



Collaboration for Environmental Evidence

Systematic Review No. 67

WORKING TITLE

***TOBACCO FARMING AND ECOSYSTEM SERVICES:
EVALUATING IMPACTS UPON
CULTIVATED AND FOREST/WOODLAND SYSTEMS***

Review Protocol

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Cover Sheet

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1. Background

Cultivated in about 130 producer countries, tobacco of the commercial smoking product species *N. tabacum* (Solanaceae [26775]), is a transgenic, labour-intensive crop, a legal drug, and the world's most widely grown non-food crop. Most land under tobacco is located in semi-arid to subhumid (sub)tropical areas of the “developing world”, with two thirds of the global land under tobacco located in only five growing countries (China, Brazil, India, Indonesia, Malawi) (Annex 1). Local- to national-scale studies demonstrate the prominent importance and ecological significance of rapid land-cover change in (sub) tropical dry ecosystems, i.e., from forests and woodlands to cultivated systems (Janzen, 1988), but still these changes remain poorly documented at the global scale (Lambin et al., 2003), what is especially true for tobacco (Heilig, 1994; Ramankutty et al., 2006).

Triggered by the public health debate about smoking, it has been suggested that tobacco poses a particularly difficult environment-development dilemma (Goodland et al., 1984; WHO, 2003, 2004). Land use interventions such as high-intensity farming and the usage of wood in curing (to dry green leaf) have been identified as environmental pressures which may pose a threat to constituents of human well-being in rural areas where the crop is grown, e.g., soil and water degradation, vegetation and biodiversity losses, and human diseases caused by pesticide poisoning, green tobacco sickness and inhalation of biomass particles (Ponting, 1991; Lightwood et al., 2000; Clay, 2004; Arcury and Quandt, 2006; Schmitt et al., 2007; WHO, 2007a, 2008a).

A global convention, the International Framework Convention on Tobacco Control (FCTC), has been put into practice in 2005 to address, among others, the socio-ecological losses of tobacco farming (article 18), and to require parties to the convention to explore sustainable (non)agricultural alternatives (article 17) (WHO, 2005). In 2006, an international study and, later on, working group has been established, “considering that the pursuit of alternative livelihoods to tobacco growing should be addressed with a long term sustainable approach and from a development perspective, as it involves health, social, environmental and economic aspects beyond substitution of one economic activity for another” (WHO, 2008b, 45). The group has synthesised features and trends of the human-environmental condition of tobacco farming (WHO, 2008a, 3-5):

- “Tobacco depletes soil nutrients at a much faster rate than most crops”, exacerbated by specific land use practices such as topping and desuckering, thus triggering a “massive outflow of nutrients” from the soil.
- Vegetation degradation and deforestation due to wood-based curing and land clearance are two major changes in native vegetation associated with biodiversity losses.
- Various occupational risks exist such as pesticide intoxication, dermatological and respiratory disorders (“tobacco lung”), and cancers at certain sites. In particular; green tobacco sickness (GTS) is seen as “the disease most specifically related to tobacco growing” (resulting from dermal absorption of nicotine), with the use of personal preventive equipment restricted by “lack of knowledge, limited access to resources, the pursuit of lower production costs and climate conditions”. Women and children have been identified as most vulnerable groups, employed due to the labour-intensive nature of the crop.

In sum, “the group acknowledged that tobacco growing causes biodiversity losses, land pollution due to pesticides, soil degradation and deforestation, as well as water pollution” (WHO, 2008a, 5). It concluded that related costs of tobacco farming such as “health risks, working conditions, contractual arrangements, ... and the environmental practices ... have negative impacts on human capital and land, the two crucial assets in rural livelihoods”, and that the mitigation of socio-ecological losses is “borne almost exclusively by farmers, despite the fact that the cause of ecosystem disruption ... is the engineering of tobacco to deliver nicotine” (WHO, 2008a, 4). The group has been mandated to standardise terminology, methods, instruments, and variables as well as elaborate policy options and recommendations for the implementation of FCTC articles 17 and 18 (WHO, 2008b, 45).

