A REVIEW OF UPLAND AGRICULTURE, POPULATION PRESSURE AND ENVIRONMENTAL DEGRADATION IN THE PHILIPPINES

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ABSTRACT

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Upland agriculture in the Philippines, which started in the Neolithic Age, has evolved from an environmentally-sound traditional shifting cultivation into a destructive form of agriculture. Population which increased from about 7 million at the turn of the century to 70 million at present, is considered as a major factor behind this change in form and extent of upland agriculture resulting in the degradation of the country's bio-physical environment. It is believed that the key to solving this ecological problem rests heavily on reduced population pressure, sound environmental management strategies, alternative livelihood for upland farmers and appropriate technologies that would suit the conditions in the uplands.

KEYWORDS: Environmental degradation. Land use. Pollution. Population pressure. Soil degradation. Upland agriculture.

INTRODUCTION

Like in most tropical countries, cultivation of upland areas in the Philippines has increased tremendously both in terms of hectarage and intensity in recent years. This includes the intensive use of steep slopes, marginal soils, grasslands and forest areas for annual and perennial crops. Although this helped alleviate hunger in some ways, it is widely perceived to have caused a multitude of environmental problems such as soil and forest degradations; floods; siltation of lakes, reservoirs, streams, rivers and rice fields; and air and water pollutions. Rapid population growth is considered as a contributing factor to these problems.

This paper reviews the available information about upland agriculture, population pressure, and environmental degradation in the country, and analyzes their relationships. This hopes to contribute to the proper understanding of the causes of environmental degradation as well as bring to light some important issues which received little attention in the past.

Upland agriculture: past and present

The Philippines is generally mountainous, hence, upland agriculture must have played a vital role in feeding people since early times; it could be their be their last hope in the face of rapid population growth.

Archaeological evidences indicate that agriculture in the Philippines started during the prehistoric period. Scott (1984) reported, for instance, that farming, hunting and fishing could have already been practiced by the inhabitants during the late Stone Age. This coincided with the start of permanent agriculture which, according to Mannion (1991), occurred during the New Stone Age (Neolithic). It could be assumed that this ancient form of agriculture started the utilization of the uplands which became significant during the Iron Age which is approximately the time when the Ifugaos built the Banaue rice terraces, i.e. between the 7th and 11th century A.D. (Maher, 1973; Conklin, 1980 as cited by Voggesberger and Margraf, 1988). Interestingly, Conklin (1980) as cited by Voggesberger and Margraf (1988) believes that the Banaue rice terraces started as shifting cultivation fields planted to gabi *(Colocasia esculenta)* which was later replaced by rice *(Oryza sativa)*. No available evidence suggests that this ancient upland agriculture posed environmental problems (Margraf, personal communication).

Until the early part of this century, upland agriculture was largely in the form of the traditional shifting cultivation (locally called "kaingin") practiced by tribal groups and the migrants which totalled less than half a million in 1916. Because of low population then, shifting cultivation was generally practiced for 2-3 years followed by 10-20 years rest or fallow period. Upland rice was the major crop grown under monoculture system although in some places, corn (*Zea mays*) and root crops like sweetpotato (*Ipomoea batatas*), cassava (*Manihot esculenta*), gabi and other minor crops were also cultivated (Kolb, 1942). In general, the early upland cultivators did not plant trees because of their nomadic nature, used no fertilizers, but usually raised a few heads of animals particularly chicken and pigs (Kolb, 1942). Because of the temporary nature of the farms, the long fallow period and the less intensive farming, the practice of upland agriculture during the early times was less destructive.

The opening of the international market like that of the U.S. , brought about dramatic increase in area devoted to monoculture of coconut (*Cocos nucifera*), abaca (*Musa textilis*), sugarcane (*Saccharum officinarum*) and tobacco (*Nicotiana tabacum*) not only in the lowlands but in the uplands as well. Professor Kolb of the University of Leipzig observed in the later part of the 1930s that crop intensification was already practiced in thickly populated areas and that soil deterioration was already observable in some upland areas. This suggests that ecological problems are consequences of crop intensification.

