

Food Security and Agricultural Sustainability in the New Guinea Highlands: Vulnerable People, Vulnerable Places

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Introduction

For most farmers, pastoralists, hunters and gatherers, gaining a secure food supply and managing the environment in a sustainable way are not seen as conflicting objectives. On the contrary, where local people exploit their own resources to meet immediate, local needs, but bearing in mind also their own future requirements, then they must regard security and sustainability as practically synonymous. These objectives only start to conflict when people lose control over the processes which regulate long-term sustainability, or lose the will to control these processes.

For a while this loss of control may not be threatening, and where there is an increased vulnerability to unfavourable trends and shocks (soil erosion, loss of fuelwood resources, harvest failure, poverty) these symptoms may be interpreted as resulting from other things: climatic change, colonialism, or the market economy. More complete explanations have only emerged from our ability to adopt the wider perspective made possible by history and the environmental sciences. From this perspective we can appreciate the extent to which actions which were supposed to control nature have actually had negative feedback effects upon long-term productivity and hence security.

These effects are perhaps inevitable. Actions designed to achieve food security must relate mainly to short- and medium-term objectives. The food needs of the household usually have to be met from an inherited support system that is enhanced or maintained over the time span of the head of household's working life. The main processes which control such systems of food security tend to be local, short-term and understood by decision makers, being based for example on the growth cycles of annual plants. Such understandings are part of the 'indigenous technical knowledge' (ITK) that development planners have learnt to respect.

In contrast many of the relevant environmental processes are only partially under control, and their workings extend across a huge range of scales in both time and space. Many long-term causes and effects and most downstream, downslope or downwind spinoffs are poorly perceived by those who, at local

scale, are ultimately responsible. Such external and long-term considerations usually do not, and sometimes cannot, enter into decision making. Irreversible soil erosion or the loss of a plant or animal species represents a 'negative externality', a cost that is passed on to others or to future generations without compensation.

These negative externalities are emerging as a policy problem in market economies, and may result in pressure for state interventions such as carbon taxes, etc. In socialist planned economies such problems are avoidable in theory, but in practice the drive for short-term expediency (including food security) can make severe environmental damage a notorious consequence of communism. The example of New Guinea perhaps demonstrates the universality of unintentional negative externalities, and suggests that there is nothing new, and certainly nothing intrinsic to capitalism or communism, in the processes by which vulnerable landscapes and vulnerable social groups are created.

In the Highlands of New Guinea we know that the contradictions between short-term food security and long-term environmental protection have had to be faced for at least 6,000 years of agricultural prehistory. Much of the agricultural technology of the Highlands can be interpreted as an attempt to manage potentially vulnerable resources so that potentially vulnerable populations are not exposed to hazard. The first question to be addressed is how far was this technology successful in achieving 'sustainable development' in the long term, as measured by the conservation of the environment itself?

Conservation in Practice

The food security/environmental sustainability conflict in Papua New Guinea's history has been reviewed in a number of publications [Winslow 1977; Bayliss-Smith and Feachem 1977; Morauta, Pernetta and Heaney 1982; Blaikie and Brookfield 1987]. The evidence shows that the people of this region had more reason than most to manage their subsistence sector in a sustainable way. The purpose was not merely food security but also the supply of other needs, most of which derived from the local environment: fuel, housing, clothing, boats, tools, utensils, ornaments and weapons:

Local resources provided more than the minimum needs for survival. They also supported leisure, pleasure, sociability, artistic creativity, political competition, spiritual contemplation — all the things that made life meaningful and worth living [Bulmer 1982:61].