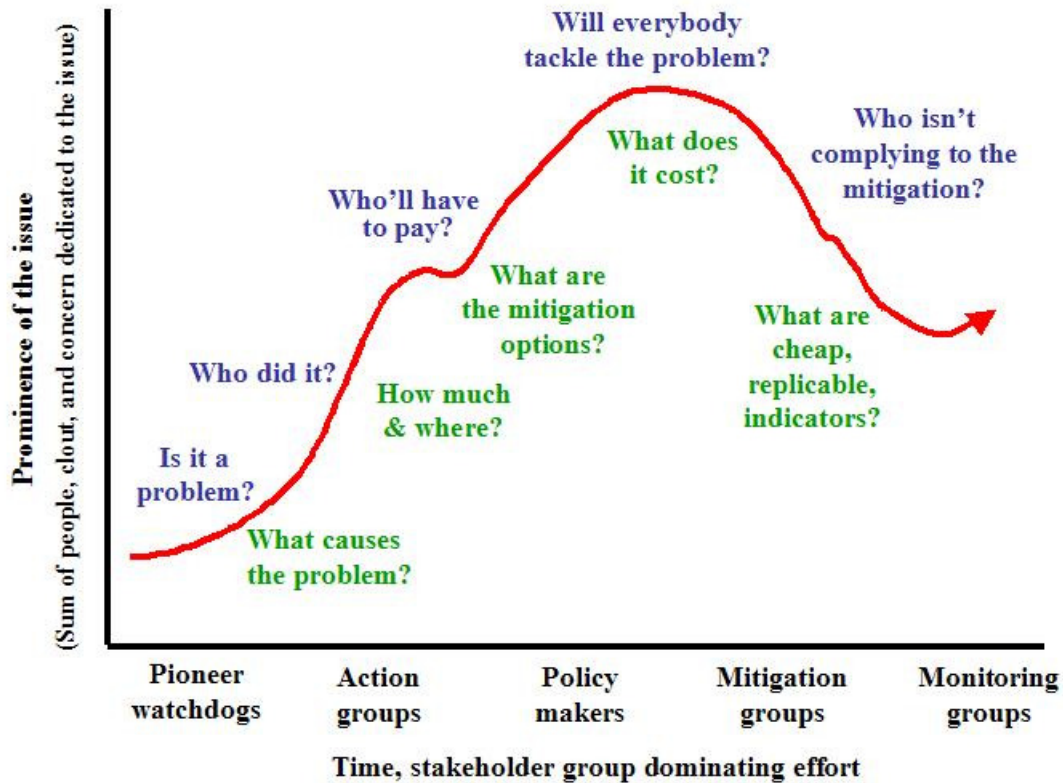
This review adopts the Millennium Ecosystem Assessment framework as a concept to guide the analysis (MA, 2003). The MA framework establishes a working relationship between three constituents of human well-being (security, basic material for good life, health) and ecosystem services (also called “ecosystem goods and services”, “environmental services” or “ecological services”), i.e., the benefits which people obtain from ecosystems. The ecosystem services include provisioning services such as food and water, regulating services such as flood and disease control, cultural services such as recreational and spiritual benefits, and supporting services such as soil formation and nutrient cycling (MA, 2003). The impact of tobacco farming upon ecosystem services is evaluated for areas where the crop is grown, i.e., “cultivated systems” (Cassman et al., 2005), and with regard to areas from which resources (wood, land) are drawn for its cultivation, i.e., “forest and woodland systems” (Shvidenko et al., 2005).