The present upland agriculture differs in many ways from that of the past. Because of shrinking arable area, pressure to produce more due to high cost of basic commodities and increasing family size, fallow period, is being shortened and in many instances eliminated. In addition, unsuitable steep slopes and marginal soils are cultivated. In contrast to the early practice of monoculture, today's upland farms are increasingly under mixed crop systems (Barbosa, 1986; Dargantes et al., 1995). Major crops like rice, corn and root crops sometimes occupy the widest area of the farm together with two or more minor crops like peanut (*Arachis hypogaea*), beans (*Phaseolus*sp.), squash

(*Cucurbita maxima*), pepper (*Capsicum annum*), pechay (*Brassica chinensis*), pineapple (*Ananas comosus*), banana (*Musa sapientum*) and others which are planted within or at the sides of the farm. In many areas, these crops are planted under coconuts or fruit trees. The use of pesticides and fertilizers is common in remote upland areas which brings not only ecological but health problems as well. The present farming systems can be classified into shifting cultivation, permanent cultivation of annual or perennial crops, lowland and wetland cultivation and others like cattle ranching. Of these systems, permanent cultivation of annual crops in the uplands, cattle ranching and shifting cultivation are the least suitable (Scholz, 1982, 1986a and 1986b).

Population pressure

The important role of population pressure in agriculture and environment is not new and has been time and again emphasized (Dudal, 1988; Von Braun, 1992). In the case of the Philippines, two aspects are described to have a clear idea of the effect of population pressure: increase in the country's population and the increase in upland population due to migration.

Records of the country's population show a startling fact. From a mere 1.5 million in 1799, the population increased rapidly to 15 million in the 1930s; 30 million in the early 1960s and more than 60 million in 1990 (Table 1). The trend indicates a rough doubling of the population in about every 30 years. If this trend continues, a staggering 120 million people will be competing for the almost exhausted resources of the country in the year 2020.

The lack of a strong population control program, resistance to adapt birth control measures due to some beliefs, and the lack of proper knowledge about birth control among the majority of the people are generally considered as the main reasons for population explosion (Scholz, 1986a; Fujisaka et al., 1986). Other people, however, argue that longer life span due to better health care and nutrition contributes to the overpopulation problem.

Table I. Population history of the Philippines.

Year	Population (millions)	Year	Population (millions)
1799	1.50	1948-52	20.30
1818	2.03	1961	30.28
1850	3.86	1965	32.03
1871	5.68	1970	37.60
1887	5.98	1975	42.56
1903	7.63	1980	48.32
1918	10.31	1985	55.12
1939	15.98	1990	62.41

Source: FAO (1970, 1975 and 1990) and Kolb (1942).
Note: Population in 1996 was estimated at 70 million.

The negative effect of high population might have been less severe had the people been well-distributed all over the country. As it is, people are concentrated where "opportunities" are -- in cities and in upland areas. Three events encouraged massive migratory movements to upland areas in the past: the opening of trails by Spanish missionaries, changes in peace and order conditions, and the government resettlement schemes (Cruz, 1986). In contrast to the perceived minimal effect of the Spanish influence, peace and order situation considerably played a vital role especially during the second world war and during the height of communist and separatist insurgency in the 1970s and 1980s. Government relocation programs which started in the 1930s and continued until the 1970s included relocation of communities into virgin forests (Cruz, 1986). The series of natural calamities like the Central Luzon earthquake, Ormoc City flood, Mt. Pinatubo and Mt. Mayon eruptions, have without doubt, aggravated the problem of upland migration.

A recent study revealed that the combination of maldistribution of good cropland, with its root from Spanish and American colonial policies, economic crises in the first half of the 1980s, and rapid population growth produced a surge in agricultural unemployment. Economically desperate, millions of poor agricultural laborers and landless peasants have migrated to shanty towns in cities while million others have moved to the steep hillsides (Homer-Dixon et al., 1993) and forests.

Whatever the reasons and causes, statistics clearly show that from a mere thousand at the turn of the century, the upland population ballooned to 11 million in 1970 (Cruz, 1986), more than 18 million in 1986 (Myers, 1988) and maybe about 20 million or more at present. In the tropics, the limit of the traditional subsistence-oriented shifting cultivation is reached with a population density of about 40 persons/km^2 (Scholz, 1982). Data from 1960 and 1970 (Cruz, 1986) show that as early as 1960, the population density of upland areas in the country already well exceeded this figure. This clearly implies that overpopulation is a major factor causing the degradation of the upland areas. A recent analysis of Siquijor province concluded that population pressure is the major cause of its environmental degradation (DuBois, 1990).