Despite the wide-ranging significance of environmental resources, and despite the restriction of highlanders to tightly-bounded tribal territories, there is little evidence of actions designed to ensure the long-term sustainability of resources. Like most of the rest of humanity, Papua New Guineans were not much concerned with conservation. Their concern was and is the present and immediately foreseeable yields of crops and catches, and the amount of time, effort and care required to produce them. If these activities were conservationally sound, it was only as an incidental consequence of the need to maximise immediate yields for little labour:

It was good conservational practice for shifting cultivators to let the land lie fallow for 15 or 25 or 40 years — whatever the optimum period to ensure both an undiminished primary forest or rooting out *pitpit* (*Miscanthus* grass). But conservation was not the object of the exercise. The object was to get

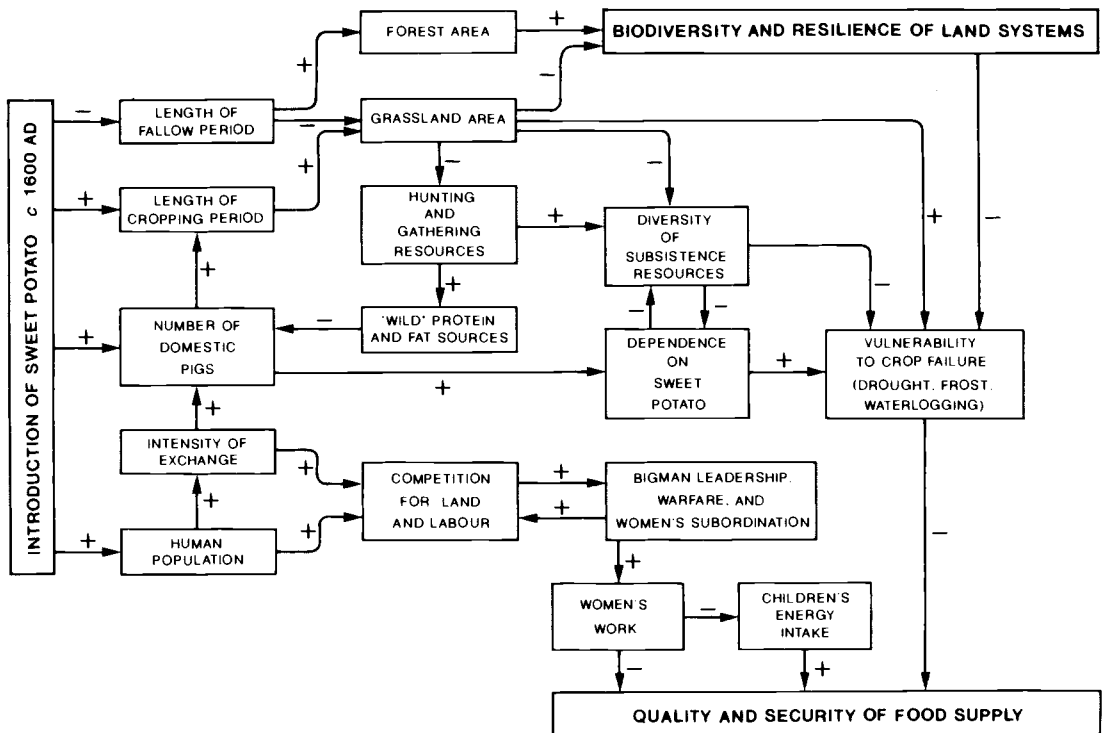
that next good crop for a reasonable minimum of effort. [Bulmer 1982:63].

Similarly the erosion barriers widely noted in Papua New Guinea constructed along the contours of hillside gardens are not primarily aimed at long-term soil conservation, but to stop that year's taro or sweet potato crop from sliding down the hill. Intensive hunting, trapping or fishing for birds, mammals and fish was often concentrated in brief periods of the year. This restraint certainly assisted these species to recover and survive, but such practices were designed to ensure a large and reliable catch the following year rather than to promote sustained yields indefinitely.

Agriculture may have started in New Guinea 9,000 years ago, and has certainly been practiced for the past 6,000 years. It is not surprising that over this period, especially in the malaria-free Highlands, substantial damage has been done to the environment [Golson 1989]. Pleistocene or late Holocene extinctions of animals such as diprodonts, the thylacine, the large highland wallaby, and the giant fruit bat were accelerated if not caused by human pressures [Menzies 1980]. The spread of anthropogenic grasslands and subsequent erosion and vulnerability to drought and frost were already under way 5,000 years ago, and

Figure 1

Effects of the Ipomoean Revolution upon food security and the environment of New Guinea



accelerated with the introduction of the sweet potato (*Ipomoea batatas*) about 400 years ago.

The main consequences of the Ipomoean Revolution, as hypothesised by Golson (1982) and Donaldson (1982), are summarised in Figure 1.