The tobacco industry (cigarette manufacturers, leaf trading companies) as well as related agricultural lobby organisations continue to refute the human-environmental arguments on the basis of poor scientific evidence. For example, the International Tobacco Growers’ Association (ITGA) states that “in developing countries (...) tobacco growing can (...) contribute to the sustainable development of the region (...), because, among others, tobacco is “less harsh on the environment than many other crops” (ITGA, 2007). In the period preceding the FCTC, the controversy has slowed the implementation of farming- and ecosystem-oriented tobacco control measures, and only at the turn of the millennium, transnational tobacco corporations in strategic partnership with groups such as UNEP, DEFRA, English Nature, Earthwatch Institute, Fauna & Flora International and Tropical Biology Association have started to address issues of environmental management. For example, issues of wood consumption in curing and related biodiversity impacts as well as crop management and related pesticide exposure have been addressed in corporate social responsibility (CSR) projects (BAT, 2008) or collaborative efforts such as the Natural Value Initiative (NVI) (Grigg, 2008). Only most recently, the mitigation of occupational health hazards such as green tobacco sickness has become a science-policy concern (Etter, 2009), but the existence of GTS in tobacco growing areas is still far from being acknowledged or formally recognised as an occupational disease (Arcury and Quandt, 2006; Schmitt et al., 2007; WHO, 2007a, 2008a).

The point has been made that the deliberate approach of establishing a controversy, especially in conjunction with sustainability projects, can further undermine the long-

term approach of crop substitution, rural livelihood diversification, and production exit (CETID, 2000; Palazzo and Richter, 2005; Mamadu et al., 2008; Bialous, 2008).

Figure 1: Schematic life cycle of an environmental externality showing how perceptions evolve over time through social interaction and scientific inquiry (Reid et al., 2006, 169)*



* x-axis: groups who focus on an environmental problem; y-axis: prominence of the problem in public discourse; blue, above line: appropriate policy questions; green text, below line: scientific questions.

In the life cycle of an environment-policy issue (Figure 1), tobacco's dilemma can be positioned as follows. While, due to the controversy, still at stage 1 – politically: “is it a problem?”, scientifically: “what causes the problem” –, the FCTC has actually moved the issue onto stage 3 – politically: “who dit it?”, scientifically: “how much and where?”. In other words, though not coined to particularly describe the dilemma of tobacco as a commercial smoking product species, the public discourse has entered a phase of “widening acceptance of existence of (potential or actual) environmental impacts, with mounting awareness and pressure for action by authorities” (Tomich et al., 2004, 11). The review intends to move the issue further onto stage 4 which is “building the evidence base for global tobacco control” (Corrao et al., 2000) so that subsequent steps of “strong and urgent action” (Osborn and Margerison, 2008) may be taken at stage 5 (Tomich et al., 2004).

2. Objective of the Review

2.1 Primary question

To systematically locate, evaluate and synthesise the available published and unpublished evidence in order to better assess tobacco farming's impact upon ecosystem services ("how much & where?").

2.2 Secondary question

Assuming that each case reveals information on tobacco's actual impact upon ecosystem services, to get a better understanding which type of ecosystem impact by which type of tobacco is most often found in various cultivated and forest/woodland ecosystems and under which contractual (institutional) arrangement ("who did it?").

3. Methods

3.1 Search strategy

In order to locate and identify published as well as unpublished cases of ecosystem impacts associated with tobacco farming, the following general electronic/computerised databases, catalogues, and meta-search engines will be searched in combination with specialist websites and resources:

General sources

- ISI Web of Knowledge (web of science abstracts and proceedings)
- Library of Congress, <http://www.loc.gov/index.html>
- FAO Library, http://www.fao.org/waicent/portal/Virtuallibrary_en.asp
- USDA National Agricultural Library catalogue, <http://agricola.nal.usda.org>
- ICRISAT Jaswant S. Kanwar Library, <http://www.icrsat.org>
- CABI resources (CAB abstracts, reviews, archive), <http://www.cabi.org>
- Elsevier Geo (Geographical, Ecological) Abstracts
- Scirus (personal websites, institutions, repositories), <http://www.scirus.com>
- COPAC academic and specialist library catalogue, <http://www.copac.ac.uk>
- Index to (UK, Ireland) theses online, <http://www.theses.com>
- ProQuest digital dissertations (US, Canada), <http://www.proquest.com>
- Directory of open access journals, <http://www.doaj.org>
- Scopus, <http://www.scopus.com>
- Science direct, <http://www.sciencedirect.com>
- Journal STORage, <http://www.jstor.org>
- Google Scholar, <http://scholar.google.com>
- General web engines

