UNCTAD/ICTSD Project on IPRs and Sustainable Development

Small-scale Agriculture and the Nutritional Safeguard under Article 8(1) of the Agreement on Trade-Related Aspects of Intellectual Property Rights

Case Studies from Kenya and Peru

Working Paper

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Explanatory Note

This case study by Robert J.L. Lettington entitled *Small-scale Agriculture and the Nutritional Safeguard under Article 8(1) of the WTO Agreement on Trade-Related Aspects of Intellectual Property Rights: Case Studies from Kenya and Peru* has been prepared in the context of the Project on TRIPS and Development Capacity Building sponsored by the Department of International Development (DFID UK). The Project is being implemented by the secretariat of the United Nations Conference on Trade and Development (UNCTAD) (Project Number INT/OT/1BH) and the International Centre for Trade and Sustainable Development (ICTSD). The broad aim is to improve the understanding of TRIPS-related issues among developing countries and to assist them in building their capacity for ongoing as well as future negotiations on intellectual property rights (IPRs).

The Project produces a series of documents through a participatory process involving trade negotiators, national policy makers, as well as eminent experts in the field, NGOs, international organizations, and institutions in the North and the South dealing with IPRs and development. The published outputs are not intended to be academic exercises, but instruments that, in their final forms, will be the result of a thorough process of consultation. This will be achieved by rapid development of working drafts and circulation of these to experts and to the intended audiences for their comments. These documents include:

- **A Policy Discussion Paper** intended to be a clear, jargon-free synthesis of the main issues to help policy makers, stakeholders and the public in developing and developed countries to understand the varying perspectives surrounding different IPRs, their known or possible impact on sustainable livelihoods and development, and different policy positions over TRIPS. (A preliminary draft of the Paper was issued on 20 Nov. 2001)

- **The Resource Book on TRIPS and Development** conceived as a guide that will provide background and technical information on the main issues under discussion in TRIPS.

- **Case studies** on various IPRs issues to supplement the Resource Book and the Discussion Paper. This will allow concrete evidence to emerge and shed light on the impact and relevance of IPRs in developing countries. Including non-voluntary licensing, these studies cover other issues such as geographical indications (available as of June 2002), technology transfer (forthcoming), nutrition (forthcoming).

In addition, the Project produces background material on Indicators of the Relative Importance of IPRs in Developing Countries (see draft of November 2001) and a Review of Activities being carried out by other organizations and institutions on TRIPS related questions and a Review of Literature (both available in the website). For details on the activities of the Project and available material, see www.iprsonline.org

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List of Acronyms

ASL	above sea level
CBD	United Nations Convention on Biological Diversity
CBO	community based organization
CIP	International Potato Centre
CRS	Catholic Relief Services
FAO	Food and Agriculture Organization of the United Nations
GMO	genetically modified organism
GNP	Gross National Product
IARC	International Agricultural Research Centre
ICIPE	International Centre of Insect Physiology and Ecology
ICJ	International Court of Justice
ICRAF	International Centre for Research in Agroforestry (World Agroforestry Centre)
IFPRI	International Food Policy Research Institute
ILRI	International Livestock Research Institute
INDECOPI	National Institute of Defence of Competition and of the Protection of Intellectual Property (Peru)
INIA	National Agricultural Research Institute (Peru)
IPC	Intellectual Property Committee (US)
IPM	integrated pest management
IPRs	intellectual property rights
KARI	Kenya Agricultural Research Institute
KEPHIS	Kenya Plant Health Inspectorate Service
NARS	national agricultural research systems
NGO	non-governmental organisation
PBRs	plant breeders' rights
PVP	plant variety protection
SME	small- to medium-sized enterprise
TPS	true potato seed
TRIPs	WTO Agreement on Trade Related Aspects of Intellectual Property Rights
UPOV	Union for the Protection of New Varieties of Plants
USAID	United States Agency for International Development
WFP	World Food Programme
WTO	World Trade Organization

1. Executive Summary

The study is based on fieldwork by the author conducted in Kitui, Kenya, and Cusco, Peru, in 2002. It focuses on the relationship between smallholder agricultural systems in the two regions and intellectual property rights.

The study begins by examining the legal nature of Article 8(1) of TRIPs. It concludes that 8(1) provides a sound legal basis for national policy and legislative safeguard initiatives. This conclusion is supported by the international norms established by the Vienna Convention on the Law of Treaties and by other standard legal practices. The meaning and implications of the term 'nutrition' in Article 8(1) are then examined. Nutrition is a term whose definition has evolved over a period of years in various international forums, primarily those of the Food and Agriculture Organization of the United Nations (FAO). Its scope is extremely broad, including sanitation, health care and socio-economic factors as well as agriculture. This study focuses on smallholder agriculture for several reasons:

- agriculture plays the principal role in nutrition, it provides food
- approximately 75% of the world's undernourished are smallholder farmers
- smallholder agriculture is of fundamental importance to the majority of the world's developing economies

A large part of the districts of Kitui and Cusco are considered to be marginal in agricultural terms. This is considered to be representative of the general situation of smallholder farmers. The majority of the agricultural lands in Kenya and Peru fall in this category and smallholder farmers are largely restricted to the least productive areas in many developing countries.

Several key elements of the smallholder agricultural system are then examined:

- Seed. Farmers in Kitui make limited use of formal sector (commercially or institutionally developed) seed, which consists of imported hybrids in the case of the private sector and nationally developed composites and hybrids in the case of the public sector. No evidence was found of efforts to introduce new varieties specific to the conditions in Kitui. Farmers in Cusco make almost no use of formal sector seed, for any crop, as it is not perceived to provide any comparative advantage. There is no on the ground evidence of any significant private sector presence, or interest, in the region. In both Kitui and Cusco the informal (farmer developed) seed sector dominates the agricultural system. NGOs and the public sector, in the case of Kitui the FAO-Government of Kenya Farmer Field Schools project, are making valuable efforts to support this system but there is minimal funding for any research into seed to support these initiatives.

- Pesticides. Farmers in Kitui make limited use of commercial pesticides in food storage and vegetable production. There is a limited range of commercial pesticides available and there are serious problems regarding their effectiveness. There is some interest on the part of farmers in alternative approaches to pest management but no evidence of current initiatives to support this was found. Farmers in Cusco make virtually no use of commercial pesticides for any crop. However, they have developed a sophisticated system of pest management based on informally developed pesticides and a range of other practices commonly found in more formal integrated pest management (IPM) strategies. No evidence of significant formal research and development support for pest management solutions was found. The Peruvian public sector has made efforts in this area but has not had major impact.
- Fertiliser. Commercial fertiliser use is minimal to non-existent in both Kitui and Cusco. Farmers, with the support of the public sector and NGOs, are making efforts to develop composite manure fertilisers and other solutions.
- Livestock. This study did not focus on livestock, but this should not be considered as suggesting they are not critical elements of smallholder agricultural systems. The cost and availability of appropriate formal veterinary medicines is a problem. Ethno-veterinary medicines are widespread and largely effective. No evidence was found of formal research into ethno-veterinary medicines in Kitui or Cusco and there is concern over issues of the protection of traditional knowledge where they are examined. While not a current concern, the diversity of the genepool of cattle may be an issue for the future. The quality of forage crops has a fundamental impact on the productivity of cattle. The situation with forage crops is the same as that with seed. In Kitui forage crops fit the situation of minor food crops, there is no significant use of formally improved forage crops.
- Agricultural Research. The private sector, for market reasons, has little or no interest in developing products for smallholder farmers. Intellectual property rights, by focusing on an ability to capture benefits through monopolies, exacerbate this trend. The public sector traditionally focuses on the needs of smallholder farmers but its effectiveness is threatened by intellectual property rights in two ways: (i) private sector intellectual property rights may limit public sector access to innovations and germplasm that may be adaptable to smallholder needs and conditions while also limiting public sector research options due to concerns over the unhindered distribution of the products of its research, and (ii) failure of intellectual property systems to preserve the integrity of the public domain, and the consequent development of IPR strategies in public institutions, risks distorting research priorities to the detriment of smallholder farmers.

The evidence found in this study points to the fact that intellectual property rights have failed to create any significant benefit for smallholder farmers. It also suggests that they are contributing to a widening of the gap between commercial scale agriculture and smallholder farmers, thus further marginalising them. Finally there is a risk that as the use of IPRs spreads in developing countries its increased enforcement may threaten many key elements of the informal agricultural system, in particular as regards seed. This situation threatens developing country nutritional security on two levels. At the local level smallholder farming households are threatened by the undermining of their subsistence livelihoods while, at the national level, food systems are threatened by a collapse in the contribution of the smallholder sector. In policy terms, the impacts of intellectual property rights on nutritional security have the potential to affect the majority of the population in many developing countries and thus should be examined as a matter of urgency.

It is recognised that a number of initiatives could be undertaken to ameliorate this situation in the context of national cross-sectoral policy and legislative reviews. However, the recognition of three basic principles at the international level is suggested as a supportive framework for such national initiatives:

- The activities of smallholder farmers, in particular the saving, use, exchange and sale of farm-saved seed, should be explicitly stated as not subject to the rights of intellectual property rights holders.
- In accordance with the purpose and objectives of TRIPs, effort should be made to develop effective incentives for research targeted at smallholder farmers. This should include the possibility of intellectual property rights creating ‘space’ for alternative incentives. Measures to preserve the integrity of the public domain could be considered in this context.
- Limited exceptions to intellectual property rights should be permitted to promote the adaptation of protected products to the needs of smallholder farmers. These should apply to both research and development and to manufacturing and distribution.

2. Background: Interpreting Article 8(1)

Article 8 of the Uruguay Round Agreement on Trade-Related Aspects of Intellectual Property Rights (TRIPs) is the central safeguard provision in the Agreement. The Article consists of two paragraphs: Article 8(2) relates to anti-competitive practices while Article 8(1), the subject of this paper, addresses national interest safeguards. Article 8(1) states:

> *Members may, in formulating or amending their laws and regulations, adopt measures necessary to protect public health and nutrition, and to promote the public interest in sectors of vital importance to their socio-economic and technological development, provided that such measures are consistent with the provisions of this Agreement.*

The principle of Article 8(1) is that states may need some flexibility in implementing international obligations when faced with overriding national interests. Similar provisions can be found in many international agreements. The text tends to vary depending on the nature of the particular agreement but the principle remains constant. The unique feature of Article 8(1), and the source of much recent controversy, is its final phrase, '*provided that such measures are consistent with the provisions of this Agreement*'. The controversy centres on the meaning of this phrase, and arguably on whether Article 8(1) is truly a safeguard provision at all, or simply a statement that the negotiating governments believed that the agreement was supportive of the national interests referred to.

The primary legal reference, when difficulties such as the ambiguity of Article 8(1) arise with the implementation of treaties, is the United Nations Convention on the Law of Treaties, the Vienna Convention. The Vienna Convention entered into force in 1980 and, due to the fact that it was drafted and negotiated by the pre-eminent international lawyers of the day and its widespread acceptance today, commands an influence in international law beyond the states that have ratified it[1].

Several provisions of the Vienna Convention potentially shed light upon the interpretation of Article 8(1). The first of these is Article 31(1) on the *General rule of interpretation*, which states:

> *A treaty shall be interpreted in good faith in accordance with the ordinary meaning to be given to the terms of the treaty in their context and in the light of its object and purpose.*

This first element leads one back to the question of what is the ordinary meaning of *consistent with the provisions of this Agreement*, consistent with all the detailed provisions or consistent with the agreement taken as a whole? However, when one considers that interpretation of a treaty should be *in the light of its object and*

purpose things do become somewhat clearer. The objective of TRIPs is easily identified due to the presence of Article 7, *Objectives*:

> *The protection and enforcement of intellectual property rights should contribute to the promotion of technological innovation and to the transfer and dissemination of technology, to the mutual advantage of producers and users of technological knowledge and in a manner conducive to social and economic welfare, and to a balance of rights and obligations.*

Considering the object of TRIPs, Article 8(1) can thus be interpreted as meaning that safeguards can be applied to the Agreement's provisions when its objectives (technological innovation, transfer and dissemination of technology, mutual advantage of producers and consumers, a conducive framework for social and economic welfare and a balance of rights and obligations) are not being met.

Article 31(1) of the Vienna Convention also requires consideration of the purpose of an agreement. In TRIPs this can be found in the opening paragraph of the preamble, which speaks of promoting the *effective and adequate protection of intellectual property rights*. *Effective* and *adequate* may be somewhat subjective terms but what is not in doubt is the fact that neither of them implies absolute protection, and thus the purpose of TRIPs does not rule out the use of safeguards as regards its provisions. Given that intellectual property rights (IPRs) theory is based on a balance of interests and rights *effective* may even be interpreted to positively encourage the use of safeguards where critical conflicts with national interests arise.

In Article 31(3) the Vienna Convention requires that *any relevant rules of international law applicable in the relations between the parties* be taken into account when interpreting a treaty. It is possible that several of the sources of international law identified in the Statute of the ICJ could be of relevance here. In Article 38(1)(b) and (c) the Statute allows for the application of *international custom* and *the general principles of law recognized by civilized nations*. There are numerous historical examples of states varying from the precise terms of their international obligations when they believe key national interests to be threatened. It could thus be argued that, where such circumstances are legitimate, the right to address them has become an accepted international custom, or a general principle of law. If such an interpretation were to be accepted, Article 53 of the Vienna Convention, *jus cogens* or the principle of conflicts between treaties and peremptory norms, may support the interpretation of Article 8(1) as a genuine safeguard provision. Article 53 clearly establishes the supremacy of *accepted and recognized* norms over treaty provisions.

The final potentially relevant provision of the Vienna Convention is Article 32, s*upplementary means of interpretation*, which establishes

that if *interpretation according to article 31* (i.e., the discussion above) *... leaves the meaning ambiguous or obscure; or... leads to a result which is manifestly absurd or unreasonable* then one may turn to outside sources of information, such as the preparatory work for a treaty or the circumstances of its conclusion, to assist in interpretation according to Article 31. In the case of TRIPs the key relevant information here would be the understanding of the key states that originally negotiated the agreement. Given the nature of the of the Green Room negotiations for TRIPs[2] this would principally involve the views of the Quad countries[3] plus India and Brazil. Given the central role of the US industry lobby in the development of TRIPs the intentions of the Intellectual Property Committee (IPC)[4] could also be considered as informative of the position of the Quad countries. What countries understood they were agreeing to would be the main question if an analysis of such supplementary information were considered necessary[5]. Given the likelihood of incompatible views on the background of Article 8(1) any attempt at clarifying interpretation under Article 32 of the Vienna Convention would probably be a circular exercise, as one would come back to the question of what is the normal understanding of the language in Article 8(1). In such an instance the final source of international law established in the Statute of the ICJ, that where the parties to a dispute agree decisions may be made *ex aequo et bono*[6] (according to what is just and good, or to equity and conscience), might be the only solution. According to Article IX, *Decision-making*, of the Uruguay Round Agreement Establishing the World Trade Organization (1994) such a decision regarding a WTO agreement is exclusively within the competence of the Ministerial Conference and the General Council, a three fourths vote being required for adoption. Of course, this would not preclude a state from requesting an advisory opinion from the ICJ on the basis of its mandate to give decisions on *treaties and conventions in force*[7].

The final, and possibly most persuasive, legal argument regarding the interpretation of Article 8(1) is to be found within TRIPs itself. In Article 1, *Nature and Scope of Obligations*, is the language:

> *Members may, but shall not be obliged to, implement in their law more extensive protection than is required by this Agreement, provided that such protection does not contravene the provisions of this Agreement.*

The key point is, as with article 8(1), the final clause, *provided that such protection does not contravene the provisions of this Agreement*. An almost universal understanding in law is that where the same concept is intended more than once in the same document the same language should be used on each occasion. An understanding that is reflected in the concept of plain language used by the WTO, thus if it says something different it must mean something different. This raises the question of what is the practical difference between *not contravene*

and *consistent with*? According to the Oxford English Dictionary, frequently relied upon by WTO dispute panels, to 'contravene' is to 'go against' in the context of a law or custom, while to be 'consistent' is to be in 'agreement with'. Although the negative tone of 'contravening' or 'going against' something would seem to suggest a more restrictive nature, these definitions still leave one asking the question of what the practical difference might be. In plain terms the fact that no provision may be contravened, would suggest that to *not contravene* means that each provision must be observed to the letter. In such a context, *consistent with* most logically means that the general spirit of the provisions taken as a whole, i.e., the Agreement, should be upheld where safeguard exceptions are invoked but that variations on the precise details are permitted. This interpretation may seem self-serving for the purposes of discussion here but for the fact that it is clearly supported by two objective facts. The first is the principle, stated in Article 31(1) of the Vienna Convention; that any interpretation of a treaty must be made in the light of its object and purpose. As previously mentioned this would suggest that the safeguards embodied in Article 8(1) of TRIPs are tied to the meeting of the objectives iterated in Article 7. Secondly, it is a common law principle that an interpretation that gives an effective meaning to a term is to be preferred to an interpretation that is of no effect. This is significant both because of the status of common law principles as one of the sources of international law and, most importantly, because the primary drafters of TRIPs came from a common law background. If Article 8(1) is interpreted as a provision that does not allow the contravention of any provision in TRIPs then it is of no effect. Within that restriction parties have an automatic right to implement the provisions any way they like; why does special mention of public health, nutrition or key economic sectors need to be made? The more suspect, and significantly weaker in legal terms, argument would thus seem to be that the negotiation and inclusion of Article 8(1) was intended to be redundant. The only logical interpretation, whether legally or politically, of Article 8(1) is that it is a genuine safeguard provision that is restricted by the fact that any safeguard deviation from the detail of a provision of TRIPs should be consistent with the object and purpose of the Agreement.

3. Introduction: The Meaning of Nutrition in Article 8(1)

Having established that Article 8(1) of TRIPs can legally be considered an operative safeguard clause discussion moves to the meaning of the specific term relevant to this paper: nutrition. In particular, examination of the relationship between the concept of nutrition in TRIPs and that of food security, used widely in other forums and by many commentators, is a key question.

3.2 The Development of the Definition of Food Security

In 1996 the decisions of the World Food Summit defined food security in the following terms:

> *Food security exists when all people, at all times, have physical and economic access to sufficient, safe and nutritious food to meet their dietary needs and food preferences for an active and healthy life*.[8]

This definition was the result of an evolutionary process that developed at an intergovernmental level for some ten years prior to the adoption of the World Food Summit definition. This process began with FAO's Committee on World Food Security defining its objective as ensuring *that all people at all times have both the physical and economic access to the basic food they need*[9]. This view of food security was recognised as implying certain fundamental conditions, namely: adequacy of food supply or availability, stability of supply and access to food at the household level, particularly by the poor[10]. A clear common feature of these conditions is their quantitative nature, if enough food is consistently available to those who need it then there is no problem of food security.

In 1992 The International Conference on Nutrition amended the Committee on World Food Security's *de facto* definition of food security adding, *safe and nutritious food to maintain a healthy and active life*. This introduced a qualitative aspect to the definition; it is not simply the availability of food but also the nature of the food available that counts. At this point the distinction between food security and nutrition is clear. Food security, the basic availability of food, is a prerequisite for nutrition, the quality of available food, but not *vice versa*.

3.3 Food Security vs. Nutrition in the Context of TRIPs

The 1992 and 1996 definitions of food security, mentioned above, clearly represent the merging of two related, but discrete, concepts, food security and nutrition, under the name of food security. Given that TRIPs mentions nutrition, and nowhere makes a reference to food security, some analysis of whether the distinction is meaningful in the

context of the Agreement is warranted.
As previously mentioned, the traditional view of food security was relatively straightforward in that it addressed the need for the consistent availability of food. In contrast to this the concept of nutrition has always been more complex. The main reason for this complexity is that while nutrition requires the availability of sufficient quantities of food it also has been seen to imply a number of other conditions. The most obvious of these is that the available food be of a minimum quality. However, it has also been widely acknowledged that health, sanitation and care for the vulnerable are inextricably linked to nutrition[11]. This is quite apart from the fact that both the traditional concepts of food security and nutrition have also been linked to issues of poverty and underdevelopment.

Traditionally, food security has been an element of nutrition but the merging of the concepts, leading ultimately to the definition adopted by the World Food Summit, turns this around and makes nutrition an element of food security. In the context of TRIPs this theoretically means that whether one sees nutrition as distinct from food security or not should not matter as whether one adopts the traditional or more recent definitions of the terms TRIPs clearly implies a broader interpretation than simply the question of the consistent availability of sufficient quantities of food.

The nature of the term 'nutrition' thus provides a broad range of options in a number of technical areas to policy makers facing difficulties at the national level. This study focuses on the significance of agriculture to nutrition, and seeks to provide field level information as a basis for informed policy making. There are a number of reasons for focusing on agriculture, and in particular smallholder agriculture.

The first is that agriculture plays the principal role in nutrition[12], i.e. it provides food. The contribution of smallholder agriculture to national food needs is significant in both Africa and Latin America. Smallholder farmers produce fifty one percent of Latin America's maize, seventy seven percent of its beans and sixty one percent of its potatoes while in Africa they produce the majority of grains and legumes and almost all root, tuber and plantain crops[13]. While smallholder farmers make such enormous contributions to national food supplies they themselves live with precarious nutritional security. Of the approximately 800 million people estimated by FAO to be living with chronic undernutrition in developing countries some three-quarters live in rural areas. The majority of the remaining two hundred million non-rural under-nourished are members of smallholder households who have migrated to urban slums. As Mazoyer has pointed out, this means that *a majority of the* [world's] *undernourished population are small farmers, and the extreme poverty and undernutrition of most of the others essentially results from the poverty and undernutrition of the small farming sector*.[14]

The second reason for focusing on smallholder agriculture is that in the majority of developing countries, including Kenya and Peru, agriculture is one of the most important economic activities, particularly at the household level. In developed countries agriculture generally involves less than 5% of the population and contributes a similar proportion to GNP. In contrast the smallholder farming sector in developing countries has been estimated to involve some four hundred and fifty million active persons directly supporting a total population of approximately one and one quarter billion[15]. In Peru this translates into some 50-60% of the population depending on smallholder agriculture for their livelihood while in Kenya the figure is closer to 70-80%. In addition to the millions who depend directly on smallholder agriculture one should bear in mind that there are thousands of artisans and traders who supply these communities and thus indirectly depend on smallholder agriculture for their livelihoods[16]. It is clear that, in developing countries, agriculture plays a critical role, not only in directly providing food but also in terms of income and employment, factors that play a significant supporting role in determining nutritional security.