Sweet potato permitted the expansion of cultivation to higher altitudes and on to drier and poorer soils, allowing an explosion of population and a new wealth economy based on pig exchanges, but founded too on the control of women's labour. The consequences were severe for women's welfare and for child nutrition, as women became virtually enslaved in a bigman-dominated society increasingly engaged in intensive agriculture in a deforested and hence degraded landscape [Blaikie and Brookfield 1987]. This revolution had other serious consequences for subsistence:

A loss of variety of edible leaves and fruits accompanies a growing domination of grassland over forest. The variety of garden crops also diminishes, to be replaced by an increasing monotony of sweet potatoes, with a consequent impoverishment of the diet. The diversity of wild birds and other animals decreases, too, as expanding gardens and grasslands destroy forest habitats and as the numbers of human hunters increase. [Clarke 1971:194].

Such pressures on both environment and food supply continue today, accelerated by the industrial technology (steel axes and knives, fishing equipment, shot guns) which has spread through the country in the last 50 years. Modern population growth is a further destabilising influence. The market economy has had more mixed effects, diversifying sources of income and permitting wage labour as an outlet for population pressure. How far has the modern agricultural economy lead to changes in the vulnerability of certain environments and certain social groups threatened by food insecurity?

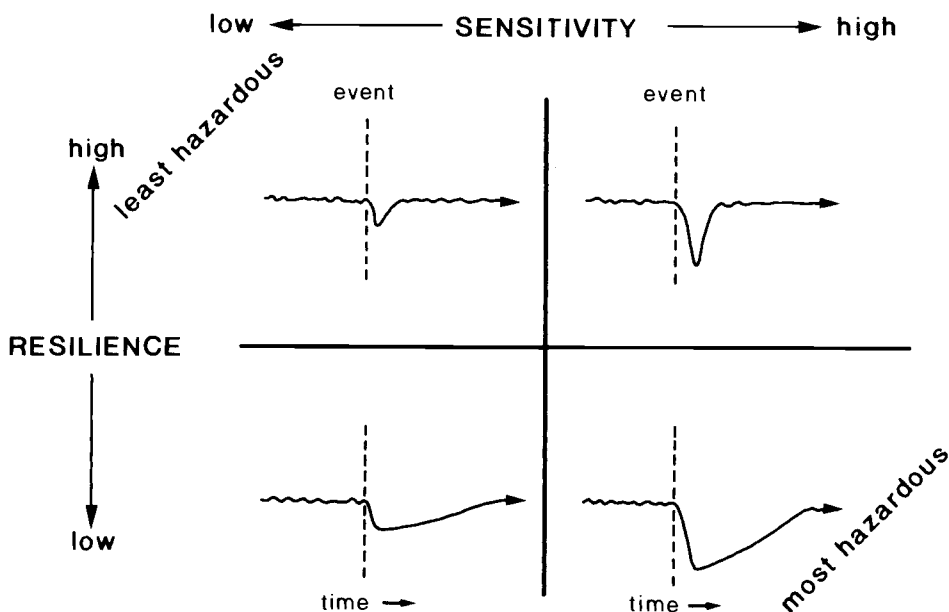
Measuring Vulnerability

There are two different dimensions to vulnerability [Blaikie and Brookfield 1987]. The first can be assessed by the magnitude of a system's response to an external event, or its **sensitivity** (Figure 2). If we are referring to the effects of agricultural exploitation, a sensitive land system is one that is greatly disrupted by an episode of agricultural use, perhaps because cultivation causes a marked fall in productivity or leads to sheetwash or gullying. A sensitive food supply system would be one liable to drastic depletion because of over-dependence on a single staple liable to harvest failure, whereas a diversity of sources of subsistence or income might lead to a low sensitivity to disruption.

