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NEGLECTED SPECIES, LIVELIHOODS AND BIODIVERSITY IN DIFFICULT AREAS: HOW SHOULD THE PUBLIC SECTOR RESPOND?

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Recent research on neglected crop and animal species suggests that there exists an important gap between the priorities of development and research agencies and the way small farmers, both in Africa and elsewhere in the world, treat such species. This paper argues that policies to promote neglected species will have positive effects on biodiversity and livelihoods, especially in more difficult areas where conjunctive management of common pool and private resources remains important.

Policy conclusions

- Neglected crops and livestock species are more important in their contribution to biodiversity and the livelihoods of the poor in difficult areas than widely believed hitherto. They merit more public sector attention than they have received.
- Such attention includes the comprehensive characterisation of varieties and species in these areas, such as the types of vegetation consumed by neglected livestock species, the agroecological niches occupied by plant types which are either little known or regarded elsewhere as weeds, and various economic characteristics of plants and livestock, including pest and disease resistance, their nutritional properties, labour requirements, complementarity with other varieties/species, and so on.
- The `niche' features of many such livestock species and plant varieties may mean that public resources cannot be allocated to in-depth research on them. However, it may be possible to promote farmer-to-farmer exchanges of materials and approaches, supporting these through the scientific information available.
- There is considerable potential for reshaping farming systems research towards more convincing descriptions of crop and livestock repertoires, thereby gaining a more accurate appreciation of the economic significance of minor species and their potential in niche markets.
- Characterising minor species with greater clarity also contributes to food security by making possible a more coherent understanding of diet in periods of nutritional stress and thereby informing the responses of agencies dealing

with emergencies.

Introduction

The study of `lost' or `minor' crops and livestock species is fraught with linguistic pitfalls; these species are no more `lost' or `minor' to the people who use them than Victoria Falls were `discovered' from the viewpoint of those who lived next to them. The usual meaning is that they have been neglected by Western-based research or that world production statistics are either not published or indicate low volumes compared to better-known crop or livestock species.

Two recent reviews (NAS [National Academy of Sciences], 1996 and Blench, in press) for crops and livestock respectively, suggest that at least in the case of Africa, there are wide disparities in the quantity and quality of research on many species. Moreover, neither their production economics nor their contribution to smallholder subsistence have usually been criteria for funding research, despite the supposed emphasis on food security or livelihoods. The International Livestock Centre for Africa (ILCA) famously discouraged research on camels, donkeys, pigs, rodents and indigenous avians in Africa, despite its apparent remit for the livestock of the continent. Other NAS publications on neglected Asian livestock and microlivestock suggest a similar pattern elsewhere in the world.

It is becoming increasingly clear that farmers make use of a much wider range of plants and animals than is encompassed in standard lists of crops and livestock and that these may not be domesticated in textbook fashion. Recent research, especially in Australia and the African rainforest, has emphasised that it is not necessary to be a farmer to manage plants; in both regions yams are transplanted and pruned so as to improve both growth characteristics and accessibility. Similarly, pastoralists can manage non-domesticated animals, most notably the reindeer across the circumpolar regions of Eurasia. Adapting research and extension strategies to accommodate this expanded view of farming systems is a process that has hardly begun.

The Pattern of Research

Despite the growth of participatory ideologies during the last decade, there has been very little increased emphasis on species of importance to smallholder farmers. It is ironic to note that much of the detailed descriptive work on such species dates from the colonial era. In the early period, descriptions grew out of Agricultural Officers' field experiences, but as professional agronomy took over, research agendas were increasingly set by the Western scientific system. The pattern of large-scale research tended to draw attention away from crops and animals of no perceived economic value outside their immediate area. The problem has been two-fold: a focus on fewer, better-known crops or species and an emphasis on higher-order issues whose relevance to the problems faced by farmers is not always clear.

