4 LAND PRODUCTIVITY POTENTIALS

4.1 PROCEDURE FOR ESTIMATING PRODUCTIVITY POTENTIAL OF LAND FOR RAINFED CROPS AND PASTURE

The characterization of climate, soil and terrain conditions relevant to agricultural production provides a first indication of the degree of suitability of land areas for rainfed agriculture, based on geophysical factors. However, this covers only one face of the total picture. The techniques of suitability analysis have been developed to permit consideration of the more complex interplay of geophysical, biological and socioeconomic factors that actually determine productivity potentials in real life conditions.

4.1.1 Definition of land utilization types (LUTs)

The GAEZ method (see Chapter one) uses crop models and environmental matching procedures to identify the degree of crop-specific environmental limitations across the world's land area, under three different assumptions about the input levels and management conditions. The crop models use the environmental requirements and adaptability characteristics of each crop species assessed and calculate the expected yields under different sets of environmental conditions and input/management scenarios, while the input/management scenarios reflect different investment options that may be implemented by humans. These are combined by specifying a number of crop production systems, termed land utilization types, or LUTs. A LUT consists of a set of technical specifications within a socioeconomic setting. As a minimum requirement, both the nature of the produce and the setting must be specified. Attributes specific to particular land utilization types include crop information such as cultivation practices, input requirements, crop calendars, and utilization of main produce, crop residues, and by-products.

For the GEAZ studies completed thus far (FAO & IIASA, 2002 and FAO & IIASA, 2003), 171 crop LUTs have been defined, each with defined environmental requirements and adaptability characteristics for a specific crop type. Table 4.1 shows the crops and crop types included in the nine crop groups considered in this report. Based on this information, global productivity potential is assessed for each crop type, at three different levels of inputs and management under rainfed conditions, and two different levels of inputs and management under irrigated conditions (see Box 4.1).

TABLE 4.1

Crop groups, crops and crop types considered in this report

CROP GROUPS AND CROPS	CROP TYPES	THERMAL CLIMATE ZONES
Cereals	**(83)**	
Wheat (hibernating)	4	Boreal, Temperate and Subtropics
Wheat (non-hibernating)	12	Boreal, Temperate, Subtropics and Tropics
Rice, japonica (wetland)	4	Tropics, Subtropics and Temperate
Rice, indica (wetland)	4	Tropics and Subtropics
Rice (dryland)	3	Tropics
Maize (grain)	13	Tropics, Subtropics and Temperate
Maize (silage)	6	Subtropics and Temperate
Barley (hibernating)	4	Boreal, Temperate and Subtropics
Barley (non-hibernating)	12	Boreal, Temperate, Subtropics and Tropics
Sorghum	7	Tropics, Subtropics and Temperate
Pearl millet	2	Tropics
Foxtail millet (setaria)	4	Subtropics and Temperate
Rye (hibernating)	4	Temperate and Subtropics
Rye (non-hibernating)	4	Boreal, Temperate and Subtropics
Fibre crops	**(7)**	
Cotton	7	Tropics, Subtropics and Temperate
Oil Crops	**(25)**	
Soybean	6	Tropics, Subtropics and Temperate
Rape (hibernating)	2	Temperate and Subtropics
Rape (non-hibernating)	6	Temperate, Subtropics and Tropics
Groundnut	3	Tropics, Subtropics and Temperate
Sunflower	6	Temperate, Subtropics and Tropics
Oil palm	1	Tropics and Subtropics
Olive	1	Subtropics and Temperate
Pulses	**(17)**	
Phaseolus bean	9	Tropics, Subtropics and Temperate
Chickpea	5	Subtropics and Tropics
Cowpea	3	Tropics
Roots and Tubers	**(14)**	
White potato	4	Boreal, Temperate, Subtropics and Tropics
Cassava	1	Tropics
Sweet potato	3	Subtropics and Tropics
White yam	2	Tropics
Greater yam	2	Tropics
Yellow yam	1	Tropics
Cocoyam (taro)	1	Tropics
Stimulants	**(7)**	
Cocoa	1	Tropics
Arabica coffee	1	Tropics
Robusta coffee	1	Tropics
Tobacco	4	Tropics, Subtropics and Temperate
Sugar Crops	**(6)**	
Sugarcane	1	Tropics and Subtropics
Sugar beet	5	Temperate and Subtropics
Fruit Crops	**(1)**	
Banana/Plantain	1	Tropics and Subtropics
Citrus	1	Tropics and Subtropics
Vegetables	**(10)**	
Cabbage	2	Tropics, Subtropics and Temperate
Onion	4	Tropics, Subtropics and Temperate
Tomato	4	Tropics, Subtropics and Temperate
Total	**171**	

BOX 4.1

ASSUMED LEVELS OF INPUTS AND MANAGEMENT IN FARMING SYSTEMS UNDER THREE INPUT SCENARIOS

Low level of inputs/traditional management (rainfed)

Under the low level of input, traditional management assumption, the farming system is largely subsistence based and not necessarily market oriented. Production is based on the use of traditional cultivars (if improved cultivars are used, they are treated in the same way as local cultivars), labour intensive techniques, and no application of nutrients, no use of chemicals for pest and disease control and minimum conservation measures.

Intermediate level of inputs/improved management (rainfed or irrigated)

Under the intermediate level of input, improved management assumption, the farming system is partly market oriented Production for subsistence plus commercial sale is a management objective. Production is based on improved varieties, on manual labour with hand tools and/or animal traction and some mechanization, is medium labour intensive, uses some fertilizer application and chemical pest disease and weed control, adequate fallows and some conservation measures.

High level of inputs/advanced management (rainfed or irrigated)

Under the high level of input, advanced management assumption, the farming system is mainly market oriented. Commercial production is a management objective. Production is based on improved high yielding varieties, is fully mechanized with low labour intensity and uses optimum applications of nutrients and chemical pest, disease and weed control.

4.1.2 Estimation of maximum attainable and long-term achievable crop yields

Ranges for maximum attainable yields ranges were calculated for each crop present in tropical, sub-tropical and temperate/boreal zones. The maximum attainable yields for each crop under rainfed conditions represent averages of simulated year-by-year yields attainable during the period 1960 to 1996.

With balanced fertilizer applications and proper pest and disease management (which is best possible at high level of inputs), only limited fallow will be required to maintain soil fertility and to keep pest and disease outbreaks in check. At low level of inputs, assuming no application of chemical fertilizer and only limited used of organic material, and very limited or no application of biocides, there is need for considerable fallow periods in the crop rotations to restore soil nutrient status and to break pest and disease cycles. In the GAEZ study, long-term achievable yields are calculated by applying a fallow-period requirement factor dependent on climatic conditions, soil type, crop, and level of inputs/management. The yields attained in the long-term are well below the estimated maximum attainable yields when accounting for fallow period requirements.

4.1.3 Estimation of land productivity potential for rainfed cereals

Table 4.2 compares maximum (short-term) attainable yields and long-term achievable yields on suitable land (see Section 4.1.5) for staple cereals (rainfed wheat, rice, grain maize). On average, long-term achievable yields are 10, 20, and 55 percent lower than maximum attainable yields, respectively at high, intermediate and low levels of inputs. These represent the best estimate of the productivity potential of land for this crop group.

TABLE 4.2

Maximum (short-term) attainable and long-term achievable yields for staple cereals (rainfed wheat, rice, grain maize) averaged over all VS+S+MS land, by region and level of inputs

Major area	Low inputs		Intermediate inputs		High inputs	
	Short-term attainable t/ha	Long-term achievable t/ha	Short-term attainable t/ha	Long-term achievable t/ha	Short-term attainable t/ha	Long-term achievable t/ha
Africa	1.0	0.4	3.7	3.0	6.4	5.8
America						
Latin America and Caribbean	1.2	0.6	3.7	3.1	5.8	5.3
North America	0.8	0.4	3.6	2.8	5.8	5.2
Asia (*including Japan*)	1.0	0.5	3.5	2.8	5.3	4.8
Europe						
Europe (excluding Russian Federation)	1.0	0.4	4.0	3.1	6.4	5.8
Russian Federation	0.7	0.3	2.9	2.5	4.4	4
Oceania (*including Australia and New Zealand*)	0.7	0.4	3.2	2.6	5.3	4.8
Developed	**0.9**	**0.4**	**3.5**	**2.8**	**5.6**	**5.1**
Developing	**1.1**	**0.5**	**3.7**	**3.0**	**6.2**	**5.6**
World	**1.0**	**0.4**	**3.7**	**3.0**	**5.9**	**5.4**

Note: the short-term attainable yields represent yields attained during the cultivation phase of cultivation-fallow cycles. These are referred to as maximum or short-term attainable yields. In low and intermediate input agriculture, fallow and/or crop rotations are needed to maintain the soil nutrient balance and to break pest and disease cycles. The required intensity of fallow depends on crop rotations implemented, on soil characteristics such as soil nutrient availability and nutrient retention capacity, on climatic conditions and on management and agricultural inputs applied. Long-term achievable yields are calculated by applying a fallow period requirement factor. As a rule of thumb for low level input/management conditions, fallow period requirements may vary between 30–90% of the cultivation-fallow cycle. For intermediate level input/management conditions, fallow requirements may vary between 10–30%.