An additional reason for focusing on smallholder agriculture as a sector is that previous efforts have tended to concentrate on discrete components of the sector. Substantial work has been done on the role of intellectual property[17] in seed development and distribution but the complexity of this issue has meant that it has generally been studied in isolation. This study seeks to build upon existing work and consider it in relation to the wider picture of agriculture in developing countries. Finally there is the simple fact that agriculture is a field of enormous complexity. To try to consider aspects of nutrition such as health care, sanitation or care for the vulnerable, along with agriculture, in sufficient depth in one study would be a daunting, if not impossible, task.

4. Field Background: Kitui and Cusco

Both regions visited for this study have been identified as consisting predominantly of land that falls into the categories of marginally to not suitable for major staples, such as maize and beans[18], when considering low input agriculture. Given that 81.06% of Kenyan and 94.39% of Peruvian territory[19] falls into these categories the areas considered are taken as reasonably representative of the situation of smallholder farmers in those countries. The idea of these regions being indicative of wider patterns is further supported by the fact that the majority of smallholder farmers tend to be concentrated in areas of marginal agricultural value due to historically weak economic and political power[20]. Both regions do also include small pockets of land that for climatic and soil fertility reasons reach the categories of moderate to very suitable but these do not comprise more than a small percentage of the total. While a multiplicity of factors influence the suitability of a region for agriculture each of the regions considered here is dominated by one principle factor. In Kitui this is rainfall while in Cusco it is altitude.

4.1 Kitui

The Kenya Forestry Research Institute station in Kitui recorded an average of 685.16mm of rainfall per year over the period 1989 to 1999. If the El Nino floods of 1998 are factored out this average drops to 605.84mm. When one also considers that rainfall during this ten-year period fluctuated from a low of 311mm to a high of 1399mm, with some two thirds or more of this falling in the two rainy seasons, totalling some 90-120 days, one can easily see the challenges facing small farmers in the region. FAO has defined drylands on the basis of the length of the growing season in a region. 75-119 growing days is taken as indicative of a semi-arid dryland. An erratic and highly inconsistent rainfall level totalling up to 600mm annually is considered further evidence[21]. While the rainfall levels in Kitui are marginally higher than those considered indicative of a semi-arid dryland region its overall characteristics clearly place it in this category.

Table 1: Kitui District, Total Annual Rainfall 1989-1999[22]

Year (Oct-Sept)	Total Rainfall[23] (mm)
1989-90	1151
1990-91	834
1991-92	485.8
1992-93	670.3
1993-94	485.5
1994-95	597
1995-96	409.5
1996-97	508.5
1997-98 (El Nino floods)	1399

1998-99	311
1989-99 Average	685.16mm

For this study farmers were interviewed at three locations in Kenya. The first was approximately 1.5km from Kitui town and was generally characterised by some limited seasonal access to water and relatively[24] well-educated and economically secure households. The second location was approximately 8km from Kitui town and displayed similar characteristics to the first. The third location was a separate town, Kabati, approximately 25km from Kitui town. Kabati is significantly dryer than the areas nearer to Kitui town and farmers there are generally correspondingly poorer. Education levels are lower, largely limiting options for alternative income generation to casual labour, and both household economic and food security are serious problems. All farmers interviewed were the primary decision-makers in agricultural activities. Of the thirty-four farmers interviewed twenty-four were female and ages[25] ranged from twenty to eighty. Interviewees were selected randomly and no attempt was made to select on the basis of gender, age, educational level, wealth or any other criterion.

The average landholding among farmers interviewed for this study in Kitui was 1.68 hectares with the vast majority of landholdings falling close to this size and only a handful being significantly larger or smaller. In all cases, except one, this land was freehold. The exception was one farmer who rented a significant proportion of the land farmed. Of the average total landholding an average of 1.2 hectares was devoted to agricultural production with the balance consisting mainly of areas used for housing, recreation and storage but also sometimes including areas with tree cover or small streams. In isolated cases some land was also devoted to livestock. These 1.2-hectare farms directly supported an average of 5.7 persons amongst the farmers interviewed. The 5.7 people usually consisted of immediate family but in a few cases also included one or two domestic staff. 92.31% farmers stated that they had some form of additional income apart from their agricultural activities. This income varied from casual labour to government pensions, money lending, formally employed spouses and a range of similar enterprises.

Given this picture it is unsurprising that the district of Kitui is well known for persistent drought and crop failure and an associated dependence on relief aid. The Government of Kenya classifies Kitui as a food deficit district and the high level of non-agricultural, supplemental, income reflects this, as does the prevalence of food aid. Historically, the dominant ethnic group in the Kitui region, the Wakamba (the 'Kamba people'), are believed to have been pastoralists that settled in Kitui sometime in the eighteenth century. In modern times they are almost exclusively sedentary farmers with a reputation as skilled craftsmen[26]. The Wakamba make up some 10 to 12% of

Kenyans according to the most recent census. The farming practices that have developed in Kitui in the last half-century involve intensive cropping with a relatively low use of inputs and low level of retention of crop residues that has led to an ongoing decline in soil productivity, in what are already poor quality soils, and poor conservation of water[27].

However, a concerted effort has been made by the Ministry of Agriculture, in cooperation with the Food and Agriculture Organisation of the United Nations, to improve the availability and quality of extension support to small farmers in Kenya through the means of 'farmer field schools'. In Kitui District the programme had been running for slightly more than one year at the time research was undertaken for this study. There are two primary ways in which the farmer field schools are of relevance to this study. The first is that their focus on practical, non-capital intensive, solutions to problems such as soil erosion, water conservation and productivity is already providing tangible results. The best indicator of this success is the relatively low drop out rate of farmers involved with the schools and the fact that groups were clearly taking ownership of the schools, both in terms of taking financial responsibility for their continuity and in terms of agenda setting for proposed future activities. The second area of relevance to this study is the proportion of farmers interviewed that participated in farmer field schools. All farmers interviewed had had some involvement with a farmer field school. It should be noted that this may imply that the sample is above average in terms of capacity and interest in innovation. An attempt was made to interview farmers not involved in a farmer field school but this proved impossible within the time available.

4.2 Cusco

In the Department of Cusco interviews were conducted in two primary locations, Lares and Pisaq. These two towns lie on the eastern and western slopes of the Eastern Range of the Andes Mountains respectively. Lares sits in a valley at approximately 3000 metres asl., while the village used as the focus of research in Pisaq, Cuyo Grande, is at approximately 3500 metres asl. In both cases interviewees came not only from the central town or village but also from surrounding communities. In Cuyo Grande these included representatives from the communities of Cuyo Chico, Viacha, Amaru, Paru-Paru, Sacaca, Chawuaytire and Pampallaqta, which collectively make up the Pisaq Potato Park. These communities lie at varying altitudes between 3300 and 4200 metres asl. Water is not an overriding problem in much of Cusco with its relatively consistent supplies of freshwater. However, low levels of precipitation and limited capacity to harness running water for irrigation can prove problematic. The altitude of the communities visited for this study is the defining characteristic of the region. The restriction of the length of the growing season by low

temperature is the most obvious element of this. However, soil erosion and limited access to fields, due to often extreme slopes, are also significant restrictive factors.

The farmers interviewed in Cusco were predominantly from the Kechua ethnic group. Indigenous Andean Peruvians constitute approximately forty per cent of the national population and, except for those that have migrated to urban centres, are almost exclusively smallholder farmers. The indigenous communities of Peru tend to live in relatively isolated cultural pockets that function largely independent of the national and global economies. Communities are organized in 'Ayllus', or traditional communities, that continue to identify strongly with their pre-Hispanic cultural traditions and languages[28].

Education levels amongst those interviewed in Cusco are moderate compared to Kitui, with less than twenty per cent having more than primary education and forty percent being illiterate. However, education rarely translates into economic opportunity, largely due to the remoteness of the location. Non-agricultural activity primarily consists of the manufacture and sale of cultural artefacts, particularly elaborate textiles, targeting the significant tourist market in the region. A limited number of farmers are also involved in other commercial activities, particularly local trading in consumer goods, while a few also occasionally provide a source of casual labour for nearby mines. 67.73% of farmers reported that they had some form of non-agricultural income, with proportions being comparable in both regions. Despite this non-agricultural income 19% of poor, and 27% of extremely poor, Peruvians are Andean indigenous people. Some 90% of Kechua are considered to be 'extremely poor'[29]. As in Kenya all farmers interviewed were the primary decision-makers in agricultural activities. The gender balance of interviewees in Peru was closer to equal representation than that in Kenya. When observing community discussions on agricultural issues the author's impression was that in this study women are under represented in relation to their significance in agricultural decision-making. Also as in Kenya, interviewees were selected randomly.

The average landholding among farmers interviewed for this study in Cusco was 3.12 hectares. The average total landholding varied considerably between Lares and Pisaq with the latter being approximately double the former. The data from Pisaq thus accounts for the significantly larger landholding found in Peru compared to that found in Kenya. However, the fact that the average proportion of total land devoted to agricultural production was almost identical in Pisaq and Lares[30] suggests that one, or more, factors are creating the disparities in total landholdings. The most likely of these is that there is simply more land per capita available in Pisaq than in Lares. The second is that there may be a higher proportion of relatively marginal or non-suitable land in the Pisaq district. Given the similar

topographies of the two districts this seems unlikely. A third possibility is that there is a natural limitation to the area that can be farmed by a family using non-mechanised, low input, agricultural practices[31]. All these possibilities are presented speculatively as it is beyond the scope of this study to research the factors influencing land distribution.

Table 2: Kitui and Cusco, Basic Socio-economic Indicators

	Kitui	Peru
Total Land	3.69acres (1.68 hect)	3.12 hect.[32]
Land Farmed	2.65 acres (1.2 hect)	1.03 hect.[33]
Other Income	92.31% Yes. 7.69% No.	67.73% Yes. 32.27% No.[34]
No. Supported	5.7	5.74[35]

In both Pisaq and Lares, as in Kitui, a proportion of total landholdings were devoted to areas for housing, recreation, storage and similar activities with further areas being taken up by tree cover, streams and other geographical features. However, unlike Kitui, Lares and Pisaq, and in particular Pisaq, have areas of land devoted to communal purposes, the most physically obvious being village botanical gardens. The local land tenure system is predominantly communal, deriving from the traditional *Ayllu* system of collective land stewardship, and thus provides greater flexibility for such cooperative initiatives. Of the farmers interviewed for this study only four held land privately while the rest all held land allotted to them communally. These communal plots support an average of 5.74 people, with the number supported by each farm being marginally larger in Pisaq than Lares. Only 33% of these households have access to potable water and only 27% have sanitary facilities.[36]

Despite the relative poverty of the region farmers in Cusco do generally produce a net surplus of food. Due to the limitations of altitude communities specialise in certain types of crop. At the highest altitudes the primary crops are potato and quinoa. Potato is particularly important to the nutritional security of the Cusco region, something that is reflected in its cultural importance to communities, due to its high vitamin C, calcium and protein levels and low fat content as compared to other staple crops such as maize, rice or wheat[37]. At medium altitudes grains, particularly maize, are grown and on valley floors fruits and vegetables can be grown. There is a strong tradition of bartering surplus produce for other foodstuffs and for consumer goods. Clearly the bartering system between communities is designed to produce a nutritional balance for all. However, in modern times rural Peru, and in particular the Andean region, has suffered from a variety of nutritional problems despite its basic level of food security. These have been somewhat ameliorated in the last two decades but stunted growth, iron-deficiency anaemia and vitamin A deficiency still affect up to forty per cent of the population in the Peruvian Andes.[38]

5. Intellectual Property Rights and Agriculture

5.1 Seed[39]

Seed[40] is the basis of production in any crop-based agricultural system. Its importance to the livelihoods of all farmers, and thus particularly to the economies of developing countries, is enormous. As such it is one of the most controversial aspects of agricultural development. This section approaches the issue of seed by examining the role and uses of both formal and informal sector seed in Kitui and Cusco to draw a rough picture of the seed systems that exist in these regions. Formal sector seed is understood as that developed commercially, in the case of the private sector, or institutionally, in the case of the public sector, i.e., in a formal setting. Informal sector seed is understood as that developed by farmers themselves. After examining the actual nature of the smallholder seed systems in the two regions the section then seeks to draw intellectual property related policy conclusions on the basis of this picture.

5.1.1 Formal Sector

For the purposes of this study formal sector seed is understood to include both private and public sector improved seed. This grouping potentially includes three basic types of seed: composite, hybrid and transgenic. Composite seed is most easily understood as 'ordinary', in that it is a traditionally bred combination of varieties that self replicates with no more than a natural reduction in vitality. Hybrids are self-explanatory in that they are hybrids of different varieties that are characterised by the expression of 'hybrid vigour' (usually in the form of higher yield) in the first generation and then a dramatic decline in productivity in subsequent generations. Transgenics are the products of modern biotechnology and involve the insertion of particular desired genetic traits[41], often from different species and even kingdoms, into existing elite varieties, usually composites.

Composite seed was the most commonly encountered formal sector seed during this study. In all cases composite varieties had been developed and distributed by the public sector. Hybrid seeds are relatively common in Kenya, although less so in Peru. The public sector is involved in the development and distribution of hybrids but this type of seed was primarily sourced from the private sector. No formally distributed transgenic seeds were encountered during this study[42]. However, as is mentioned later, the informal entry of transgenic seed into local seed systems cannot be ruled out.

The most immediately noticeable feature of the data from both Kenya and Peru regarding formal sector seed is the level of its use. 76.92% of farmers interviewed in Kenya and 62.5% in Peru had planted certified[43] seed at least once. Governments[44], NGOs and other agencies regularly

supply seed to smallholder farmers as part of development and relief projects. However, even when this factor is screened out, the level of exposure to improved crop varieties is still high, with 50% of Peruvian farmers and 46.15% of Kenyan having bought certified seed at least once. Kenyan farmers had planted an average of 2.12 improved composite or hybrid maize varieties at least once. Only 7.69% of Kenyan farmers had never planted certified seed, although 15.38% had never bought any. A third of the 77% who had planted certified seed had only planted certified vegetable seed or had only planted it once. 15.38% of Kenyan farmers had only planted second generation certified seed that was either purchased or 'borrowed'[45] from relatives or neighbours. Exposure to certified seed in Peru was substantially lower than that found in Kenya. 34.34% of Peruvian farmers had never planted certified seed while 46.86% had never bought it. Only one Peruvian farmer interviewed stated that he had bought second generation certified seed and this was purchased from a climatic zone different to that of his own farm.

This data on exposure to improved seed is somewhat misleading if it is taken to imply much more than exposure. Peruvian farmers were almost unanimous in stating that they had experimented with certified seeds but had rarely, if ever, planted them in successive seasons or years. The situation in Kenya was significantly different, with a number of farmers making regular use of improved seed. A clear line must be drawn between horticultural and staple crops in this regard. It should also be noted that no use of improved seed was encountered for any crops other than vegetables and maize in Kenya. By far the widest exposure to improved seed in Kenya involves vegetable production. All farmers interviewed for this study that produce vegetables are almost exclusively reliant on improved seed, and occasionally seedlings, as the basis of their production.

The situation with the main staple crop in Kenya, maize, is closer to the picture found in Peru than that with vegetables. A large number of farmers had only recently been introduced to improved seed due to new initiatives by government extension services, FAO and a number of NGOs. In contrast to the situation in Peru, most farmers indicated that their initial experimental plots for improved varieties either had been, or would be, continued in some manner as part of regular production strategies. The key point to note is that, even with farmers well accustomed to planting improved varieties, these only constituted one aspect of a farmer's planting strategy. Kenyan farmers interviewed for this study planted up to 4kg of an improved variety in a season, meaning in most cases that improved varieties constituted 25% or less of total maize seed planted and in a few isolated instances reached 50%. Similarly, very few Kenyan farmers planted improved seed every season, every second or third season was far closer to the rule.

There appear to be a number of reasons for this situation of relatively

significant experience of improved varieties and yet relatively low proportions of general use. Some of these reasons have clearly socio-economic implications but a number of them also highlight certain aspects of intellectual property rights policies and legislation.

In Kenya the most openly and commonly cited reason for farmers not making wider use of improved seed is cost. The standard packet of seed for smallholder farmers at all retailers is 2kg. 2kg of private sector improved maize seed is approximately[46] 350 KShs (Kenya Shillings, approximately US$4.43 at the current exchange rate) while 2kg of public sector improved maize seed sells at approximately 250 KShs (approx. US$3.16) from seed retailers in Kitui town. The retailer does not generally set these prices but rather the distributor sets them, which is normally either the seed company or its agent. Given that GNP per capita in Kenya is usually estimated at somewhere around US$320, and everything from healthcare to education must be paid for, these are significant costs. An estimation of seed production costs also provides a useful insight into the relative weight of these prices[47]. It has been estimated that the cost of purchasing foundation seed, multiplication and distribution, plus a follow up service for retailers and farmers, and including a reasonable profit margin at each stage of the process, results in a price of approximately 100 to 110 KShs for a 2kg bag of seed. Even allowing some flexibility for variations in costs[48], including the fact that all of the major private sector varieties are imported rather than locally developed and multiplied, this suggests that up to 70% of the cost of private sector, and up to 50% of the cost of public sector, seed consists of profit or inefficiency.

A further commonly cited problem with some improved varieties was their suitability for local consumption. In most regions of Kenya maize is primarily processed into maize flour. In Kitui, traditionally the grains are separated from the husks in a mortar and pestle. One of the most readily available, and popular, private sector varieties creates a major problem in this form of processing as, rather than the grain and the husk separating, the two tend to shatter, thus rendering separation impossible. The importance of the preparation quality of varieties cannot be underestimated. In recent years smallholder farmers in Kitui, as in much of the rest of Kenya, have ceased to regard maize as a commercial crop due to plummeting commodity prices[49], and thus household consumption is the almost exclusive motive for its production.

The third commonly cited factor regarding choice of seed variety relates to preferences in production characteristics. As can be seen from table 4, less than 20% of farmers interviewed in Kenya identified an improved variety as their preferred seed. In the majority of cases this was because improved seeds are only seen as beneficial in years when rainfall is sufficient and predictable. In a few cases improved

seeds are preferred for pest and drought resistance as well. In general improved seeds are seen as too prone to natural factors to be relied upon for more than a small proportion of total production. Even farmers who initially stated that they would plant only improved seed, if cost were not such a prohibitive factor, upon further questioning stated that they would never completely rely on improved seed.

There are a number of reasons to believe that cost is not the primary factor preventing the wider adoption of improved seed. Improved vegetable seed prices, which are almost exclusively from the private sector, are also high and yet they are widely used. Furthermore, the behaviour of farmers in Kitui as regards pesticides, discussed later in this study, shows that they are prepared to invest in products where they can see a direct benefit in terms of productivity. There is also the fact that no major distinction as regards the use of improved seed can be made between those farmers with little or no financial flexibility and those with relatively significant wealth.

When one considers the large number of farmers that have experimented with improved seed a relatively complex cost-benefit analysis seems to exist. The majority of the improved seed available in Kitui tends to provide specific benefits depending upon the variety in question. The private sector varieties, without exception, are hybrids that provide a high yield in good rains and in the absence of major pest problems. If the rains fail, or come in unexpected months, as has often been the case in the last four to five years, then the crop fails completely. A further problem with the private sector hybrids is the problem of saving seed for replanting in subsequent seasons. Farmers are clearly told by retailers and extension workers that new hybrid seed must be purchased every season. Of course a number of farmers do replant hybrids anyway[50]. The purchase of a hybrid seems to be weighed in two main ways. The first is the value of any potential additional production against the additional cost in relation to the relative performance and cost of a non-hybrid seed. The second is the value of decreased production against the cost of repurchasing in subsequent seasons. When these various factors are combined it is clear that when the benefits are measured against the risks the majority of farmers are not prepared, or in many cases cannot afford, to devote more than a small proportion of their productive land to hybrids. Even for the few farmers whose land has ready access to water, and who are thus able to mitigate a significant proportion of the risk of planting hybrids, the decision is not automatic. One such farmer had experimented with the most popular private sector hybrid and stated that he was unlikely to use it more widely. The primary reason was that he had grown the variety in a season with very good rains and had used commercial inputs and specific planting practices, as recommended by the retailer. While the yield was good he did not perceive it as sufficiently better than the yield of his informal varieties, with which he did not use any inputs, to justify the additional

expenses and effort.

Public sector hybrid varieties available in Kitui seem to present farmers with the same situation as the private sector varieties. Unlike the private, the public sector has produced some hybrid varieties specifically bred for use in the dryland regions of Kenya. However, these generally seem to be regarded in the same manner as other hybrids by farmers, although they are somewhat less popular than the private sector varieties. Public sector improved composite varieties available in Kitui, the only improved composites available, focus on a different set of production characteristics to hybrids and thus involve different assessments. The majority of improved composites tend to be 'insurance' crops. If the rains fail, or major pest problems are encountered, these varieties will still produce a minimum crop in all except the worst circumstances. However, in ideal or average conditions they do not produce a significantly higher yield. Farmers in Kitui do plant improved composites as insurance crops, particularly when expecting bad rains, but many also plant them as part of a strategy to maintain vitality in informal seed by mixing a small quantity of the improved composite with their other seed and then planting.

The existence of some form of cost-benefit analysis is also supported by the ready adoption of a set of field trials suggested within the framework of the farmer field school system. At the time interviews were conducted for this study, the 5 Kay Farmer Field School was in the process of analysing the results of a set of field trials involving both informal and formal seeds planted with a range of input and other variables.