Africa represents an elaborate mosaic of crop and livestock species and races produced using non-standard strategies. Weeds or weed hybrids symbiotic with

cereals can be tolerated or even planted. Toxic yams can be cultivated to deter crop thieves. `Minor' livestock, such as the donkey, the land snail or the giant rat, can play a major role in the economic life of ordinary rural householders. They are, however, of no significant interest to major donor agencies and research is often confined to enthusiastic individuals. The first edition of *Useful Plants of West Tropical Africa* (1937) lists many species on the cultivation boundary; for the majority the bibliography has barely been extended. Early volumes of the journal Economic Botany are larded with `promising' tropical crops whose promise has never been realised. Despite encouraging texts on unconventional livestock (e.g. NAS, 1991), the volume of research remains small.

The sceptic's view of this might be that unconventional species are not further developed because they are in fact of limited value, i.e. they do not show the appropriate economic characteristics to expand onto the larger stage of international trade. However, this would be to ignore numerous other factors contributing to their neglect: the difficulties of maintaining research funding, the inaccessibility of the regions where these species are produced, culinary and nutritional conservatism and the powerful interests of large seed and veterinary companies who have actively discouraged biodiversity maintenance because of the higher costs of servicing a more diffuse market.

Domestication, cultivation and taming

The process of domestication can be characterised as adapting the genetic makeup of a species to the needs of human society, a process often deleterious to the survival aptitudes of that species in the wild. Apart from the pig, the major species of domestic animal no longer have wild relatives in Europe and America and modern breeding systems tend to ensure that genetic introgression from such relatives is not a significant factor in variation. This is less true for plants, although where there is introgression from wild forms it is usually intentional. Geneticists use wild forms to breed for specific economic characteristics, rather than to maintain the diversity inherent in the larger gene pool.

Sheep, goats, chickens and pigs arrived in Africa fully domesticated and although local races have developed there is no further genetic interaction with their wild relatives. In contrast, domestication remains a dynamic process for indigenous African fauna, both in terms of interbreeding with wild populations and continuing experimentation with new species. The donkey was almost certainly domesticated in Africa and there is evidence for interbreeding with wild ass populations in historic times. With the probable elimination of the last Somali wild asses this process has come to an end. On the other hand, the guinea-fowl is part of the indigenous avifauna of Africa which has been only partly domesticated. In west-central Africa, guinea-fowl are kept in the compound, grow fat and have little tendency to fly away, but in eastern and southern Africa they are still caught in the wild.

Taming, on the other hand, implies temporarily adapting a wild species to human requirements without altering its genetic makeup. The evolution of a social niche for pets may be a prelude to domestication, although cachet can attach to taming wild animals so that the taming process becomes an end in itself. The iconographic records of Ancient Egypt document a remarkable skill in controlling animals, especially birds.

The Romans in North Africa are shown using trained cheetahs for hunting while hyena-taming is found across Sahelian Muslim Africa, usually as a type of circus act. Taming also implies some selection, as many animal species revert to wild behaviour patterns once adult. Evidence from the ethnographic literature suggests that experimentation continues in sub-Saharan Africa, and there are `new' domesticates, wild-caught animals initially `finished' in captivity such as the giant rat (*Cricetomys*), the grasscutter (*Thryonomys*) and the African Land Snail (*Achatina*) but now being selectively bred in captivity.

A comparable process occurred with many plants which were cultivated before being domesticated. Cultivation is here defined as altering their location or growth habit in some way to make them more useful to human beings. The simplest manner is transplantation. Forest yams are uprooted and replanted near the homestead. Seeds from fruit trees such as *Canarium schweinfurthii* are dropped near the compound and protected from fire. Cereal grains are gathered from the wild and scattered so that they can be more easily collected the following year. Palm trees (such as the dum palm, *Hyphaene thebaica*) are coppiced to harvest the leaves annually. Although these processes are assumed to have been more common in the past, when human population densities were lower, they continue today, as accounts of the `pseudo-cultivation' of *Paspalum scrobiculatum* in Guinea show.