4.1.4 Variability of rainfed cereal production

The historical climate data for individual years (see Section 3.1) have been used to calculate a time series of production potentials for cereals. Of a total of 83 cereal types, consisting of cultivars of wheat, rice, barley, rye, sorghum, millet, and setaria, AEZ tests and selects for each of the 2.2 million gridcells of the land resources database for each year the cereal type that results in the highest production, given the climatic conditions for that year.

During the 20th century, the global average of potential cereal production, based on year-by-year simulations for currently cultivated land with fixed inputs, increased by over five percent between the period 1901-30 and the period 1961-90. On the other hand, simulations based on average climate data for the whole period from 1961 to 1990 produced a figure for average potential cereal production for the globe that was almost 10 percent higher than the average obtained using historical climate data for individual years. This comparison provides a rough estimate of the losses being incurred due to climate variability. Results by region are shown in Table 4.3.

The table highlights the fact that the coefficient of variation for production potential for rainfed cereals actually appears to be significantly higher in developed nations than in developing nations. However, Map 4.1, which presents the variability of cereal production potential for the period 1961-1990 on a country-by-country basis, shows that the most vulnerable individual countries occur mainly in Central Asia and Africa.
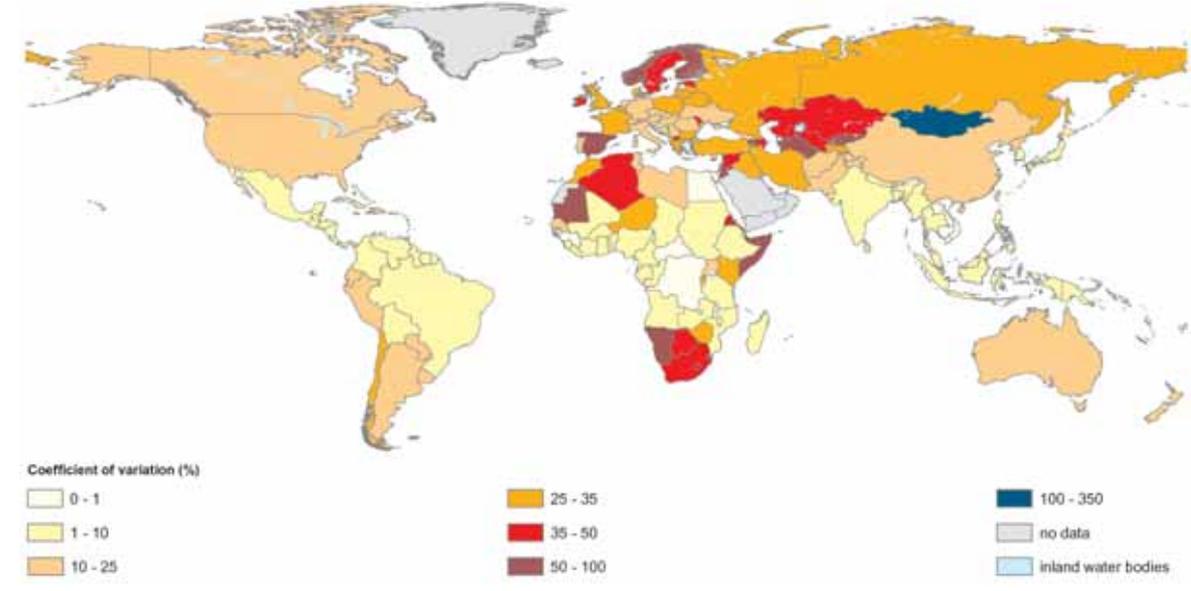
TABLE 4.3

Variability of cereal production potential, based on observed climate variability for the periods 1901-30, 1931-60, 1961-90 compared to reference climatic conditions of 1961-90, on current cultivated land, by region

Major area and region	Time period average, based on historical climate data for individual years						Simulated average for period
	1901-30		1931-60		1961-90		1961-90
	average potential production	coefficient of variation	average potential production	coefficient of variation	average potential production	coefficient of variation	average potential production
	mill. tons	%	mill. tons	%	mill. tons	%	mill. tons
AFRICA							
Eastern Africa	326	3.5	324	3.0	327	5.6	344
Middle Africa	81	2.6	79	3.1	80	2.0	82
Northern Africa	22	18.0	22	20.4	23	22.4	25
Southern Africa	43	33.2	42	29.8	41	36.7	38
Western Africa	134	5.5	135	5.7	133	7.6	139
AMERICA							
Central America & Caribbean	96	3.2	97	6.1	98	5.9	101
North America	993	16.6	1,006	18.0	1,060	14.4	1,189
South America	469	7.8	464	6.0	487	7.1	543
ASIA							
East Asia & Japan	391	9.4	410	10.7	420	10.1	448
South Asia	711	9.7	736	6.0	739	6.5	783
Central Asia	28	19.7	30	21.8	31	23.0	26
Southeast Asia	220	2.6	221	1.9	219	2.4	220
Western Asia	73	22.2	60	33.7	66	23.3	79
EUROPE							
Eastern Europe	473	17.0	460	20.5	499	17.0	613
Russian Federation	408	27.0	402	23.3	495	26.5	629
Northern Europe	111	25.7	125	22.0	122	17.2	154
Southern Europe	149	14.4	148	14.2	150	10.0	170
Western Europe	272	19.9	274	16.3	278	19.8	345
OCEANIA							
Oceania & Polynesia	49	32.3	50	29.0	54	26.3	55
Developed	**2,477**	**10.1**	**2,489**	**10.8**	**2,681**	**8.1**	**3,178**
Developing	**2,579**	**3.4**	**2,606**	**3.3**	**2,650**	**3.8**	**2,815**
World	**5,055**	**5.3**	**5,095**	**5.3**	**5,330**	**4.7**	**5,993**

Note: the climate datasets used to create this table are explained in Section 3.1.

MAP 4.1

Variability of rainfed cereal production potential, by country, 1961-1990

Coefficient of variation (%)

0 - 1	25 - 35	100 - 350
1 - 10	35 - 50	no data
10 - 25	50 - 100	inland water bodies

4.1.5 Estimation of crop and pasture suitability indices

For each of the approximately 2.2 million gridcells of the database suitability results were estimated for each crop type, at each of the three input levels considered under rainfed conditions and for gridcells classified as irrigated area for each of the two input levels considered under irrigated conditions. The outcomes were then mapped by means of a suitability index (SI). This index reflects the suitability make-up of a particular gridcell. In this index VS represents the portion of the gridcell with attainable yields that are 80 percent or more of the maximum potential yield for the specified input scenario. Similarly, S, MS and mS represent portions of the gridcell with attainable yields 60–80 percent, 40–60 percent, and 20–40 percent of the maximum potential yield, respectively. SI is calculated using the following equation:

$$SI = VS*0.9 + S*0.7 + MS*0.5 + mS*0.3$$

where: *VS = very suitable; S = suitable; MS = moderately suitable; mS = marginally suitable*

The resulting database permits generation of a suitability map based on the crop suitability index (CSI) for each gridcell for any combination of crop types that the analyst specifies. In this report, CSI are presented for nine crop groups at low, intermediate and high input levels under rainfed conditions.

To estimate production potential of the global land surface for pasture, estimates of maximum potential and attainable pasture yields were generated and a pasture suitability index (PSI) at low input level under rainfed conditions was obtained for each gridcell in the land resources database, using the same AEZ matching procedures that were employed for estimating rainfed crop production potential. For the GAEZ study, a reassessment of global pasture production potential was made by combining the AEZ matching procedure results and the zonal features of grassland composition. First, the original AEZ biomass and yield calculation procedures were revised to better cope with, in particular, arid and hyper-arid environments. This modification

entailed the incorporation of monthly rainfall events, available from CRU climate database (see Section 3.1). This enabled more realistic assessments of moisture regimes in space and time. Another modification involved the replacement of the LGP-based biomass and yield estimation in arid zones by an enhanced Net Primary Productivity (NPP) calculation procedure, which was applied in the arid environments prevailing in zones with LGP of less than 30 days (Zhang and Zhou, 1995). These two modifications have significantly improved correspondence with satellite-derived data for arid pasture and shrub areas.

4.2 SUITABILITY OF CURRENTLY AVAILABLE LAND FOR RAINFED CROPS AND PASTURE
4.2.1 Estimation of land area currently available for rainfed agriculture
The fact that an area of land has been determined to be suitable for rainfed crop agriculture or pasture does not necessarily mean it is available for such use. A sizeable part of the more suitable area is covered by forests, and is likely to remain so for the foreseeable future. Some suitable land, much of it forested, has been set aside as protected area, for environmental or other reasons. Also, although the extents involved are small, in some locations human settlements have been built on land that would otherwise be suitable or very suitable for agriculture. Finally irrigated area, although representing highly productive agricultural land which may also be used for rainfed crops as well, has been kept separate from land currently available for rainfed agriculture. Although suitability analysis has also been done for irrigated area, in this report we are considering only suitability under rainfed conditions, as these are the conditions where agriculture is likely to be more vulnerable and poor and hungry people are likely to be found. Hence, land area currently available for rainfed agriculture excludes area belonging to the above-mentioned land cover categories. The method used to create the land cover database from which area currently available for rainfed agriculture has been derived is explained in more detail in Annex 2. The Annex also contains the individual maps generated for each land cover category.