In these circumstances it easy to see why farmers do not rely on any particular improved variety: there is none available that serves the broad range of their needs and circumstances. The smallholder farmers of Kitui are almost entirely dependent on low-, or zero-, input, rain fed agriculture in what is a highly unpredictable climate[51]. Thus there is a premium on crops and varieties that are highly versatile in the sense that a farmer will achieve minimum yields required to meet basic quantitative food security and preferably also a qualitative food security that includes a nutritional element. This implies that effective agricultural research to serve the needs of smallholder farmers in Kitui probably needs to provide a range of varieties of the major staple crops, particularly maize and beans. Such a range of varieties would allow for balanced planting strategies where farmers are able to take advantage of good years while having adequate 'insurance' for bad years. However, effective agricultural research would also provide improved varieties in a wider range of crops than is currently available. Some of the minor crops may not play a major role in good years, although they do contribute to nutritional balance, but in bad years they serve to reinforce farmers' ability to produce a minimum

subsistence crop. It is also clear that more effort in research on commercially oriented crops, primarily fruits and vegetables, would have direct benefits.

The public sector in Kenya has made some effort to address the conditions of smallholder farmers, although this has decreased in recent years with budget constraints. Increasing focus on capital-intensive projects, particularly biotechnology, may also have limited the variety of crops and geographic areas that the public sector is able to address. In contrast, the private sector appears to have made little or no effort to address the specific needs of smallholder farmers in Kenya. The majority of available private sector improved varieties are imported and are tailored to the needs of medium- to high-input agriculture where climatic factors are either not a significant problem or are mitigated by the extensive use of irrigation and inputs. Private sector improved vegetable varieties are popular but this popularity is not due to a higher level of local relevance than with other crops but rather seems to depend on three factors. The first is the relative profitability of vegetable production, allowing for relatively extensive use of inputs. The second factor is that farmers produce small quantities of vegetables. This also facilitates the relatively extensive use of inputs since the quantities used are not large and thus the capital investment required is manageable. The scale of production is also relevant to the issue of rain-fed vs. irrigated agriculture. In a vegetable plot, usually not more than a few square metres, irrigation is a question of a watering can; something that is obviously not feasible, either from a labour or water availability point of view, when one is talking in hectares. Finally, there is the fact that the nature of vegetable seed is such that it's harvesting as the basis of subsequent crops is a technically more complex undertaking than saving grain or tubers.

What might be described as the informal use of formal sector seed includes the possible introduction of transgenic seed, or genetically modified organisms (GMOs) into Kitui's seed system. In the period 1998–2001 Kitui received significant quantities of food aid through both national and international agencies in response to the severe drought that affected the district, and much of the rest of Eastern and Northern Kenya. At least one farmer[52] interviewed for this study had planted some of the United States supplied[53] yellow maize provided as relief food as an experiment with a new variety[54]. This was isolated from the farmer's primary maize crops but at a distance of not more than ten to fifteen metres, insufficient as a set aside to prevent the cross-pollination of maize[55]. No evidence was found, or sought, during this study to confirm whether food aid shipments to Kitui did contain GMOs. Recent disclosures by the World Food Programme stating that it has been distributing relief food containing GMOs, without informing recipient countries, since 1996[56] suggests that there is a strong likelihood that transgenics have entered Kitui's, and probably the

national, seed system[57]. This is despite the fact that Kenya has detailed requirements on both quarantine and biosafety, and is also a party to the, not yet in force, Cartagena Protocol requiring the prior informed consent of recipient states when shipping GMOs. The primary purpose of such regulatory systems is to allow authorities to make some form of advance assessment regarding the possible impacts[58] of introducing alien organisms into the local environment. As has been stated in the context of the current crisis in Southern Africa, [t]*he problem is precisely that not enough is known about what the implications would be and how it* [GMO relief food] *would affect traditional maize varieties*.[59]

Whether due to the lack of inputs or for other reasons, the planting of relief food as seed was not a success. The quality of the resulting cobs and grains was below that of food grain bought in the local market and the farmer stated that he did not intend to replant the products of this experiment. However, due to the strong likelihood of cross-pollination the matter does not end there. Regardless of the exact nature of the relief food in question, the introduction of seed with characteristics totally unsuitable to the local environment could have an adverse impact on the quality of the wider seed supply. The second problem is that up to six years of the unrestricted release of unidentified GMOs into the Kenyan environment may well have rendered many aspects of its biosafety regulatory systems redundant in the absence of massive investment to assess the levels and nature of informal GMO leakage.

5.1.2 Informal Sector

In the majority of cases encountered during this study farmers' primary seed supply was informal. 'Primary seed supply' is understood to mean that the source of the majority of seeds for their main crops and for the majority of the range of crops grown does not involve either public or private sector improved seed. The exceptions being four or five farmers interviewed in Kenya. At least some of these four or five may well also, in reality, depend largely on informal seed, in particular for minor crops, but their declared preference was for improved seed. No exceptions were encountered in Peru.

The exact sources of this informal seed vary somewhat between Kenya and Peru. In addition, while patterns of seed supply in Peru are relatively consistent, in Kenya they tend to be more varied; both among farmers and over time. The main source of informal seed in both countries is what has come to be known as 'saved seed', i.e. seed selected from a previous crop and kept back for replanting. A secondary source of informal seed is the exchange of saved seed among individual farmers and communities, which takes place in a range of formats involving a multiplicity of terms and conditions depending on circumstances. A third source is formal seed, as

discussed above. It can also be considered to play a role as an informal source, as it is frequently purchased, although often more opportunistically used when donated, expressly to be blended in with sources of informal seed. Other informal sources include seed retailed not as seed but for consumption and a range of occasional or random sources of seed, usually from some distance, that are integrated as and when they are available.

Farmers interviewed for this study in Peru depended almost exclusively on the first two sources of informal seed: saving and exchanging. The exceptions to this were one farmer who had used government supplied hybrids[60] to mix with his saved seed and the fact that on direct questioning regarding certified seed 62.5% of farmers had planted some at least once. As mentioned above this latter use of certified seed is a far from regular pattern but it does indicate that at times the local seed supply has been exposed to improved varieties. This dependence on seed saving and exchange is common to the majority of crops in Cusco, including all varieties of the main staples, potato and maize.

The process of seed classification, selection and development for use in subsequent seasons in Cusco is a systematic, well-planned one. Farmers interviewed for this study were growing as many as 30 or 40 distinct varieties of potato, and 5 or 10 of maize, on farms of little more than one hectare. Other studies have identified as many as one hundred distinct varieties of potato in a single plot[61]. Each variety is individually named and farmers from different communities are able to relate these names and their associated varieties. In addition the majority of farmers also seemed to be aware of the names, descriptions and characteristics of a number of varieties that they do not grow, particularly of potatoes. The average number of varieties that a farmer has specific knowledge of is hard to determine with the short space of time available for this study. However, it seems to number well into the hundreds. The area of the Potato Park has been described as a micro-centre of origin for potatoes and the communities within it are well aware of the more than four hundred varieties that have been identified there[62], with individuals able to name many of them. This may seem a large number but when one considers that approximately one thousand three hundred potato varieties have been identified in the Cusco region it becomes far more comprehensible.

The distinct naming and well defined production and preparation characteristics of varieties of key crops in Cusco is matched by careful planting strategies that suggest detailed understanding of the mechanics of crossing varieties. Prior to planting this primarily consists of seed selection. Seed is selected on the basis of a number of criteria that generally match desired traits, such as pest and environmental stress resistance, timing of maturity, yield and

preparation qualities. Farmers are clearly seeking an optimum combination of these traits but they also show evidence of planning combination strategies that allow for maximising output if the conditions and events of the season prove to be less than ideal. The criteria listed by farmers were broadly the same in almost all cases but the relative order of priority varied. It was not possible to determine whether this was due to individual preferences, varying situations, a combination of the two or some other factor. Selection is invariably made pre-harvest, something that is generally understood as allowing for a more accurate assessment when examining criteria other than yield. While selection criteria are important for the quality of harvests in the short term, they also provide the basis of crossing for the improvement of a variety in the longer term. Farmers in Cusco have a long tradition of active engagement in crossing plants and varieties on the basis of desired criteria identified pre-harvest. This type of understanding is critical to the maintenance of the vitality and ongoing of crops, in particular when local seed supplies have relatively few external additions. Potato presents particular challenges due to a number of complexities. The main challenges relate to the choice of either relying on clonal reproduction through tubers as seed or the use of what is known as 'true potato seed' (TPS). The difficulties of reproducing quality potatoes is compounded by the life cycle of a tuber, or TPS derived seedling, that requires detailed knowledge to be able to plan and match optimum maturity with appropriate planting seasons[63].

However, this cultivated element of agricultural strategies in Cusco is only one half of the picture where potato is concerned. Farmers in the region do not tend to see a clear line between cultivated and wild varieties[64], an attitude that seems likely to encourage constant geneflow between the two pools. Such a strategy clearly contributes to the continued development of potato diversity, and thus to experimentation with desirable characteristics such as high yield, pest and environmental stress resistance, variable maturity or preparation quality. It is equally clear that any seed related policy or law must take such a situation into account or risk undermining agricultural biodiversity conservation efforts and, more importantly in the short to medium-term, the livelihoods of local communities. The strategies for the management of different crops vary according to the individual nature and needs of each, but the common theme in Cusco is that farmers depend on a detailed systematic knowledge of the agroecosystem in which they operate to maintain and improve their varieties. This knowledge base includes information on a broad range of wild and semi-cultivated crops and varieties as well as those that are formally cultivated. Some of these wild and semi-cultivated varieties contribute to the maintenance of the viability of cultivated crops, but many serve as nutritional supplements, active components in pest management strategies or as medicinals, all of which are critical to community well being. This type of integrated agroecosystem

approach, which maximises the use of local resources and minimises unnecessary external influences, has been identified as a fundamental requirement of sustainable agricultural strategies[65].

The highly structured and systematic approach that farmers in Cusco use in selecting and developing seed is, to some degree, mirrored in the practices that have developed regarding the exchange of seed. An initial important point is that all farmers are aware of the purpose of seed exchange, both in terms of maintaining the viability of their established varieties and in terms of further developing and improving these varieties. This knowledge is inextricably entwined with farmers' seed saving practices. Only one farmer interviewed in Cusco stated that they did not exchange seed in any manner. All other farmers exchanged seeds within their communities and 12.5% of farmers also stated that they exchanged seed with other communities. These levels apply to regular exchanges of seed and it seems likely that the levels of exchange with outside communities is higher if irregular transactions are also considered. Furthermore, if 12.5% of farmers are exchanging seed with other communities and exchanging seed within their community, then, by default, the rest of their community is also ultimately involved in the external exchange. For those farmers not directly involved in the external exchange those that are act as a form of limited guarantee against poor quality externally sourced seed, as they will use it before it enters the community seed system. The issue of cross-pollination limits the guarantee, but farmers in Cusco seem to be well aware of the need to segregate crops where this is a concern. The communal land system facilitates this to some degree, as farmers frequently have rights to a number of plots in different locations under the authority of their community.

The structured approach to seed exchange appears in both intra- and inter-community exchange. At the intra-community level seed exchange has deep cultural roots, playing a part in several non-agriculturally related social interactions. The most notable of these is marriage, where the provision of a quantity of seed is a prerequisite for the process. At the inter-community level barter markets or seed fairs play the most obvious role in seed exchange where farmers, sometimes from quite widespread communities, will meet. These barter markets and seed fairs also seem to have fairly deep roots. The basis for believing this is that, traditionally, the majority of Andean communities have depended on barter systems to meet their basic nutritional needs. This is the result of topography, where the situation of a community in terms of altitude tends to restrict it to a particular range of crops. In general terms, high altitude communities primarily produce potatoes, other root and tuber crops and quinoa. Medium altitude communities specialise in grains, particularly maize, and often also beans. Communities in valley floors produce fruits and vegetables. All of the three types of community thus have had a need to meet and trade with the others on a regular basis to fulfil their basic

nutritional requirements and this has encouraged the development of a relatively formal system of barter markets. With the need to access a wide range of varieties to maintain and improve one's crop it is not difficult to see why the exchange of seed is as well entrenched as the exchange of foodstuffs. The large difference in levels of seed exchange at the intra- and inter-community levels is influenced heavily by practical considerations such as proximity and frequency of interaction. However, a further significant factor is the question of trust. The relative isolation of many Andean communities means that the level of mutual trust is often low. Given that quality seed is one of the most important assets that a community can have, people are predictably hesitant to place it at risk by introducing seed of unknown provenance and quality into the system. NGOs have been making efforts to encourage increased levels of seed exchange among communities that might not normally barter seed, or at least might do so only rarely, as a means to enlarging the genepool available to individual farmers. However, the long-term viability of such strategies may depend on the ability to introduce some form of policy to guarantee quality that communities will be prepared to trust.

Farmers interviewed for this study in Kenya depend on a wider variety of informal sources of seed than those in Peru. There is a strong similarity in the fact that the saving and exchange of seed are the most important elements of the local informal seed system. 100% of farmers interviewed rely on saved seed for at least some proportion of their planting and 76.92% stated that they were involved in some level of informal exchange. However, the broad range of seed introduced from other sources illustrates a fundamental distinction. As with the limited introduction of certified seed by Peruvian farmers, there is little regular pattern in the use of these external seed sources but they do indicate a very high level of exposure of the local seed system to what are fairly random introductions. It should be noted that there are significant variations in the sourcing of seed for different crops in Kenya. The primary staples, maize and beans, demonstrate a relatively similar pattern while minor crops, such as cassava or sorghum, are more highly dependent on saving and exchanging and correspondingly less influenced by introduced seed.

Only one instance of a minor crop having an identifiable origin in formal sector seed was found in Kitui. This was the case of one farmer who had been supplied with, what he assumes was, an improved cassava variety by a local government official in approximately 1940 and has been replanting that ever since. A pattern of total dependence on informal seed sources, primarily saving and exchanging amongst close neighbours and relatives, applies to almost all minor crops. This includes fruit trees, despite their significant role as a cash crop. In the case of the primary staples it is more difficult to assess the exact proportions of productive land devoted to formal versus informal seed due to several factors. The first is that the proportions tend to vary

dramatically from season to season as farmers often use formal sector seed only every second or third season while also varying their habits depending on their predictions for rain in any given season. The use of formal sector seed also varies significantly from farmer to farmer, sometimes according to objective factors such as access to water or comparative wealth but often also due to less easily defined preferences. Finally there is the fact that many farmers using formal sector seed do so as a means of maintaining the vitality of their informal seed, mixing the two together whenever formal seed is planted. In general this means that only a relatively long-term study over a period of years could confidently provide detailed data on the proportions of formal and informal sector seed used. However, from the information collected for this study it seems likely that an average of up to 20% of the seed supply for primary staples comes from the formal sector in any given season. Such an average would include the few farmers who make significantly greater use of formal sector seed, up to 50 or 60%, as those who use little or none balance these. The majority of farmers would probably fall somewhere close to the average. As noted elsewhere in this study, vegetables represent an exception to the patterns of seed sourcing found with minor crops and staples due to the almost total dependence on certified seed.

The process of seed classification, selection and development for use in subsequent seasons in Kitui is a less detailed and systematic approach when compared to that found in Cusco. The importance, and prevalence, of maize and bean production, means that the seed system for these is the most easily identified. All farmers interviewed for this study readily recognised the distinction between certified and informal varieties but regarded all informal varieties as part of a collective, 'Kikamba'[66]. Second generation certified seed is sometimes recognised as distinct but more usually is subsumed into Kikamba. All farmers interviewed plant Kikamba but the relative contributions of saved, exchanged and externally sourced seed vary enormously from farmer to farmer. As a general rule farmers that are the most complex in their approach to selecting seed for saving, and thus in the ongoing development of their varieties, tend to be the most cautious about exchanged and externally sourced seed. The most common method for seed selection in both beans and maize is an examination of yield and quality either during or post-harvest. A small number of farmers have historically selected seed in a two step process beginning with a pre-harvest examination and marking of plants, particularly on the basis of maturation dates but also looking at factors such as pest or environmental stress resistance depending on exact locations. This is then followed by the normal examination for yield and quality either during or post-harvest but focusing on the plants marked pre-harvest. This latter, more complex, seed selection strategy is slowly becoming more widespread as it is being actively encouraged and guided by agricultural extension initiatives, in Kitui primarily in the form of the farmer field school project. A further variable in seed selection

strategies is location. There is a distinct contrast between the two groups of farmers interviewed close to Kitui town and those interviewed near Kabati. Farmers in Kabati are only using the during and post-harvest approach in seed selection. This is clearly due to the fact that while their inclination is to try to save seed this is undermined by their general seed insecurity. In a good season they are only able to save a small proportion of the seed they will require for the following season and in bad years they are not able to save any significant amount. In practical terms this means that there is little or no continuity in their seed selection efforts and thus these efforts do not offer the longer-term benefits in improved seed quality available to farmers in the more fertile areas close to Kitui town.
In general terms the seed saving system in Kitui is less deeply entrenched than that found in Cusco. It is not clear whether this is due to cultural and historical or, more likely, climatic and other physical factors or some combination of the two. The relative stability and success of the system of seed saving in Cusco, as compared to that in Kitui, suggests that there is considerable scope for the further development of the current system of seed saving in Kitui. It would obviously be a mistake to directly transfer practices from one region to the other but recognising the key strengths of the system in Cusco, particularly in seed selection and development, and using these to highlight and entrench best practices found in Kitui would be a useful initiative.

As in Cusco, in Kitui the process of seed exchange is inextricable from that of seed saving. However, similar to the situation with seed saving, the process of seed exchange in Kitui is far less structured than that found in Cusco. Evidence that the maize and bean seed produced by certain farmers was sometimes recognised for particular, desirable, characteristics was found but this was invariably on an individual basis. These farmers do not seek to promote their seed and the number of farmers who seek to access it is limited. Those few who do seek out such seed from other farmers do so on an *ad hoc* basis, sometimes as random as simply seeing a good quality crop when passing a farm. A major factor in the limited scope of seed exchange in Kitui seems to be that only a relatively small proportion of farmers has a deep understanding of its purpose, whether in terms of the maintenance of the vitality of existing seed supply or the development of improved characteristics. The farmers that do understand the purpose of seed exchange frequently use formal sector seed to cross with their existing stock when seeking to maintain vitality. Occasionally they will also use it when seeking to enhance certain traits, particularly early maturity and environmental stress resistance. Where informal seed exchange does occur it tends to be characterised by two factors that are frequently interrelated. The first is that the majority of farmers only seek seed when they have a shortfall for planting for some reason, most commonly due to drought. The second is that the farmers interviewed seemed to exhibit a cultural prejudice

against being seen to exchange seed. Farmers like to be seen as providing seed to others, as this is perceived to suggest that one is generous and successful, while they do not like to be seen as receiving seed as this is perceived as implying that one is needy. These factors suggest that the data in this study probably exaggerate the level of the provision of seed to others and underestimate the level of seed received.

The seed exchanging that clearly does occur, and that which seems likely to be occurring but for which data is unavailable due to the cultural prejudices noted above, is almost exclusively at the intra-community level. It involves close neighbours who know each other well and tend to have a general traditional system of mutual support and sharing. In areas with higher levels of seed security, in this study those close to Kitui town, farmers usually talk of 'borrowing seed' but the evidence suggests that the loan is a very soft one that is frequently not repaid in a direct sense[67]. In Kabati, where seed security is an almost constant problem, seed exchange still tends to be among close neighbours but is more often a commercial transaction. However, the premium on seed as opposed to food grain is negligible to non-existent, thus making informal seed, at 5-10% of the cost, far more affordable than formal sector seed. Just as common as exchange between close neighbours is exchange between close relatives, who may or may not be neighbours. This fact is particularly important when one considers that seed exchange among relatives is the only form of regular inter-community exchange in Kitui that was identified during this study, as close relatives frequently live in different villages and towns. This situation, and comments by one or two farmers, suggests that trust is one of the main barriers to wider exchange of seed. As noted earlier, this is also an issue in Peru but it is a far bigger barrier in Kenya. Government officials and seed distributors note that there have historically been difficulties with fake or sub-standard seed at various times, particularly during periods of crisis such as droughts, and these experiences may add to farmers' caution.

There is no traditional structured system of seed exchange in Kitui. However, a new 'seed fair' initiative has been launched in various locations in Kitui and neighbouring districts in the last two years. This has been supported by FAO and implemented by an NGO, Catholic Relief Services (CRS), as an emergency intervention to assist in drought recovery. Beyond informing farmers and seed companies the organisers did not involve themselves with supplying seed to the fairs but rather focused on their hosting, and in facilitating farmers purchase of seed through a voucher system. A limited number of vouchers, mostly valued at 500-600KShs ($US6.33-7.59), were provided to farmers identified by their communities on the basis of need. These vouchers could be used for the purchase of any seed available at the fair, with seed suppliers then being able to redeem them with the organisers. Seed suppliers included private sector distributors but primarily consisted of smallholder farmers, both from

the communities in which fairs were held and from others. The overwhelming majority of farmers involved in this initiative strongly supported it and other farmers with whom it was discussed, without mention of the voucher element, also indicated it was something they would like to be involved with. Some suggested that they saw increased productivity as a benefit from wider seed exchange while others focused more on the potential benefits to those suffering from severe seed insecurity. While both formal and informal sector seed was made available[68] at the seed fairs, farmers almost exclusively opted for informal sector seed. The fairs were also open to farmers who had not received vouchers and a number did come, purchasing seed from their own resources, also primarily opting for informal sector seed. The organisers ascribed the preference for informal sector seed primarily to the cost of formal sector seed and, while this was clearly true to some degree, in interviews farmers suggested that it was, in most cases, an issue of cost in relation to perceived incremental benefit rather than simply cost. The seed fairs were intended as a one off initiative to restore seed supplies after the droughts of 1998-2001 in Kitui and surrounding areas. Although there has been some discussion, it is not clear whether the events will be repeated.