Specialist sources

- CORESTA reports and library websites, <http://www.coresta.org>
- ITGA trees & tobacco and tobacco literature website, <http://tobaccolleaf.org>

- The British American Tobacco (BAT) Biodiversity Partnership project website, <http://www.batbiodiversity.org/content/projects/projectindex.htm>
- NVI case study website, <http://www.naturalvalueinitiative.org>
- WWF international and national websites, <http://www.wwf.org>
- PAN resources website, <http://www.pan-international.org>
- ERF The Rachel database, <http://www.ecomall.com/activism/erfund.htm>
- The World Bank “Economics of tobacco control” website, <http://www1.worldbank.org/tobacco>
- WHO-TFI Economics of tobacco control website, <http://www.who.int/tobacco>
- FCA Alternative livelihoods and environment website, <http://www.fctc.org>
- IDRC Research for International Tobacco Control website, http://www.idrc.ca/en/ev-83331-201-1-DO_TOPIC.html

As for internet searches, when using sets of specified keywords, the first 100 hits from each search will be examined (.doc, .pdf or HTML hits, but other web pages as well). Prior to an assessment of relevance, all references retrieved will be exported into a bibliographic system. Bibliographies of included material will be searched for further, relevant references. In order to provide missing data and/or updated information, both authors and bodies of relevant articles/material will be contacted. In particular, tobacco-specific databases, catalogues and bibliographies, deemed relevant by individual experts, companies, and institutions will be examined.

Foreign language searches are considered to be useful (especially in Chinese, Portuguese and Spanish), but not cost effective. Therefore, English language search terms will be used which focus on “tobacco” as intervention element (rather than variety and scientific names of the crop). Experiments with NOT Boolean operators will be done to keep returned hits manageable. The search terms as listed below will be tested to produce the most effective combination, so that a single search string can be created:

1. tobacco AND cultivat* OR grow* OR prod* OR farm* OR cur* NOT smok*
2. tobacco AND impact* OR influenc* OR chang* OR effect* NOT smok*
3. tobacco AND ecosyst* OR environment* OR biodivers* NOT smok*
4. tobacco AND resourc* OR soil* OR vegetat* OR forest* OR wood*
5. tobacco AND nutrient* OR water OR fertil* NOT smok*
6. tobacco OR intens* OR pesticid* OR nicotin* NOT smok*

Complementing the online search strategy, hand searching of specific sources will be done to extract further relevant material. For this, libraries of agricultural and especially tobacco research institutions as well as tobacco museums containing special (paper) collections on the situation of tobacco growing areas will be visited.

3.2 Study inclusion criteria

The inclusion criteria below will be applied by trained support staff to all potential studies at the level of title and abstract, proceeding to full text assessment as necessary. The lead reviewer will examine a random subset of at least 25% of the reference list for repeatability of the selection criteria.

- **Relevant subjects:** Effect or impact on ecosystem (ecological, environmental) services in terms of both quantity and quality with regard to constituents of human well-being such as security, basic material for good life, and health – i.e. supporting services (primary production, soil formation, nutrient cycling, water cycling), provisioning services (food, fibre, biomass/fuel, freshwater, genetic resources, natural medicines, pharmaceuticals, biochemicals), regulating services (disease, pest, erosion, water, air quality, climate, pollination, water purification, waste treatment), and cultural services (recreation, spiritual/ethical values) in areas where tobacco is grown (cultivated system) and from which resources (land, wood) are drawn for its cultivation (forest and woodland systems).
- **Types of intervention:** Tobacco farming in the post-1960 era in terms of growing and curing the crop – i.e., any kind of on-farm land use, land management, crop husbandry and pre/post-harvest activity – in growing areas of ca. 130 producer countries (Annex 1) for various naturally (e.g., air or sun) as well as artificially cured tobacco varieties (e.g., Virginia, Burley, Oriental).
- **Types of comparator:** Any other (non-tobacco) cropping system, i.e., food and cash crops (including tree crops) and other drugs (cannabis, coca, opium poppy, khat) as well as with/without and before/after tobacco farming scenarios.
- **Types of outcome:** Positive, negative or neutral impacts on various ecosystem services expressed in terms of extent, intensity and rate of change, i.e., ranging from maintenance, restoration or innovation to endangerment, disruption or loss of one or more of these services. Examples of potential outcomes are excessive uptake of N-P-K nutrients, soil fertility decline, overfertilisation and soil contamination (disrupted supporting services), enhanced food security, increases of genetic resources, stability or increases in forest/woodland cover and/or biodiversity (sustained provisioning services), erosion control, water purification, and absence of human (occupational) diseases such as pesticide poisonings and green tobacco sickness (sustained regulating services), and environmental or landscape simplification with low potential for recreation and well-being (disrupted cultural services).
- **Types of study:** Striving to obtain relevant literature, primary empirical studies using both quantitative and qualitative approaches are included which have site-specific information, i.e., observational studies of existing farming sites as well as experimental field studies (but no laboratory designs/experiments). A wide array of materials will be consulted, ranging from grey literature, crop (monitoring) reports, consultancy work, and public testimonies to books, book chapters, encyclopedia entries, and (non)peer-reviewed journal articles.