4.2.2 Suitability results
Crop and pasture suitability indices have been calculated for all of the world's land area, using the procedures described in Section 4.1.5. Rainfed suitability has been calculated for nine crop groups that are important to most farming systems in developing countries, namely, cereals, fibre crops, oil crops, pulses, roots and tubers, stimulants, sugar crops, tree fruits and vegetables. The algorithm examines in each gridcell all the crop types belonging to a particular crop group. Among these it determines the crop type that maximizes agronomic suitability. In the suitability maps for the crop groups and for pasture, CSI and PSI have been classified according to the Box 4.2.

BOX 4.2

CROP AND PASTURE SUITABILITY CLASSES

CROP AND PASTURE SUITABILITY CLASSES	CSI AND PSI VALUE
not suitable	0
very low	1-10
low	10-20
medium low	20-35
medium	35-50
medium high	50-65
high	65-80
very high	80-100

Figure 4.1 shows the share of global land area with medium high to very high suitability for each of these crop groups under rainfed conditions at high, intermediate and low inputs ok level, and for pasture and low levels of input; Figure 4.2 shows the same information for land area currently available for rainfed agriculture. Annex 3 contains maps showing present rainfed suitability on currently available land for each of the nine crop groups that have been assessed, at all three level of inputs .

FIGURE 4.1

Rural land area with medium high to very high suitability for rainfed crops, by crop group, with low, intermediate and high level of inputs, and pasture at low level of inputs
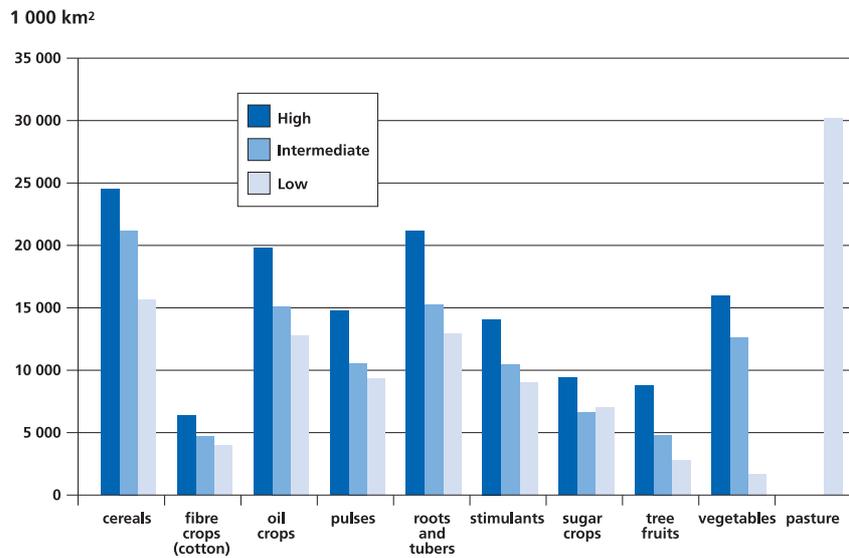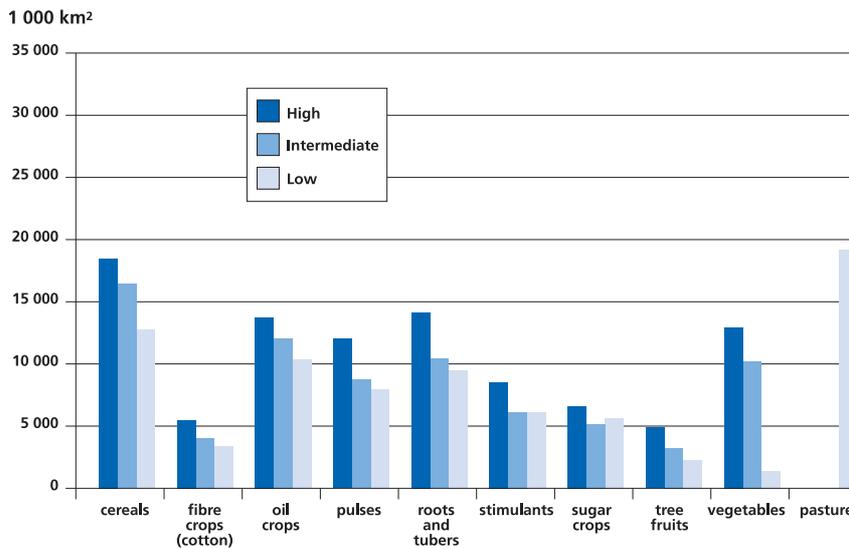

FIGURE 4.2

Rural land area currently available for rainfed agriculture with medium high to very high suitability for rainfed crops, by crop group, with low, intermediate and high level of inputs, and pasture at low level of inputs

4.2.3 Multiple cropping zones

In the AEZ crop suitability analysis, the LUTs considered refer to single cropping of individual crop types, i.e., each crop type is presumed to occupy the land only once a year and in pure stand. In areas where the growing periods are sufficiently long to allow more than one crop to be grown in the same year or season, single crop yields do not reflect the full potential of total time and space available per unit area of land for rainfed production.

To assess multiple cropping potential, a number of multiple cropping zones have been defined through matching both growth cycle and temperature requirements of individual suitable crop types with time available for crop growth. For rainfed conditions this period is approximated by the LGP, i.e., the number of days during which both temperature and moisture conditions permit crop growth. Eight zones were defined and are depicted for currently available land in Map 4.2. Table 4.4 presents the occurrence of these multiple cropping zones on currently available land in major world regions.

MAP 4.2

Multiple cropping zones under rainfed conditions, currently available land

Multiple cropping zones

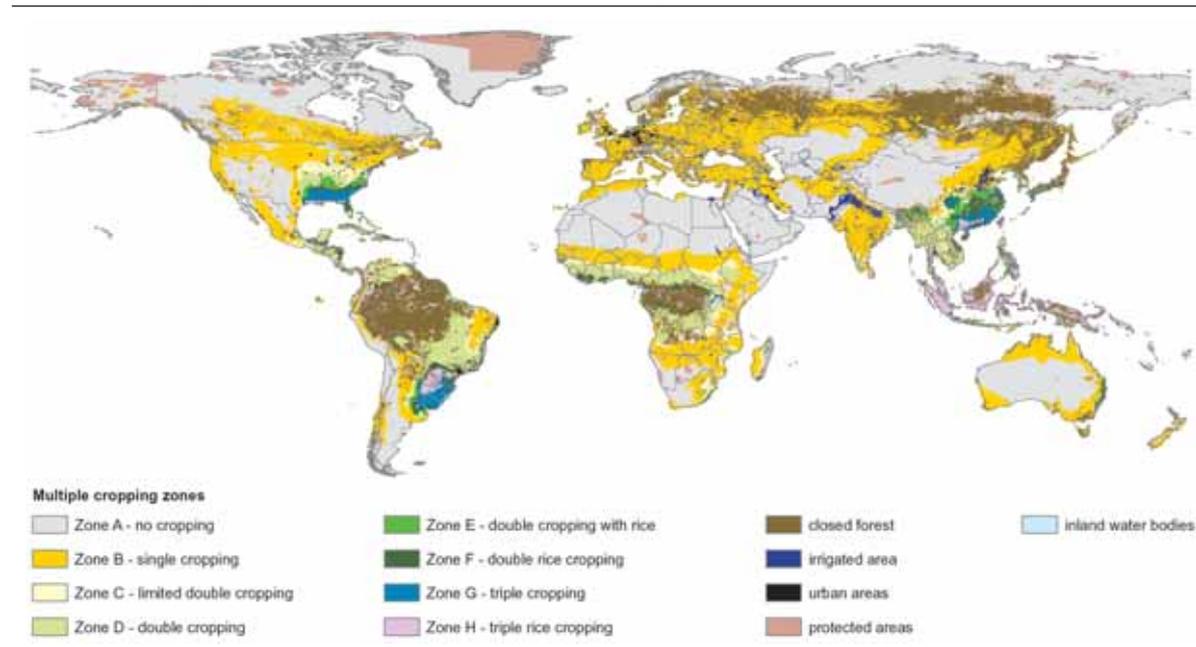|		
Zone A - no cropping	Zone E - double cropping with rice	closed forest	inland water bodies
Zone B - single cropping	Zone F - double rice cropping	irrigated area	
Zone C - limited double cropping	Zone G - triple cropping	urban areas	
Zone D - double cropping	Zone H - triple rice cropping	protected areas	

TABLE 4.4

Occurrence of multiple cropping zones under rainfed conditions, currently available land