In addition to saving and exchanging, farmers in Kitui make use of a range of other informal sources of seed. As mentioned earlier, one of the regular introductions into the local seed system is the informal use of formal sector seed. In such cases a small amount of formal sector seed, usually around 10-20% of that planted every second or third season, is blended in with a farmer's existing seed supply. Farmers engaged in such a practice are generally aware that its purpose is to maintain the vitality of their seed supply. None stated that the use of formal sector seed was part of any effort at seed improvement, something supported by the fact that farmers introduce the same formal variety each time.

There are also irregular introductions of formal seed. One is the opportunistic use of formal varieties provided free of charge by NGOs or the government. Historically, this has primarily occurred at times of crisis, or occasionally elections, and there has not been a particular pattern to the initiatives. When this occurs farmers have mostly taken the seed and mixed it in with their existing supply, with one or two initially segregating it. In recent years certain projects, particularly that of Winrock International, and the farmer field schools have sought to introduce the wider use of improved varieties and have provided some seed free of charge for pilot tests. Farmers have complied with the requirement to plant these tests in separate plots and usually only mix any seed they harvest in with their main supply.

A further regular introduction of externally sourced seed is the use of food grain as seed. This is a very common practice in Kitui with 76.92% of farmers regularly mixing food grain into their supply of

saved seed. Many of these are farmers who are unable to save sufficient seed from previous seasons but a significant proportion of those who clearly could also make extensive use of food grain as seed. In a number of cases this includes farmers who also regularly purchase small quantities formal sector seed. This is a clear sign of an understanding on the part of farmers of the need to introduce external sources of seed to maintain vitality and of the general benefits of diversity in their saved seed supply. It also suggests that the question of trust is not necessarily as big a barrier to the introduction of externally sourced seed as farmers state in other contexts, since the origin of food grain is rarely declared and comes with no guarantee as to its quality for use as seed. Indeed, farmers are generally warned against the use of food grain as seed and still use it extensively.

The final source of informal seed identified during this study is more accurately a range of sources that are grouped under the general description of random introductions. These are usually connected to events in the life of particular farmers or their relatives. Examples include one farmer who brought the seed for his first maize crop with him from Ethiopia when he served in the army during the colonial era[69]. He has been saving and replanting seed from this original crop for more than forty years[70]. Another farmer had retired from a career as a civil servant and his last posting had been in the coastal region of Kenya, from where he had brought two varieties back with him that were mixed and formed his first crop. More recently a farmer, who had been retrenched during civil service cut backs, purchased food grain that he believed had come from one of Kenya's prime maize producing areas, Kitale, in the west of the country. This was then mixed with locally purchased formal sector seed as the basis of his first crop. While these sources demonstrate a high degree of variability they have a common theme. This is that the farmers in question have some reason to believe that the seed they are using is of a quality that will either allow them to establish a productive seed supply or that will improve an existing one. In this sense these sources of seed are actually not random at all, particularly when contrasted with the use of food grain as seed.

In line with the treatment of all informal varieties as the collective 'Kikamba', farmers in Kitui rarely take measures to segregate any new seed they are introducing. In the majority of cases any introduced seed, whether formally or informally sourced, is mixed with a farmer's existing supply prior to planting. Some level of segregation of crops is found in three situations. The first of these is experiments by farmers who occasionally test a new source of seed by planting a small plot apart from their main crops. However, this almost always involves formal sector seed, the one exception encountered in this study being that of food aid grain mentioned earlier. A number of pilot tests, usually of formal sector seed but sometimes also including informal with a range of variables including inputs and planting strategies, were

also encountered in Kitui. These were primarily instigated by NGOs or the farmer field school program and, while varying in their success in terms of immediate impact, they are clearly contributing to deepening farmers' understanding of the mechanics of seed, and general yield, improvement. The second situation is that of the farmers who demonstrated a preference for formal sector seed in certain situations and sought to plant it separately from their informal seed. Where the seed in question is composite the segregation serves to allow a farmer to save and reuse the seed with knowledge of its origin. Where the seed is hybrid, segregation allows a farmer to prevent it's tendency to dramatically decline in productivity in the second, and subsequent, generations from negatively impacting the quality of the informal saved seed elsewhere on their farm. The third situation where farmers segregate crop varieties is where there is concern about the preparation qualities of a particular variety. This usually involves informal seed that is perceived to have its origins in a particular formal sector variety. The most common example of this in Kitui involves beans where the seed actually planted is usually a mixture of saved seed and food grain purchased in local markets but is segregated on the basis of colour as a rough indicator of varietal origin. In contrast to the situation found in Cusco, no cases of the segregation of varieties with the express intention of maintaining an informal seed supply with distinct varieties serving specific roles, or for purposes of experimenting in varietal improvement, were encountered. However, these limited efforts at segregation, which were only identified in the cases of maize and beans, are unlikely to be effective. The primary reason for this is the nature and scale of land tenure in Kitui. As discussed earlier, the average landholding amongst farmers interviewed in Kitui is 1.68 hectares. These landholdings are usually privately owned and consolidated[71]. Maize is an open-pollinating crop and since farmers aren't normally able to establish set asides or buffers of more than ten or twenty metres from their neighbours' fields, let alone among their own plots, segregation is largely redundant. In contrast, beans are primarily a self-pollinating crop and thus, while segregation may have some limited purpose, it is not a particularly important factor. This general situation means that the planting of a particular maize variety, or of any other open-pollinating crop, by any farmer in Kitui is likely to have significant impact on the majority of farmers in the area. However, probably the most important factor as regards crop segregation and cross-pollination is that the majority of farmers, and particularly those that claimed not to exchange seed, does not seem to have detailed awareness of the phenomenon of cross-pollination. As a consequence farmers generally do not seek to manage it in terms of risks and benefits and hence the limited interest in variety segregation.

5.1.3. Conclusions

The current state and nature of seed supply systems, in both Kitui and

Cusco, raises a number of questions relating to the framework and implementation of intellectual property rights under TRIPs. The conclusions presented here focus on the nature of the flexibility that must be maintained in the international intellectual property framework to allow for national legislation tailored to the realities of developing country agricultural systems. In particular emphasis is placed on issues relating to the incentive patterns created by intellectual property rights, the necessity of realising Farmers' Rights, competition issues, emergency response and wider implications resulting from the impact of intellectual property rights on smallholder agriculture.

The primary reason for the low to non-existent use of improved varieties in both countries is that they are not, on average, perceived as performing better than informal varieties. To some degree this may be the result of farming methods and input use as well as the particular characteristics of a given variety, but this simply suggests that the available varieties are not appropriate to the general situation of smallholder farmers. The superior performance of informal varieties in both regions points to the fact, noted by many commentators[72], that farmers breed a multiplicity of varieties appropriate to their specific environments and conditions. Research on formal sector varieties is not being directed to varieties for *low-input areas where the diversity and variability of growing conditions cannot be normalised through the purchase of inputs*[73]. Both Kenya and Peru have implemented UPOV-consistent plant variety protection legislation for almost a decade[74]. It is clear that in neither country has PVP created an incentive for the private sector to develop varieties appropriate to the specific environments and conditions of smallholder farmers. This fact applies to key staple crops, such as maize or potato, as well as to minor crops. In Peru there is no significant use of private sector developed varieties and in Kenya all of the varieties available are imported. The availability of imported varieties in Kenya is clearly not tied to the implementation of PVP legislation, as all of the varieties in question are hybrids rather than composites. It is likely that PVP legislation has increased the availability of private sector vegetable varieties but these are primarily targeted at the commercial export sector and are incidentally used by smallholder farmers due to the feasibility of high-input strategies on a very small scale. This is borne out by data from the office of the Registrar of Plant Breeder's Rights in Kenya, which shows that only two categories of food crop varieties are covered by PBR's: horticultural export crops and public sector varieties for which rights have been sought defensively[75]. Current UPOV-consistent PVP regimes presuppose unitary national seed systems, based on the formal sector model. However, as CIP points out in the context of potato, this does not reflect the on-the-ground reality in developing countries where *a minuscule "official" or formal seed system, serving a very select clientele* [is] *dwarfed by the informal farmer-based seed system*.[76]

It is important to note that this study has not found evidence that PVP legislation is harming smallholder agriculture. Patents are not currently in question, as neither Kenya nor Peru has granted a patent on a plant variety to date. Peruvian law, derived from Decision 486 of the Andean Pact, expressly prevents such patents and, while Kenyan law is a little ambiguous on the issue[77], such a patent seems unlikely. However, not causing harm is hardly the hallmark of an effective system. The evidence from this study does suggest that the current system of PVP is failing to create solutions to existing problems. This raises the question of the understanding of the term 'effective' in the implementation of any *sui generis* regime of plant variety protection pursuant to TRIPs Article 27(3)(b). In a concept paper recently submitted to the TRIPs Council the European Communities noted that the absence of a definition allowed countries,

a considerable degree of flexibility in determining how their legislation meets the standard of effectiveness, thus allowing them to design a protection regime that is appropriate to their specific national situation[78].

The findings of this study support such a statement. It would seem that developing countries need to interpret the effectiveness of a system in terms of its ability to create adequate incentives for the development of varieties suitable for use in the country in question, whether through formal or informal means. In 1994 the Crucible Group noted that there is a need *to stimulate agricultural and other rural-based innovation*[79]. To do otherwise would seem to be inconsistent with the purpose and objectives of TRIPs. A project supported by Winrock International to develop a commercially viable system for the local multiplication and distribution of formal sector seed in Kitui provides a good example. This project is not involved in plant breeding and currently depends on public sector seed developed by KARI. If it were to be denied access to varieties, or access was precluded due to excessive royalty demands, it would shut the project down. At the same time the value of the project would be greatly enhanced if it were able to focus on seed that provides clear comparative advantages in the areas in which it is active. In this instance UPOV-style PVP protection both poses a threat to existing activities and is limiting their effectiveness by not promoting appropriate innovation. This may suggest that UPOV-style PVP does not *meet the standard of effectiveness in Article 27.3(b)*[80], at least in a developing country context. If the interpretation of 'effective' should evolve into some form of absolute standard for PVP legislation, that limits options for the development of the informal seed sector, countries may wish to invoke the nutritional safeguard under Article 8 to apply more appropriate standards in their national legislation.

Apart from the need to implement legislative systems that will stimulate locally relevant innovation the evidence from this study also

suggests that developing country policy makers should monitor three other issues relating to the incentive patterns intellectual property may create in relation to seed. All of these relate to the promotion of commercial style agriculture, as opposed to locally developed farming practices. There was no evidence that any of them is a current problem during this study. In Peru, the fact that farmers weren't planting PVP protected varieties precluded such evidence. In Kenya farmers weren't planting private sector varieties protected by PVP, only hybrids. The PVP protected Kenyan public sector varieties that farmers do plant were only granted PVP retroactively as a defensive mechanism, thus PVP criteria were not a factor in their development. These two facts suggest that PVP is not currently playing a role in the adoption, or otherwise, of Kenyan crops. As in Peru, PVP is not playing a role in smallholder agriculture at all. However, the ongoing promotion of formal sector seed by various groups in Kenya, and the fact that intellectual property rights enhance the incentives to create formal sector seed that is tailored to commercial priorities[81], does show a need to monitor the situation.

The first issue is, in the immediate term, an environmental question and relates to the issue of genetic uniformity in agricultural crops. Advocates of UPOV-style PVP legislation point out that it aims to promote the development of new plant varieties, and thus promotes agrobiodiversity. Critics point to the fact that these new varieties must be genetically uniform within themselves and that their introduction into a traditional agricultural system thus destroys the diversity previously found in the farmers' range of varieties. The vulnerability of formal sector varieties to the harsh local climate could create severe problems in the event that a few come to dominate local agriculture. For example, if any of the private sector formal varieties currently available in Kitui were to become prevalent even a relatively mild drought could significantly lower production levels in the region and trigger a crisis.

The second issue is that a significant shift towards formal sector varieties would, on current evidence, be accompanied by shifts in agricultural practices and input use[82]. This is due to the fact that the production advantages of formal sector varieties are, in most cases, tied to such shifts. Changes in agricultural practices and input use can, in some cases, lead to the elimination of beneficial plants and organisms that may be vital to the agricultural system, in terms of pest protection, soil fertility or a number of other factors[83], and should thus be well planned and effected.

Both of these issues focus on the possible impacts of IPRs on smallholder farmers directly. It should also be borne in mind that the diversity of varieties in smallholder farmers' fields, and the diversity of life in and around them, are not only important to the farmers directly but also hold significant potential value for agriculture on a wider

scale. To some degree, commercial agriculture, both within countries and globally, is dependent on this diversity. At a national level, the majority of the formal sector varieties available in Kenya are developed from the diversity of the informal seed systems of smallholder farmers in Kenya and other countries. As pointed out by the Crucible Group,

The agricultural research community cannot guarantee the long-term survival of any crop, in any country, if the breeding options for that crop are curtailed through the non-availability of cultivated or so-called wild germplasm. Humanity shares a common bowl containing only 20 cultivated crops that sustain 90% of our calorie requirements. All 20 crops originate in developing countries. All are alarmingly vulnerable to pests and diseases and depend on genetic diversity for their continued survival[84]*.*

Miller and Rossman also note the potential for increasing the value of agricultural crops in the diversity of varieties found in smallholder farmers' fields, and in the environment that surrounds them, due to,

...the mind boggling potential that plants hold for the future of agricultural crops. Millions of dollars have been added to the tomato industry through increased levels of soluble solids derived from an inconspicuous species of Andean tomato, and disease resistance has been added to the genome of cultivated corn from a nearly extinct species discovered in Mexico[85]

A third issue related to incentive patterns that deserves monitoring is the that of the economic implications of the increased use of formal sector seed. Recent reports from Kenya's neighbour Ethiopia[86] point to instances where farmers have taken on loans to fund the purchase of formal sector seed and input 'packages'. Some of the regions in which such projects were promoted have now been hit by drought and crops have failed, with farmers thus unable to repay their loans. The end result has been a hastening of the deterioration of the food security situation in these areas, and in some cases has even been reported as leading to the jailing of farmers[87]. If the formal sector seed available to farmers is not locally adapted there is an inherent risk in its use in low input agriculture. Even where formal sector seed is locally adapted, if it is not economically appropriate, i.e. it places a relatively large financial burden on farmers in its adoption, then it still entails an inherent risk as it multiplies the consequences of crop failure. Incentives for the development of locally adapted seeds are thus vital. The need for governments to limit the cost of seed in areas that are economically and climatically marginal may also suggest a need to place limits on the nature of intellectual property rights.

The next area of concern is the realisation of Farmers' Rights. The preamble to the recently adopted International Treaty on Plant Genetic Resources for Food and Agriculture[88] states that the *rights recognized*

in this Treaty to save, use, exchange and sell farm-saved seed and other propagating material...are fundamental to the realization of Farmers' Rights. Although the Treaty also recognises other aspects of Farmers' Rights, particularly participation in decision-making and benefit sharing[89], attention here focuses on the issue most immediate to farmers, their use of seed. The evidence from this study clearly shows that smallholder farmers are significantly dependent on the right to save, use, exchange and sell farm-saved seed. Even in Kitui, where a number of farmers are using formal sector seed, the majority of the seed supply depends on these mechanisms. Intellectual property rights, whether PVP or patents, do not directly threaten this pattern. The seed system found in Peru is almost completely isolated from formal sector seed and, as long as it remains so, intellectual property is unlikely to have any effect on Farmers' Rights. The concern arises when, as in Kitui, formal sector seed begins to appear in a local seed supply system but does not yet dominate it.

In Kitui, a few formal sector varieties, particularly the public sector composites Makueni and Katumani, have become standard elements of many farmers informal seed supply. When PVP protected varieties play this kind of role in informal seed systems questions are raised regarding the interaction of PVP and Farmers' Rights. The nature of these questions varies slightly depending upon whether one is considering legislation that is based on UPOV in its 1978 or 1991 versions. As noted by Graham Dutfield[90], it is often assumed that the 1978 version of UPOV allows farmers to re-sow saved seed from protected varieties for their own use. What is expressly precluded is the offering for sale of a protected variety[91], there is no specific reference to restrictions on the use of harvested material. Farmers' ability to use and exchange second-generation protected seed would seem to be preserved, or at a minimum the issue sufficiently blurred to allow smallholder practices to continue. The 1991 text of UPOV substantially broadens the scope of a breeder's rights and closes the loopholes left by the 1978 text. It increases the number of acts for which the breeder's authorisation is required[92] while also extending the application of rights to harvested material[93] and what are described as 'essentially derived' varieties[94, 95]. Critically, while the 1991 text does provide an option for UPOV member states to allow for limited Farmers' Rights[96] this option only applies to uses *on their own holdings*[97], thus clearly precluding the exchange of seed. Data from both Kitui and Cusco collected for this study show the ability to exchange seed, whether through barter or sale, is an integral part of informal seed systems. In Kitui, where formal sector seed plays a role in the local seed system, PVP legislation modelled on the 1991 text, even that including the Article 15(2) option, clearly has the potential to be highly disruptive. Farmers' exchange of 2nd generation protected seed would almost certainly be problematic, and, depending on interpretations of 'essential derivation'[98], the exchange of informal seed that incorporated protected seed could also be limited or

prevented. As the only PVP protected seed currently available in Kitui is from the public sector it would seem unlikely that this will be a problem in the immediate future. Should current PVP models be maintained, and increased private sector presence push for the enforcement of such models, there is clearly a risk that they would fatally undermine the current seed systems of smallholder farmers.

Where PVP is concerned countries have the option to vary from the UPOV text as they wish, provided they do so in a manner that is understood to create an '*effective* sui generis *system*' within the context of the purpose and objectives of TRIPs. This is clearly an option that needs to be considered by any country with a substantial smallholder agricultural sector and thus probably would not need the invocation of the safeguards in Article 8.

The situation with patents is not so easily addressed. Plant patents, or biotechnology patents on the genetic components of plants, including components that have been introduced to plants by modern biotechnologies, are prevented from allowing the kind of flexibilities countries may avail themselves of when introducing PVP legislation. These flexibilities would almost certainly be considered as limiting the minimum rights guaranteed to patent holders under Article 28 of TRIPs. Plant patents would create more severe forms of the problems described in relation to UPOV 1991 above. The increased difficulty relates to the fact that a patent would preclude any use of the protected variety not authorised by the patent holder. Some of the crossbreeding of protected varieties with informal ones that might be permissible under UPOV 1991-style legislation would clearly be unacceptable in the case of plant patents. Although the majority of developing countries do not allow for plant patents, whether expressly or implicitly, many do allow for extensive scope in the field of biotechnology patents. Biotechnology patents allow for an even greater assertion of rights than plant patents as they frequently apply to the genetic component itself, and thus extend to any variety that contains it. The increasing use of the products of modern biotechnology in developing countries has led to concerns that if such seed enters a local seed system it could, through cross-pollination and exchange among farmers, *raise legal implications of patent right violations of the biotech companies that "own" the seed technology*.[99] In jurisdictions such as the Andean Pact countries, the majority of patents on genetic components are precluded, along with those on whole plants, by definitions of invention. Thus smallholder seed systems can only be affected if they aim to export their products to a market where such patents are granted, something that is unlikely in the context of the farmers interviewed for this study. However, countries that are seeking to develop significant capacity in biotechnologies, and believe that the availability of patent protection will be a significant factor in this development, may not wish to take such an approach. Where this is the case the exemption of the activities of smallholder farmers from

any infringement of patent rights would seem to be justified on the basis of the need to maintain the integrity of local seed systems as the basis of rural nutrition.

A further area of concern is the question of competition policy. The evidence from Kitui shows a remarkable consistency in the cost of formal sector seed among relatively few producers and an absence of competition between these producers to promote the use of their seed through such mechanisms as advertising, follow-up services or even distribution to retailers. This does not necessarily demonstrate the presence of anti-competitive practice; it may just be the result of a limited and relatively new market. However, it is suggestive of a market that is vulnerable to anti-competitive practices. Given that commentators have frequently registered concern over anti-competition issues in the seed industry[100], regulators would be well advised to be monitoring the industry. Two issues are of particular interest. The first is the direct question of the pricing of seed and the range of products available. As in any other market, anti-competitive practices tend to raise prices and limit choice. The evidence from this study demonstrates smallholder farmers' dependence on multiple variety options for key crops while also leaving little doubt that limited economic resources make price a critical issue in the supply of formal sector seed. The second is the general effect of anti-competitive practices on markets for a given product. The potential for IPRs to *contribute to a market and regulatory environment unfriendly to unprotected commercial seed and farmers' varieties or both*[101] in such a situation has been highlighted for a number of years. IPRs are obviously not inextricably linked to anti-competitive practice but their monopolistic features can serve to exacerbate its effects. This is of considerable concern when one considers that both intellectual property and competition authorities are relatively new phenomena in most developing countries.

Regulatory authorities in developing countries also need to be aware of the potential implications of intellectual property rights over seed for their ability to respond to emergency situations. Seed generally becomes an issue in emergency response after the most visible point of any crisis has passed; it is part of the reconstruction effort. As a consequence variations to intellectual property rights on the basis of national emergency may well be attacked with the argument that the emergency has passed. If the multiplication of protected varieties is required at short notice and minimal cost to contribute to reconstruction efforts after a drought, flood, war or any other disaster, authorities need the flexibility to be able to permit it. They also need the flexibility to ensure that such seed can be freely mixed with any remaining supplies farmers may have and that the harvest of such seed is free from any restriction regarding sale, exchange or other activities. However, possibly the most important point regarding emergencies is that if smallholder farmers have access to a well-

developed informal seed system their ability to insure against all but the worst disasters is considerably enhanced. Thus preserving the rights to undertake all of the key features of such a system, to save, replant, exchange and sell seed, is a necessity in good times as well as bad.

5.2 Inputs

Evidence of the use of inputs in Cusco and Kitui provides some clear distinctions between the two regions. Despite this there are some common features that may suggest the need for similar policy initiatives. Frequent reference is made to traditional or organic inputs as opposed to commercial or synthetic. It is recognised that modern science does not always support such a distinction, with some organic and synthetic products being chemically identical. However, it is one that is very clear in the minds of the farmers questioned, particularly in Peru. It is also not only marginalized farmers that perceive such a distinction; frequently this is the basis of organic agriculture in developed countries as well. The distinction is maintained here without making any judgements as to its scientific validity but rather on the basis that it is a reality on the ground.

