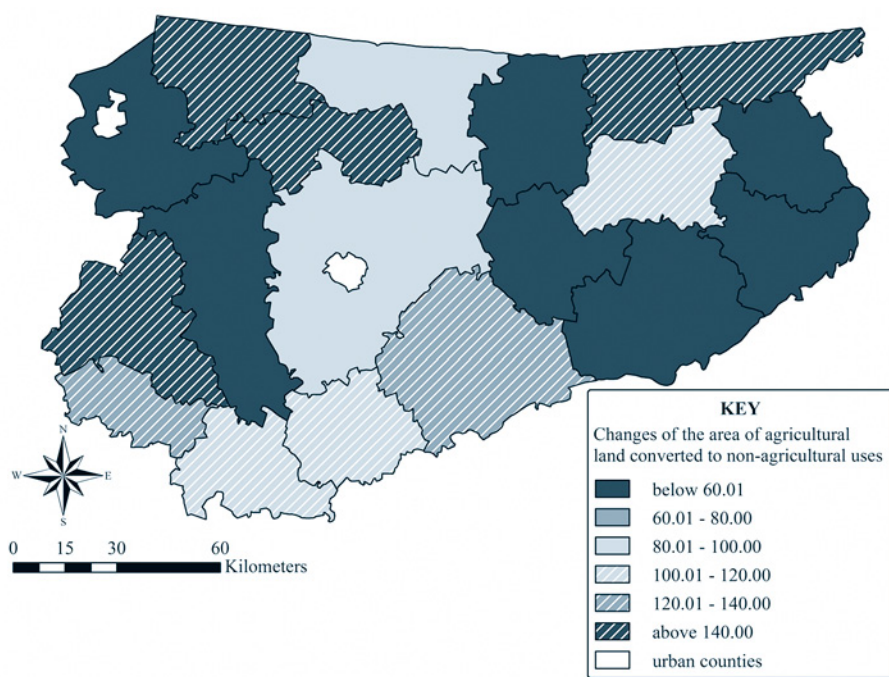
Tab. 1. Area of agricultural land converted to non-agricultural uses in each county of the Warmińsko-Mazurskie Voivodship in 2007–2012

County	Area of land converted to non-agricultural uses (ha)						Total	Share ^a
	2007	2008	2009	2010	2011	2012		
Bartoszycki	4,45	15,62	4,67	4,65	7,1	3,58	40,07	4,34
Braniewski	3,54	6,56	1,22	5,59	17,68	8,81	43,4	4,70
Działdowski	61,49	45,19	35,52	77,76	35,08	73,55	328,59	35,61
Elbląski	46,77	55,06	2,66	3,36	2,23	3,54	113,62	12,31
Ełcki	12,25	9,12	7,98	15,75	5,41	5,43	55,94	6,06
Giżycki	0,41	0,46	1,68	0,3	0,42	0,46	3,73	0,40
Gołdapski	0,32	0,12	1,17	0,08	0	0,57	2,26	0,24
Hawski	0	4,15	0,01	0,01	0,55	0,58	5,3	0,57
Kętrzyński	3,14	3,23	0,87	8,17	1,22	0,42	17,05	1,85
Lidzbarski	0,05	0,12	0	0,05	0,11	0,21	0,54	0,06
Mrągowski	2,63	4,05	0,35	0,56	0,29	0,47	8,35	0,90
Nidzicki	0	0	0	0	0	0,07	0,07	0,01
Nowomiejski	0,35	0,22	0,39	0,39	0,24	0,43	2,02	0,22
Olecki	2,73	1,01	0,89	1,26	0,22	0,1	6,21	0,67
Olsztyński	54,58	30,87	24,93	22,13	35,92	51,38	219,81	23,82
Ostródzki	27,83	37,46	0,47	0,77	3,46	2,28	72,27	7,83
Piski	0,09	0,08	0	0,18	0,06	0,01	0,42	0,04
Szczycieński	0	0,28	0,15	0,07	0,05	0,27	0,82	0,09
Węgorzewski	0,19	0,1	0,15	1,34	0,15	0,61	2,54	0,28
Total	220,82	213,7	83,11	142,42	110,19	152,77	923,01	100,00

Source: own study based on RRW-11

^aShare of total land area converted to non-agricultural uses in the voivodship (in %)

Map 3. Changes in the area of agricultural land converted to non-agricultural uses in the Warmińsko-Mazurskie Voivodship in 2007–2012



county and Ostródzki county. In four counties: Nidzicki, Piski, Lidzbarski, Szczycieński, the area of converted agricultural land did not exceed 1 ha in the analyzed period. The changes in the area of agricultural land converted to non-agricultural uses in each county of the analyzed voivodship are presented in map 3.