Major area and region	Currently available land	Zone A	Zone B	Zone C	Zone D	Zone E	Zone F	Zone G	Zone H
	km² (1 000)	share of currently available land %							
AFRICA									
Eastern Africa	5,595	16.6	50.1	15.8	14.0	-	1.6	-	1.9
Middle Africa	4,060	18.2	23.0	7.2	42.5	-	7.3	-	1.8
Northern Africa	7,704	76.2	18.2	3.3	2.3	-	-	-	-
Southern Africa	2,360	50.6	41.2	5.5	1.4	0.7	0.3	0.3	-
Western Africa	5,685	46.4	28.4	6.9	14.7	-	3.3	-	0.3
AMERICAS									
Caribbean	156	-	-	3.2	62.2	-	21.8	-	12.8
Central America	2,230	27.9	34.7	7.4	18.4	-	7.8	-	3.8
Northern America	16,196	51.7	34.9	3.7	3.3	2.0	1.2	2.8	0.4
South America	9,992	21.5	20.8	5.4	32.6	1.5	5.2	5.2	7.8
ASIA									
Eastern Asia	9,402	52.8	24.5	3.6	3.3	5.2	4.9	4.5	1.2
Japan	88	-	47.8	12.5	19.3	17.0	1.1	2.3	-
South-central Asia	8,812	45.7	46.4	3.2	2.9	1.0	0.4	0.2	0.2
South-eastern Asia	3,158	0.1	0.6	1.4	48.1	2.3	6.7	0.2	40.6
Western Asia	4,152	73.6	26.1	0.2	0.1	-	-	-	-
EUROPA									
Eastern Europe	11,173	58.5	40.9	0.6	-	-	-	-	-
Northern Europe	1,005	42.7	57.3	-	-	-	-	-	-
Southern Europe	1,002	1.9	87.6	9.5	1.0	-	-	-	-
Western Europe	655	7.0	91.0	1.8	0.2	-	-	-	-
OCEANIA									
Australia and New Zealand	7,332	63.1	34.3	1.1	0.8	0.5	0.1	0.1	-
Melanesia	273	-	-	-	8.1	-	7.3	-	84.6
Developed	**37,451**	**53.5**	**39.6**	**2.3**	**1.7**	**1.0**	**0.5**	**1.2**	**0.2**
Developing	**63,579**	**41.2**	**28.4**	**5.3**	**14.8**	**1.3**	**3.2**	**1.5**	**4.3**
World	**101,030**	**45.7**	**32.6**	**4.2**	**9.9**	**1.2**	**2.2**	**1.4**	**2.8**

Note: Zone A – no cropping; Zone B – single cropping; Zone C – limited double cropping (relay cropping, one wetland rice crop may be possible); Zone D – double cropping (sequential cropping, wetland rice crop not possible); Zone E – double cropping (sequential cropping; one wetland rice crop possible); Zone F – limited triple cropping (partly relay cropping, if two wetland rice crops, no third crop possible); Zone G – triple cropping (sequential cropping of three short-cycle crops; two wetland rice crops possible); Zone H – triple rice cropping (sequential cropping of three wetland rice crops possible).

4.3 PRODUCTIVITY POTENTIAL OF CURRENTLY AVAILABLE LAND FOR RAINFED CROPS AND PASTURE

4.3.1 Productivity potential for rainfed crops with maximizing technology mix

Map 4.3 presents the spatial distribution of currently available land with cultivation potential for rainfed crops, under a maximizing technology mix. The estimates on which this map are based depend on a variety of assumptions: the range of crop types considered, the definition of what minimum level of output qualifies as acceptable, the social acceptance of land-cover conversions (in particular forests), and the assumptions on what land constraints may be alleviated with different levels of inputs and investment. To estimate the overall productivity potential of the global land surface for rainfed crops, a procedure has been applied that creates a set of assumptions for each of the above factors for each gridcell in the database, and then mixes crops and inputs so as to maximise extents of land suitable for cultivation.

When considering all crop types modelled in AEZ and applying a maximizing technology mix, results show that a little less than one-quarter of the Earth's land surface can be regarded as suitable for rainfed crop cultivation. When suitable land that is not currently available is deducted, Table 4.5 shows that only 22.7 percent of the Earth's land surface is both suitable and available, 36 percent of it in developed regions and 64 percent in developing regions. The share of currently available land that has medium high to very high potential for rainfed crop cultivation is by far the highest in Western Europe and Caribbean where the figure is respectively 66 and 51 percent. The lowest shares occur in Western Asia, Australia and New Zealand and Southern Africa where the figures fall below 10 percent. These differences only become significant, however, if scarcity of good agricultural land forces people onto less suitable and therefore less productive land, where obtaining a sustainable livelihood from agriculture may be more difficult, if not impossible.

MAP 4.3

Suitability of currently available land for rainfed crops, using maximising crop and technology mix

Crop suitability classes

- not suitable (0)
- very low (1 - 10)
- low (10 - 20)
- medium low (20 - 35)
- medium (35 - 50)
- medium high (50 - 65)
- high (65 - 80)
- very high (80 - 100)
- closed forest
- irrigated area
- urban areas
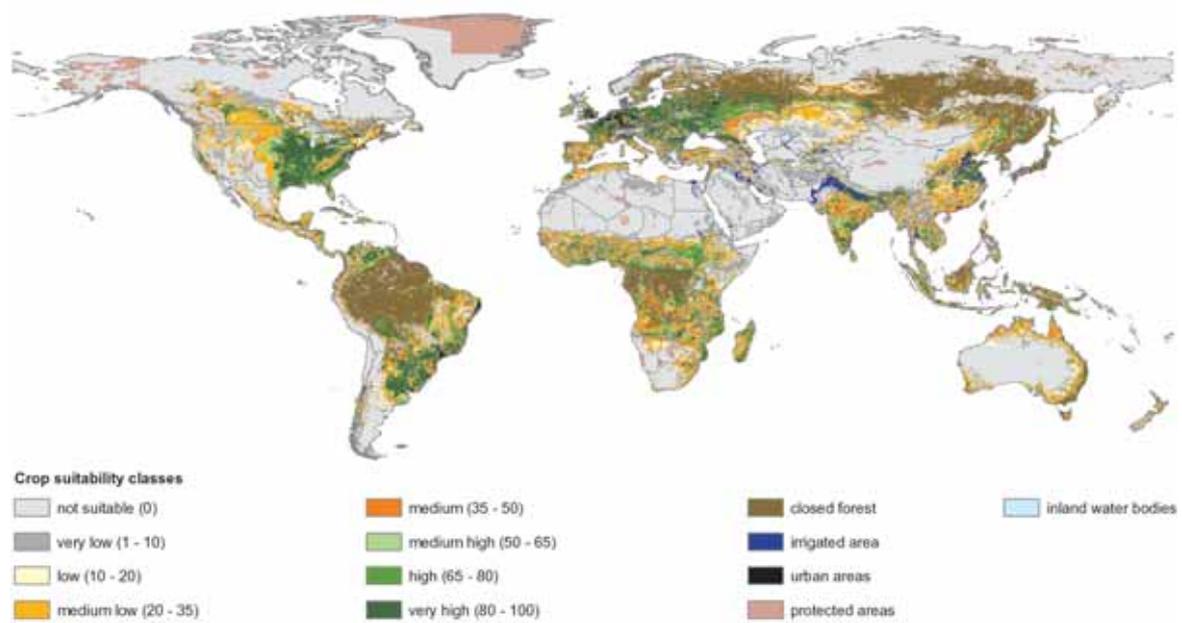- protected areas
- inland water bodies

TABLE 4.5

Extents of currently available land with potential for rainfed cultivation under maximizing technology mix, by region

Major area and region	Currently available land	Available land with medium high to very high suitability for rainfed cultivation		Available land with very low to medium suitability for rainfed cultivation	
	km²	km²	share of currently available land in the region	km²	share of currently available land in the region
	(1 000)	(1 000)	%	(1 000)	%
AFRICA					
Eastern Africa	5,595	2,227	39.8	2,803	50.1
Middle Africa	4,060	1,866	46.0	1,438	35.4
Northern Africa	7,704	808	10.5	2,044	26.5
Southern Africa	2,360	164	6.9	1,054	44.7
Western Africa	5,685	1,328	23.4	1,612	28.4
AMERICAS					
Caribbean	156	80	51.3	75	48.1
Central America	2,230	337	15.1	1,351	60.6
Northern America	16,196	3,855	23.8	5,237	32.3
South America	9,992	4,104	41.1	3,684	36.9
ASIA					
Eastern Asia	9,402	1,134	12.1	3,086	32.8
Japan	88	32	36.4	56	63.6
South-central Asia	8,812	1,206	13.7	4,537	51.5
South-eastern Asia	3,158	1,064	33.7	2,071	65.6
Western Asia	4,152	239	5.8	1,297	31.2
EUROPA					
Eastern Europe	11,173	2,824	25.3	1,655	14.8
Northern Europe	1,005	286	28.5	274	27.3
Southern Europe	1,002	369	36.8	596	59.5
Western Europe	655	433	66.1	175	26.7
OCEANIA					
Australia and New Zealand	7,332	493	6.7	2,671	36.4
Melanesia	273	85	31.1	181	66.3
Developed	**37,451**	**8,292**	**22.1**	**10,664**	**28.5**
Developing	**63,579**	**14,642**	**23.0**	**25,233**	**39.7**
World	**101,030**	**22,934**	**22.7**	**35,897**	**35.5**

4.3.2 Productivity potential of currently available land for rainfed pasture

Recent estimates of pasture and grazing areas available globally suggest that almost a quarter of the earth's land surface is covered by pasture or shrub vegetation that could, and often does, provide feed resources for ruminants. Results of the pasture suitability assessments for currently available land are given in Table 4.6. Worldwide, about 19 percent of available land has medium high to very high potential for pasture – slightly less than the aggregate amount with medium high to very high potential for rainfed crops. However, the share of available land area that has at least marginal suitability for pasture is double the share for rainfed crops – around 70 percent for pasture compared to 35 percent for crops. Map 4.4 shows the suitability of currently available land for pasture.