5.2.1 Pesticides

Pest management, both at the production and storage stages, is a critical element in agriculture. This is at its most extreme in developing countries where tropical climates and levels of development leave farmers more consistently exposed to the vagaries of nature. At the time fieldwork for this study was conducted in Kitui, farmers had recently brought in a harvest and many complained that they had lost some 50% of their stored maize to pests in about four weeks.

Given the critical nature of pest control, the levels of pesticide use among the farmers interviewed for this study are surprisingly low. The data from Kenya and Peru suggests some common factors influencing the level of pesticide usage although their relative significance varied in each country. In Peru only one farmer stated that they had ever used commercial pesticides. Several factors seemed to influence this but the dominant one was cultural. All of the farmers interviewed were Quechua, the ethnic group making up the majority of small farmers in the country. This, and the rural location, means that traditional beliefs and values are a strong influence on all aspects of life. At the heart of the local belief system is the concept of *pacha mama*, or Mother Earth[102]. This concept prohibits the use of most high kill or broad target synthetic chemical products as these are seen as poisoning Mother Earth. Relevance to local conditions is a second factor influencing the limited use of pesticides. The high altitude nature of farming in the region means that not only are the crop varieties quite

specific but so are their associated pests and local farming methods. This means that the effectiveness of more target specific pesticides cannot be assured. However, even in the absence of a cultural taboo or a need for locally relevant products and strategies economics would clearly be a prohibitive factor due to the limited extent of a cash economy in the areas studied.

This is not to suggest that rural Peruvians are not interested in pest management strategies. The communities interviewed for this study have a strong tradition of pest management that probably reflects the idea that, [b]*efore the advent of pesticides, herbicides, and inorganic fertilizers, the need to understand the biology and biological requirements of agricultural organisms was of considerable importance*[103]. This tradition makes use of widely found strategies, such as the combination of ash with other ingredients to produce a basic insect repellent or the production of a form of concentrated urea from manure as an herbicide, but also involves more complex approaches. In particular the use of push-pull strategies, the use of a variety of plants that attract or repel pests to manage their impacts, is well understood. This suggests that despite the cultural taboo on synthetic pesticides rural Peruvians are open to the idea of some forms of integrated pest management (IPM). The current use of push-pull strategies also suggests that Peruvian communities may have many lessons to teach in IPM. This culturally based approach would seem to have a strong grounding in scientific fact when one considers issues of resistance to synthetic pesticides and the consequent desirability of an understanding of the*, 'complex of organisms that occurred, or should occur, in agricultural fields, livestock, orchards, and backyards, and to discover how they interact'*[104]*.*

Despite the use of traditional pest management techniques, pests, in particular insects, are still a commonly cited problem for smallholder farmers in Peru. This would seem to indicate that there is a clear need to make more advanced pest management techniques available to them. Given the breadth of pest management techniques available today, and the fact that alternative methods to highly toxic chemicals are generally preferred on both environmental and human health grounds, the cultural preferences of traditional Peruvian communities should not be a barrier. The basic availability of locally appropriate techniques and products is clearly a problem. Peru is a regional leader in biological pest control, with 23 laboratories mass-producing the natural enemies of a number of pests[105], but even this impressive effort clearly needs to be augmented and broadened. However, even if an appropriate range of products and techniques can be developed, the question of economic capacity will still present a considerable barrier to their adoption by smallholder farmers.

Pesticide use in Kenya is far more widespread than in Peru, despite the existence of many similar factors militating against it. This is primarily

for food storage (76.92%) and the only recorded field use was farmers using commercial pesticides in vegetable production (46.15%). The overwhelming factor preventing the wider use of pesticides is economic. The primary evidence for this is an examination of when farmers do make use of pesticides in contrast to when they don't. Almost without exception, the main use of pesticides, insecticides in particular, was in the production of vegetable crops. Farmers readily recognised that the key reason for this is the fact that vegetables are primarily considered to be a cash crop, although a limited range are also consumed directly by households. The income provided by vegetables, and the increasing premium on quality produce, when balanced against the cost of pesticides clearly seems to be assessed as a viable equation. However, as mentioned earlier, the fact that vegetable growing, with its dependence on seasonally purchased certified seed, is almost completely a cash investment from start to finish seems to suggest that it involves a different mindset from the farming of other crops. The general view of fruit as a primarily cash crop initially suggests a similar situation to that with vegetables. However, the similarity ends there. First, there is no evidence of the recent[106] purchase of fruit trees and where they have been added to farms they have been obtained from neighbours, or, most commonly, from immediate relatives. There was also no evidence of the use of pesticides in fruit production. All farmers queried on this issue were clear in stating that the cost of pesticides for fruit was prohibitive. It also seems possible that pest management was not considered such a critical problem in fruit production as with vegetables[107].

The situation with grains is radically different. No farmers interviewed used pesticides in the production of grains. Once again a commonly cited issue was cost but underlying this seemed to be an assessment that pesticide use was generally not viable in cost-benefit terms due to the natural resistance of varieties planted[108]. It should be noted that the cost-benefit equation in this instance is far more complex than simply an assessment of cost of the pesticide vs. additional output for the crop. The collapse in commodity prices means that grain is primarily for consumption not sale, and thus additional output is discounted, while households with limited finances place a premium on liquidity for the payment of school fees, household goods, medical costs and other similar expenditures[109]. Grain saved for use as seed is similarly not commonly treated with insecticide as it is felt that the traditional storage methods[110] are adequate. In contrast to this, pesticides are commonly used in the storage of grain for food. This is clearly due to the overwhelming need to find some means of limiting the enormous loss of stored grain to pests in the region. However, farmers who were using pesticides for food storage suffered the losses of 50% or more of their harvest quoted in the introduction to this section. This involves a significant drop in the previous performance of the preferred pesticide product in the area. It is not clear what has caused this drop in performance. Some speculate that it could be due

to the development of resistance by the main pests, or the introduction of new resistant pests through food aid consignments[111], while others believe it is due to the adulteration, or outright pirating, of the key pesticide product[112]. If the problem is resistance then there is a serious concern. Since the need is for food storage, increasing the concentration of pesticide is not a viable option on health grounds. Neither is switching to an alternative product an option, as farmers were unanimous in saying that there was no other product on the local market in which they had any confidence. Unfortunately this latter issue remains even if the problem is not with resistance. If the existing product is not reliable for whatever reason then there must be alternatives. Ideally there should be alternatives anyway, from both the perspective of market competition and that of more technical concerns such as environmental impacts and resistance management. The remarkable ability of pestiferous species to develop resistance to chemical control agents is a fact that is all too familiar to specialists in the field[113].

Cultural issues relating to pest management, similar to those found in Peru, also arose in Kenya. There was no clearly defined issue, such as the concept of *pacha mama*. Rather there was a general feeling expressed by many farmers that they would prefer to experiment with natural or organic solutions to their pest problems[114]. This is made evident by two main factors. The first is the continued development by some farmers of traditional pest management techniques, such as similar uses of ash as those found in Peru, and experimentation with alternative methods such as the use of urea from manure, also found in Peru. Despite these similarities with Peru the farmers interviewed in Kenya had not experimented with as many other techniques, particularly push-pull strategies, as farmers in Peru do. Notable for its absence was the use of the Neem tree, which is common throughout the Kitui region and much of the rest of Kenya. When asked if they had ever experimented with Neem the farmers stated that they knew it to have a number of medical properties but that they had never experimented with it in agriculture, whether as a fertiliser or insecticide. All of the farmers informed of the effectiveness of Neem were immediately keen to experiment with it. The second factor suggesting a cultural bias towards alternative pest management solutions was more explicit. At the time research was conducted for this study the ‘5 Kay’ Farmer Field School had already agreed that their next major activity would be to pool funds to bring an expert in organic agriculture from the capital to teach them about the various options and approaches available. When queried on their motives for this decision the group’s first response was that they felt it was better for human health, both in terms of what they consumed and in terms of the application of toxic pesticides, than the extensive use of chemicals. With further discussion it also became clear that the idea that alternative methods were healthier for the environment, and somehow simply more natural, was a motivating factor. These

motivations might not have the same explicit framework of a defined belief system as is present in Peru but they are no less real.

The availability of appropriate and effective pesticides to smallholder farmers in Kenya faces some of the same problems as it does in Peru. There is an urgent need to make a broader range of products and techniques available to farmers. Some are being developed by locally based international institutions, such as the International Centre of Insect Physiology and Ecology (ICIPE) and the International Centre for Research in Agroforestry (ICRAF), as well as by lead agencies of the Government of Kenya, particularly the Kenya Agricultural Research Institute (KARI). However, there has only been limited success in making the results of research by these institutions widely available. As in Peru there is also the fundamental question of the economic capacity of smallholder farmers.

Pesticide use by smallholder farmers in Peru and Kenya suggests that TRIPs is failing to achieve its objectives in two ways. The first is as regards the availability of existing technologies to those who need them. The second involves incentives for the development, and above all deployment, of alternative technologies to complement or improve upon existing ones.

Existing commercial pesticides are generally synthetic chemicals. Developed country agrochemical corporations produce the majority and they are invariably subject to patent protection in their early lives. In recent years these, relatively few, agrochemical companies have increasingly focused on producing chemicals with increased target specificity[115], a characteristic that has both practical and policy advantages. The downside is that the development of this specificity has increased the costs of development and marketing a new insecticide to more than US$75m[116]. Given the expectation of future pest resistance to these products, producers need to recoup their R&D investments relatively quickly[117]. The provisions of both Articles 39 and 70 of TRIPs are targeted at protecting the market positions of, and thus investments of agrochemical corporations in, pesticides. The former by protecting information submitted in fulfilment of registration requirements[118] and the latter establishing exclusive marketing rights in countries that have traditionally limited, or denied, patent protection for pesticides. The industry trends, reinforced by the provisions of TRIPs, create a situation where the price of new pesticide products is inevitably high, and thus far beyond the reach of the smallholder farmers interviewed for this study. However, it must be recognised that even a significant reduction in the cost of pesticides would not necessarily lead to a major increase in their use. There are two reasons for this. The first is the reality of the poverty of smallholder farmers, which, since it involves questions of commodity prices, subsidies etc., is a broader question than those addressed by this study. The second is the question of local relevance, which leads

to the pattern of incentives, and thus research priorities, created by TRIPs.

The increasing costs of developing new pesticides do not only affect the prices of the final product but also have fundamental implications for what types of pesticides are developed. The focus of industrial R&D, already skewed towards commercial farming, is increasingly aimed at the markets that can afford its products[119]. Not only do products tend to be expensive but they also tend to be only incidentally relevant to developing country needs. The public sector does go some way towards filling this gap, but, as is discussed later in this paper, also faces difficulties. The increasing costs of pesticide research are obviously a major factor in industry's focus on wealthy markets. The basic profit motive of the private sector is also a factor. These factors mean that even in the absence of intellectual property issues industry would focus its R&D on the wealthier markets. However, intellectual property serves to intensify this already latent bias. It allows a rights holder to move beyond the premium the market assigns to their product to the maximum that the market will bear. Obviously a wealthy market will bear a higher profit margin and thus be the focus of industry attention.

TRIPs does not only affect the focus of industry at a general level. National intellectual property laws in wealthy countries would be enough to achieve this. What the globalisation of minimum intellectual property standards through TRIPs does do is to largely preclude the local adaptation of existing pesticides to developing country needs. However, prior to TRIPs, and in many least developed countries that are yet to implement it fully, it is clear that there was, and is, only minimal local adaptation of existing pesticides. This is partly a technical capacity and investment question but the major factor is the nature of the pesticides themselves. Although it is believed that biological control methods will play an increasingly important role in pest control,[120] simple synthetic chemical compounds are relatively easy to protect, both on paper and in practice, using intellectual property rights. Complex, or biological, solutions tend to raise wider questions of what constitutes an invention. Most importantly they are more easily further developed or adapted, thus potentially circumventing the original protected product and undermining its profit premiums. This creates an incentive for a company to produce a pesticide that has limited options for adaptation. Biological or other pesticide alternatives generally are either more problematic in terms of receiving or maintaining intellectual property protection and thus the relative priority attached in R&D investment is discounted. Intellectual property rights are playing the major role in research priorities as opposed to the actual needs of farmers[121].

As previously mentioned smallholder farmers do have some traditional pest management methods that have the potential for further

development. TRIPs encourages two basic risks in this regard. The first is that a traditional method will be picked up and improved by the private sector, but along a line that does not target the farmers that originally provided the method. The R&D incentive pattern encouraged by TRIPs suggests that this would be the most likely scenario. The second risk is related to the first and is the commonly discussed problem of traditional knowledge in general. The intellectual property principles embodied by TRIPs place value upon certain types of technology at the expense of traditional knowledge. A community providing details of traditional pest management methods would thus be likely not only to not receive any practical benefit from doing so but would also be unlikely to benefit from the profits generated by that method. The theory behind the TRIPs patent standards (i.e. that they encourage inventors to reveal their inventions for the benefit of all) clearly needs to be revisited in the case of traditional technologies as, for them, the incentive pattern is currently the reverse of that claimed by TRIPs.

The end result of the current pattern of pesticide research is that developing countries are left to make use of older, highly toxic[122], chemicals that do not necessarily suit local farming methods. Where these are made use of at all they frequently lead to severe health risks at both the production and farmer level[123]. The evidence from both Kenya and Peru is that the needs, usually quite urgent, of smallholder farmers are not being catered for. The incentive pattern encouraged by TRIPs must be revisited to allow for support to affordable and appropriate pest management solutions for smallholder farmers as well as for industrial scale agribusiness.

5.2.2 Fertilizer

The situation with fertilizer is, in many respects, similar to that of pesticides. Wisely used, it is a valuable input that can boost crop yields, particularly in areas with poor soil qualities. However, as with pesticides, no farmers questioned for this study make use of commercial fertilizers. Also in common with pesticides is the fact that many farmers are making use of some form of traditional fertilizer. Overwhelmingly this is simple manure: 81.25% in Peru (Tables 5 and 6) and 61.54% in Kenya (Table 3). However, in both countries some farmers are experimenting and building on traditional fertilisers to develop improved organic versions (18.75% in Peru and 23.08% in Kenya).

Both cultural and economic factors seem to be playing a part in this picture, although the relative significance of each varies from the picture seen with pesticides. In Peru the cultural hostility towards synthetic inputs also extends to fertilisers but does not seem to be as strong, probably because of the more limited association with toxicity[124]. While cultural factors are the dominant reason for low levels

of use, a close link with cost and availability seems likely. The remote nature and high altitude of many farming communities means that the transport of high volume, low value products can be prohibitive. Even where fertiliser is available it is almost inevitably beyond the reach of small farmers for economic reasons. The prevailing use of manure as fertiliser fits this picture. It is locally available, meaning that transport costs are not a major factor, while, as a by-product of other activities, also being relatively cheap. Manure also suits the Peruvian preference for 'natural' solutions. However, the nearly 20% of farmers experimenting with variations on manure, or other forms of organic fertiliser, suggests a need for improved inputs and a willingness on the part of farmers to explore options.

In Kenya, farmers had no express hostility towards any type of fertiliser. At the time research was conducted for this study the '5 Kay' Farmer Field School were analysing the results of some experimental plots that included fertilisers and dressings as a variable. However, the latent preference for organic agriculture may suggest a favouring of 'organic' fertilisers rather than synthetic. Although there may be some cultural influence the dominant factor in low levels of fertiliser use is cost. However, the cost factor is, in a manner distinct from pesticides, inextricably linked to perceptions of utility. It is rather a cost-benefit analysis that dictates as opposed to simple economic capacity. Suppliers are readily prepared to break up the standard 50kg bags[125] of fertiliser to provide quantities appropriate for small farmers at reasonably low prices. The reasons why fertiliser use is still low, even compared to more expensive pesticides, seem to relate to the fact that pest damage is seen as more urgent than boosting production. This is partly due to the obvious impact of pests and partly due to the fact that, as mentioned previously, surplus production has a discounted value due to low commodity prices. In this situation the premium attached to cash liquidity does not generally allow farmers to invest in what is seen as a marginal benefit. However, one supplier did note that fertiliser use had increased significantly in the last one or two years and that he expected this trend to continue. This would seem to be linked to the introduction of the Farmer Field School project, and thus presumably greater awareness of the utility of fertilisers.

The results of this study indicate that TRIPs policy is unlikely to be a significant influence in the levels of fertiliser use by smallholder farmers in either Kenya or Peru in the near future. Issues of simple cost and local relevance are not the primary barriers. Where policy makers may wish to consider the influence of TRIPs is in the maintenance of adequate flexibility for communities, or public research institutions, to develop improved fertilisers that can be produced at the local level. A patent on neem in Kenya or Peru may, for example, limit the options for its use in such a manner. However, the majority of commercial fertilisers tend to be chemical and thus not appropriate for local production. In such a situation, cases of conflict

between patent rights and local production are likely to be few and far between. The central question is that of the direction of research. The private sector is unlikely to invest in research into fertilisers appropriate for local level production and thus, apart from flexibility for local development, intellectual property rights are not likely to play a major role in fertiliser use until small farmers have significantly greater economic capacity.

5.3 Livestock

The primary focus of this study is crop-based agriculture and thus the factors influencing livestock ownership are not considered in depth. However, it should be noted that livestock play a critical role in smallholder agriculture. They provide a valuable source of protein and dairy products while also providing the main source of fertiliser for small farms. They also constitute the primary form of economic insurance for their owners, and thus have a far wider impact on nutrition than just in terms of protein and dairy products. In the event of any crisis affecting other sources of nutrition livestock can be sold off to meet immediate needs with a cash substitute.

As can be seen in tables 3, 5 and 6, the majority of small farmers have some form of livestock, 68.75% in Peru and 100 % in Kenya. For the purposes of this study the term has been interpreted broadly and includes any form of livestock, particularly cattle, chickens, goats and guinea pigs. In both Kenya and Peru poultry is by far the most common form of livestock. The relative low cost and ease of maintenance of poultry would seem to be the main reason for this. In all cases encountered poultry scavenged for their food and ran free and there was no evidence of the use of veterinary medicines. Equally, there did not appear to be any attempt at selective breeding. As a consequence it is unlikely that TRIPs and related policies will have any impact on the use of poultry by smallholder farmers in the foreseeable future. The situation with goats in Kenya and guinea pigs in Peru was largely similar to that of poultry except for the fact that these are more highly prized as a delicacy.

Cattle are also reasonably common in both countries. In Peru they are used mainly for ploughing and transport purposes while also providing milk. In Kenya the farmers interviewed keep cattle primarily for milk production, both for subsistence and for income generation. The main ethnic group in the Kitui region, the Kamba, have had a farming culture for at least two centuries but their pastoralist heritage and close proximity to other pastoralists, combined with prevailing African attitudes, means that there is also a strong social value attached to cattle. Cattle are generally treated differently to other livestock. Their cultural significance in Kenya, and the fact that they represent a major asset in both countries, means that they will be treated with veterinary medicine in the event of sickness and also that generally more care is

taken over their fodder. The availability of effective veterinary medicines is extremely important, particularly in Kenya, due to the simple factor of the tropical climate and the large variety of diseases and parasites that it hosts. However, as with the availability of pharmaceuticals for humans, cost and relevance are major, and often prohibitive, barriers to the wider use of veterinary medicine. The majority of research and development spending in veterinary medicine, as with all other research and development spending, is concentrated in developed countries and focuses on developed country problems. Where these coincide with developing country problems, products, except for the oldest, are priced for developed country farmers and are thus frequently beyond the means of smallholder farmers. However, in many cases effective modern medicines are not readily available as the diseases or parasites in question are not research priorities. As has been mentioned before, intellectual property rights do not cause such asymmetries in research spending, but they do exacerbate them. Difficulties with the adaptation of medicines also apply, in particular due to the rapid development of resistance in most parasites and diseases.

A wide range of traditional veterinary, or 'ethnoveterinary', medicines are readily available, and in frequent use, in both Kenya and Peru. Communities generally seem to have confidence in such remedies and their combination of effectiveness and local relevance with locally appropriate pricing makes them an attractive alternative to modern veterinary products. The fact that traditional remedies are frequently 'multi-pronged' solutions, i.e. that they involve a combination of plant or tree extracts, is an additional advantage that they possess over modern products, which are all too often single chemical compound approaches. The multi-pronged approach lowers the risk of resistance while at the same time providing more options for adaptation in the event that it does develop. The presence of a strong intellectual property rights system raises a series of complex problems in this field. The most commonly discussed is the question of piracy. Traditional knowledge holders are faced with a dilemma. It would clearly be desirable to make their knowledge widely known. However, should they do so, there is a significant likelihood of misappropriation. Traditional knowledge is often seen as public property, and thus not eligible for protection, by intellectual property offices. Where more enlightened views prevail, the cost of protection, or cultural objections to it, generally preclude seeking it anyway. However, the isolation and purification of active compounds from known traditional remedies is increasingly considered eligible for protection in many jurisdictions[126]. Although such an occurrence could be seen as a case of unjust enrichment through misappropriation, it is unlikely, despite fairly widespread concerns, to lead to restrictions on the local use of the traditional remedies themselves. However, what it is likely to do is to preclude the possibility of further research to improve such remedies for the benefit of the smallholder farmers that created them. The

result is increasingly found in both Kenya and Peru; a basic desire to share information for the benefit of others facing similar problems but a reluctance to actually do so due to fear of piracy. This situation is clearly in contradiction to TRIPs' stated policy aims, as it is one of intellectual property rights actively discouraging the sharing of valuable information.

