Economic Valuation of Agricultural Land Resources:
The Multifunctional Benefit Value Approach of Agricultural Land in the Karangsambung-Karangbolong Geopark Area

Rika Harini[1,*] Bowo Susilo[1] Evita Hanie Pangaribowo[1] Rina Dwi Ariani[1]

[1]*Faculty of Geography, Universitas Gadjah Mada, Indonesia*
*Corresponding author. Email: rikaharini@ugm.ac.id

ABSTRACT

The strategic role of agricultural land faces serious challenges, including the conversion of agricultural land. Agricultural land conversion is related to people's understanding of multifunctional value concept of agricultural land including economic and environmental value. Agricultural land is considered only as a producer of tangible and marketable products. Meanwhile, intangible functions tend to be ignored. This study aims to assess the economic and environmental value as well as the multifunctionality of agricultural land in the Karansambung-Karangbolong Geopark Area. The basic method used in this research is descriptive quantitative. Physical, social, and economic variables were obtained from secondary data using the data from the Central Statistics Agency (Badan Pusat Statistik=BPS) in the form of data on harvested area, palawija production, horticultural production, and agricultural land area. The research method is carried out by analyzing Total Economic Value through market price and replacement cost approaches. The results showed that the total economic value was IDR 3,349,807,994,706 with the value of environmental services amounting to IDR 1,107,713,585,706. The highest economic value of agricultural land is obtained from the production value of palawija commodity of IDR 2,011,099,558,500, and the lowest economic value of agricultural land is obtained from the value of forage or agricultural waste used for animal feed of IDR 11,269,828,000.

Keywords: Economic Valuation, Agricultural Land, Multifunction

1. INTRODUCTION

Agricultural land is a basic resource that has an important role in farming production factors whose functions cannot be replaced. The Karangsambung-Karangbolong Geopark area is a potential area for the development of the agricultural sector in Kebumen Regency. This is supported by the availability of natural land resources in the form of land, water, and agro-climate as well as human resources in the form of farmer labor. Judging from the contribution of the agricultural sector to the Gross Regional Domestic Product (GRDP) during 2016 to 2020, it is quite large with an average of 5,815,58 billion rupiah or 22.73% [1].

The increase in population and the growth of economic activities require lands. Land uses that are less economically profitable will be converted to other, more profitable land uses [2]. According to economic law, land conversion takes place from activities with lower to higher land rents [3], [4]. Land conversion is actually a normal phenomenon in relation to the development of an area [5]. One of the causes of agricultural land conversion to other land uses is the lack of awareness of many parties regarding the agricultural land multifunctionality [6]. The existence of land conversion will cause the community to become vulnerable but also encourage a variety of healthy habitats towards marginality and extinction [7]. Miscalculating goods and services produced by an ecosystem will encourage the use of resources that tend to damage [8] so that agricultural businesses cannot survive in a sustainable manner [9].

The economic benefits assessment of a resource is one of the factors that determine the resource sustainability. Low resource prices result in inefficient allocations where the level of production or extraction becomes higher than it should be. The public's view of

the agricultural function is generally limited to the function of producing marketable products, while the function of producing public services is still not widely known. In addition, agriculture is often seen only from the side of producing tangible and marketable products. Agricultural land is not only a producer of food and fiber (tangible and marketable) but also provides benefits to the community in many ways [10], [11] such as producing other services (intangible) or environmental services [12]. Environmental services from agriculture include providing employment, preserving rural culture, providing groundwater, preventing erosion, and preserving biodiversity [13], [14]. These services are often or not taken into account in the market system (non-marketable).

Moreover, agricultural land also has a significant role in flood mitigation, water resources conservation, erosion control, carbon sequestration, decomposing air heating, maintaining biodiversity, and recycling organic waste. However, all the functions of agricultural land will be lost if agricultural land is converted into non-agricultural land [15]. So that the goods and services in the ecosystem need to be quantified and measured with a common measure. This then becomes the focus of resource and environmental economics to assess environmental benefits in monetary terms [16]. Goods and services from an ecosystem are important to be quantified because to ensure social recognition and public approval in the management of ecosystems and resources [17]. Economic valuation is an important instrument to be able to provide an overview of the potential economic value of agricultural land as well as plans to direct environmental management, especially sustainable agricultural management [18], [19], [20].