The number of indigenous African plant domesticates is much greater than for animals and in many cases their exact taxonomy remains problematic. Important genera, such as the Dioscoreaceae, from which come the many species of commercial yams, remain in confusion in part because of the continuing interaction with wild species.

Table 1 gives some examples of indigenous Africa plants and animals that have been cultivated or tamed as opposed those truly domesticated.

Table 1. Cultivation versus domestication: some African examples

	Cultivated/Tamed	**Domesticated**
Plants	*Dioscorea praehensilis*, aerial yam (*Dioscorea bulbifera*), Futa Jalon fonio (*Brachiaria deflexa* var. *sativa*), koko vine (*Gnetum bucholzianum*), African olive (*Canarium schweinfurthii*), *Polygala butyracea*	Sorghum, bulrush millet, finger-millet, tef, African rice, cowpeas, Bambara nuts, Guinea yam, Hausa potato (*Solenostemon rotundifolius*), rizga (*Plectranthus esculentus*), oil-palm

Animals	Guinea-fowl, spur-wing goose, giant rat (*Cricetomys*), grasscutter (*Thryonomys*), Land Snail (*Achatina*), marine turtle (*Chelonia mydas*), bees	Cattle, donkeys, pigeons, guinea-fowl
N.B. Where recorded, `English' names are given, but many of these are local and not well-known; the scientific name is therefore also given.		

Species, landraces and breeds

The argument concerning minor species can also be taken to extend to cultivars or breeds of major economic species. Many of the world's major economic cultigens have regions of high genetic diversity, often close to where they were first domesticated. This agrobiodiversity has often been conserved incidentally, simply because smallholders remain on the periphery of high-input agriculture. The diversity of potatoes in the Andes or of cattle-like species in south-east Asia are cases in point. Plant and animal breeders increasingly recognise this and indeed often treat areas of conserved agrobiodiversity as a free genetic resource. The intellectual battle to conserve this diversity is now largely won in the case of major species simply because of the importance of the headline species. This does not mean that the appropriate methods to conserve landraces *in situ* have been developed nor that the resource created by local breeding strategies is justly rewarded. But the conservation of local races can no longer be mapped simply against the larger problem of the conservation of minor species.

Between wild and domestic: a dynamic frontier

Development specialists, research station scientists and anthropologists all have a substantial investment in the distinction between the wild and the domestic. Sets of well-established domesticates permit the research specialisations, projects and diagrams of dichotomies favoured by this type of literature. Plants or animals that are domesticated in some locations and not others, and the management of wild plants or animals make for fuzzy categories and do not lend themselves to well-structured genetics. For this reason, species that cross over between the wild and the farm, such as fonio, *Digitaria exilis*, tend to be neglected. Where well-bred plants form weedy crosses with their wild relatives, such as in the case of West African pearl millets, considerable efforts go into eliminating these rogue plants.

In reality, this dynamic frontier is built into farming and pastoral systems across the world and its fluidity is a response to changing environmental and economic conditions. Table 2 lists some species of plants and animals that illustrate variable domestication according to geography and where the `domestic' types are constantly subject to outcrossing with `wild' relatives.

Table 2. Between the wild and the domestic: some examples

Plants	Tubers:	*Dioscorea bulbifera, D. dumetorum, D. sansibarensis*
	Cereals:	*Brachiaria deflexa, Paspalum scrobiculatum* var. *polystachyum, Oryza glaberrima*
	Sedges: :	*Cyperus esculentus* (tiger-nut)
	Pulses: :	*Macrotyloma geocarpa, Psophocarpus tetragonolobus, Sphenostylis stenocarpa*
	Potherbs: :	*Portulaca oleracea, Bidens pilosa, Amaranthus hybridus*
	Tree-crops: :	Tamarind, oil-palm, *Moringa oleifera*, carob
Animals	Donkey, Bactrian camel, guinea-fowl, ostrich, elephant, Chinese and European geese, reindeer, yak, Bactrian camel, vicuna	