TABLE 4.6

Extents of currently available land with potential for pasture, by region

Major area and region	Currently available land	Available land with medium high to very high suitability for pasture		Available land with very low to medium suitability for pasture	
	km²	km²	share of currently available land in the region	km²	share of currently available land in the region
	(1 000)	(1 000)	%	(1 000)	%
AFRICA					
Eastern Africa	5,595	1,493	26.7	4,071	72.8
Middle Africa	4,060	1,205	29.7	2,470	60.8
Northern Africa	7,704	89	1.2	3,855	50.0
Southern Africa	2,360	142	6.0	2,206	93.5
Western Africa	5,685	492	8.7	3,582	63.0
AMERICAS					
Caribbean	156	144	92.3	12	7.7
Central America	2,230	496	22.2	1,733	77.7
Northern America	16,196	3,339	20.6	11,477	70.8
South America	9,992	3,865	38.7	5,793	58.0
ASIA					
Eastern Asia	9,402	1,895	20.2	6,418	67.4
Japan	88	76	86.4	11	12.5
South-central Asia	8,812	374	4.2	7,305	85.3
South-eastern Asia	3,158	1,910	60.5	1,242	39.5
Western Asia	4,152	47	1.1	3,534	85.1
EUROPA					
Eastern Europe	11,173	1,915	17.1	8,906	79.7
Northern Europe	1,005	312	31.0	693	69.0
Southern Europe	1,002	262	26.1	735	73.3
Western Europe	655	485	74.0	166	25.3
OCEANIA					
Australia and New Zealand	7,332	413	5.6	6,852	93.5
Melanesia	273	198	72.5	75	27.5
Developed	**37,451**	**6,802**	**18.2**	**28,840**	**77.0**
Developing	**63,579**	**12,350**	**19.4**	**42,296**	**66.7**
World	**101,030**	**19,152**	**19.0**	**71,136**	**70.5**

MAP 4.4

Suitability of currently available land for pasture

Pasture suitability classes

- not suitable (0)
- very low (1 - 10)
- low (10 - 20)
- medium low (20 - 35)
- medium (35 - 50)
- medium high (50 - 65)
- high (65 - 80)
- very high (80 - 100)
- closed forest
- irrigated area
- urban areas
- protected areas
- inland water bodies
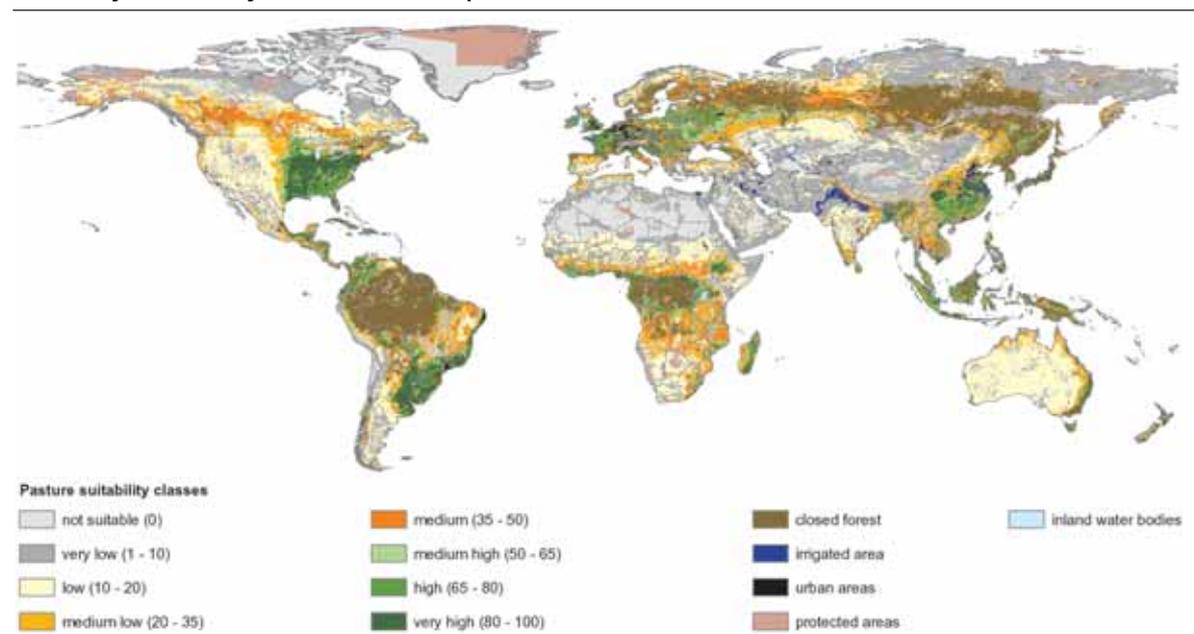
4.4 DISTRIBUTION OF RURAL POPULATION ON CURRENTLY AVAILABLE AGRICULTURAL LAND

The previous sections have examined the suitability of currently available land for rainfed production of crops and pasture, considered separately. In this Section, the combined productivity potential of available land is examined and the distribution of rural population on this land, by combined agricultural suitability class, is presented.

Map 4.5 shows the combined suitability of currently available land for pasture and for rainfed crops at intermediate level of inputs. Area and population data for currently available land, by region and combined agricultural suitability class are given in Table 4.7. For this purpose, four suitability classes have been defined as shown in Box 4.3.

BOX 4.3
COMBINED AGRICULTURAL SUITABILITY CLASSES

A. Not suited for rainfed agriculture	Land not suited for pasture or rainfed crops (PSI = 0 and CSI < 20)
B. Marginal agricultural land	Land very poorly suited for pasture and at best poorly suited for rainfed crops (PSI: 1-10 and CSI < 20)
	Land poorly suited for pasture and at best poorly suited for rainfed crops (PSI: 10-20 and CSI < 20)
	Land suited for pasture and at best poorly suited for rainfed crops (PSI > 20 and CSI < 20)
C. Good agricultural land	Land suited for rainfed crops and pasture possible (CSI: 20-50 and PSI > 0)
	Land well suited for rainfed crops and pasture possible (CSI: 50-80 and PSI > 0)
D. Prime agricultural land	Prime land for rainfed crops and pasture possible (CSI > 80 and PSI > 0)

The difference in the distribution of good to prime land across regions reflects mainly the distribution of cold barren land, desert and tropical rainforest among the continents. What is more important is the pattern of human settlement. In developed countries, 26.4 percent of the rural population live in areas with prime agricultural land, and only 11.3 percent live in marginal areas. In developing countries, by contrast, only 10.5 percent live in areas with prime agricultural land, whereas 23.3 percent live on land that is only marginally suitable for rainfed agriculture, even with an intermediate level of inputs and management. This result suggests that, even with substantial investment to raise inputs and management from their current low level to an intermediate level, the prospects for alleviating poverty through sustainable agricultural growth in these marginal areas is slim. And if investment in a high level of inputs and management are made, this will almost certainly mean introducing large-scale commercial agriculture, with current small–scale farmers becoming paid farm workers or leaving agriculture.

MAP 4.5

Combined suitability of currently available land for pasture and rainfed crops (intermediate level of inputs)

Combined suitability classes

A. Not suited for rainfed agriculture

land not suited for pasture or rainfed
crops (PSI = 0 and CSI < 20)

B. Marginal agricultural land

land very poorly suited for pasture and at best poorly
suited for rainfed crops (PSI: 1-10 and CSI < 20)

land poorly suited for pasture and at best poorly suited
for rainfed crops (PSI: 10-20 and CSI < 20)

land suited for pasture and at best poorly suited
for rainfed crops (PSI > 20 and CSI < 20)

C. Good agricultural land

land suited for rainfed crops and pasture
possible (CSI: 20-50 and PSI > 0)

land well suited for rainfed crops and pasture
possible (CSI: 50-80 and PSI > 0)