2. MATERIAL AND METHOD

The research was carried out in the Karangsambung-Karangbolong Geopark Area. Administratively, the Karangsambung-Karangbolong Geopark area is located in Kebumen Regency, Central Java Province. The Geopark area covers 12 sub-districts on the west side of Kebumen Regency. The selection of research locations was carried out by purposive sampling because agricultural land in the Geopark area has potential agricultural resources with the highest percentage of GRDP and the existence of agricultural land has many functions, namely as food-producing materials, as well as other functions.

The data used in this study are secondary data and primary data. Secondary data is obtained from data published by the Central Statistics Agency as well as the results of previous research or journals related to research data. The analysis of the total economic value was carried out using two stages, namely a) identification of benefits and functions of agricultural land in the Geopark Area and b) quantifying all benefits and functions of agricultural land into monetary value [21]. The quantification technique used in this study is to use market value and indirect prices. Variable economic value of agricultural land can be seen in Table 1.

The Total Economic Value is the sum of the total benefits that have been identified from natural resources of agricultural land and formulated in formula (1) [22].

$$TEV = UV + NUV \tag{1}$$

Where UV is a use value and NUV is a non-use value which is then reduced to formula (2)

$$TEV = DUV + IUV + OV + EV + BV \tag{2}$$

Where DUV is direct use value, IUV is indirect use value, OV is option value, EV is existence value and BV is bequest value.
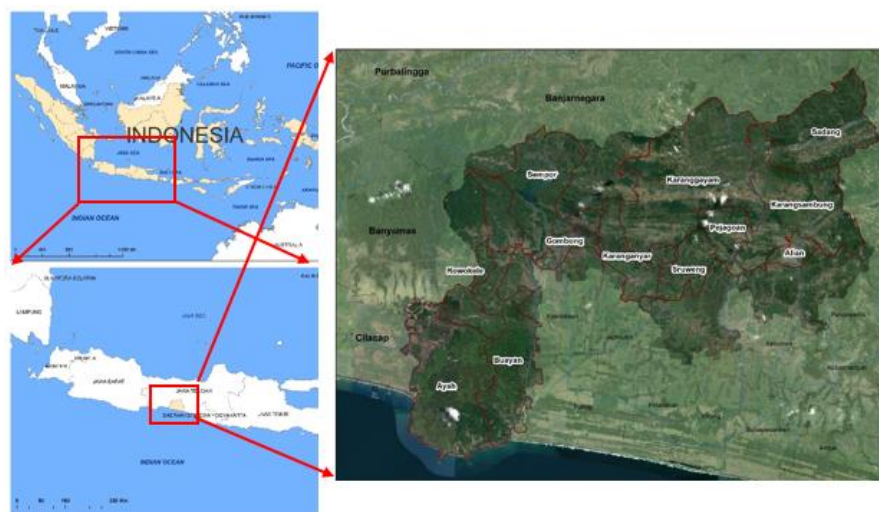

Figure 1 Geopark Karangsambung Karangbolong Map

Table 1. Variable Economic Value of Agricultural Land

Variable	Data Parameters	Indicator	Data Source	Data Analysis Method
Direct Use Value	Palawija Production Value	Palawija Production	Secondary Data	Market price approach
		Palawija prices	Primary data	
	Horticultural Production Value	Horticultural Production	Secondary Data	Market price approach
		Horticulture prices	Primary data	
	Forage value	Forage Production	Secondary Data	Market price approach
		Forage price	Primary data	
	Providing employment value	Total manpower	Secondary Data	Market price approach
		Labor wages	Primary data	
Indirect Use Value	Flood control	The value of the loss incurred to repair the water line	Secondary Data	Replacement Cost
	Landslide and flood control	The value of the loss that must be incurred to repair the water line	Secondary Data	Replacement Cost

Table 2. Agricultural Commodity Production Value, Straw Production And Labor Absorption