3.3 Potential effect modifiers and reasons for heterogeneity

The main effect modifiers associated with the results of the studies are assumed to relate to time (i.e., point-in-time or between-time-point studies), the different methodological quality of the studies (see 3.4), on- *versus* off-farm factors (e.g., availability and sources of wood for curing), and broad ecosystem endowment (i.e., temperate zone ecosystems *versus* more fragile (sub)tropical ecosystems).

The general factors for heterogeneity are seen to include initial conditions (ecology, land use), causal clusters (proximate causes, underlying driving forces), and feedbacks (societal, ecological). Tobacco-specific factors that may influence the outcome of the study can be detailed as follows:

- Position in production cycle (old *versus* new growing area)
- Natural endowment of growing area (soil and biomass features)
- Modification of land use practices (crop rotation, afforestation)
- Modification of curing practices (energy source, burning technology)
- Farm size, i.e., large (estate, plantation) *versus* small holdings
- Mode of contractual arrangement (state monopoly, private company etc.)
- General type of environmental governance (state, civil society, company)
- Type of tobacco grown
- Size of growing area/country
- Overall “development” status of the growing area/country

In addition, heterogeneity may also arise from different outcome measures such as the number of trees (logs, poles) used in the on-farm curing of all green leaf harvest *versus* standardised measures such as specific fuelwood consumption (SFC), i.e., amount of wood (in kg) used to cure 1 kg of tobacco leaf (Fraser, 1991).

3.4 Study quality assessment

In an effort to minimise bias, a hierarchy of the quality of evidence is used. Following principles applied in medical sciences, public health and environmental management (Pullin and Knight, 2003), the findings of studies which use strict experimental designs of tobacco growing will be accorded greater weight than those that have control elements or no comparison at all. An example of the former are randomised controlled trials (RCTs) which involve the random allocation of different tobacco farming practices (interventions) to one or more (agro)ecosystem components and their services. Studies are likely to be included in the evaluation of impacts if they do meet quality standards of categories 1 to 4 (i.e., “strong” or “adequate” evidence), and studies are likely to be excluded if they do not meet quality standards of categories 5 and 6 (i.e., “opinions” and “inadequate” evidence) (Table 1).

If categorisation remains unclear, agreement is resolved by consensus between lead reviewer and support staff. This probably relates to category 5 opinions, in particular, which may be considered for evaluation only if they cite the results of studies which have undertaken research (so that the respective individuals or authorities can be contacted for these studies). In this context, tobacco farming-specific “opinions” relate to testimonies which stem from two public hearings of the WHO, with eligible submissions from tobacco farmer’ and workers’ associations, leaf companies, cigarette manufactures, public/private organisations, civil society groups, non-governmental organisations, and some individuals. In October 2000, more than 400 written statements were submitted on the FCTC in general (WHO, 2000), and in February 2007 around 40 statements were submitted on agricultural diversification and alternative crops (WHO, 2007b).