D. Prime agricultural land

prime land for rainfed crops and pasture
possible (CSI > 80 and PSI > 0)

closed forest

irrigated area
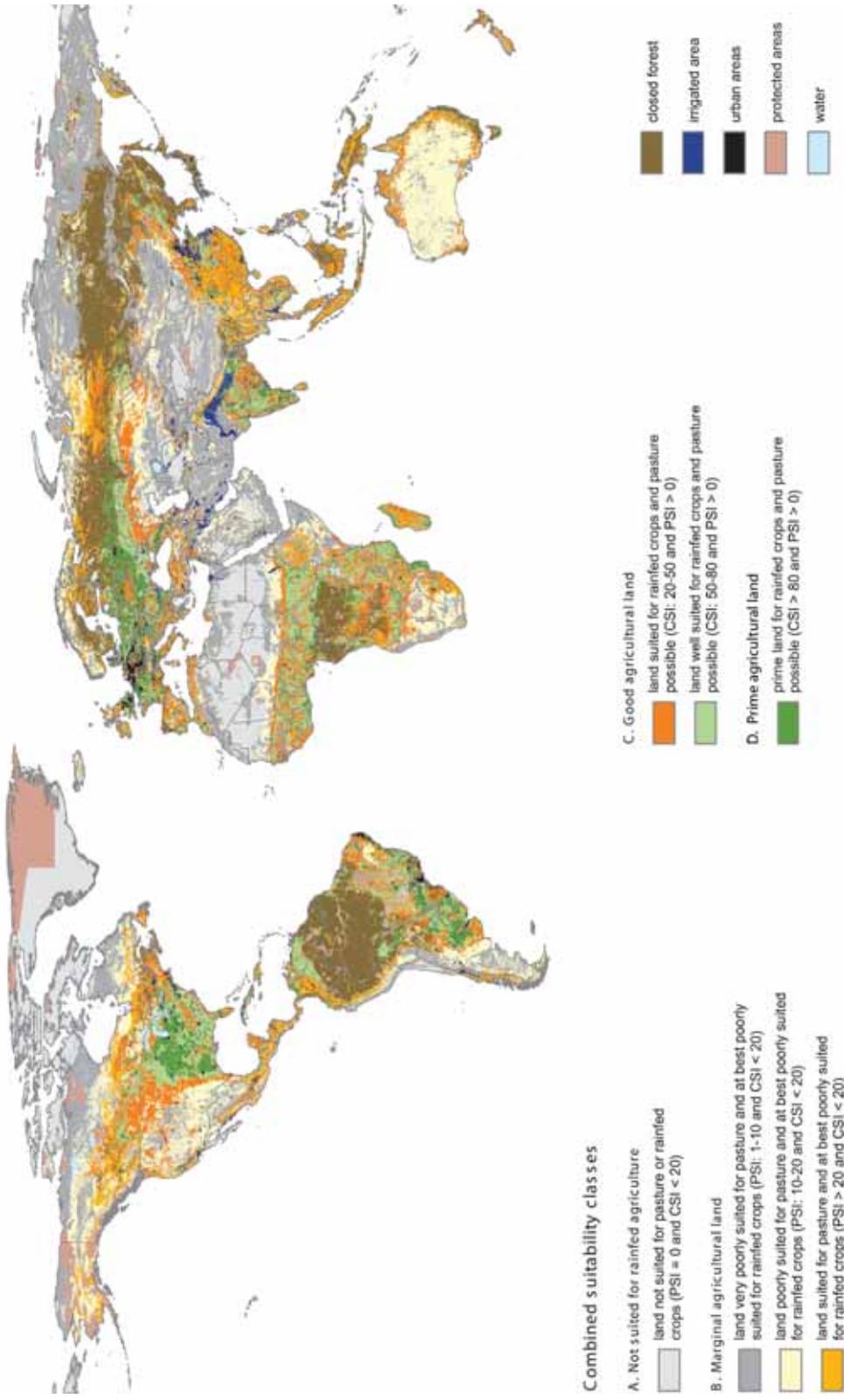
urban areas

protected areas

water

TABLE 4.7

Currently available land area and rural population, by region and combined agricultural suitability class at intermediate level of inputs

Major area and region	Data	Unit	A. Not suited for rainfed agriculture	B. Marginal agricultural land	C. Good agricultural land	D. Prime agricultural land	Total
AFRICA							
Eastern Africa	area	km² (1 000)	12	2,082	3,139	362	5,595
		share of total %	0.21	37.21	56.11	6.47	100
	population	persons (1 000)	64	44,305	121,199	15,894	181,462
		share of total %	0.04	24.42	66.78	8.76	100
	density	persons/km²	5	21	39	44	32
Middle Africa	area	km² (1 000)	351	757	2,672	280	4,060
		share of total %	8.64	18.65	65.81	6.90	100
	population	persons (1 000)	63	5,266	34,649	4,957	44,935
		share of total %	0.14	11.72	77.11	11.03	100
	density	persons/km²	less than 1	7	13	18	11
Northern Africa	area	km² (1 000)	3,404	2,925	1,273	102	7,704
		share of total %	44.19	37.98	16.52	1.31	100
	population	persons (1 000)	1,818	18,731	27,468	1,611	49,628
		share of total %	3.66	37.74	55.35	3.25	100
	density	persons/km²	1	6	22	16	6
Southern Africa	area	km² (1 000)	10	1,877	466	7	2,360
		share of total %	0.42	79.53	19.75	0.30	100
	population	persons (1 000)	4	11,800	10,393	154	22,351
		share of total %	0.02	52.79	46.50	0.69	100
	density	persons/km²	less than 1	6	22	22	9
Western Africa	area	km² (1 000)	1,473	1,717	2,325	170	5,685
		share of total %	25.91	30.20	40.90	2.99	100
	population	persons (1 000)	415	16,096	102,343	10,982	129,836
		share of total %	0.32	12.40	78.82	8.46	100
	density	persons/km²	less than 1	9	44	65	23
AMERICAS							
Caribbean	area	km² (1 000)	1	35	113	7	156
		share of total %	0.64	22.44	72.43	4.49	100
	population	persons (1 000)	1	3,147	8,010	387	11,545
		share of total %	0.01	27.26	69.38	3.35	100
	density	persons/km²	1	90	71	55	74
Central America	area	km² (1 000)	2	1,474	722	32	2,230
		share of total %	0.09	66.10	32.38	1.43	100
	population	persons (1 000)	2	22,146	16,245	1,148	39,541
		share of total %	0.01	56.01	41.08	2.90	100
	density	persons/km²	1	15	23	36	18
Northern America	area	km² (1 000)	1,380	8,789	4,883	1,144	16,196
		share of total %	8.52	54.27	30.15	7.06	100
	population	persons (1 000)	25	6,448	39,184	15,644	61,301
		share of total %	0.04	10.52	63.92	25.52	100
	density	persons/km²	less than 1	1	8	14	4
South America	area	km² (1 000)	280	3,880	4,850	982	9,992
		share of total %	2.80	38.83	48.54	9.83	100
	population	persons (1 000)	1,206	22,947	42,902	10,204	77,259
		share of total %	1.56	29.70	55.53	13.21	100
	density	persons/km²	4	6	9	10	8
ASIA							
Eastern Asia	area	km² (1 000)	1,021	6,270	1,986	125	9,402
		share of total %	10.86	66.69	21.12	1.33	100
	population	persons (1 000)	3,877	183,241	428,873	54,166	670,157
		share of total %	0.58	27.34	64.00	8.08	100
	density	persons/km²	4	29	216	433	71

Major area and region	Data	Unit	A. Not suited for rainfed agriculture	B. Marginal agricultural land	C. Good agricultural land	D. Prime agricultural land	Total
Japan	area	km² (1 000)	1	30	50	7	88
		share of total %	1.14	34.09	56.82	7.95	100
	population	persons (1 000)	136	2,948	9,823	1,576	14,483
		share of total %	0.95	20.35	67.82	10.88	100
	density	persons/km²	136	98	196	225	165
South-central Asia	area	km² (1 000)	821	5,301	2,314	376	8,812
		share of total %	9.32	60.15	26.26	4.27	100
	population	persons (1 000)	3,644	116,715	489,706	134,161	744,226
		share of total %	0.49	15.68	65.80	18.03	100
	density	persons/km²	4	22	212	357	84
South-eastern Asia	area	km² (1 000)	1	1,442	1,678	37	3,158
		share of total %	0.03	45.66	53.14	1.17	100
	population	persons (1 000)	1	63,271	210,790	7,062	281,124
		share of total %	-	22.51	74.98	2.51	100
	density	persons/km²	1	44	126	191	89
Western Asia	area	km² (1 000)	518	3,083	525	26	4,152
		share of total %	12.48	74.25	12.64	0.63	100
	population	persons (1 000)	369	28,685	22,289	1,907	53,250
		share of total %	0.69	53.87	41.86	3.58	100
	density	persons/km²	1	9	42	73	13
EUROPA							
Eastern Europe	area	km² (1 000)	351	6,964	2,807	1,051	11,173
		share of total %	3.14	62.33	25.12	9.41	100
	population	persons (1 000)	308	5,215	44,078	28,768	78,369
		share of total %	0.39	6.65	56.24	36.72	100
	density	persons/km²	1	1	16	27	7
Northern Europe	area	km² (1 000)	1	582	332	90	1,005
		share of total %	0.10	57.91	33.03	8.96	100
	population	persons (1 000)	-	2,388	7,792	2,589	12,769
		share of total %	-	18.70	61.02	20.28	100
	density	persons/km²	-	4	23	29	13
Southern Europe	area	Km² (1 000)	5	291	632	74	1,002
		share of total %	0.50	29.04	63.07	7.39	100
	population	persons (1 000)	116	6,110	26,651	5,688	38,565
		share of total %	0.30	15.84	69.11	14.75	100
	density	persons/Km²	23	21	42	77	38
Western Europe	area	km² (1 000)	4	104	380	167	655
		share of total %	0.61	15.88	58.02	25.49	100
	population	persons (1 000)	24	1,811	14,582	7,213	23,630
		share of total %	0.10	7.66	61.71	30.53	100
	density	persons/km²	6	17	38	43	36
OCEANIA							
Australia and New Zealand	area	km² (1 000)	31	5,670	1,560	71	7,332
		share of total %	0.42	77.33	21.28	0.97	100
	population	persons (1 000)	2	1,318	2,044	160	3,524
		share of total %	0.06	37.40	58.00	4.54	100
	density	persons/km²	less than 1	less than 1	1	2	less than 1
Melanesia	area	km² (1 000)	-	154	118	1	273
		share of total %	-	56.41	43.22	0.37	100
	population	persons (1 000)	-	2,488	1,144	3	3,635
		share of total %	-	68.45	31.47	0.08	100
	density	persons/km²	-	16	10	3	13