Tropical zone livestock are exposed to a wide range of parasites and diseases. This leads to what may be an emerging problem with the application of intellectual property rights in the field. Constant exposure, particularly in comparison to livestock reared in an industrial environment, means that tropical zone livestock are the world's primary repository of resistance to parasites and infection. This is in addition to their generally greater tolerance to harsh environments. Thus, they are of significant interest in orthodox breeding. The advent of biotechnology has dramatically increased their potential because of the ability to pick out the genetic sources of resistance or tolerance from tropical zone livestock and implant them in the generally higher yielding temperate zone livestock. Such activities once again raise issues of misappropriation, as it seems likely that it will be the middleman, the scientist or corporation that isolates the relevant genetic sequence, that will benefit as the 'inventor' as opposed to the community or communities that developed the breed from which it was sourced[127]. However, the more disturbing long-term issue is the question of intellectual property rights accelerating the loss of traditional breeds, and the increasing genetic uniformity, of livestock. This is already becoming a problem, mostly without the involvement of intellectual property rights, in developed countries and developing countries thus possess an overwhelming majority of the world's remaining livestock diversity. The main barrier to the wider introduction of genetically uniform livestock in developing countries is that the higher yielding developed country breeds do not have the necessary resistance or tolerance. Where they have been introduced it has generally been through crossbreeding with traditional breeds, largely maintaining, or even enhancing, diversity in the existing genepool. Advances in biotechnology mean that the necessary resistance or tolerance can increasingly be engineered. It is at this point that intellectual property rights become a concern. Their encouragement of uniformity through the requirement for an identifiable 'invention' is likely to lead to the increasing introduction of genetically uniform livestock that provide short-term yield gains. However, these short-term yield gains are more than outweighed by two, related, consequences of genetic uniformity. The first is that genetically uniform animals, as with plants, are critically vulnerable to the appearance of new parasites or diseases, as if one animal has no resistance then neither will the others. Even previously harmless, or minimally damaging, pests and parasites can become devastating as they adapt to the new situation. The second consequence is that as livestock become vulnerable to new problems

the pool of genetic diversity from which resistance would normally be selected for crossbreeding is diminished. Vulnerability is increased simultaneously with a diminishing of our capacity to react to unforeseen events.

Intellectual property rights are not yet playing a major role in this deterioration of the diversity of livestock genepools but current trends with livestock bred by orthodox means suggests that as the animal biotechnology industry matures they will become more and more of a factor in encouraging uniformity. It should be noted that this is likely to occur whether or not Kenya or Peru allow for the patenting of animals[128]. In the absence, and probably regardless, of an animal patent a research company will simply seek one on the relevant gene sequences, actually providing broader, inter-breed, coverage than would be available with an actual animal patent. Where patents on genetic sequences are not provided, an increasingly rare situation, this may not help either. A few isolated jurisdictions are unlikely to provide a sufficient haven for livestock diversity as the short-term yield gains available with improved breeds will still lead to the displacement of traditional breeds. The problem once again lies in the pattern of research incentives created by TRIPs compliant intellectual property legislation. The possibility of finding an intellectual property mechanism that will encourage diversity rather than uniformity in biological inventions needs to be explored as a matter of urgency.

Finally the role of forage crops should not be underestimated in the welfare of livestock, particularly cattle. Despite the popular image of cattle basically taking care of themselves the provision of a variety of quality forages can produce dramatic improvements in the yield and health of livestock. One farmer in Kenya noted that experiments with the types and combinations of forages he fed his six cattle led to a five litre per day increase in milk production, something that translates into immediate economic benefit at minimal cost. TRIPs will undoubtedly affect developments regarding key forage crops and the pattern essentially follows that discussed earlier under the section on seeds.

6. Intellectual Property Rights and Agricultural Research

6.1 The Role of Agricultural Research in Kitui and Cusco.

Agricultural research undertaken by international and national institutions, often in collaboration with each other, has played a key role in developing the productivity of smallholder farmers for some fifty years or more[129]. The most famous example of this role is probably the Green Revolution of the 1960s and 1970s that transformed agriculture in much of Asia. Almost all farmers questioned in this study have, usually indirectly, had some exposure to the results of public sector agricultural research. The most obvious example of this is the fact that the majority of farmers have, at least once, planted some form of improved seed. In Peru this improved seed has almost exclusively been public sector produced, as access to it has usually been the result of government donations rather than purchases by farmers. Kenyan farmers have had a far wider exposure to commercial sector seed, particularly in the last two years, but the majority of improved seed still comes from the national agricultural research system. The influence of the public sector is more widely seen than simply in the use of seed. The majority of extension work, which has had a chequered history in Kenya and is conducted primarily by NGOs and CBOs amongst the communities interviewed in Peru, is based on the results of public sector research. Private sector agricultural research varies in its influence over the activities of small farmers. The longest involvement seems to be as regards inputs, primarily pesticides for food storage and vegetable production, used by Kenyan farmers. The use of private sector seed is a fairly recent phenomenon with, as previously mentioned, most farmers saying that they have historically been sceptical. Technical support or monitoring by the private sector was notable for its absence, with the exception of one local subsidiary of a multinational agrochemical corporation.

6.2 The Role of Intellectual Property Rights in Agricultural Research

Historically IPRs have not been a major issue in agricultural research. Public institutions conducted the majority of such research, whether at the national or international level, and thus the ability to capture economic benefits was not a factor. Germplasm and scientific information were largely freely available and, by the nature of public research, the results of research on them were equally freely available.

The basic mechanism of IPRs is that they allow for the capture of economic benefits as a stimulant to the development and dissemination of innovation. This is achieved through a manipulation of market forces that allows for the creation of temporary monopolies as a privilege granted by individual states. Monopolies are normally frowned upon in commercial activity as they eliminate competition and

raise prices for products and services. However, these negative impacts are not uniform across the range of intellectual property rights available. With copyright the monopoly product, recognition and the expression of information, does not prevent others from making use of the essential idea. Trade secrets do not create a monopoly at all. In contrast, patent monopolies exclude others from anything that could be defined as commercial use.

6.3 Copyright

Copyright probably has the longest history of any IPR in terms of its links to agricultural research. This stems from the fact, which still exists today, that scientists need to disseminate their research results as early and as widely as possible. The motivations for publishing usually include a combination of influences. Chief among these being recognition, peer review, comparative analysis of one's work, institutional requirements and a simple desire to share findings, the latter having been traditionally viewed as a critical part of scientific life[130]. Since recognition is critical to career advancement, largely due to its impacts on institutional funding, copyright is used to protect the author or inventor's right to be recognised as such[131]. Copyright does not protect the subject of an article, merely its particular expression in writing; other scientists can freely use published material in their research. Copyright is a case where IPRs can be seen as a useful tool in the dissemination of scientific information. They are cheap, or free, to obtain and relatively easily enforced. Most importantly, however, they seem to function in a manner that serves societies' broader interests. They facilitate the wide dissemination of scientific information, particularly in the internet age, in a manner that is useful to other scientists in a given field[132] and that contributes to the incentives pushing the author to invent and donors to support their work. Even as regards the protection of the particular expression of an idea most public institutions go beyond the normal 'fair use' exemptions and allow the use and further dissemination of their copyrighted material, maintaining only the rights of recognition and to control commercial use.

6.4 Trade Secrets

Trade secrets, or in TRIPs parlance the 'protection of undisclosed information'[133], are not, strictly speaking, an IPR as they do not protect any idea, or the expression of that idea. As recognised by TRIPs Aricle 39(1) they are intended to protect against unfair competition. In common with copyright, trade secrets are basically free as all an author or inventor has to do is to keep information secret. They allow for the sharing of information with others where it is shared on the understanding that it is secret. Where trade secrets are used in agricultural research they generally involve projects that are under development. Consequently they do not tend to restrict the

dissemination of useful information as once a result is achieved the background information is also made public. The private sector sometimes uses them to protect non-obvious background information or techniques that are difficult to reverse engineer and unlikely to be independently invented. This point is critical as trade secrets do not restrict independent invention or reverse engineering. Obviously trade secrets do restrict the exchange of information but they do not do so to any greater degree than human nature and, given their relatively weak protection and the fact that they do not actually limit the use of anything, are unlikely to present a major obstacle. The main risk might be that, in the absence of monopolistic IPRs, trade secrets become more widespread, with technologies being specifically developed to hide critical elements and thus not be generally available.

The use of trade secrets by commercial sector plant breeders to protect the parental lines used to produce hybrid varieties is probably their best-known use in agricultural research. At first sight this might seem to be a highly restrictive practice. However, it must be recognised that such protection is limited. It does not restrict the use of the genetic material of those parental lines, whether in part or in whole. It only prevents somebody from unfairly acquiring knowledge, i.e., stealing it, of the parental lines and then using it to the commercial detriment of the trade secret holder. An individual holding a trade secret over hybrid parental lines could not use this to limit the breeding or production activities of farmers, public sector researchers or commercial breeders. Trade secrets are unlikely to create adverse impacts on the general availability of genetic material and thus on the state of agrobiodiversity or Farmers' Rights.

Where trade secrets have proved problematic in agricultural research is with technical data that must be disclosed when products are required to be registered by government authorities[134]. In agriculture this usually concerns pesticides and other agro-chemicals but, in theory, could become an issue for agrobiotechnology under emerging biosafety regimes. The problem is that information submitted for regulatory purposes is often considered to be public but can frequently be used to copy products where they are not patented. Alternatively a regulatory authority could, even without disclosing data, use it to consider the registration of a comparable product, thereby considerably reducing that applicant's costs. TRIPs requires that its members 'protect such data against disclosure, except where necessary to protect the public'. This may seem to resolve the issue but when one considers what might be necessary to protect the public, which in some countries requires a disclosure of test data and the basic mechanisms of action for public scrutiny, the problem is not so simple.

6.5 Patents

Patents provide the strongest form of monopoly available through IPRs and involve the most significant costs. These most frequently consist of application and maintenance fees but enforcement costs can be astronomical[135]. The debate over patents has become polarised but one should bear in mind that there are pros and cons regarding their application in agricultural development.

6.5.1 Positive Aspects of Patent Strategies in Agricultural Research

There are attractive aspects to developing a patent portfolio in agricultural research in the context of the dynamics of the agroindustrial sector today. The first is an increasingly common factor in the private sector in general; that holding strategically valuable patents allows a company or institution to trade for licenses on patents held by others. Patents can be extremely restrictive in terms of activities related to the object of the patent by other than the patent holders. This can become extreme when very broad, or 'blocking', patents are granted[136]. Public institutions have begun to be involved in this type of 'asset swapping', usually to gain access finance and equipment as well as specialist techniques. However, more often than they are bringing proprietary rights to the table, public institutions are bringing public relations value or access to a particular context, including particular environmental conditions or resources, or even an entry point into a market.

Most research institutions do not have significant capacity for the delivery of the results of their research, particularly where manufacturing is required. This can be contracted but the manufacturer will be seeking a commercial profit. An alternative, where marketing possibilities exist in developed countries, is to trade these in return for manufacture at cost, or minimal profit, in developing countries. Manufacturers will require IPR protection, in particular patents, as security for their investment for such a deal to be viable. Related to this issue is that of bridging technology. Frequently a new technology may be developed but it requires the use of some other technology for optimum delivery. In such an instance a deal of bridging technology for certain marketing rights can be struck. Once again the crucial factor in the bargain is likely to be the question of IPRs, as this is both the only way to control the product. It is also the element that gives the research institution bargaining power in the first place.

Patents also allow for the marketing of products that have incidental relevance to commercial farmers, particularly those in developed countries, for profit. The potential value of such activities should not be underestimated. In 1996 IFPRI estimated that the US economy had gained somewhere between US$30m and US$1bn from improved varieties of rice provided free by IRRI[137]. Other institutions, whether

international or national, often have similar situations, such as ICIPE's insect repellents or ILRI's research on East Coast Fever in African cattle that may have spin off value for malaria and cancer research[138]. However, there is considerable concern that budgetary pressures, combined with a ready means to find alternative finance, will lead to a situation where institutions begin to focus on the development of commercial products. That this is a real concern can be seen in the fact that IARC intellectual property policies clearly iterate that they expect to continue being primarily donor funded development institutions while also stating that they may seek patents for products that are commercially viable in developed countries. This is not negative per se but history has shown that it is a difficult balance to maintain in a research institution.

Finally there is the issue of defensive patenting, an increasingly common phenomenon in public institutions. Defensive patenting is not aimed at establishing any monopoly rights but is rather a reaction to the erosion of the public domain by predatory patenting strategies. If an institution places its research results in the public domain there is a risk that a minor alteration or refinement by another party will be considered an 'inventive step' and give rise to a patent claim. History suggests that such minor alterations or refinements are far less likely to be recognised as an 'inventive step', or that such a claim is less likely to be attempted, where the original innovation is patented rather than in the public domain. Thus defensive patenting provides some protection against predatory patenting and maintains the integrity of publicly available information. Defensive patenting is obviously a somewhat ad hoc measure as the rights held are still monopolistic, publicly available depending on the good will of the holder. It is also contrary to the basic theories of intellectual property rights as it creates a cost to society without any corresponding benefit. The cost to society is the expenditure of funds on patenting, rather than research, while the patent creates no broader access to the information protected or any additional incentive for innovation for the institution seeking it. This leads discussion to the negative aspects of patents in agricultural research.

6.5.2 Negative Aspects of Patent Strategies in Agricultural Research

Patents are monopolies on the use, manufacture and distribution of commercial products. Capturing benefits through a monopoly depends on an ability to exclude; if everybody has, or has access to, something its economic value is minimal. The concept of exclusion on the basis of economic power fundamentally contradicts the basic ethic of public agricultural research: open access to benefits with a focus on the resource poor.

Patents seem to have two particular negative effects on agricultural

research, both of which are currently emerging. The first involves the control of biological resources and associated information and primarily impacts the public sector and small to medium[139] enterprises (SMEs) in the private sector. Patents on the genetic components of plant varieties, or of other organisms used in the development of inputs, provide a very broad degree of control. They do not only control the specific variety or organism in the context of which they were identified or developed but allow for control over other varieties or organisms in which the same components occur. The limits on this breadth of control generally depend on the policies of individual patent authorities but a number of patents have been granted, particularly in Europe and the United States, that allow for the control of all varieties in a family that contain a given component[140]. By 1994, US patent claims that potentially control all varieties of cotton, soybean, rice, maize groundnut and beans containing particular genetic components had already been made[141]. TRIPs is not clear on the obligations it creates in this area, due to doubts over the interpretation of 'micro organism' in Article 27(3)(b). Kenya has a fairly inclusive approach to genetic component patents but the limits are not yet clear since they largely depend on the Kenya Industrial Property Institute's drawing of lines on the question of invention vs. discovery. It currently seems likely that patents demonstrating a specific use for an isolated or purified component will be granted[142]. Peru's laws and policies are clearer in the prohibition of patents on life forms but some questions will still depend on the interpretations of the Office of Patents and New Technologies of the National Institute of Defence of Competition and of the Protection of Intellectual Property (Indecopi).

As the control of intellectual property rights is primarily dictated by economic power it is inevitable that large-scale private sector enterprises will be the dominant actors. If they are able to establish monopolistic control over a significant proportion of key resources and information, public institutions and SMEs will be forced to negotiate for access. At best this would dramatically restrict the research options for the public sector and SMEs and at worst it could fatally undermine their economic viability[143]. As Heisey points out, society benefits when the public sector has 'freedom to operate', when it maintains public access to research tools subject to intellectual property protection by the private sector[144]. Examples, such as the development of Golden Rice or the Kenyan transgenic sweet potato, have frequently been cited to show that multinationals would be willing to share access to the subjects of their intellectual property rights. However, these few, if prominent, examples of such sharing are generally limited to specific projects and do not allow for the wider adaptation of technologies. The reason for this reluctance is clear in the comment of the President and CEO of Monsanto that the granting of licenses for the development of Golden Rice would, cost the corporation financially[145]. In the context of the prevailing world opinion regarding agricultural biotechnology, and the current state of the

developing world's agricultural markets, such examples can, from the corporate perspective, be seen as flagship projects that are more about market entry and legitimising controversial technologies than they are about assisting agricultural research.

A further aspect of the question of control impacts strategic research decisions and investments in developing countries. This is the issue of the impact of intellectual property rights on export potential, and it was raised at a workshop in Cusco during research for this study. The Nuña bean is widely produced as a nutritious snack food in the high Andes of Peru. The urban areas of Peru provide a ready market for surplus Nuña production and in recent years its export potential has been explored in the lucrative United States market. In response to this potential the Instituto Nacional de Investigacion Agricultura (INIA) has invested considerable time and resources in the development of improved varieties of Nuña. US Patent No. 6,040,503 has been granted to Appropriate Engineering and Manufacturing of the USA over a variety of Nuña bean identified as 'Palomero'. This clearly does not affect the production and marketing of Nuña in Peru, where it is for local, or non-US, consumption. However, it does have the potential to affect Peruvian access to the US market. At first sight this is a commercial rather than a nutritional question, although economics obviously can play important role in nutrition. The problem occurs when one considers the impact of the patent on INIA's priorities. INIA is concerned that its research and development work is largely redundant due to the foreclosure of the export option. The patent is clearly having a discouraging effect on INIA's efforts regarding Nuña varieties and the experience is likely to push INIA to avoid similar future experiences, and thus to limit the range of crops with which it works.

The second emerging negative effect of patents on agricultural research primarily involves public institutions. It relates to the question of control and is the result of the strategies of IPR trading or defensive patenting mentioned earlier. Public sector institutions begin aggressively seeking patents to either protect information and resources they have developed or to build a sufficient IPR portfolio to be able to trade or cross license for key information and resources held by others. To effectively combine such strategies with the service-oriented mandate of a public institution requires a very fine balance between the two. The most frequent result seems to be that this balance is not maintained and that the institution slowly shifts its focus towards the development of commercially attractive products. This undermines an institution's ability to self-evaluate on the basis of its production of research fitting the 'public good' model[146] and its goal of serving the needs of resource poor farmers. The main reason for the inability to maintain a balanced approach is that the cost of seeking and maintaining a broad IPR portfolio can be extremely high. When this is combined with the costs of negotiating access to the

proprietary resources and information of others it quickly becomes prohibitive for most developing country NARS, and probably also for the wealthier developed country NARS and the IARCs[147]. Even where an institution does manage to provide the finances required to implement a comprehensive defensive patenting strategy while resisting the pull towards commercially oriented research the situation can be problematic. The strategy contributes to the overall pattern of the privatisation of key biological material and inefficiently reallocates scarce finances away from productive research and into the unproductive strategy. Ultimately it is clear that patents have become a commercial tool and that, as such, their use is extremely difficult to reconcile with the primarily non-commercial purpose of public sector agricultural research. Public-sector institutions must guard...against transforming themselves into profit-seeking entities at the expense of conducting more fundamental research that does not have immediate market applicability.[148]

6.6 Plant Variety Protection

TRIPs Article 27(3)(b) requires that a WTO member provide protection for plant varieties, 'either by patents or by an effective sui generis system or by any combination thereof'. Countries are thus free to develop any form of PVP protection they wish.[149] However, the dominant standard to date is that of the UPOV Convention and that is what is considered here. As with patents, there is a significant cost factor with PVP. It is certainly less than the costs of patents, but litigation could potentially become expensive.

The UPOV standard of PVP is comparable to that of a patent in many respects. As an IPR it is a monopoly right on the commercial use of the plant variety. However, key distinctions do exist, primary among these being the farmer's privilege and breeder's exemption. The farmer's privilege allows states to grant 'reasonable' exemptions for small farmers to save and reuse protected seed on their own land. Given that smallholder seed systems examined in this study involve the frequent exchange of seed between farmers this is far from ideal but it is clearly far less restrictive than patent protection would be, assuming that states make use of the option. The breeder's exemption allows use of protected plant varieties as parents in further plant breeding. This again varies from the restrictive nature of patents in that the desirable genetic traits of a variety remain available to farmers and breeders alike. However, the concept of essentially derived varieties[150] may be problematic. If one considers the current problems with 'clearly distinguishing'[151] invention from nature in biological patents in some jurisdictions, the protection of varieties 'predominantly derived from the initial variety, or from a variety that is itself predominantly derived from the initial variety'[152], all of which may be protected under UPOV 1991, one may well have surpassed the interpretation of inventive step required for patents. Thus, in at least one aspect, there is a risk that

some interpretations of UPOV could be more restrictive than patents.

Apart from its potential to restrict access to germplasm there is a further difficulty with PVP in its interaction with traditional agricultural systems. PVP is concerned with only one type of plant variety, the type that fits its criteria. The distinct, uniform and stable criteria exclude the enormous number of landraces and farmers' varieties upon which elite varieties, and crop diversity in general, are based. This is not to say that PVP should be extended to landraces and farmers' varieties. Rather, its potential impact in terms of promoting genetic uniformity both in the field and the marketplace should be thoroughly examined in any country where small farmers make up a significant proportion of the agricultural economy or population. Rangnekar proposes a review of the impacts of plant breeder's rights on agricultural research; in particular as regards the agronomic qualities of new varieties released[153]. Such a proposal would seem to be justified when one considers the evidence from this study showing that very few varieties of direct relevance to smallholder farmers are being made available to them.

A final point to note regarding PVP is that if the current trend, in both developed and developing countries, of a rapid increase in the patenting of plant components, such as genes, nucleic acid sequences or gene transformation processes[154] continues, PVP may, in many cases, become redundant, as instead of a limited protection on the uses of seed, patents will provide complete control of the genetic structure of the seed[155].

6.7 Conclusion

The realities of the risks inherent in public sector IPR strategies are readily apparent in the current situation in Kenya. In common with many other developing countries, Kenya's national agricultural research system maintains a divide between agricultural research and the dissemination of its products. The Kenya Agricultural Research Institute (KARI) develops some 90 – 95% of improved seed available in the country. The Kenya Seed Company has an exclusive relationship with KARI and dominates seed multiplication and distribution. Between them these two parastatal institutions thus control the vast majority of the germplasm that is the basis of agricultural production in Kenya. Plant variety protection is currently being granted for this germplasm out of concern that failure to do so will make it vulnerable to misappropriation, a classic defensive strategy. The rights are generally being granted to the two institutions jointly but Kenya Seed seems particularly keen to maintain control. Given that the Government of Kenya is unlikely to seek to restrict the activities of smallholder farmers this should not be problematic. However, the Government of Kenya is being pressured to privatise parastatals as part of its programme of structural adjustment, latterly poverty alleviation. Kenya

Seed is a prime candidate for privatisation and with international consolidation in the seed sector it is not impossible to imagine Kenya Seed being privatised and rapidly purchased by a multinational[156]. Such a situation would potentially give the purchaser control, via IPRs, of the vast majority of Kenya's improved plant genetic resources for food and agriculture.