Environmental degradation

Forest degradation

Evidences show that the Philippines was predominantly forested until the turn of the century (Sajise, 1986). This condition was also implied in an essay written by the British Consul to Manila in 1887 (Gifford-Palgrave, 1973). Assuming that there were 28 million hectares (about 95%) of forest at the turn of the century, this decreased rapidly to 17 million (57%) in 1932, 13 million (44%) in 1979 and 10 million (35%) in 1989 (Table 2). However, these figures camouflage an important fact: only a fraction of these 10 million hectares is actually primary forest. The rest is secondary and even dying forest. For instance, a recent report by the Philippine Department of Environment and Natural Resources (DENR) revealed that the forested area is only 6.46 million hectares or 21.5% of the country's total land area (DENR, 1990). Also, some provinces, for example Cebu and Negros, have even less than 5% forest cover. It has been reported that from 1972 to 1981 alone, the rate of deforestation in the whole country was 379,000 hectares per year (Villavicencio, 1987). It is believed that by the year 2000, most of the remaining forests will have disappeared and replaced by subsistence farming (Myers, 1988). When one compares such trend with that of population, it clearly shows an inverse relationship.

The major causes of the demise of Philippine forests, such as short-sighted timber harvesting, agriculture, and firewood (fuelwood) collection (Sajise, 1986; Longman and Jenik, 1987; Scholz, 1986a and 1986b) are generally true for other tropical rainforests. Some

Table 2. Distribution of the major land uses in the Philippines.

Land use	1932	1961-65	1970	1979	1989
			(in million hectares)		
Estimated total land area	30.0	30.0	30.0	30.0	30.0
Arable land	6.30 (21.0%)	5.42 (18.0%)	6.57 (22.0%)	4.51 (15.0%)	4.55 (15.2%)
Land under permanent crop		2.24 (7.5%)	2.40 (8.0%)	3.20 (10.7%)	3.42 (11.4%)
Permanent pasture	5.54 (18.5%)	0.94 (3.1%)	0.84 (2.8%)	0.99 (3.3%)	1.24 (4.0%)
Forest and woodland	17.00 (57.0%)	14.70 (49.0%)	13.30 (44.0%)	12.66 (42.0%)	10.55 (35.5%)
Barren land and others	0.83 (2.8%)	6.70 (22.2%)	6.88 (23.0%)	8.45 (28.0%)	10.06 (33.0%)

Source: FAO (1970, 1975, 1990) and Kolb (1942).

evidences indicate that timber harvesting started significantly in the early part of this century for lumber production and logs for export (Kolb, 1942). Logging activities peaked in the 1960s (Scholz, 1986) although it still continues at an alarming rate, both legally and illegally.

Much has been written about the major role of fuelwood gathering by rural people in the tropics in forest degradation. In the Philippines, fuelwood gathering appears to have contributed more to the destruction of mangrove forest (with an annual loss of 5,000 hectares), which usually lies close to heavily populated areas, than to the destruction of upland forest. What is usually overlooked is the significant contribution of coconut trees as source of fuel material for rural people in the Philippines. The hard shell, a by-product in copra production, and the dried leaf stalks, are very good fuel materials.

Most people believe that forest clearing for agriculture in the tropics is the major factor of deforestation (Scholz, 1986a, 1986b; Theng, 1991). In the Philippines, shifting cultivation is considered as the major cause of forest destruction (Villavicencio, 1987). This author believes, however, that it varies from place to place. In some areas, logging has caused more destruction than shifting cultivation. Shifting cultivators usually follow logging activities.

Soil degradation

Soil degradation involves a number of interrelated processes leading to the deterioration of the chemical, physical and biological conditions of the soil. Although it is commonly mentioned by agricultural scientists and ecologists, it is still less understood especially in humid tropical areas. Soil degradation is generally believed to be basically due to forest removal and inappropriate land use which enhance soil erosion, rapid organic matter decomposition, decline in biotic activity, leaching and other processes (Lal, 1986; Moll, 1980; Sanginga et al., 1992). An example of soil degradation upon cultivation of a forest under Philippine condition is shown in Table 3. It should be noted, however, that forest removal or its use for cultivation of crops may not always lead to soil deterioration (Blum, 1983; Theng, 1991; Asio, 1996).