Major area and region	Data	Unit	A. Not suited for rainfed agriculture	B. Marginal agricultural land	C. Good agricultural land	D. Prime agricultural land	Total
Developed	area	km² (1 000)	1,773	22,430	10,644	2,604	37,451
		share of total %	4.73	59.90	28.42	9.95	100
	population	persons (1 000)	611	26,238	144,154	61,638	232,641
		share of total %	0.26	11.28	61.97	26.49	100
	density	persons/km²	less than 1	1	14	24	6
Developing	area	km² (1 000)	7,894	30,997	22,181	2,507	63,579
		share of total %	12.42	48.75	34.89	3.94	100
	population	persons (1 000)	11,464	538,838	1,516,011	242,636	2,308,949
		share of total %	0.50	23.34	65.66	10.50	100
	density	persons/km²	1	17	68	97	36
World	area	km² (1 000)	9,667	53,427	32,825	5,111	101,030
		share of total %	9.57	52.88	32.49	5.06	100
	population	persons (1 000)	12,075	565,076	1,660,165	304,274	2,541,590
		share of total %	0.48	22.23	65.32	11.97	100
	density	persons/km²	1	11	51	60	25

5 PRODUCTIVITY POTENTIALS IN MAJOR FARMING SYSTEMS OF DEVELOPING AND TRANSITION COUNTRIES

5.1 FARMING SYSTEM ZONES OF DEVELOPING AND TRANSITION COUNTRIES

A pioneering study published jointly by FAO and the World Bank in 2001 on farming systems and poverty, identified and characterized 44 farming systems (FS) practiced to greater or lesser extent in developing and transition countries. The classification method bases the definition of each farming system on the dominant type of resource base and the dominant livelihood pattern of farm households. In most cases, there is a gradual transition from one system to another, so the boundaries between them are not actually as sharply defined as they appear in maps. Detail regarding the characteristics of each farming system, by region, is given in Annex 4.

In this report, seven major farming system classes have been used as the basis for assessing the distribution of rural area and rural population in each farming system class with respect to severity of environmental constraints, suitability for rainfed agriculture and dominant land cover type. Map 5.1 depicts the spatial distribution of the seven farming system classes on the entire area of developing and transition countries; Table 5.1 shows the farming system classes and the farming systems belonging to each.

MAP 5.1

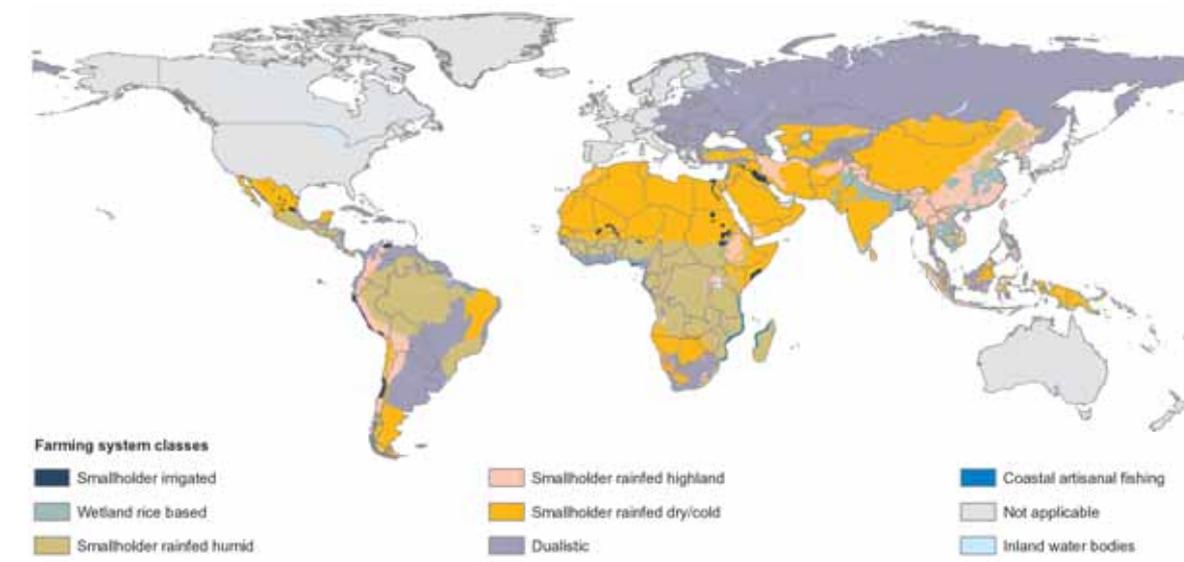**Farming system classes in developing and transition countries, 2000**

Farming system classes

- Smallholder irrigated
- Wetland rice based
- Smallholder rainfed humid
- Smallholder rainfed highland
- Smallholder rainfed dry/cold
- Dualistic
- Coastal artisanal fishing
- Not applicable
- Inland water bodies

TABLE 5.1

Farming system classes and farming systems of developing and transition countries

Farming system class	Farming systems	Where found
Smallholder irrigated*	Smallholders in large-scale irrigation schemes	Africa, Western Asia, Latin America and Caribbean
Wetland rice-based	Rice, rice-wheat, lowland rice Lowland rice	South Asia East Asia and Pacific
Smallholder rainfed humid	Forest based, rice-tree crop, root crop, cereal-root crop mixed, maize mixed Tree crop, root-tuber, temperate mixed Forest based, intensive mixed, maize-beans	Africa South Asia, East Asia Latin America and Caribbean
Smallholder rainfed highland	Highland perennial, highland temperate mixed Highland mixed, sparse mountain Upland intensive mixed, highland extensive mixed Intensive highland mixed, high altitude mixed, moist temperate mixed forest-livestock	Africa Western Asia, South Asia East Asia, and Pacific Latin America and Caribbean
Smallholder rainfed dry/cold	Agropastoral millet/sorghum Pastoral, sparse arid, small scale cereal-livestock Rainfed mixed, dryland mixed Rainfed mixed, dry rainfed, pastoral, sparse arid Pastoral, sparse arid, sparse forest Dryland mixed, pastoral, sparse forest	Africa Africa, Western Asia Western Asia South Asia East Asia and Pacific Latin America and Caribbean
Dualistic	Tree crop, large commercial and smallholder Irrigated, mixed, forest based livestock, horticulture mixed, large scale cereal-vegetable, extensive cereal-livestock, pastoral, sparse cold Tree crop mixed Coastal plantation and mixed, extensive mixed, cereal-livestock, temperate mixed, extensive dryland-mixed	Africa European and Central Asian countries in transition East Asia and Pacific Latin America and Caribbean
Coastal artisanal fishing	Coastal artisanal fishing	Africa, Western Asia, South Asia, East Asia and Pacific

* In this farming system category, which represents a small but important class of agriculture, smallholders in large-scale irrigation schemes grow most or all of their crops under irrigation. However, various forms of small-scale irrigation and moisture management techniques are found in most farming systems dominated by rainfed cropping.

5.2 DISTRIBUTION OF SUITABLE AREA, CURRENT LAND COVER AND RURAL POPULATION BY MAJOR FARMING SYSTEM CLASS IN DEVELOPING AND TRANSITION COUNTRIES

Area and rural population data have been generated for each of the seven major farming system classes represented in Map 5.1; the results are given in Table 5.2. Two classes are so small in area that meaningful analysis of the suitability of cropland currently in use was not possible. These are the smallholder irrigated and coastal artisanal fishing systems. Together, they contain less than three percent of the total rural population in the countries covered by the farming systems analysis. They are shown as "other" in the table.

TABLE 5.2

Area and population of the developing and transition countries, total and rural, by major farming system class

Farming system (FS) class	Total area	Rural area		Total population	Rural population		
	FS area	FS area	FS area as share of rural area	FS population	FS population	FS population as share of rural population	Density of rural population
	km² (1 000)	km² (1 000)	%	persons (1 000)	persons (1 000)	%	persons/km²
Wetland rice based	3,260	3,030	3.1	1,647,484	1,102,317	36.6	364
Smallholder rainfed humid	19,725	19,398	14.6	766,570	409,633	13.6	21
Smallholder rainfed highland	7,938	7,749	8.5	851,816	564,317	18.7	73
Smallholder rainfed dry/cold	34,890	34,608	43	880,763	545,489	18.1	16
Dualistic	31,261	30,675	29.7	785,527	304,111	10.1	10
Other*	1,342	1,260	1.4	200,928	85,538	2.8	68
Total	98,416	96,720	100	5,133,088	3,011,405	100	31

* Includes smallholder irrigated and coastal artisanal fishing, which together cover less than 1.5 percent of total rural area and contain less than three percent of total rural population.