Commodity	Total Production (Kg)	Price (Rp)	Value (Rp/year)
Paddy	432,455,520	4,200	1,816,313,184,000
Corn	8,094,720	3.050	24,688,896,000
Cassava	46.277.050	1.650	76,357,132,500
Sweet potato	241,830	6,000	1,450,980,000
Peanuts	602.820	26,600	16,035,012,000
Soya bean	3,607,570	7,200	25,974,504,000
Mung beans	3,351,990	15,000	50,279,850,000
Palawija Commodities Value			**2,011,099,558,500**
Red onion	500	27,000	13,500,000
Spinach	20,100	5,000	100,500,000
Big Chili	95,800	8.000	766.400.000
Cayenne Pepper	378,640	60,000	22,718,400,000
Long beans	143,500	6,000	861,000,000
Mushroom	1,084,900	14,000	15,188,600,000
Kale	85,100	22,500	1,914,750,000
Cucumber	471,400	4,000	1.885.600.000
Eggplant	41,300	9,000	371.700.000
Tomatoes	36,000	13,000	468,000,000
Horticultural Commodity Value			**44,288,450,000**
Rice straw	138,405,000	80	11,072,400,000
Corn waste	2,204,600	80	176,368,000
Peanut leaves	210,600	100	21.060.000
Forage Production Value			**11,269,828,000**
Agricultural Land Area (Ha)	**Number of Workers (Hok/Ha/year)**	**Wages (Rp)**	**Value (Rp/year)**
11,138.83	315	50,000	175,436,572,500
Labor absorption value			**175,436,572,500**
Direct use value			**2,242,094,409,000**

Source: Data processed, 2021

3. RESULT AND DISCUSSION

The increase in population will have an impact on increasing the fulfillment of social and economic needs. To meet these needs, the agricultural sector must be sacrificed, with the high conversion of agricultural land into built-up land

Agricultural land has multiple functions, in addition to functioning economically, it also has an important environmental function for the community. Through a total economic value instrument, several direct and indirect benefits are obtained from agricultural land in the Karangsambung-Karangbolong Geopark Area. These benefits are then quantified using the market price and replacement cost approach. Analysis of the total

economic value of agricultural land resources from the sum of use values with non-use values in the Karangsambung-Karangbolong Geopark Area can be explained in detail in the following discussion.

3.1. Use Value of Agricultural Land in Geopark Area

Use value in this study consists of direct use value, indirect use value, and option value. Direct use value is the natural resources value of agricultural land consisting of agricultural commodity production, straw production, and employment. While the indirect use value consists of flood control and water sources. The value of choice consists of the value of biodiversity.

3.1.1. Direct Use Value

Direct use value is a value that can be directly felt by the community around agricultural land. This value includes the use of agricultural commodity production, straw production, and employment. The direct use values in the Geopark area can be seen in Table 2.

Agricultural commodities in the Geopark Karangsambung-Karangbolong area as presented in Table 2 consist of palawija and horticulture commodities. The use of agricultural commodities is generally to meet daily needs and also for sale. Rice is still a commodity that can be seeded in the Geopark Area.

Figure 1 Agriculture in the Karangsambung-Karangbolong Geopark Area (Field photo, 2020)

The benefits value of palawija felt by the community is still mostly given by the rice commodity which contributes 90% of other commodities with the total economic value of palawija production of IDR 2,011,099,558,500. This is in accordance with the type of staple food that exists in the area, even paddy which later becomes rice is the most important staple food for most of the world's population, especially people who are in the tropics [23], [24] and are able to provide 20% of the world's food energy supply [25], [26]. For the largest horticultural commodity, Cayenne pepper was contributed with a percentage of 51.30% and an economic value of IDR 22,718,400,000. Cayenne pepper (Capsicum annuum L.) belongs to the Solanaceae family and is one of the most important vegetable crops and is widely cultivated and consumed throughout the world

[27]. This is because cayenne pepper is widely used as a cooking spice and is also rich in phytochemicals that can improve health because it contains vitamins (B, C and E) polyphenols, flavonoids and capsaicinoid, which have the function of preventing cardiovascular disease, anti-aging, increasing immunity, and eliminating pain caused by arthritis [28], [29], [30].