The current effects of IPR on the exchange of biological resources and related information are that we are entering a period where exchange is based on proprietary control rather than the historical free flow. Agro-biotech multinationals and plant breeders, given their investments of funds and time respectively, are unlikely to change their strategies on this. The public sector, in both developed and developing countries, seems to be responding by following suit, sometimes only to defend the germplasm and information it has developed but often also to trade for private sector rights, or even to generate profit. The trend of the privatisation of improved material, genetic components and related information has been matched regarding traditional varieties and wild genetic material by most countries' proprietary interpretations of the CBD's twin concepts of sovereign rights and access to genetic resources. It is clear that in this situation there is the risk of a snowball effect; as more actors privatise the resources they control the cost of not doing so increases for those who remain outside the trend. They have nothing to trade for access but need it nonetheless due to the tremendous interdependence of geographical regions and actors for biological resources and information. There is a real possibility that we will soon be in a situation where the entire agricultural system has been effectively privatised.

The question is whether, on balance, agricultural research will benefit from, or at least not be harmed by, a privatised system? In the case of agro-biotechnology the answer, with certain caveats, is probably that it will be of benefit. A privatised system does seem to allow for the leveraging of the enormous sums required in a far more efficient manner than the public sector could ever achieve. However, the caveats are also significant. One is that privatisation of resources and consolidation seem to go hand in hand and consolidation brings major risks of anti-competitive practices, meaning that government oversight of the agro-biotech industry must be proactive[157]. A second caveat is related to the first in that one must be prepared for the disappearance of smaller actors who do not have competitive means to leverage either finance or access to biological resources. The third caveat is what impact this will have on other sectors, including both traditional plant breeding and pest management and non-commercial agriculture.

The lack of any demarcation between the high investment, largely private sector agro-biotechnologies, and the lower investment, largely public sector, traditional technologies is likely to create fundamental

problems for traditional plant breeders and informal agriculture. The privatisation of the basic raw materials of agro-biotech, formal plant breeding and small farmers, i.e. germplasm, through the protection of plant component patents may well overtake PVP. Even if it does not, the need to maintain a broad portfolio of rights to be able to trade for the rights of others, given the wide range of plant varieties that go into the production of a new variety, means that small players will be squeezed out. This could well include the majority of plant breeders, as at the international level even significant national players have little leverage.

This will result in a lower flow of genetic material and thus a smaller number of less effective products. The agriculture research sector will be focused on narrow, niche-market, products with the highest profit margins possible. They will thus be broad application products dependent on an extensive use of inputs. They will be targeted at commercial farmers and with only limited adaptation to local conditions, with what adaptation there is based on the needs of the large markets in developed countries. Such a scenario stands in stark contrast to the idea that, the public sector...will yield the largest social returns if it continues to focus on research directed at carefully identified problem areas and research with clear public good components.[158] Benefits to small farmers and developing countries, if they occur at all, will be incidental. Some commentators have gone further and suggest that the aggressive expansion of intellectual property rights is leading the agricultural research sector into a 'tragedy of the anti-commons' where, too many property rights may lead to [an] underuse of research resources...in which innovation is delayed or deterred altogether.[159]

The key point to note here is that it is not the mere existence of IPRs that has created this situation, it is rather the way that they have been interpreted in recent years and, in particular the way that they have developed in the agricultural sector. Patents on plant components are clearly central to the problem as while they are targeted at one sector, agro-biotech, they are impacting others, i.e. traditional plant breeding and informal agriculture.

7. Conclusion

The various sections of this study have included conclusions as to the current situation in several key sectors of direct relevance to smallholder agriculture. When considered together they point towards a possible pattern. This is that IPRs have not, in most sectors relevant to smallholder agriculture, created any significant harm. In both Cusco and Kitui there is no significant presence of IPR protected seeds and there is no real evidence of problems with fertilisers or livestock. However, the fact that the reason one can say there is no significant harm is that there is little or no presence of improved seeds or other products in these regions does suggest that there is a problem. This problem is that the research and development incentive patterns created by IPRs do not encourage products suitable for smallholder farmers. The past two decades have been characterised by the expansion of IPRs, both in terms of technical fields and geography, and they have become a major factor in decision-making in agriculture, in both the private and public sectors. Already marginalised smallholder farmers are faced with an even further deterioration in their competitive position vis-à-vis the commercial sector, and perhaps some 'post-Green revolution' areas, due to the enormous resources being devoted almost exclusively to enhancing the production levels and cutting the costs of the commercial sector. Furthermore, if current trends in IPR development continue it seems likely that the level of enforcement of such rights, which is currently non-existent in regions such as Kitui or Cusco, will increase. In countries like Kenya and Peru, the private sector will pressure governments to implement laws that have thus far been little more than paper beyond key export sectors such as horticulture. The public sector will also encourage governments in many cases, as its perception that IPRs are necessary for defensive purposes or to deal with the private sector will lead it down that path.

The lack of effective research and development activities targeting smallholder farmers leaves this sector excessively vulnerable to natural catastrophes, such as drought and pests, thus creating enormous unpredictability in its contribution to national food systems. When this is considered in the context of advances benefiting the commercial sector, it is clear that there will be a reduction in the comparative competitiveness of the smallholder sector, thus inhibiting production that is surplus to subsistence needs. In addition, the undermining of the smallholder agricultural system through the possible extended implementation of IPR regimes may exacerbate concerns regarding vulnerability and competitiveness, while also directly threatening the subsistence livelihoods of smallholder farming households. Threats to the smallholder sector have enormous direct and indirect consequences for developing countries. In direct terms the undermining of the subsistence livelihoods of smallholder farming households creates a nutritional crisis for what is a large proportion of

the population of most developing countries. In indirect terms, reductions in the surplus production of the smallholder sector threaten the national nutritional security of many developing countries due to the dependence of the national food system on this sector for many key food crops.

A number of detailed measures may be necessary to address these problems in any given country depending upon its particular situation and development strategies. However, for any country with a significant proportion of smallholder farmers, and perhaps also for those developed countries with research institutions focusing on the needs of developing country smallholder farmers, three broad policy approaches would seem advisable:

- Recognition that intellectual property rights, including *sui generis* plant variety protection under Article 27.3(b), should not extend to the prohibition of activities undertaken by smallholder farmers, in particular as regards the saving, use, exchange and sale of farm-saved seed.
- TRIPs, and national legislation modelled to its requirements, should allow for the creation of incentives for research targeted at smallholder farmers. Given that the poverty of the smallholder agricultural sector is unlikely to allow for the effective use of market-based mechanisms, such as IPRs, creating space for such incentives to be created through means other than intellectual property rights should be considered. One element of this might be efforts to ensure the integrity of the public domain.
- The possibility of limited exceptions to intellectual property rights should be considered where protected products might be adapted to the needs of smallholder farmers. Such exceptions should allow for any research and development necessary but also for manufacturing, or multiplication in the case of seed, and distribution. They should also be sufficiently clear, and ideally not subject to a case-by-case negotiation and permission process as is required with the current system of compulsory licensing.

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Annex: Data Summary Tables

Table 3 – Data Summary, Kitui Region, Kenya.

ID#	Total Land	Land Farmed	Crops Planted	Seeds Received	Seeds Provided	Source of Seeds	Saved Seed	Certified Seed Planted	Certified Seed Bough	Livestock	Fertilizer	Pesticides	Sale/ Exchange	Other Income	No. Supported by Farm
1	6 acres	3 acres	4	Yes	No	Save, buy from neighbours and buy food seed	Yes	2nd generation	Bought 2nd generation from neighbour	Yes	No	No	No	Yes	9
2	5 acres	3 acres	4	Yes	No	Save, buy from neighbours and buy food seed	Yes	2nd generation	Bought 2nd generation from neighbour	Yes	No	In extreme circumstances	Sale	Yes	7
3	1 acre	1acre	5	Yes	No	Save, buy from neighbours and buy food seed	Yes	No	No	Yes	No	No	Sale	Yes	4
4	3.75 acres	3.25 acres	18	Yes	Yes	Saves, buys food seed, borrows from relatives, company demonstration	Yes	Yes	Not since 1956	Yes	Used to but stopped due to cost. Preparing composite manure for next season	Food storage and vegetables	Sale	Yes	N/A
5	1.5 acres	1 acre	10	Yes	Yes	Saves, buys food seed, exhanges, company demonstration and some certified purchased	Yes	Yes	Yes	Yes	Yes, manure and commercial. Experiments with organic	Yes, some commercial for vegetables and storage. Experiments with traditional.	Sale	Yes	N/A
6	2 acres	1/2 acre	11	No	Yes	Saves, buys food seed and some certified purchased. Rarely borrows.	Yes	Yes	Yes (1/3seasons)	Yes	Yes	Yes, storage and vegetables. Would like for fruit but too expensive.	Yes, but not grains	Yes	4
7	2.5 acres	1 acre	12	No	Yes	Saved, buys certified	Yes	Yes	Yes (1/2 seasons)	Yes	Manure	Yes, storage and vegetables. Not happy with effectiveness	Sale	Yes	7
8	3 acres	3 acres	13	No	Yes	Saves, bought certified once	Yes	Yes, vegetables	Once (vegetables every season)	Yes	Always for vegetables, last season first time for other crops.	Yes, storage and vegetables	Sale	Yes	5

9	1.5 acres	3 acres†	13	Yes	Yes	Saves, buys food seed, buys certified	Yes	Yes (vegetables every season, grains max 25%per season)	Yes	Yes	Mixes fertiliser and compost (since 1993)	Yes, storage and vegetables	Fruit and vegetables sold	Yes	7
10	(200 acres) Excluded from average as clearly unusual for area	(15 acres)	9	No	Yes	Saves (originally mix of certified composites and food grain), experimented once with hybrid.	Yes	Once, experiment	Once, experiment	Yes	Manure, experiment with manure/ commercial fertiliser mix	Yes, storage	Sale, depending on market price	Yes	1.5††
11	2 acres	1 acre	11	Yes	Yes	Saves, buys food seed, given composite once, bought hybrid once	Yes	Yes	Once, experiment	Yes	Manure, experiment with manure/ commercial fertiliser mix	Yes, storage	No	Yes	8
12	7 acres	5 acres	5	Yes	Yes	Saves, buys composite, buys food seed	Yes	Yes (1/year)	Yes	Yes	Manure	Yes, storage of food and seed	Yes	Yes, erratic	2
13	9 acres	7 acres	7	Yes	Yes	Saves, buys food seed, certified vegetable seed,	Yes	Yes, vegetables	Yes, vegetables	Yes	Manure, occasionally fertiliser for vegetables	Yes, storage	Yes	No	8
Averages	3.69 acres	2.65 acres	9.38	69.23% Yes 30.77% No	76.92% Yes 23.08% No	100% save, 76.92% buy food seed, 46.15% from neighbours/ relatives, 76.92% have used certified	100% Yes	76.92% Yes (23.08% only vegetables or only once), 7.69% No, 15.38% 2nd generation only	46.15% Yes 15.38% No 15.38% 2nd generation 23.08% Once	100% Yes	76.92% Yes 23.08% No 61.54% Manure 23.08% Organic 53.5% Commercial	23.08% No 76.92% Food Storage 7.69% Seed storage 46.15% Vegetables 0% in field other than vegetables	84.62% Yes 15.38% No	92.31% Yes 7.69% No	5.7

Notes. * When 20 farmers were questioned as a group only 1 bought certified seed every season. ** When 20 farmers were questioned as a group 11 consistently saved seed. † 2 acres rented.

†† 1 full time, 1 at weekends.

Table 4 - Maize Data Summary, Kitui Region, Kenya.							
ID#	Varieties Planted	Source of varieties	Seed Received	Seed Provided	Planting	Selection	Preferences
M1	Kikamba (8kg), Pioneer (2kg)	Kikamba - bought food seed in 1994. Pioneer - bought for first time last season. Won't plant this season due to rains and next season will plant saved Pioneer not buy.	Received Kikamba from two sources. Thinks wider exchange will raise productivity.	Gives Kikamba to 4-5 people / season	Separately, but in close proximity	Early maturation but also looks for general quality. Selects and marks in the field for separate harvest.	Likes Kikamba due to early maturation. Hasn't tried composites or hybrids other than Pioneer due to cost - not against it.
M2	Kikamba (4kgs/season), Makueni (2-4kgs/season), Pioneer (1kg, only last season)	Kikamba - Grandmother in 1992, food grain (1kg last season). Makueni - has bought for at least 6 years. Pioneer - bought as experiment	Receives Kikamba once / 2-3 years. Local as trust is a big issue.	Gives Kikamba to about 5 people / season	Separately, but in close proximity	Cob size and no. of grains - post harvest	Kikamba - for drought resistance. Trusts it as reliable in bad rains.
M3	Kikamba, Makueni	N/A	Received Kikamba from one source	No	N/A	N/A	N/A
M4	Kikamba, Makueni	N/A	Received Kikamba from one source	No	N/A	N/A	N/A
M5	Kikamba, Makueni	N/A	Exchanges Kikamba, buys food grain	No	N/A	N/A	N/A
M6	Kikamba, Makueni	N/A	Exchanges Kikamba, doesn't purchase	No	N/A	N/A	N/A
M7	Kikamba, Cargill 41/41	N/A	Exhanges Kikamba, never purchased. (Cargill is a first time experiment)	Gave saved Makueni to mother.	N/A	N/A	N/A
M8	Kikamba, Makueni (3kg), Katumani (3kg), Pioneer (2kg)	Kikamba - 1998 bought approx. 6kgs food grain (thinks from Kitale), 3kgs Makueni and 3kgs Katumani and mixed the three. Saved since then. Makueni - bought but only the one time. Katumani - bought but only the one time. Pioneer - bought as experiment last season.	None. Likes idea of wider exchange - would try in experimental plot before mixing.	Gives Kikamba to 5/season	Pioneer planted separately at some distance (300m+).	N/A	Kikamba - good pest and disease resistance and better than composites in average - good rains. Kikamba good flavour (sweet) and easy processing. Katumani and Makueni - thinks better in drought. Pioneer - good with inputs and good rains but too expensive and thinks with same inputs Kikamba would be as good. Pioneer - watery flavour and difficult processing.
M9	Kikamba (4kg), Makueni (1kg), Pioneer (1kg).	Kikamba - originally given by mother but lost in 1999 drought. Bought food grain to replace. Makueni - given by government. Pioneer - bought as experiment in 2000.	None. When does receive restricted to family.	Gives Kikamba to 5/season	Makueni imediately mixed in with Kikamba. Pioneer planted separately but close.	Looks for early maturation in field and long, straight cobs with good grains post harvest.	Kikamba - good pest and disease resistance and better than composites in average - good rains. Kikamba good flavour (sweet) and easy processing. Makueni - thinks better in drought. Pioneer - good for yield in good rain but not good for food preparation and longer maturation, also too expensive.

M10	Kikamba	Kikamba - given by relative.	Received once.	None.	N/A	N/A	Kikamba - good pest and disease resistance and better average yield, provides in drought and good in average-good rains. Also likes flavour and preparation qualities.
M11	Kikamba, Makueni	Kikamba - food seed 4kg/season. Makueni - bought 2kg once.	None.	Gives 2/season.	Mixed.		Kikamba - good pest and disease resistance and better average yield, provides in drought and good in average-good rains. Also likes flavour and preparation qualities.
M12	Kikamba, Makueni, Katumani	Kikamba - food seed 2kg/season. Makueni and Katumani given by government.	None.	Gives 2/season.	Mixed.	N/A	Kikamba - good pest and disease resistance and better average yield, provides in drought and good in average-good rains. Also likes flavour and preparation qualities.
M13	Kikamba, Cargill 41/41, Pioneer	Kikamba - food seed 4kg/season, mixed with exchanged seed. Cargill and Pioneer - given as demostration (hasn't planted Pioneer yet).	Average 2/season.	Gave 7 people last season.	Separately, but in close proximity	N/A	Kikamba - good for pest and disease resistance, flavour and preparation. Likes certified for yield but finds cost prohibitive of wider use.
M14	Kikamba, Cargill 41/41, Pioneer, Makueni	Kikamba - mix of saved and food seed. Certified are mix of purchased and demonstration seed.	N/A	N/A	Separately, but in close proximity	N/A	Likes composites and hybrids but cost of seed and commercial inputs too high. Also concerned about residues and runoff of commercial inputs. Likes Kikamba as security against combination of drought and pests/disease.
M15	Kikamba (8kg), Katumani (2kg), Makueni (2kg once)	Kikamba - originally borrowed from neighbour (c. 1995). Idea of mixing in Katumani and Makueni to maintain vitality understood. Katumani - buys 1/3 seasons. Makueni - given by government c. 1992.	None.	Gives to 3-4 people/season + school. Usually different people each season depending on need. Is aware that people who borrow seed borrow from several sources. Likes idea of wider exchange.	Mixes all varieties. Neighbouring fields with mix of varieties < 100metres.	Quality of grains post-harvest. Will switch to selecting in field as learnt in farmer field school.	Kikamba - preparation qualities and pest / disease resistance. Likes Katumani for drought resistance and yield but discouraged by cost.
M16	Kikamba (6kg), Makueni (1kg), Katumani (2kg)	Kikamba - originally certified seed (thinks hybrid) c. 1987. Makueni - bought but not every season. Katumani - bought but not every season. Does not plant any variety (incl. Kikamba) every season and Makueni and Katumani often saved for a second season. E.g Last season 6kg Kikamba, 1kg of saved Katumani. This season only 2kg new Makueni as thinks rains will be bad.	None.	Gave to 10 people last season, none this season. Depends on rains. Not sure about idea of wider exchange as not sure of quality.	Separately, but in close proximity. Aware of cross-pollination from neighbours and thus prefers fresh seed.	N/A	Makueni - early maturation so good if rains bad. Would consider abandoning Kikamba if Makueni good this season - cost not a factor as husband (businessman) buys seed.

M17	Kikamba, Katumani, Makueni.	Kikamba - mixture of food seed and bought from neighbours. Katumani and Makueni - both saved seed bought from neighbours.	Yes but bought. Likes the idea of wider exchange but concerned about cost of seed and need for inputs.	No.	Planted separately but so close that effectively mixed.	Quality of cob - post-harvest.	N/A
M18	Kikamba, Katumani	Kikamba - mixture of food seed, bought from neighbours and saved. Katumani - saved seed bought from neighbour.	Yes but bought. Likes the idea of wider exchange but concerned about cost of seed and need for inputs.	No.	Mixed.	Quality of cob - post-harvest.	N/A
M19	Kikamba	Kikamba - bought from neighbours.	Yes but bought. Likes the idea of wider exchange but concerned about cost of seed and need for inputs.	No.	N/A	Quality of cob - post-harvest.	N/A
M20	Kikamba (20kg), Katumani (10kg)	Kikamba - originally 2nd generation Katumani purchased from neighbour. Katumani - buys every other season (1/year).	No. Likes the idea of wider exchange as will help many people buy better seed. Thinks mixture of purchase and borrowing would be good.	Gives approx. 10 / season.	Planted separately but so close that effectively mixed.	Maturation.	Kikamba - likes for yield in good rains. Katumani - 1st generation matures earlier than 2nd generation or Kikamba so good in drought.
M21	Kikamba (25-30kg)	Kikamba - originally given by grandmother c. 1970 but buys 5kg food seed 1/year to mix in.	No. Likes the idea of wider exchange, particularly for those with no seed or money.	No.	N/A - but food seed and Kikamba mixed.	Maturation.	N/A
M22	Kikamba, Katumani (2kg)	Kikamba - originally from Ethiopia c. 1970. Last season mixed US relief grain with Kikamba in separate plot. Katumani - given as demonstration, first time last season.	No.	Gives approx. 6/season.	Separately. However, neighbours fields <100m so cross-pollination.	Quality of cob - post-harvest - then takes grains from centre of cob for seed.	Likes Katumani for yield but Kikamba for pest and disease resistance.
M23	Kikamba, Katumani, DH1	Kikamba - saved, food grain and exchanged. Katumani - bought. DH1 - given as demonstration.	Yes - from 1 source.	Gives approx. 2/season.	Separately.	N/A	Kikamba - for pest and disease resistane. Makueni for drought resistance.
M24	Kikamba, Katumani, 511, Makueni.	Kikamba - saved, food grain and exchanged. Katumani and 511 - bought. Makueni - given as demonstration.	Yes - from 1 source.	Gave to 15 last season.	Separately.	N/A	511 for yield. Kikamba for pest and disease resistance and low inputs. Makueni for drought resistance.
M25	Kikamba, Makueni	Kikamba - saved, food grain and exchanged. Makueni - 2nd generation.	No.	Gave to 4 last season.	Separately.	N/A	Makueni for early maturation, i.e. drought resistance. Otherwise depends on season and rains.