The revenues collected in virtue of land conversion fees collected in every county are presented in table 2. The highest revenues were generated in the Elbląski county, Kętrzyński county and Olsztyński county, where they exceeded 71% of total revenues (conversion fees, annual duties and

Tab. 2. Revenues collected in virtue of conversion fees, annual duties and other payments in each county of the Warmińsko-Mazurskie Voivodship in 2007–2012

County	Revenues collected in virtue of conversion fees, annual duties and other statutory payments (PLN)						Total	Share ^a
	2007	2008	2009	2010	2011	2012		
Bartoszycki	27 395	39 711	35 032	35 664	52 760	51 404	241 966	2,24
Braniewski	15 630	14 813	14 033	34 031	10 699	89 653	178 859	1,66
Działdowski	47 754	36 895	57 054	97 046	71 410	69 575	379 734	3,52
Elbląski	270 607	427 075	398 888	291 887	136 137	271 017	1 795 611	16,63
Elcki	18 593	37 912	10 682	29 877	13 128	17 990	128 182	1,19
Giżycki	1 788	497	19 210	15 930	18 303	35 290	91 018	0,84
Gołdapski	188	2 583	82	111 454	6 206	27 328	147 841	1,37
Īawski	30 100	6 575	136 440	43 976	43 835	49 803	310 729	2,88
Kętrzyński	45 320	147 513	57 085	2 077 897	241 554	277 393	2 846 762	26,37
Lidzbarski	7 560	739	4 598	4 794	3 822	5 563	27 076	0,25
Mrągowski	34 990	269 140	123 539	108 714	99 581	192 504	828 468	7,67
Nidzicki	7 323	1 298	1 890	2 088	1 445	1 226	15 270	0,14
Nowomiejski	2 834	16 230	10 485	33 461	26 891	29 670	119 571	1,11
Olecki	13 215	20 821	4 589	6 337	3 299	1 562	49 823	0,46
Olsztyński	204 315	347 664	912 835	471 582	451 501	701 654	3 089 551	28,62
Ostródzki	72 035	75 733	30 326	52 411	39 473	85 439	355 417	3,29
Piski	5 135	8 675	2 481	14 729	2 964	3 550	37 534	0,35
Szczycieński	720	608	927	1 080	907	896	5 138	0,05
Węgorzewski	6 339	3 469	7 434	66 586	32 395	30 954	147 177	1,36
Total	811 841	1 457 951	1 827 610	3 499 544	1 256 310	1 942 471	10 795 727	100,00

Source: own study based on RRW-12

^aShare of total revenues collected in the voivodship (in %)

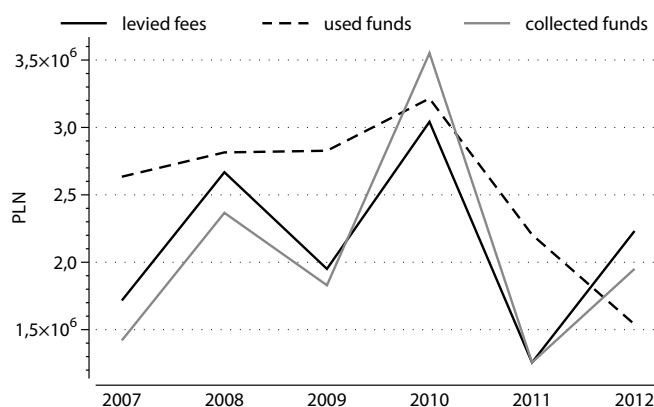


Fig. 2. Collection and utilization of funds raised from conversion fees and annual duties in the Warmińsko-Mazurskie Voivodship in 2007–2012.