Table 1: Hierarchy of quality of evidence based on the type of research undertaken (modified from Pullin and Knight, 2003, 85)*

Category	Quality of evidence	Example
1	Strong evidence obtained from at least one properly designed, randomised controlled trial of appropriate size (ca. 0.2 ha and beyond).	Experimental field studies
2	Adequate evidence from well designed controlled trials without randomisation.	Experimental field studies
3	Adequate evidence from a comparison of differences between sites with and without tobacco growing (controls).	Comparative observational studies
4	Adequate evidence obtained from multiple time series of sites or from dramatic results in uncontrolled experiments.	Experimental field studies, observational studies
5	Opinions based on reports of expert committees, qualitative field assessment or narratives as obtained from individuals and authorities accredited for international public hearings.	Public testimonies on tobacco control (2000, 2007)
6	Inadequate evidence owing to problems of methodology, e.g., sample size, length or comprehensiveness of monitoring, or conflicts of evidence.	

3.5 Data extraction strategy

Based on the search for reported impacts of tobacco farming upon ecosystems in title, abstract and, finally, full text, a review-specific data extraction form is applied per each piece of literature or document found. The form is tested in a pilot phase with the goal to modify and amend as necessary to ensure repeatability. A database or spreadsheet of all information relevant to the review will be used for application of the QUORUM flowchart statement to characterise and quantify excluded *versus* included studies, sources of studies, and types of ecosystem service impacts. Rather than building upon the generalised results from existing meta-analyses – e.g., Geist (1999) on deforestation and Schmitt et al. (2007) on occupational health hazards – individual studies from these works will be used and evaluated by using the review-specific data extraction form as necessary. Also, authors will be contacted for a potential update of their list of case studies. Assuming that no study covers the full range of ecosystem impacts, authors and/or organisations will be contacted, as necessary, for the retrieval of missing data per ecosystem service considered.

3.6 Data synthesis and presentation

Assuming that each selected case study reveals information on tobacco's actual impact upon ecosystem services, and based on the data extraction form, an evaluation and subsequent coding of data is performed, using standard statistical software. Data availability allows for both qualitative synthesis and quantitative analysis in a portfolio approach. Thus, a middle-way is taken between (qualitative, descriptive, narrative) case studies and (quantitative) variable-oriented research, combining the strengths of within-case analysis (e.g., per growing area) and cross-case analysis (e.g., identification of patterns across growing areas) (Shenhav, 2005; Newell et al., 2005; Young et al., 2006).

As for the quantitative analysis, a meta-analytical design will be applied to pool the results of individual studies (Hedges and Olkin, 1985; Osenberg et al., 1999; Lipsey and Wilson, 2001). An application of formal statistical procedures intends to estimate, for example, the frequency of occurrence of causative factors (e.g., source, type and amount of wood used in curing) and to semi/quantify the extent, intensity and rate of impacts per ecosystem service (e.g., rate of deforestation in tobacco-growing *versus* non-tobacco growing areas). As necessary, heterogeneity in data will be protocolled graphically or tested statistically (Q statistics), and quantitative pooling will be done separately for subgroups of studies according to study-level variables (see 3.3) and ecosystem services.

Assuming that each study identifies one or more types of tobacco farming impacts upon ecosystem services, the presentation applies a comparative perspective, i.e., evaluating which impacts due to growing and curing of tobacco are reported and thus most often found in various cultivated and forest/woodland systems in terms of extent, intensity and rate, and how do these insights relate to other crops grown (cash crops, food crops, drugs).