Many regions of the world are capable of producing various forms of agricultural by-products that have the potential to be used as animal feed [31]. From several palawija commodities, there are agricultural wastes that can be used as animal feed, namely rice straw, corn, and peanuts. To calculate the production of agricultural waste, the assumption is used that rice straw waste from one hectare of harvested area can produce 5 tons of straw, 2 tons for corn, and 1.8 tons for peanut leaves [32]. The economic value of forage from agricultural waste, the largest contribution, is obtained from rice straw waste with a contribution of 98.25% of the total economic value of forage of IDR 11,269,828,000. Agricultural land also has a function as a provider of employment. This is very useful in the absorption of the local workforce. The absorption of labor for agricultural businesses includes bund improvement, soil processing, planting, weeding, fertilizing, irrigation, controlling plant pests and diseases, as well as harvesting and post-harvesting. Farming in the agricultural sector is able to absorb 315 hok/ha/year. Based on the average wage of agricultural sector workers in the Karangsambung-Karangbolong Geopark area of IDR 50,000/day, the value of the function of agricultural land as an absorber of labor is IDR 175,436,572,500. From these various benefits, the direct use value of agricultural land in the Karangsambung-Karangbolong Geopark Area is IDR 2,242,094,409,000.

3.1.2. Indirect Use Value

The indirect use values of agricultural land in the Geopark area include flood control and landslide prevention. Agricultural land can be used for flood mitigation where agricultural land has the ability to hold rainwater temporarily during and shortly after the rain. Rainwater that falls on agricultural land will be retained by the plant canopy, pooled on the soil surface, and absorbed by the soil through the soil pores, thereby reducing runoff. The approach used to estimate agricultural land as flood control and water source is replacement cost. The replacement cost used is the cost of building a dam.

The water buffer capacity on agricultural land is 9.4 cm or it can be said that in 1 hectare of agricultural land it is able to control flooding of 740 m3. Theoretically, the flood control function can be used by building a dam that can accommodate runoff water. The indirect use value of

agricultural land in the Geopark Karangsambung-Karangbolong area can be seen in Table 3.

Table 3. Indirect Use Value of Agricultural Land in the Karangsambung-Karangbolong Geopark Area

Area (Ha)	Flood Control Volume/Ha	Repair Cost per m3 (Rp)	Total cost
11,138.83	8,242,734	131,682	1,085,416,989,695
Economic Value of Flood Control			**1,085,416,989,695**
Area (Ha)	**Erosion and Landslide Control Volume/Ha**	**Repair Cost per m3 (Rp)**	**Total cost**
11,138.83	740	2,705	22,296,596,011
Economic Value of Erosion and Landslide Control			**22,296,596,011**
Indirect Use Value			**1,107,713,585,706**

Source: Data processed, 2021

The highest indirect use value in the Geopark Karangsambung-Karangbolong area is flood control with a value of IDR 1,085,416,989,695 or 98% of the total indirect use value of the Geopark Karangsambung-Karangbolong area of IDR 1,107,713,585,706.

Flood mitigation by holding water on land has been discussed in various academic debates [33], [34]. Flood containment measures require land, and agricultural land can be used as water retention areas. So that the use of land and also the management of agricultural land requires caution as one of the mitigations against flooding that can be carried out by the community. Apart from being flood control, agricultural land can also be used to control erosion and landslides. Soil erosion caused by water is one of the most significant environmental problems worldwide [35], so that this problem also needs to be considered where knowing the value of agricultural land economic services in controlling erosion and landslides can raise public awareness to manage sustainable agricultural land.

Table 4. Total Economic Value of Agricultural Land in the Geopark Karangsambung-Karangbolong Area

Variable	Economic Value	Amount (Rp)
Direct use value	Palawija production value	2,011,099,558,500
	Horticultural production value	44,288,450,000
	Straw value	11,269,828,000
	Employment value	175,436,572,500
Amount		**2,242,094,409,000**
Indirect use value	Flood control	1,085,416,989,695
	Erosion and landslide control	22,296,596,011
Amount		**1,107,713,585,706**
Total Economic Value of Agricultural Land		**3,349,807,994,706**

Source: Data processed, 2021

3.2. Total Economic Value of Agricultural Land in Geopark Area

The total economic value of agricultural land in the Karangsambung-Karangbolong Geopark Area is the sum of the use value and non-use value. Use value consists of direct use value and indirect use value.

The total economic value is IDR 3,349,807,994,706. These values are detailed in Table 4.

When compared between direct use value and indirect use value based on Table 4, the direct use value has a greater value than other values. This is because people still think that agricultural land needs to be exploited as much as possible to improve the welfare of the community, especially farmers. Meanwhile, the low use value is not directly caused by limitations in calculating the monetary value of agricultural land that has not been done much, such as the ability to produce oxygen, absorb carbon dioxide, and biodiversity. This is also reinforced by the lack of public awareness about the importance of the economic value of natural resources and the environment, especially agricultural land. Currently, the government has provided support for the preservation of agricultural land with the issuance of Law Number 41 of 2009 concerning the Protection of Agricultural Land for Sustainable Food.