Tolerated Weeds

Weeds have generally had a bad press in professional literature. Harlan and de Wet (1965), who collected statements about weeds, contrast those from professional agronomists (`obnoxious plants known as weeds', `a nuisance') with those of enthusiastic amateurs (`a plant whose virtues have not yet been discovered', `weeds ... condemned without a fair trial'). Weeds typically colonise disturbed habitats and cultivated fields represent a special case of such a habitat. Recent research suggests that many major economic crops have co-evolved with weeds and that those weeds are retained in non-intensive farming systems and harvested for food or other uses. Such weeds have been renamed `companion-crops' or `anecophytes' to reflect this changed status. African farming systems include many such species, especially greenleaved potherbs and these make an important contribution to diet.

It has been argued that some species of animal fill a corresponding niche in relation to human society. Rats, pigeons, sparrows and rabbits (in the Antipodes) have been advanced as candidates in this respect. The analogy is not precise since almost all of these are regarded as pests. However, the European house-rat has only begun to spread in Africa subsequent to European contact and in some regions is encouraged through leaving out scraps so that it will be available as an emergency food reserve.

Does it matter?

It could be argued that, since these various minor species have been thrown off the express-train of history, they did not possess the biological attributes necessary to enter the world economic system. In other words, their limited importance is justified. The history of domestication can be taken to show that species which do not conform to the social and technical niches available in their period are eliminated. Such eco-Darwinism rides roughshod over the actual process of crop domestication. A crop of major world importance such as maize depended on the generations of unknown Meso-American farmers working with the apparently unpromising *teosinte*. From this perspective the failure of such a species to produce returns within a short research cycle would be reason enough for rejecting it.

This makes for self-fulfilling prophesies; since certain crop/livestock species are defined as `minor', statistics on their prevalence are either not collected or of doubtful value. This absence of data then becomes a reason for proscribing further research. Another more banal discouragement may be at work; describing crop repertoires in detail involves long lists of scientific names with no easily remembered English equivalents and no entries in readily available textbooks. Practical development workers can often be heard to dismiss this type of research as a sort of antiquarianism.

Nonetheless, research in Africa has shown that `minor' crops often play a major role in household nutrition. Studies reported in Schippers and Budd (1997) indicated, for example, that in south-west Cameroon indigenous potherbs constitute up to 50% of a household's vegetable intake, and that there is as yet no tendency for them to be replaced by exotic species. A ranking exercise to compare the role of indigenous vegetables in the economy of five African countries identified several of considerable regional importance that are so little-known as to have no common English name.

In a similar vein, although less acknowledged, is the problem that African governments, even those with an explicit poverty-focus, are not willing to promote species seen as `backward' or that seem to project an image that is `not modern'. Recent criticism of a report on donkey utilisation in poor areas of South Africa by ANC officials suggests that not all the values of the preceding government have been summarily dismissed. Similarly, the practice of eating pets and work animals at the end of their useful lives, as is common with dogs and donkeys, is often categorised as repugnant to `modern' values.

Arguements for promoting minor species and races

The strongest argument for promoting minor species is simply that since people continue to use them, this constitutes a recognition of their value sufficient to suggest that research priorities should be re-oriented. However, a more proactive case can be made in terms of both food security and economics.

Minor crops are strongly associated with marginal environments: regions where extreme heat, poor soils and access problems make the large-scale production of world crops and livestock uneconomic. They play a dis-proportionately large role in food security systems; plants that will grow in infertile or eroded soils and livestock that will eat degraded vegetation are often crucial to household nutritional strategies. They usually demand reduced labour inputs and are resistant to disease while also providing nutritional diversity. This is especially important in regions where

increasing dependency on purchased cereal staples such as maize can lead to vitamin-deficiency diseases.