4. Potential Conflicts of Interest and Sources of Support

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Annex 1: Ranked list of countries and territories growing tobacco in the post 1960-era (FAO, 2009)

Rank	Country or territory	Area harvested (ha) 2007	Class ¹	Region ²
1	China	1,401,200	MIC	EA&P
2	Brazil	461,482	MIC	LA&C
3	India	380,000	MIC	SA
4	Indonesia	215,000	MIC	EA&P
5	Malawi (<i>LDC</i>) ⁴	155,000	LIC	SSA
6	Turkey	146,000	MIC	E&CA
7	United States of America	144,168	HIC	NA
8	Argentina	92,000	MIC	LA&C
9	Pakistan	62,000	LIC	SA
10	Zimbabwe	51,800	LIC	SSA
11	Korea, Democratic Republic	45,000	LIC	EA&P
12	Thailand	40,000	MIC	EA&P
13	Tanzania (<i>LDC</i>) ⁴	36,000	LIC	SSA
14	Italy	35,000	HIC	E&CA
15	Bangladesh (<i>LDC</i>) ⁴	30,000	LIC	SA
16	Bulgaria	29,900	MIC	E&CA
17	Philippines	27,000	MIC	EA&P
18	Viet Nam	27,000	LIC	EA&P
19	Cuba	27,500	MIC	LA&C
20	Nigeria	23,000	LIC	SSA
21	Myanmar (<i>LDC</i>) ⁴	20,000	LIC	EA&P
22	Côte d'Ivoire	20,000	LIC	SSA
23	Iran	20,000	MIC	ME&NA
24	Japan	19,000	HIC	EA&P
25	Uganda (<i>LDC</i>) ⁴	18,000	LIC	SSA
26	Colombia	18,000	MIC	LA&C
27	Poland	17,600	MIC	E&CA
28	Greece	17,400	HIC	E&CA
29	Macedonia	17,200	MIC	E&CA
30	France	17,000	HIC	E&CA
31	Syrian Arab Republic	16,800	MIC	ME&NA
32	Canada	16,500	HIC	NA
33	Korea, Republic	15,000	HIC	EA&P
34	Kenya	15,000	LIC	SSA
35	Spain	14,000	HIC	E&CA
36	Malaysia	13,000	MIC	EA&P
37	Mexico	9,800	MIC	LA&C
38	Guatemala	9,500	MIC	LA&C
39	Yemen (<i>LDC</i>) ⁴	9,300	LIC	ME&NA
40	Dominican Republic	9,000	MIC	LA&C
41	South Africa	9,000	MIC	SSA
42	Lebanon	9,000	MIC	ME&NA
43	Cambodia (<i>LDC</i>) ⁴	8,500	LIC	EA&P

44	Congo, Democratic Republic (<i>LDC</i>) ⁴	8,200	LIC	SSA
45	Paraguay	8,200	MIC	LA&C
46	Serbia	8,043	MIC	E&CA
47	Mozambique (<i>LDC</i>) ⁴	7,900	LIC	SSA
48	Uzbekistan	6,600	LIC	E&CA
49	Hungary	6,000	HIC	E&CA
50	Kyrgyzstan	5,800	LIC	E&CA
51	Ghana	5,750	LIC	SSA
52	Algeria	5,500	MIC	ME&NA
53	Croatia	5,300	MIC	E&CA
54	Kazakhstan	5,000	MIC	E&CA
55	Lao, People's Dem. Republic (<i>LDC</i>) ⁴	4,800	LIC	EA&P
56	Ethiopia (<i>LDC</i>) ⁴	4,500	LIC	SSA
57	Zambia (<i>LDC</i>) ⁴	4,500	LIC	SSA
58	Germany	4,459	HIC	E&CA
59	Honduras	4,200	MIC	LA&C
60	Togo (<i>LDC</i>) ⁴	4,100	LIC	SSA
61	Ecuador	4,100	MIC	LA&C
62	Venezuela, Bolivarian Republic	3,600	MIC	LA&C
63	Angola (<i>LDC</i>) ⁴	3,500	LIC	SSA
64	Cameroon	3,400	MIC	SSA
65	Moldova	3,400	MIC	E&CA
66	Chile	3,000	MIC	LA&C
67	Jordan	2,900	MIC	ME&NA
68	Rwanda (<i>LDC</i>) ⁴	2,800	LIC	SSA
69	Nepal (<i>LDC</i>) ⁴	2,729	LIC	SA
70	Sri Lanka	2,680	MIC	SA
71	Morocco	2,500	MIC	ME&NA
72	Tunisia	2,500	MIC	MA&NA
73	Bosnia and Hercegovina*	2,321	MIC	E&CA
74	Guinea (<i>LDC</i>) ⁴	2,100	LIC	SSA
75	Nicaragua	1,950	MIC	LA&C
76	Madagascar (<i>LDC</i>) ⁴	1,800	LIC	SSA
77	Iraq	1,700	MIC	ME&NA
78	Tajikistan	1,600	LIC	E&CA
79	Panama	1,500	MIC	LA&C
80	Romania	1,400	MIC	E&CA
81	Benin (<i>LDC</i>) ⁴	1,350	LIC	SSA
82	Jamaica	1,200	MIC	LA&C
83	Albania	1,200	MIC	E&CA
84	Azerbaijan	1,191	MIC	E&CA
85	Burkina Faso (<i>LDC</i>) ⁴	1,050	LIC	SSA
86	Burundi (<i>LDC</i>) ⁴	970	LIC	SSA
87	Niger (<i>LDC</i>) ⁴	970	LIC	SSA
88	West Bank and Gaza (Occupied Palestine)	900	MIC	ME&NA
89	Uruguay	900	MIC	LA&C
90	Bolivia	850	MIC	LA&C
91	Belarus	820	MIC	E&CA