Figure 2

Sensitivity and resilience of environments and food supply systems

The vulnerability of environments and food supply systems



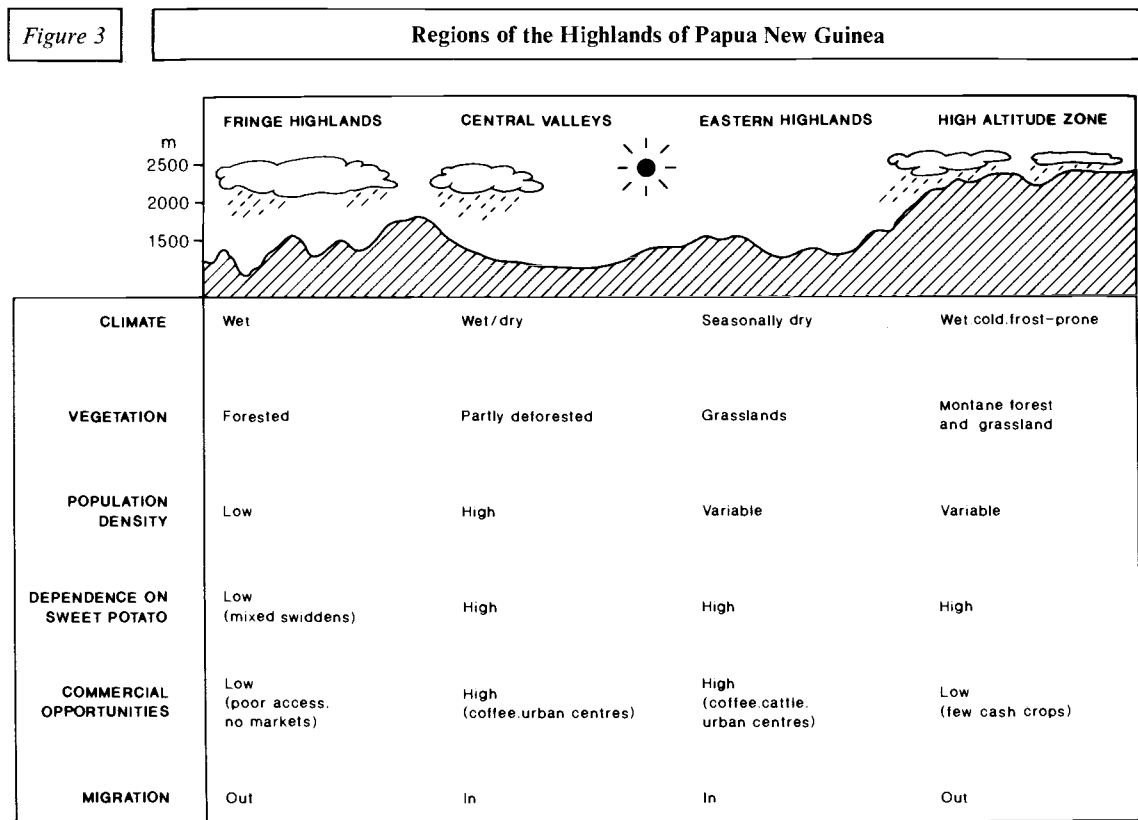
The second dimension of vulnerability is the ease and rapidity of a system's recovery from stress, or its **resilience**. Resilient land systems are those able to bounce back from damage, so that however disruptive a shock is in the short term, it does not in the long term have lasting effects on productivity. High productivity is not necessarily associated with resilience: soils can be infertile but easy to manage because they are resilient. Food supply systems can be described as resilient when they enable people to respond effectively to food shortages by switching quickly from one source of supply to another. This resilient response is made possible by such factors as flexible land tenure systems, diverse land resources, and a successful integration with wider economies.

Guinea (Figure 3). The largest concentrations of population, both people and their domestic pigs, are in the central valleys (Enga, Wahgi, Chimbu) and the drier Eastern Highlands, between 1,500m and 1,900m altitude. Since the introduction of the sweet potato subsistence agriculture and pig husbandry has also extended to plateaux above 2,000m, where climatic conditions are distinctly marginal. Much less effected by the Ipomoean Revolution has been the Fringe Highlands, the steep, wet, forested zone that surrounds the Highlands. Here the much more scattered populations have access to hunting and gathering and low altitude resources like sago, as well as swidden agriculture.