At the same time, minor species are important to the maintenance of agrobiodiversity. Traditional agricultural sys-tems combine homegardens with the sequential combination of annuals and perennials with tree crops. Studies in West Java found more than 230 species of plant within the overall cropping system (Christanty *et al.*, 1986). In addition these systems include livestock, aquaculture and harvestable insects and are found to encourage a greater diversity of bird species than regions of monocropping (for example, paddy rice).

Another more strictly economic argument for greater atten-tion to minor species is that poor people have a comparative advantage in their production. As world production of major crops and livestock becomes more hi-tech, farmgate prices do not keep pace with the price of inputs for smallholders (McNeely, 1995 and references therein). The world system constantly reduces their ability to compete as individuals, although they may be drawn into wage-labour in agro-industrial enterprises. They *can* compete, however, by producing crops and livestock for specialised consumers, both through ethical trading and the exotic products market. This discovery is not limited to the developing world; farmers in Europe and America are increasingly turning to designer foods as the recent spread of ostriches and quinoa demonstrates. Minor species can also help poor farmers spread risk and diversify their output against fluctuations in major cash crops.

Box 1. Wonder crops and magical breeds A contradictory aspect of agricultural development that hardly seems to change is the way rapid waves of enthusiasm develop for wonder crops and magical livestock breeds. The productivity of some tree, crop or animal is seen to give spectacular advantages compared with the indigenous species. Eucalyptus, Gmelina, Leucaena, vetiver grass and exotic livestock breeds have all come and gone, none recording a fraction of the original success hoped for them. That such entities should exist seems contrary to agricultural ecology, which suggests that too dominant a crop (in the sense of promoting monoculture) will excite equally enhanced interest from parasites and diseases. But such enthusiasms are not really technically driven, but rather reflect the internal politics of development agencies, constantly under pressure to come up with solutions by the time of the next annual report. Farmers are usually too sensible to uproot existing crops in favour of some fashionable nostrum, planting only enough to test them and, from a sceptic's viewpoint, to ensure that funds continue to flow from visiting developers. More damage is probably done by encouraging the adoption of exotic livestock breeds. Although initially impressive, individual animals often turn out to have either unacceptably high veterinary costs or to die, sometimes taking the existing flock/herd with them.

Summary

Recent research on the repertoires of both crops and animals suggests that there exists an important gap between the priorities of development and research agencies and the way small farmers, both in Africa and elsewhere in the world, treat such species. The most important aspects of this are:

- Farmers use a wider range of crops and livestock than are usually enumerated in standard texts.
- They regularly experiment with `new' species.
- Crops and livestock leave and enter domestication, a process that should not be conceptualised as one-way.
- Species can remain tamed or cultivated for millennia until domestication becomes appropriate.
- Research focuses almost entirely on species of interest to Western donors and promotes a vision of agriculture that is far less fluid and responsive than the existing smallholder systems.
- Exotic crops and livestock are heavily promoted as having significant production advantages over existing species, but when inadequately adapted, almost always have high long-term costs and may impoverish smallholders.

A consequence of this situation is that very often the main promot ers of neglected species are individual enthusiasts or amateurs and this sometimes acts as a further deterrent to major agencies.

Neglected species are almost always found in `difficult' areas comprising combinations of poor soils, unreliable rainfall, hilly topography and degraded vegetation. High proportions of the poor live in these areas, and neglected species are often the only ones capable of coping with these conditions and thereby contributing to their livelihoods.

There is a sense in which the reduction in diversified systems represents a version of the `tragedy of the commons' writ large. In biodiverse resource management systems communities manage private and common pool resources in an integrated fashion over long periods. High-input single-species systems can produce more from a unit area for a defined market over a shorter time-span and it is often therefore in the interest of individuals to produce them. But in doing so they may weaken joint management systems by withdrawing from them or, even worse, by seeking to privatise parts of the resource.

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