Source: own study based on RRW-12

the relevant payments) in the Warmińsko-Mazurskie Voivodship. In the Olsztyński county and Elbląski county, high revenues can be attributed to the large area of agricultural land converted to non-agricultural uses. In Kętrzyński county, the area of converted land was relatively small, which indicates that converted land belonged to the category of high quality soils.

The total value of conversion fees and annual duties charged in the Warmińsko-Mazurskie Voivodship is presented in figure 2. In 2007–2009, the value of collected fees was lower than the value of levied fees, but those disproportions were leveled out in 2009–2011. A dramatic drop in the fund utilization rate was noted as of 2010.

The funds raised from conversion fees are used mainly for the purpose of building and upgrading farm access roads (tab. 3). More than 90% of funds are allocated to the above purposes, and they are rarely allocated to other measures.

Tab. 3. Utilization of funds raised from conversion fees, annual duties and other statutory payments in the Warmińsko-Mazurskie Voivodship in 2007–2012

Year	Total funds (PLN)	Funds used for the construction and upgrading of farm access roads (PLN)	Funds used for other purposes (PLN)	Share of funds used for the construction and upgrading of farm access roads in total funds (%)	Share of funds used for other purposes in total funds (%)
2007	2 634 556	2 510 743	123 813	95,30	4,70
2008	2 814 738	2 794 738	20 000	99,29	0,71
2009	2 827 095	2 788 096	38 999	98,62	1,38
2010	3 214 846	3 181 083	33 763	98,95	1,05
2011	2 204 708	2 203 978	730	99,97	0,03
2012	1 538 671	1 521 304	17 367	98,87	1,13

Source: own study based on RRW-12

Conclusions

The results of this study indicate that land reclamation rates are very low both in the Warmińsko-Mazurskie Voivodship. In 2007–2012, a total of 807 ha of land was reclaimed in the analyzed voivodship, which accounts for only 2,8% of the area of degraded land. Our findings point to the need for much more extensive land reclamation schemes. The area of degraded land remained stable, which indicates that degradation has not progressed in the analyzed period.

The low rate of land conversion for non-agricultural purposes prevents land devastation and contributes to the preservation of the unique environmental features of the Warmińsko-Mazurskie Voivodship. Land conversion leads to changes in space and the natural environment and is invariably associated with increasing anthropogenization. Low conversion rates can be attributed to low levels of economic development and the low population of Warmińsko-Mazurskie Voivodship, which decreases the demand for land for housing, industrial and commercial purposes. In 2007–2012, 983 ha of agricultural land was converted to non-agricultural uses. The revenues generated from conversion fees and the relevant payments amounted to approximately PLN 11 million, and more than 96% of those funds were used to build and upgrade farm access roads.

References

- BAI, Z.G., D.L. DENT, L. OLSSON, and M.E. SCHAEPMAN. 2008. "Proxy Global Assessment of Land Degradation." *Soil Use and Management* no. 24 (3):223–234. doi: 10.1111/j.1475–2743.2008.00169.x.
- BAJOCCO, S., A. DE ANGELIS, L. PERINI, A. FERRARA, and L. SALVATI. 2012. "The Impact of Land Use/Land Cover Changes on Land Degradation Dynamics. A Mediterranean Case Study." *Environmental Management* no. 49 (5):980–989. doi: 10.1007/s00267–012–9831–8.
- BOJORQUEZ-TAPIA, L.A., G.M. CRUZ-BELLO, and L. LUNA-GONZALEZ. 2013. "Connotative Land Degradation Mapping. A Knowledge-Based Approach to Land Degradation Assessment." *Environmental Modelling & Software* (40):51–64. doi: 10.1016/j.envsoft.2012.07.009.