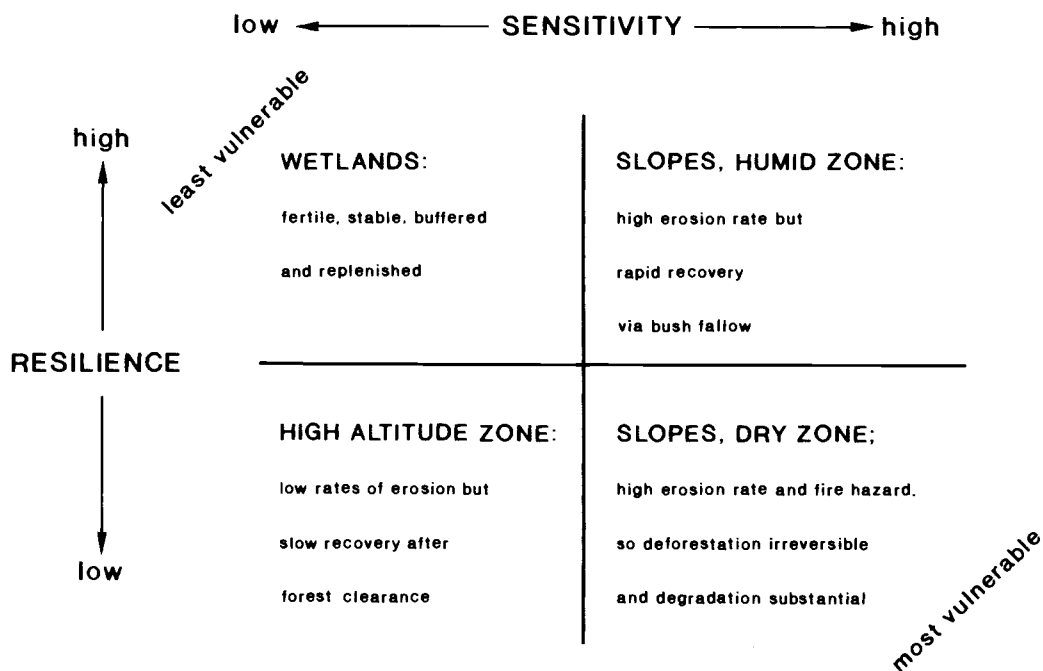
In general the Eastern Highlands (seasonally dry) and the high plateaux (wet and cold) seem to have been the least resilient of these four landscapes in the face of agricultural exploitation (Figure 4). Deforestation in the Eastern Highlands began at an unknown date and led to land degradation which stimulated widespread efforts at terracing, before these dry grasslands acquired new value in the era of the sweet potato [Golson 1989]. Deforestation at high altitude seems to be equally irreversible, but here the process is largely post-Ipomoean. Erosion in this zone is less rapid

Resilience and Sensitivity in the Highlands

Today the New Guinea Highlands is the home of about 1.5 million people, divided between Indonesia and Papua New Guinea. The zone above 1,000m extends 1,100km from west to east and is about 160km wide, and naturally contains great variations in geology, relief, climate and vegetation. Four distinct Highlands regions can be defined for Papua New



New Guinea Highlands: long-term vulnerability of environment



(lower sensitivity), but the ecosystems have low resilience: the ecological succession back to montane forest is so slow that forest clearance effectively marks a permanent change in the landscape [Bayliss-Smith 1985]. In contrast, conditions in the Central Highlands at lower altitude allow there to be a more rapid recovery of soils via a resilient bush fallow. It is the wetlands, however, that provide the least sensitive and most resilient resource base, given high labour inputs. Not surprisingly it is the wetlands that have been a repeated focus of agricultural management during the past 6,000 years [Golson 1977].

Vulnerability of Production Systems

Today, however, the vulnerability of the various production systems centred on these land resources depends as much on their integration with the market as on ecological sensitivity or resilience. Since the 1930s the spread of administration, roads, trade and new crops has greatly diversified the Highlands economy. Coffee is a major cash crop in the mid-altitude zone, and livestock, foodstuffs, fuelwood and

labour are in the process of commoditisation.