Not surprisingly, the wetland rice-based system, found entirely in Asia, accounts for more than a third of the total rural population in developing and transition countries; it also has by far the smallest area (only three percent of total rural area in developing and transition countries) and by far the highest population density count (364 persons per square kilometre). Other systems with relatively high population densities are the smallholder rainfed highland (73 persons per square kilometre) and the irrigated other (68 persons per square kilometre).

Table 5.3 shows that the share of the rural population living in areas with severe constraints remains fairly constant across most farming systems. At around 45 percent of the total, this is about the same as the share for the rural population of developing countries as a whole (see Section 3.4.2). Exceptions are the dualistic system, where the share drops to 36.8 percent, and the "other" category, where the share comes to 72.9 percent, reflecting population living in irrigated areas that are otherwise too dry for rainfed agriculture.

TABLE 5.3

Rural area and rural population of the developing and transition countries, by major farming system class, with proportion subject to severe environmental constraints

Farming system class	Rural population	Too cold		Too dry		Too steep		Poor soils		All severe constraints		
		Area	Pop.	Area	Pop.	Area	Pop.	Area	Pop.	Area	Pop.	Share of pop. in FS class
	persons (1 000)	km² (1 000)	persons (1 000)	km² (1 000)	persons (1 000)	km² (1 000)	persons (1 000)	km² (1 000)	persons (1 000)	km² (1 000)	persons (1 000)	%
Wetland rice based	1,102,317	-	-	186	53,197	36	1,883	1,359	455,137	1,454	480,419	43.6
Smallholder rainfed humid	409,633	10	6	42	229	439	10,322	10,275	178,042	10,600	185,278	45.2
Smallholder rainfed highland	564,317	136	805	564	15,010	2,874	116,803	3,035	188,477	4,787	269,463	47.8
Smallholder rainfed dry/cold	545,489	1,839	2,655	21,345	80,514	2,633	19,204	14,268	196,842	28,041	253,165	46.4
Dualistic	304,111	7,435	1,365	2,702	11,942	1,926	11,187	19,341	97,624	21,432	111,954	36.8
Other	85,538	0.5	0.1	491	44,112	66	618	533	55,286	806	62,377	72.9
Total	3,011,405	9,421	4,831	25,330	205,004	7,974	160,017	48,811	1,171,408	67,120	1,362,656	45.2

Note: data shown in this table differ slightly from those given in Section 3.4 because a different reference map has been used for the farming system analysis.

As explained earlier, however, the presence of severe constraints does not necessarily mean that an area is unsuitable for certain types of rainfed agriculture, unless it is absolutely too cold to support any kind of vegetative growth. Thus, for example, pasture and browse may still be suitable in areas that are generally considered too dry for rainfed agriculture, or fruit trees and pasture may be suitable in areas that are generally considered too steep. Similarly, soils that are generally considered poor may nevertheless be suitable for certain kinds of vegetation with economic value. This explains why 13 percent of the population belonging to the smallholder rainfed dry/cold farming system can survive in areas that are classified as too dry, and 20 percent of the population belonging to the smallholder rainfed highland farming system are found in areas that are classified as too steep.

Because of this, the distribution of rural population by combined agricultural suitability class gives a better indication of the number of people farming in marginal areas, and the farming systems to which they belong. Data given in Table 5.4 show that in the wetland rice-based system, despite the high population densities there, only 11 percent of the rural population belonging to that system lives on marginal land. In the smallholder rainfed humid system the figure is similarly low – only 15 percent. On the other hand, in the smallholder rainfed highland and smallholder rainfed dry/cold the figures are 47.5 percent and 28.2 percent respectively. Across all farming systems, 76 percent of the total rural population in developing and transition countries lives on good or prime agricultural land. However, though only 24 percent of the total live on marginal land, they number more than 700 million people – sufficient to account for a substantial proportion of the world's hungry, currently numbering 852 million, according to latest FAO estimates.

TABLE 5.4

Rural area and rural population of the developing and transition countries, by major farming system class and combined agricultural suitability class at intermediate level of inputs

Farming system class	Data	Unit	A. No rainfed agriculture possible	B. Marginal agricultural land	C. Good agricultural land	D. Prime agricultural land	Total
Wetland rice based	area	km² (1 000)	15	606	2,041	368	3,030
	population	persons (1 000)	2,610	123,019	782,087	194,601	1,102,317
	share on total	%	0.24	11.16	70.95	17.65	100.00
Smallholder rainfed humid	area	km² (1 000)	16	2,639	14,817	1,926	19,398
	population	persons (1 000)	137	61,657	313,227	34,612	409,633
	share on total	%	0.03	15.05	76.47	8.45	100.00
Smallholder rainfed highland	area	km² (1 000)	172	5,275	2,210	92	7,749
	population	persons (1 000)	1,406	262,480	278,257	22,174	564,317
	share on total	%	0.25	46.51	49.31	3.93	100.00
Smallholder rainfed dry/cold	area	km² (1 000)	7,569	21,339	5,345	355	34,608
	population	persons (1 000)	7,964	153,843	322,740	60,942	545,489
	share on total	%	1.46	28.20	59.17	11.17	100.00
Dualistic	area	km² (1 000)	652	16,457	10,958	2,608	30,675
	population	persons (1 000)	2,046	56,858	191,886	53,321	304,111
	share on total	%	0.67	18.70	63.10	17.53	100.00
Other	area	km² (1 000)	64	591	518	87	1,260
	population	persons (1 000)	1,151	50,982	30,093	3,312	85,538
	share on total	%	1.35	59.60	35.18	3.87	100.00
Total	area	km² (1 000)	8,488	46,907	35,889	5,436	96,720
	population	persons (1 000)	15,314	708,839	1,918,290	368,962	3,011,405
	share on total	%	0.5	23.5	63.7	12.3	100.0

Note: data shown in this table differ slightly from those given in Section 4.4 because a different reference map has been used for the farming system analysis.

The distribution of rural population of each farming system class by current dominant land cover type (Table 5.5) shows that rural people are settled mainly on cropland, or at least on land where crops are grown in combination with livestock, fish and/or tree crops. Despite the importance of pastoralism for some farming systems, only 15 percent of the total rural population of developing and transition countries lives on land that is predominantly or mainly pasture and browse, and among those who do, the share is surprisingly highest in the smallholder rainfed humid farming system, and not in the highland or dry/cold systems where pastoralism is more common. The data also confirm the importance of forests, where the share of the rural population living there ranges from two to 16 percent, depending on the system in question.

TABLE 5.5

Rural area and rural population of the developing and transition countries, by major farming system class and dominant land cover type

Farming system class	Data	Unit	Forest 50% or more	Crops 50% or more	Pasture and browse 50% or more	Barren and sparsely vegetated 50% or more	Mixed (no land use dominant)	Total
Wetland rice based	area	km² (1 000)	320	1,831	123	37.0	719	3,030
	population	persons (1 000)	20,402	860,008	13,667	13,550.0	194,690	1,102,317
	share on total	%	1.9	78.0	1.2	1.3	17.7	100.0
Smallholder rainfed humid	area	km² (1 000)	10,532	825	5,947	78.0	2,016	19,398
	population	persons (1 000)	66,367	135,021	121,920	678.0	85,647	409,633
	share on total	%	16.2	33.0	29.8	0.1	20.9	100.0
Smallholder rainfed highland	area	km² (1 000)	2,506	431	2,475	624.0	1,713	7,749
	population	persons (1 000)	84,712	95,260	128,553	7,240.0	248,552	564,317
	share on total	%	15.0	16.9	22.8	1.3	44.0	100.0
Smallholder rainfed dry/cold	area	km² (1 000)	2,649	1,729	9,455	19,382.0	1,393	34,608
	population	persons (1 000)	47,501	252,698	118,020	43,176.0	84,094	545,489
	share on total	%	8.7	46.3	21.6	7.9	15.4	100.0
Dualistic	area	km² (1 000)	12,155	2,885	9,409	1,711.0	4,515	30,675
	population	persons (1 000)	44,241	100,577	56,620	5,010.0	97,663	304,111
	share on total	%	14.5	33.1	18.6	1.6	32.1	100.0
Other	area	km² (1 000)	224	186	429	250.0	171	1,260
	population	persons (1 000)	7,292	48,546	7,985	5,993.0	15,722	85,538
	share on total	%	8.5	56.8	9.3	7.0	18.4	100.0
Total	area	km² (1 000)	28,386	7,887	27,838	22,082.0	10,527	96,720
	population	persons (1 000)	270,515	1,492,110	446,765	75,647.0	726,368	3,011,405
	share on total	%	9.1	49.5	14.8	2.5	24.1	100

Note: data shown in this table differ slightly from those given in Section 4.4 because a different reference map has been used for the farming system analysis.

Further exploration of the significance of the relationships hinted at in this Section is planned as part of the continuing investigation of the influence of geophysical factors on agricultural production performance, rural vulnerability and the prevalence and extent of hunger and poverty in developing countries.

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