- CASTRO FILHO, C., T.A. COCHRANE, L.D. NORTON, J.H. CAVIGLIONE, and L.P. JOHANSSON. 2001. Land Degradation Assessment: Tools and Techniques for Measuring Sediment Load. Paper read at 3rd International Conference on Land Degradation and Meeting of the IUSS Subcommission C — Soil and Water Conservation, 2001.09.17–21, at Rio de Janeiro.
- ESWARAN, H., R. LAL, and P.F. REICH. 2001. "Land Degradation. An Overview." In *Responses to Land Degradation. Proc. 2nd. International Conference on Land Degradation and Desertification, Khon Kaen, Thailand*, edited by E.M. Bridges, I.D. Hannam, L.R. Oldeman, F.W.T. Pening de Vries, S.J. Scherr and S. Sompatpanit. New Delhi: Oxford Press.
- GISLADOTTIR, G., and M. STOCKING. 2005. "Land Degradation Control and Its Global Environmental Benefits." *Land Degradation & Development* no. 16 (2):99–112. doi: 10.1002/Ldr.687.
- GREINERT, H., and A. GREINERT. 1999. *Ochrona i rekultywacja środowiska glebowego, Monografia/Politechnika Zielonogórska*. Zielona Góra: Wydawnictwo PZ.
- HAIGH, M.J. 2007. "Land Rehabilitation." In *Land Use, Land Cover and Soil Sciences. Encyclopedia of Life Support Systems (EOLSS)*, edited by W. Verheye. Oxford: UNESCO-EOLSS Publishers.
- HANPING, X., and S. WENSHENG. 2003. Application of the Vetiver System in the Reclamation of Degraded Land. Paper read at The Third International Conference on Vetiver and Exhibition. Vetiver and Water. An Eco-Technology for Water Quality Improvement, Land Stabilization, and Environmental Enhancement, 2003.10.6–9, at Guangzhou, P. R. China.
- JIMOH, H.I., O.D. AJEWOLE, S.I. ONOTU, and R.O. IBRAHIM. 2012. "Implications of Land Degradation, Reclamation and Utilizations in the Oil Producing Areas of Nigeria. Perspectives on Environmental Sustainability and Development." *Environmental Research Journal* no. 6 (2):100–105.
- LORENT, H., C. EVANGELOU, M. STELLMES, J. HILL, V. PAPANASTASIS, G. TSIURLIS, A. ROEDER, and E.F. LAMBIN. 2008. "Land Degradation and Economic Conditions of Agricultural Households in a Marginal Region of Northern Greece." *Global and Planetary Change* no. 64 (3–4):198–209. doi: 10.1016/j.gloplacha.2008.05.005.
- MACIAK, F. 2003. *Ochrona i rekultywacja środowiska*. 3rd ed. revised, Warszawa: Wydawnictwo SGGW Szkoły Głównej Gospodarstwa Wiejskiego.
- NKONYA, E., N. GERBER, P. BAUMGARTNER, J. VON BRAUN, A. DE PINTO, V. GRAW, E. KATO, J. KLOOS, and T. WALTER. 2011. The Economics of Desertification, Land Degradation, and Drought. Toward an Integrated Global Assessment. *IFPRI Discussion Paper* (01086), <http://www.ifpri.org/sites/default/files/publications/ifpridp01086.pdf>.
- OSTRĘGA, A., and R. UBERMAN. 2010. "Kierunki rekultywacji i zagospodarowania – sposób wyboru, klasyfikacja i przykłady." *Górnictwo i Geoinżynieria* no. 34 (4):445–461.
- Raport o stanie lasów w Polsce 2011*. 2012. Warszawa: Centrum Informacyjne Lasów Państwowych.
- Raport z wyników – Powszechny Spis Rolny 2010*. 2011. Warszawa: Główny Urząd Statystyczny.
- Raport z wyników. Narodowy Spis Powszechny Ludności i Mieszkań 2011*. 2012. Warszawa: Główny Urząd Statystyczny.
- SALVATI, L., and M. CARLUCCI. 2010. "Estimating Land Degradation Risk for Agriculture in Italy Using an Indirect Approach." *Ecological Economics* no. 69 (3):511–518. doi: 10.1016/j.ecolecon.2009.08.025.
- SALVATI, L., and M. ZITTI. 2009. "Assessing the Impact of Ecological and Economic Factors on Land Degradation Vulnerability through Multiway Analysis." *Ecological Indicators* no. 9 (2):357–363. doi: 10.1016/j.ecolind.2008.04.001.
- SIUTA, J. 2007. "Odpady w rekultywacji gruntów." *Inżynieria Ekologiczna* (19):59–78.
- STOCKING, M.A., and N. MURNAGHAN. 2001. *Handbook for the Field Assessment of Land Degradation*. London: Earthscan.