Statistics show the severity of this problem in the Philippines. Barren lands and other agriculturally non-usable areas (e.g. populated, etc.) increased from 0.83 million hectares in 1932 to about 7.0 million in 1970 and 10 million in 1989, resulting in a considerable decline in arable land, permanent pasture, forest and woodland (Table 2). One major cause of soil degradation is soil erosion. As early as 1982, it was already observed that many areas have been severely eroded beyond 50% of the land area (Table 4). A recent report estimated that at least 90,000 km^2 of land are so badly affected by erosion that they can no longer sustain crop production. Open grassland cumulatively experience an annual loss of 84 t/ha of soil, overgrazed losses 250 t/ha

Table 3. Changes in chemical properties of surface soil due to change in land use in Leyte, Philippines.

Parent Material of soil	Soil Properties	Land Uses		
		Forest	Shifting Cultivation (5 yrs. old)	Shifting Cultivation (10 yrs. old)
Limestone	pH (water)	7.6	7.2	6.4
	O.M. (%)	7.0	4.7	4.2
	Avail. P (ppm)	1.5	4.2	8.0
	K (m.e./100g)	0.2	0.1	0.3
	Mg (m.e./100g)	9.0	6.8	7.7
	Ca (m.e./100g)	46.0	23.6	35.3
Recent	pH (water)	6.4	5.4	4.8
	O.M. (%)	8.0	4.3	3.5
	Avail. P (ppm)	3.8	1.7	1.8
	K (m.e. /100g)	0.3	0.2	0.4
	Mg (m.e./100g)	2.1	1.6	0.8
	Ca (m.e./100g)	12.3	2.4	4.6

compared with 12 and 3 t/ha annually for soils under secondary and primary forest, respectively (Myers, 1988). Recently, Sajise (1991) reported that deterioration of soil resource base is one of the environmental impacts of productivity-oriented green revolution in the country.

The extent of soil degradation in upland areas is also indicated by soil appearance, native vegetation and soil chemical properties. It has been observed, for instance, that in many cases, the red appearance of soils indicates exposure of iron oxide-rich subsoil due to removal of humus-rich topsoil by erosion (Asio, 1990, 1996). Also, as observable in many parts of the country, degraded areas are usually dominated by native grasses like cogon (*Imperata cylindrica*) and talahib (*Saccharum spontaneum*) and sometimes wild guava (*Psidium guajava*).

Floods, siltation and pollution

The degradation of the upland environment in the Philippines has tremendous environmental consequences in the lowlands and

Table 4. Estimated extent of erosion in the Philippines.

Province	Area Affected ha (%)	Province	Area Affected ha (%)
Batangas	256,059 (83)	Abra	248,102 (65)
Cebu	371,207 (76)	Iloilo	337,132 (64)
Ilocus Sur	198,225 (74)	Cavite	77,999 (61)
La Union	96,565 (70)	Rizal	121,790 (58)
Batanes	13,439 (68)	Capiz	243,079 (55)
Bohol	269,074 (66)	Marinduque	47,593 (55)
Masbate	269,516 (66)	Negros Occ.	385,203 (50)

35 other provinces with 4.5 to 48%
Total affected area: 8,895,958 (30%) as of 1982

Source: El-Swaify and Dangler (1982)

coastal areas. It has been suggested that the public interest in the uplands has been aroused less from the concern to improve the livelihood of uplanders but the realization that lowland environmental and agricultural problems are directly related to upland deforestation and ecosystem degradation (Russel, 1986).

The increasing frequency and intensity of floods in many areas of the country are undoubtedly related to the degradation of the upland environment (Scholz, 1986a; Fujisaka et al., 1986; DENR, 1990). Although the contribution of forest cutting to the occurrence of floods is recently being questioned (Hamilton, 1991), realities in the Philippines indicate the important role played by deforestation in flood occurrence. For instance, a physio-geographical analysis of the flash-flood tragedy in Ormoc City in November 1991 where more than 5,000 people perished in less than an hour, revealed a strong role of deforestation, degraded soil and improper land use (Eller and Asio, 1991). The increasing frequency and intensity of floods in the rivers draining Mt. Pangasugan in Leyte in recent years, is also related to the rampant cutting of forest and shifting cultivation in the watershed.