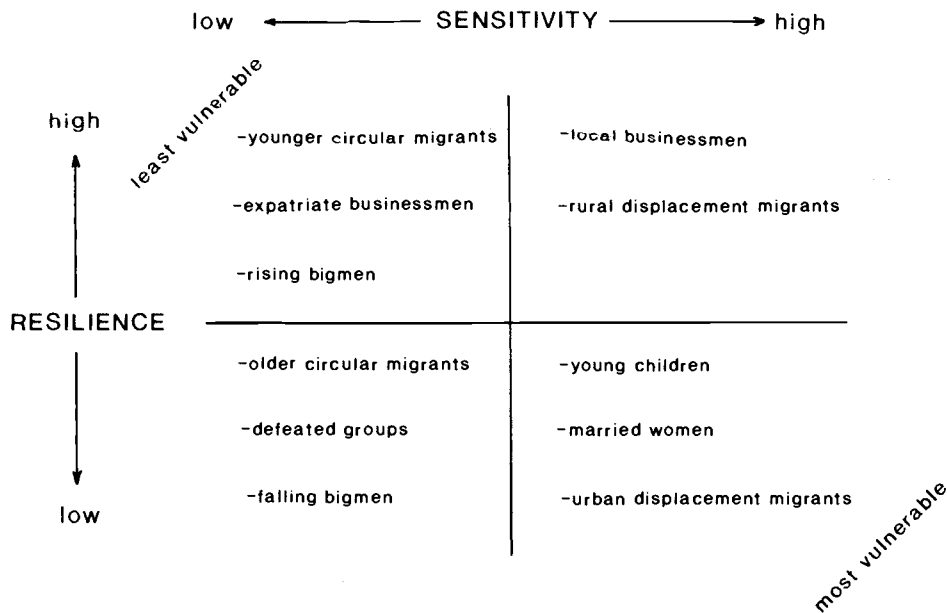
Some indigenous coping mechanisms have been eroded by the modern economy, for example the population movements between high and mid-altitude zones which once allowed the people at high altitude to escape from the effects of frost damage. Otherwise such communities would have been vulnerable to famine after their sweet potato crops had been wiped out [Waddell 1975]. Famine relief measures in 1972 and 1982 may have helped to discourage this response, increasing vulnerability in future should government aid fail to be forthcoming [Allen and Brookfield 1989].

In general, however, the new political economy of the Highlands has facilitated mobility and has also increased the diversity of crops and income sources. In this way it has reduced the sensitivity and enhanced the resilience of systems of food supply [Bourke 1988; Dennett and Connell 1988]. At the same time population growth (up to 2 per cent per annum) and social changes associated with the incipient commoditisation of labour have created some new and vulnerable social groups (Figure 5). Women's work was already heavy in the traditional economy,

Figure 5

The short-term vulnerability of social groups

New Guinea Highlands: vulnerability of social groups to unfavourable shocks and trends



particularly in communities where intense competition for status was based on surplus production of sweet potato and pig husbandry [Donaldson 1982]. This traditional role of women has been little affected by new technology, while cash crops and larger families are added burdens. Young children's diets have been improved by purchased food supplements where they are available, but in ecologically marginal and economically peripheral areas the largely vegetarian, largely sweet potato diet has not seen much improvement. Young children therefore remain an important vulnerable group in nutritional terms, as do urban migrants displaced from village society and so lacking the resilient response that is retained by circular migrants.

Conclusion

In these various ways a new political economy of vulnerability is being created in the Highlands. As some old (but historically quite recent) problems stemming from sweet potato dependence are reduced, so new

problems emerge in disadvantaged regions. With continuing population growth, settlement is spreading to ecologically fragile areas. Even in the most favoured areas there are newly marginalised groups of wage labourers. There is an emerging class of urban landless and there are participants in rural resettlement schemes whose dependence on cash crops may make them vulnerable to market failure. In addition, there are new opportunities for the destruction of forests and animals, as common property resources become commoditised and as a new and far more effective technology becomes available for their exploitation.

In such processes of increasing complexity of economy and society, or at least in their early stages, we see a weakening of the bond between the land manager and his or t. The connection between food security and environment thus becomes more indirect and, probably, less well understood by those in a position to influence it. Experience elsewhere in the world suggests that the weakening of this connection is perhaps the most insidious and threatening effect of 'development', even though so far in the New Guinea Highlands case the effects on food security at least, have generally been positive.

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