92	Portugal	800	HIC	E&CA
93	Mali (LDC) ⁴	720	LIC	SSA
94	Georgia	720	MIC	E&CA
95	Congo, Republic of	700	MIC	SSA
96	Libyan Arab Jamahirya	700	MIC	ME&NA
97	Peru	690	MIC	LA&C
98	Slovak Republic	656	HIC	E&CA
99	Central African Republic (LDC) ⁴	600	LIC	SSA
100	El Salvador	600	MIC	LA&C
101	Switzerland	550	HIC	E&CA
102	Fiji	500	MIC	EA&P
103	Ukraine	500	MIC	E&CA
104	Armenia	500	MIC	E&CA
105	Haiti (LDC) ⁴	450	LIC	LA&C
106	Oman	270	HIC	ME&NA
107	Somalia (LDC) ⁴	250	LIC	SSA
108	Mauritius	250	MIC	SSA
109	Swaziland	200	MIC	SSA
110	Austria	200	HIC	E&CA
111	Montenegro	200	MIC	E&CA
112	Chad (LDC) ⁴ [since 1970]	150	LIC	SSA
113	New Zealand [until 1995] ³	150	HIC	EA&P
114	Trinidad and Tobago	130	HIC	LA&C
115	Bhutan (LDC) ⁴ [since 1980]	110	MIC	SA
116	Guayana	100	MIC	LA&C
117	Solomon Islands (LDC) ⁴	100	LIC	EA&P
118	Cyprus	100	HIC	E&CA
119	Costa Rica	75	MIC	LA&C
120	Belgium	71	HIC	E&CA
121	Saint Vincent and the Grenadines	70	MIC	LA&C
122	Sierra Leone (LDC) ⁴	60	LIC	SSA
123	Samoa (LDC) ⁴	50	MIC	EA&P
124	Israel [until 1992] ³	49	HIC	ME&NA
125	United Arab Emirates	40	HIC	ME&NA
126	Réunion	20	(France)	SSA
127	Russian Federation	10	MIC	E&CA
128	Guadeloupe [until 1979] ³	8	(France)	LA&C
129	Puerto Rico	2	HIC	LA&C
130	American Samoa [until 1984] ³	1	MIC	EA&P
131	Singapore [until 1986] ²	1	HIC	EA&P
All countries [only tobacco grown in 2007]		3,927,568 ha		

¹ LIC = low-, MIC = middle-, and HIC = high-income country (World Bank, 2009).

² E&CA = Europe & Central Asia, EA&P = East Asia & Pacific, LA&C = Latin America & Caribbean, ME&NA = Middle East & North Africa, NA = North America, SA = South Asia, SSA = Sub-Saharan Africa (World Bank, 2009).

³ Last value of land under tobacco before discontinuation.

⁴ Least developed country (LDC) according to FAO (2009).