In many areas of the country, many streams and rivers are heavily silted or even ecologically dead (DENR, 1990). In the sugar producing areas of Negros, some streams are totally covered with rocks and soil coming from the slopes cultivated continuously for sugarcane (Asio, 1990). Likewise, many major rivers in the country have very high siltload, thus, badly affecting not only the aquatic organisms but also the potential use of the river water especially for crop production (DENR, 1990).

Siltation has positive and negative effects on lowland fields. In ricefields along rivers in many places in Samar, the periodic deposition of fertile silt (at the expense of the uplands) has kept the soil productive despite the long history of rice cultivation. In contrast, siltation in many rice fields in Central Luzon, either through irrigation of river water (from Agno and Bued rivers) or due to flooding during the rainy season, caused decline in the fertility of the soils (Asio, 1987).

The destructive effect of siltation in coastal waters is generally known. A recent study in Siquijor concluded that the bay's mud coming from the uplands, is the major factor preventing the establishment of highly diverse and productive benthic communities such as coral reefs and marine grassbeds. Corals, particularly those in proximity to the mudzone, appeared to be suffering from effects of sediment-related stress (DuBois, 1990).

Upland cultivation contributes also to both air and water pollution. Removal and burning of forests and cultivation of upland areas are believed to be significant sources of carbon dioxide thus, contributing to global warming (Theng, 1991; Mannion, 1991; Lugo and Brown, 1993). The recent report that the Philippines is warming by 1-2°C (DENR, 1990) may be partly attributed to these. As regards water pollution, the significant effect of soil erosion, improper use of agricultural chemicals by farmers, and household wastes are very evident in many parts of the country. Sajise (1991) cited a study which revealed a significant correlation between increasing death rates of men and women and increasing pesticide use in the rice-growing regions of Luzon.

Additional issues and comments

No doubt the effort to improve agricultural production in the last several years in the Philippines has resulted in increased food production. However, this is overshadowed by the negative environmental impact of increased upland cultivation which is generally caused by rapid population growth.

Intensive agriculture which is believed to be the hope for the future (Dudal, 1988; de Haen and Saigal, 1992), will not be enough if not supported by a strong population control program because aside from the fact that productive areas are fast shrinking due to degradation, lands have also production limits. In addition, a considerable part of prime agricultural land is being used for infrastructure such as roads, subdivision, factories and warehouses.

Impressive cropping system models and soil conservation technologies for upland areas have been developed over the years but suffer a very low adoption level by farmers (Fujisaka et al., 1986; Cramb and Saguiguit, 1994). This is partly because of the incompatibility of the introduced technologies and farmers' condition.

There has been an imbalance in the treatment of erosion problems in the country. Much effort has been put on erosion control methods but very little on understanding its nature and extent under the Philippine environment. One consequence of this is the lack of reliable soil erosion data. Some of the important aspects that should be considered in erosion studies are the relationship of soil loss to crop yield or productivity, the site specificity of soil erosion and the contribution of geologic erosion (Dudal, 1986).

Agroforestry appears to have promise in sustainable upland agriculture as has been demonstrated in some areas in the Visayas and Mindanao. However, basic research is still needed because it is not yet clearly determined whether the three main functions of agroforesty (nutrient cycling, soil organic matter maintenance, and protection from erosion and runoff) can be attained in acid soils (Scott et al., 1991) which dominate the country's upland areas.

CONCLUSION

It is clear from the foregoing discussion that population pressure is a major factor behind the increased use of upland areas (forest, grasslands, marginal areas, steep slopes) for agriculture. Because of unsuitability of most of these areas for agriculture, unsuitable farm practices and change in land use, upland cultivation resulted in a multitude of environmental problems. The key, therefore, to solving these problems should be an effective population control program, sound environmental management strategies, and alternative livelihood for the upland farmers, and appropriate technologies that would suit the conditions of the uplands since in most cases farmers cannot be driven out of these areas.

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