4. CONCLUSION

The economic value of agricultural land resources shows its role in contributing to human welfare, especially in rural communities through economic development of sustainable agricultural land. On the other hand, this contribution is also balanced with sustainable agricultural land management to maintain the existence and preservation of agricultural land. The economic value of this agricultural land can be used to increase public investment in the form of knowledge of the intrinsic value of natural resources. Therefore, this value can be the basis for policy holders in managing natural resources so that their ecosystem is more

maintained and sustainable so that they can still provide environmental services for the welfare of the community and the region. The total economic value produced by agricultural land in the Karangsambung-Karangbolong Geopark Area is IDR 3,349,807,994,706, which consists of a direct use value of IDR 2,242,094,409,000 and an indirect use value of IDR 1,107,713,585,706. Where the direct use value is still greater than the indirect use value.

AUTHORS' CONTRIBUTIONS

The first and fourth authors understand the ideas presented then develop theories and perform calculations. The second author and third author verified the analysis method. All authors discussed the results and contributed to the final manuscript.

ACKNOWLEDGMENTS

REFERENCES

[1] Central Bureau of Statistics, Kebumen Regency in Figures 2021 (BPS, Kebumen, 2021)

[2] E. Rustiadi, S. Saefulhakim, and D. R Panuju, Regional Planning and Development (Crestpent Press and Yayasan Obor Indonesia, Jakarta, 2001)

[3] BT Zanten, Ph. Verburg, M. Espinosa, SG Paloma, G. Galimberti, J. Kantelhardt, M. Kapfer, M. Lefebvre, R. Manrique, A. Piorr, M. Raggi, L. Schaller, S. Targetti, I Zasada and D. Viaggie, European Agricultural Landscapes, Common Agricultural Policy and Ecosystem Services: a review. Agronomy for Sustainable Development, 34(2), 309–325 (2014)

[4] R. Harini, RA Ariani, Supriyati and MC Satriagasa. Analysis of Agricultural Land Area on Rice Production in North Kalimantan. Kawistara Journal, 9 (1), 15-27 (2019)

[5] R. Harini, Spatial Study of Converted Agricultural Land Valuation and Its Impact on Food Production in Sleman Regency. Thesis. (Post Graduate Program, Gadjah Mada University, Yogyakarta, 2012)

[6] AR Nurmanaf, H. Mayrowani, and E. Jamal, Socio-economic evaluation of multifunctional paddy fields. Proceedings of the National Seminar on Rice Field Multifunction, pp. 121-136

[7] TK Saha and S. Pal, Emerging Conflict Between Agriculture Extension and Physical Existence of Wetland in Post-dam Period in Atreyee River Basin of Indo-Bangladesh. Environment, Development and Sustainability, 21(3), 1485–1505 (2019)

[8] WN Adger, K. Brown, R. Cervigni and D. Moran, Total Economic Value of Forests in Mexico. Ambio 24 (55), 286-296 (1995).

[9] R. Hanafie, Introduction to Agricultural Economics (Andi Offset, Yogyakarta, 2010)

[10] B. Irawan, P. Simatupang, R. Kustiari, Sugiarto, Supardi, FS Yulia, M. Iqbal, M. Ariani, V. Darwis, R. Eliizabet, Sunarsih, C. Muslim, TB Purwantini and T. Nurasa, Agricultural Panel National, Analysis of Agricultural and Rural Development Indicators (Center for Agricultural Analysis and Policy, Bogor, 2007)

[11] W. Zhang, TH Ricketts, C. Kremen et al, Ecosystem Services and Dis-services to Agriculture. Ecol Econ, 64, 253–260 (2007)

[12] BT Zanten, Ph. Verburg, M. Espinosa, SG Paloma, G. Galimberti, J. Kantelhardt, M. Kapfer, M. Lefebvre, R. Manrique, A. Piorr, M. Raggi, L. Schaller, S. Targetti, I. Zasada and D Viaggie, European Agricultural Landscapes, Common Agricultural Policy and Ecosystem Services: a review. Agronomy for Sustainable Development, 34(2), 309–325 (2014)

[13] AG Power, Ecosystem Services and Agriculture: Tradeoffs and Synergies. Philos Trans Royal Soc Lond B Biol Sci, 365, 2959–2971 (2010)

[14] R. S de Groot, R. Alkemade, L. Braat et al, Challenges in Integrating The Concept of Ecosystem Services and Values in Landscape Planning, Management and Decision Making. Ecol Complex, 7, 260–272 (2010)

[15] Y. Erfrissadona, L. Sulistyowati and I. Setiawan, Environmental Economic Valuation Due to the Transfer of Agricultural Land Functions (Case Study in Tasikmalaya City, West Java). Journal of Agricultural Socioeconomics 13 (1), 1-15 (2020)

[16] L. Venkatachalam, Economic Valuation of Watershed Services of Commons: Marginal Opportunity Cost Approach within the Environmental Accounting Framework. Institute

for Social and Economic Change (Bangalore, India, 2006)

[17] MA Wilson and S. Carpenter, Economic Valuation of Freshwater Ecosystem Services in The United States: 1971-1977. Ecol. Appl 9(3), 772-783 (1999)

[18] JA Dixon and PB Sherman, Economics of Protected Areas. Environmental Economics, 20(2), 68-74 (1991)

[19] K. Prager, M. Reed and A. Scott, Encouraging Collaboration for The Provision of Ecosystem Services at a Landscape Scale—rethinking Agri-environmental Payments. Land Use Policy, 29, 244–249 (2012)

[20] JM Rey Benayas and JM Bullock, Restoration of Biodiversity and Ecosystem Services on Agricultural Land. Ecosystems (2012)

[21] Ruitenbeek and H. Jack, Mangrove Management: An Economic Analysis of Mangrove Option With a Focus on Bintuni Bay Irian Jaya (EMDI Environment Report, Jakarta, 1992)

[22] D. Pearce and D. Moran, The Economic Value of Biodiversity. The World Conservation Union, 2(1), 111-119 (1994)

[23] FAO, WFP, The state of food insecurity in the world (FAO, Rome, 2015)

[24] FAO, International Year of Rice 2004: Rice and Us (FAO, Rome, 2004)

[25] FAO, Rice and Human Nutrition (FAO, Rome, 2004)

[26] FAOSTAT, Food and Agriculture Data (FAO, Rome, 2013)

[27] FAO, FAO STAT database on crop production (FAO, Rome, 2017)

[28] N. Baenas, M. Belović, N. Ilic, DA Moreno and C. García-Viguera, Industrial use of pepper (Capsicum annum L.) derived products: Technological benefits and biological advantages. Food Chemistry, 274, 872-885 (2019)

[29] E. Morales-Soriano, B. Kebede, R. Ugás, T. Grauwet, A. Van Loey and M. Hendrickx, Flavor characterization of native peruvian chili peppers through integrated aroma fingerprinting and pungency profiling. Food Research International, 109, 250-259 (2018)

[30] O. Fayos, AC De Aguiar, A. Jimenez-Cantizano, M. Ferreiro-González, A. Garcés-Claver, J. Martínez, et al. Ontogenetic variation of individual and total capsaicinoids in malagueta peppers (Capsicum

frutescens) during fruit maturation. Molecules, 22 (5) (2017)

[31] CM Ajila, SK Brar, M. Verma, RD Tyagi, S. Godbout, and JR Valéro, Bio-processing of agro-byproducts to animal feed, Crit. Rev. Biotechnol., 32 (4), 382-400 (2012)

[32] JP Gittinger, Economic Analysis of Agricultural Projects, Second Edition (UI Press, Jakarta, 1986)

[33] T. Hartmann, L. Slavíková, S. McCarthy (Eds.), Nature-Based Flood Risk Management on Private Land: Disciplinary Perspectives on a Multidisciplinary Challenge, Springer International Publishing, Cham (2019)

[34] J. Schanze, Nature-based solutions in flood risk management - Buzzword or innovation?. J. Flood Risk Manag., 10 (3), 281-282 (2017)

[35] P. Borrelli, DA Robinson, LR Fleischer, E. Lugato, C. Ballabio, C. Alewell, K. Meusburger, S. Modugno, B. Schütt, V. Ferro, V. Bagarello, KV Oost, L. Montanarella, P. Panagos, An assessment of the global impact of 21st century land use change on soil erosion. Nature Communications, 8 (2017)