M26	Kikamba, Katumani, DH1, Makueni, Pioneer	Kikamba - saved, food grain and exchanged. Others all bought.	Yes - from 1 source.	Gave to 20 last season.	Separately.	N/A	Makueni for drought resistance. Kikamba as has better biomass than Pioneer and is good for consumption (sweeter) but is late maturing.
M27	Kikamba, Katumani, 511.	Kikamba - saved, food grain and exchanged. Katumani and 511 - bought.	Yes - from 2 sources.	Gave to 15 last season.	Separately.	N/A	Kikamba for resistance and flavour. Makueni for early maturation.
M28	Kikamba, Katumani, 511, DH1, Makueni, Cargill 41/41.	Kikamba - saved, food grain and exchanged. Katumani - bought. 511, DH1, Makueni and Cargill 41/41 - gven as demonstration.	Yes - from 1 source.	Gives to approx. 10/season.	Separately.	N/A	Kikamba is favourite due to resistance to pests and disease. DH1 for yield in good rains. Makueni for early maturation.
M29	Kikamba, Katumani	Kikamba - saved, food grain and exchanged. Katumani - given as demonstration.	Yes - from 3 sources.	Gives to approx. 12/season.	Separately.	N/A	Kikamba for flavour and preparation qualities.
M30	Kikamba, Makueni	Kikamba - saved, food grain and exchanged. Makueni - given as demonstration.	Yes - from 1 source.	Gives to approx. 4/season.	Separately.	N/A	Kikamba for resistance. Makueni for early maturation.
M31	Kikamba, Pioneer, Makueni	Kikamba - saved, food grain and exchanged. Pioneer and Makueni - given as demonstration.	None.	None.	Separately.	N/A	Likes Makueni for early maturation but would never leave Kikamba as more reliable overall.
M32	Kikamba, Katumani, DH1, Pioneer, Cargill 41/41, 511.	Kikamba - saved, food grain and exchanged. Katumani - bought. DH1, Pioneer, Cargill 41/41, 511 - given as demonstration.	Yes - 1 source/season.	Gives to 5/season.	Separately.	N/A	DH1, Cargill, 511 if rain. Kikamba and Katumani for pest and disease resistance.
M33	Kikamba, Pioneer, DH1, Makueni, WS202, WH909, Katumani.	Kikamba - saved, food grain and exchanged. Pioneer, DH1, Makueni, WS202, WH909, Katumani - given as demonstration.	None.	Gives to approx. 10/season.	Separately.	N/A	Pioneer, Makueni and 513 for yield in good rains but would never leave Kikamba as more reliable.
M34	Kikamba, Katumani, 511, 513, DH1, DH2, Makueni, Pioneer, Cargill 41/41.	Kikamba - saved, food grain and exchanged. Katumani, 11, 513 - bought but often saves 2nd generation. DH1, DH2, Makueni, Pioneer, Cargill 41/41 - given as demonstration.	From government to multiply or village.	gives to whole village - > 12/season.	Separately.	N/A	513, 511, Cargill 41/41 - has a stream on land and thus almost permanent source of water. In general prefers hybrids and composites to Kikamba.
Averages	Kikamba- 100%. On average farmers have tried 2.12 composite and hybrid varieties at least once.	N/A	From 0.67 sources.	To 5 people.	N/A	N/A	Of those who expressed a preference - Kikamba - 80.77%, Makueni - 7.69%, Katumani - 3.85%, 511 - 3.85%, 513 - 3.85%.

Table 5 - Data Summary, Lares Region, Peru.																		
ID#	Land Ownership	Total Land††	Land Farmed††	Crops Planted	Varieties Planted	Seeds Received	Seeds Provided	Source of Seeds	Saved Seed	Certified Seed Planted	Certified Seed Bought	Livestock	Fertilizer	Pesticides	Sale/ Exchange for Food	Sale/ Exchange for Cash	Other Income	No. Supported by Farm
1	Communal	1 Hect	1 Topo	3	3	No	Exchange	Saved	Yes - no specifics	No	No	N/A	Manure	No	Barter	Sale	No	10
2	Private	2 Hect	1 Hect	6	20*	No	Sale	Saved	6 Crops 20 Varieties*	No	No	Yes	Manure	No	Sale and Barter	Sale	Yes	9
3	Communal	3 Hect	2 Hect	8	N/A	Barter and Purchase	Sale and Barter	Saved	Yes - no specifics	Yes	Yes	N/A	Manure	No	Barter	Barter	Yes	4
4	Communal	3 Hect	3 Topos	6	10**	Barter	Barter	Saved	Yes - no specifics	Yes	Yes	N/A	Manure	No	Barter	No	Yes	6
5	Communal	2 Hect	2 Topos	7	N/A	Barter	Barter	Saved	Yes - no specifics	Yes	Yes	N/A	Manure	No	Barter	Sale and Barter	Yes	5
6	Communal	1 Hect	1 Topo	7	N/A	No	No	Saved	Yes - no specifics	No	No	N/A	Manure	No	Barter	Sale and Barter	No	4
7	Communal	3 Hect	3 Topos	7	N/A	Barter	Barter	Saved	1 Crop	Yes	Yes	N/A	Manure	No	Barter	Sale and Barter	Yes	5
8	Private	3 Topos	2 Topos	3	4**	No	Sale	Ancestors	3 Crops	No	No	No	Manure	No	No	Barter	Yes	5
9	Communal	5 Topos	4 Topos	3	N/A	Barter	Barter	Saved	Yes - no specifics	Yes	No	N/A	Manure	No	Barter	Barter	No	4
10	Communal	2 Hect	2 Topos	8	N/A	Barter	Barter	Saved	Yes - no specifics	Yes	Yes	N/A	Manure	No	Barter	Sale and Barter	Yes	2
11	Communal	1 Hect	4 Topos	4	N/A	Barter	Barter	Saved	Yes - no specifics	Yes	Yes	N/A	Manure	No	Barter	Barter	Yes	3
12	N/A	N/A	8 Topos	7	N/A	N/A	N/A	N/A	3 Crops	No	No	N/A	Manure	No	No	Sale	Yes	7
13	Communal	Parcelas	5 Topos	8	N/A	Barter	Barter	Community	5 Crops	From Village	From High Altitude Zone	No	Organic	No	Sale and Barter	Barter	Yes	4
14	Communal	4 Topos	3 Topos	7	N/A	Exchange with other villages. Hybrids from government	Sale and Barter	Local, other villages, government and saved	7 Crops	Yes but always mixed with saved	No	Yes	Organic	Yes	Sale and Barter	Barter	Yes	8
15	Private	0.5 Topo	0.5 Topo	1	4	Barter	Barter	Saved	1 Crop 4 Varieties	No	No	Yes	Manure	No	No	No	No	4

16	Private	3 Topos	1.5 Topos	1	5	No	No	Saved	1 Crop 5 Varieties	No	No	No	Manure	No	No	No	No	3
Averages	26.67% Private 73.33% Communal	1.66 Hect	1.02 Hect	5.38	7.67†	Barter 66.67% No 33.33% Purchase 6.67% Donation 6.67%	Barter 73.33% Sale 26.67% No 3.35%	100% Local 6.67% Local and others	100% Yes 3.38 Crops† 9.7 Varieties†	50% Yes 43.75% No 6.25% 2nd Generation	56.25% No 37.5% Yes 6.25% 2nd Generation	50%	87.5% Manure 12.5% Organic	93.75% No 6.25% Yes			68.75% Yes 31.25% No	5.19
Notes. * No. of Varieties not given for 4 crops. ** Varieties only given for potato. † Based on Limited Data Provided.																		
†† 1 Hectare = 3 Topos. 1 Topo = 2 Yuntas.																		

Table 6 - Data Summary, Pisac Region, Peru.																	
ID#	Land Ownership	Total Land*	Land Farmed*	Crops Planted	Varieties Planted	Seeds Received	Seeds Provided	Source of Seeds	Saved Seed	Certified Seed Planted	Certified Seed Bought	Livestock	Fertilizer	Pesticides	Sale/ Exchange for Food	Sale/ Exchange for Cash	Other Income	No. Supported by Farm
1	Communal	3.5 Hect	4 Topos	12	54	Purchased	No	Community Ancestors	5 Crops 28 Varieties	Yes	Yes	Yes	Manure	No	Sale and Barter	Barter	No	9
2	Communal	5 Hect	N/A	8	40	Purchased	No	Community Ancestors	5 Crops 33 Varieties	Yes	Yes	Yes	Manure	No	Sale and Barter	Barter	No	7
3	Communal	4 Hect	7 Yuntas	8	42	Purchased	No	Ancestors, exchange within community and barter with others	3 Crops 29 Varieties	Yes	No	Yes	Organic	No	Barter	Barter	Yes	4 (familias)
4	Communal	5 Hect	4 Yuntas	10	31	Purchased	No	Community Ancestors	4 Crops 14 Varieties	Yes	Yes	Yes	Manure	No	Barter	Barter	Yes	7 (familias)
5	Communal	9 Hect	9 Yuntas	6	53	Purchased	No	Community Ancestors	5 Crops 50 Varieties	Yes	Yes	No	Manure	No	Sale and Barter	Barter	N/A	N/A
6	Communal	2 Hect	3 Yuntas	11	48	Ancestors	Exchange	Community Ancestors	1 Crop 10 Varieties	No	No	Yes	Manure	No	Sale	Barter	Yes	3
7	Communal	5 Hect	6 Yuntas	5	40	Purchased	No	Ancestors, exchange within community and barter with others	3 Crops 36 Varieties	Yes	Yes	Yes	Organic	No	Barter	Barter	Yes	8 (familias)
8	Communal	4 Hect	6 Yuntas	11	58	Ancestors	Exchange	Community Ancestors	2 Crops 31 Varieties	No	No	Yes	Manure	No	Sale	Barter	N/A	6
Averages	100% Communal	4.69 Hect	1.03 Hect	8.88	45.75	75% Purchase 25% Inherited	25% Exchange 75% No	75% local 25% local and others	3.5 Crops 28.88 Varieties	75% Planted	62.5% Bought	87.5% Own	75% Manure 25% Organic	0%	37.5% Both 37.5% Barter 25% Sale	100% Barter	66.7% Yes	6.29
* 1 Hectare = 3 Topos. 1 Topo = 2 Yuntas.																		

References

[1] This is not simply a question of respect for the skill of these experts but also draws upon the Statute of the International Court of Justice (ICJ) that establishes the opinions and writings of leading experts as a recognised source of international law. Article 38(1)(d), Statute of the International Court of Justice (1945).

[2] See Drahos, P., 2001. *Negotiating intellectual property rights: between coercion and dialogue*. Paper presented at the *Oxfam International Seminar on Intellectual Property and Development: What Future for the WTO TRIPs Agreement*, held in Brussels, Belgium, March 20, 2001. Draft available from the author at p.f.drahos@qmw.ac.uk.

[3] United States, Europe, Japan and Canada.

[4] Sell, S.K., 2002. TRIPs and the access to medicines campaign (2002). Paper presented to the conference *Access to Medicines for the Developing World: International Facilitation or Hindrance?*, held at the University of Wisconsin Law School, Madison, Wisconsin, March 9-10, 2002. (Available from the author, email address: sellskgw@gwu.edu).

[5] It should be noted that, according to the common law principle of *contra proferentum*, if it were established that one group had a clear understanding of the meaning of Article 8(1) while another group was aware of the likelihood of future ambiguities the interpretation of the former group would prevail. A related relevant principle of common law is that the interpretation of the primary drafter, if such exists, is generally given least weight on the basis that the primary drafter has a disproportionate influence on the outcome, particularly through ambiguous provisions. In the case of the history of TRIPs this would suggest that the interpretations of developing countries should have greater weight than those of the Quad countries. These principles would be relevant on the basis that they constitute part of the general principles of law recognized by civilized nations, both at a national level and according to the common standards of international commercial practice.

[6] Article 38(2), Statute of the International Court of Justice (1945).

[7] Article 36(1), Statute of the International Court of Justice (1945).

[8] World Food Summit Plan of Action, FAO 1996.

[9] *Success Stories in Food Security*, World Food Summit Technical Background Document 2 (FAO, 1996).

[10] Id.

[11] See *Success Stories in Food Security*, World Food Summit Technical Background Document 2 (FAO,1996) and *Food Security and Nutrition*, World Food Summit Technical Background Document 5 (FAO, 1996).

[12] *Food Security and Nutrition*, World Food Summit Technical Background Document 5 (FAO, 1996).

[13] Scialabba at 112.

[14] Mazoyer at 3.

[15] Scialabba at 109.

[16] Mazoyer at 3.

[17] Primarily plant variety protection (PVP) as the principal IPR on crop plants worldwide. Some work has also looked at patents, particularly in the context of biotechnology.

[18] FAO GAEZ. Data Set 04 Bean and Data Set 11 Maize.

[19] Id. Derived from *Land with Cultivation Potential for Cereal Crops, Low Input Level*. Cereals are taken as an indicator on the basis that maize is a key staple in both regions and due to the fact that beans, another key staple in both regions, generally fit similar land suitability patterns to maize. It should be recognised that the primary staple in the Cusco region, potato, has a higher level of local suitability.

[20] See Mazoyer.

[21] Squires and Sidahmed at xiii.

[22] Table derived from data available at, <www.kefri.org/kitui/rain.htm>.

[23] The majority of these totals falls in the two rainy seasons of October/November and March/April, nationally known as the short and long rains respectively. In Kitui the short rains constitute the primary growing season while the long rains are more of a supplementary growing season that is considered highly unpredictable. Several

farmers interviewed stated that this had been the case since approximately 1960, before which the long rains were the primary growing season. The two rainy seasons together make up some two thirds or more of total annual rainfall in Kitui.

[24] 'Relatively' is used in local, rather than national, terms.

[25] Ages are, with one or two exceptions, the author's estimates, as farmers were not directly queried on this.

[26] E.g. The Wakamba are believed to have been the first to introduce iron working to the region while today they are well known for woodcarving. See *Kamba*.

[27] See KEFRI.

[28] ANDES, personal communication.

[29] World Bank, 1994.

[30] At 1.03 and 1.02 hectares respectively, almost matching the 1.2 hectares found in Kitui.

[31] It has been suggested that approximately 1 hectare is the natural maximum land that can be farmed manually (using low input, non-mechanised, or non-animal traction, methods). Mazoyer at 6.

[32] Of the two primary regions studied Pisaq had an average landholding double that of Lares. The average landholding in Lares was 1.66 hect., comparable to that found in Kitui.

[33] Average areas farmed were almost identical in Pisaq and Lares.

[34] Proportions of the community with non-agricultural income were comparable in Pisaq and Lares.

[35] Households were marginally larger in Pisac than Lares.

[36] ANDES, personal communication, 2002.

[37] See <www.cipotato.org>.

[38] FAO, *Nutrition Country Profiles: Peru*.

[39] It should be noted in considering seed systems that seed laws and intellectual property rights legislation and policies should be mutually supportive. This issue is not considered here as it is beyond the scope of the study.

[40] Understood to include both seed and other propagating material.

[41] Insect resistance and herbicide tolerance are currently the most commonly inserted traits but recent high profile projects involving nutritional boosters may indicate a shift in this pattern, at least as far as developing countries are concerned.

[42] Neither country has approved the release of any transgenic crops although Kenya has ongoing field trials for a transgenic sweet potato and pending applications for field trials of transgenic maize and cotton.

[43] Certified seed is used as a proxy for improved seed. The reason for this is that certified seed is instantly recognisable and a common concept to rural farmers. All certified seed encountered in this study was improved and no first generation improved seed was encountered that wasn't certified.

[44] A large proportion of the improved seed that has been made available by the Government in the Cusco region, or at a minimum Pisaq on the basis of farmers' statements, in the past seems to have been timed to coincide with election campaigns rather than taking the form of coherent development projects.

[45] 'Borrowed' is placed in inverted commas as it is not a simple concept when involving informal seed exchange. Borrowing may involve some form of loan or a number of other permutations including barter and deferred payment in kind. The main variable seems to be the relative seed security of a given community; the greater the relative seed security the closer 'borrowing' is to a gift.

[46] The approximations are due to small variations between particular varieties and seed companies although the prices offered by the various sectors are remarkably consistent countrywide.

[47] This estimate was provided confidentially due to concern over the future activities of its authors.

[48] Although one should bear in mind that neither the private nor the public sector seed distributors in Kenya provide any kind of follow up service for small farmers and rural retailers, or in most cases even delivery.

[49] Several years ago farmers could count on the equivalent of US$15 to 20 for a

standard 90kg bag of maize, prices are currently around US$5.50 to 6 for a 90kg bag. Even at the low current prices the parastatal National Cereals and Produce Board has generally been unable to purchase much of the production of smallholder farmers due to financial difficulties.

[50] Several farmers were clear in stating that they did not trust the idea that hybrids would significantly lower in yield if saved and replanted, they felt it was simply a story by seed companies to maximise profits.

[51] The years since 1998 have been particularly adverse beginning with the El Nino floods and then three years of prolonged drought. However, farmers note fundamental shifts in local weather patterns dating back some forty years.

[52] This farmer's experiment with relief food as seed was encountered incidentally as the author noticed the harvested maize cobs being dried and queried their origin due to the visibly low quality of both cobs and grains. The farmer had not intended to hide this experiment when interviewed about his maize varieties but, rather, had not mentioned it, feeling it was irrelevant, because the planting was a small-scale experiment that was not a success. It would seem likely that if one farmer conducted such an experiment and reacted in such a manner then more have also done so.

[53] There is no doubt as to the origin of the relief food as US supplied grain is very clearly labelled as such.

[54] The farmer was not aware of the implications of the origin of the variety and, although not questioned on the issue, may not be aware of the existence and nature of transgenics at all.

[55] Between 100 and 200 metres is normally considered to be an adequate set aside for maize according to Kenyan regulations, which broadly reflect international standards.

[56] Pearce, F., *UN is Slipping Modified Food into Aid* at 5 (New Scientist, 19 September 2002). Available at <http://www.connectotel.com/gmfood/ns190902.txt>.

[57] 50% of WFP supplied grain, and all of USAID supplied grain, is of US origin while 25% of the US maize supply is transgenic and is routinely mixed with non-GMO grain during processing. It would seem likely that the grain supplied in Kitui did contain GMOs.

[58] Noting that these impacts can be environmental, socio-economic or trade related.

[59] Mutizwa Mukute, secretary-general of PELUM, a Harare-based regional ecological association. Quoted in IRIN, 2 July 2002.

[60] It was not possible to verify whether he actually uses hybrids or composites, the latter being more likely since this did not seem to be a one off experiment.

[61] ANDES, unpublished 2002.

[62] Results of research by ANDES and the Regional Research Centre for Andean Biodiversity (CRIBA) of the University of Cusco. For further information contact <andes@andes.org.pe>.

[63] For further details on all aspects of potato cultivation see <www. cipotato.org>.

[64] ANDES 2002, unpublished.

[65] Miller and Rossman at 221

[66] Kikamba is almost used as a generic term as it is applied not only to all informal crop varieties but also to livestock. In the latter case livestock tend to be categorised as cross-breeds, including both genuine cross-breeds and recognised distinct breeds, or Kikamba, meaning all other livestock bred according to traditional practices, whether intentionally or not.

[67] Rather it is based on something like the concept of 'what goes around comes around'.

[68] Informal sector seed brought for sale at the fairs was examined from a phytosanitary perspective but no other conditions were applied.

[69] The farmer in question also gave a date of 1970 for his introduction of the Ethiopian seed but it seems that it must have been earlier given his age and the fact of Kenyan independence in 1963.

[70] The farmer in question stated that he had never introduced any externally sourced seed as he felt that his Ethiopian seed was superior. Given that his crop was clearly subject to cross-pollination, it was only about twenty metres from that of the

neighbouring farmer, it clearly is subject to external sources. This contributes to the suggestion that cross-pollination is not well understood in the Kitui region. This was the only case of a farmer identifying his seed supply as consisting of a particular informal variety.

[71] Two exceptions to this pattern were encountered during this study. One is a farmer who rents a small amount of land in addition to their own. The second is a farmer who is considerably wealthier than the others and has a far larger total land holding that is fragmented, and most of which was not being farmed at the time of the interview.

[72] See for example Crucible (1994) at 43 and Rangnekar at 16.

[73] Rangnekar at 16.

[74] Kenya's parent legislation for PVP protection dates back to 1972 but was not practically implemented until 1994. Kenya joined UPOV under its 1978 version in 1999. Peru's implementation of PVP derives from Andean Pact Decision 345 of 1993.

[75] Dr. Evans Sikinyi, personal communication (2002).

[76] http://www.cipotato.org/market/impactcs/seedcase.htm

[77] The Kenyan Industrial Property Act expressly prevents the patenting of plant varieties that are eligible for PVP protection but is silent on the eligibility of other plant varieties, or the patenting of genetic components that may allow for the *de facto* control of varieties.

[78] European Communities at 2.

[79] Crucible (1994) at 49.

[80] European Communities at 2.

[81] Crucible 1994 at 17 and 24-25.

[82] Some commentators fear that promoting such shifts is innately unsustainable, e.g. ADNA 2001.

[83] Miller and Rossman at 219.

[84] Crucible (1994) at 4-5.

[85] Miller and Rossman at 224.

[86] IRIN 14 June 2002.

[87] Id.

[88] The text was adopted by the Thirty First FAO Conference in November 2001 and will enter into force upon its ratification by forty countries.

[89] See Dutfield at 104.

[90] Dutfield at 28.

[91] Article 5(1), UPOV (1978).

[92] Article 14(1), UPOV (1991)

[93] Article 14(2), UPOV (1991)

[94] Article 14(5), UPOV (1991)

[95] Dutfield at 28.

[96] Article 15(2), UPOV (1991).

[97] Id.

[98] UPOV 1991 does not provide any formal definition of 'essentially derived' but does provide an operative one in the text of Article 14(5). This operative definition is dependent on ambiguous terms such as 'predominantly derived' and 'essential characteristics' that leave the practical meaning of 'essentially derived' in the hands of national legislatures, or, more likely, administrative agencies.

[99] IRIN 1 August, 2002.

[100] Most recently the Report of the British Government's Commission on Intellectual Property Rights. Available at <http://www.iprcommission.org/graphic/documents/final_report.htm>.

[101] Crucible (1994) at 17.

[102] A concept common to many, and probably the majority of, traditional communities around the world and that can be detected in the discourses of the green movements in many modern societies.

[103] Miller and Rossman at 217.

[104] Miller and Rossman at 218.

[105] Beyond Silent Spring at 206. The University of Cusco has also expressed its desire

to establish a programme to conduct research on and implement alternative pest management techniques for the region. Ramiro, personal communication, March 2000.

[106] 'Recent' meaning within living memory, bearing in mind that several farmers were able to trace back, in detail, their sources of seed and seedlings at least 60 years.

[107] Despite this situation pests have been identified as a major limiting factor in fruit production in Africa. This fact is evidenced by the development of programmes such as the African Fruit Fly Initiative (AFFI), <http://www.icipe.org/cgi-bin/WebObjects/ICIPE.woa/wa/selectProject?projectTitle=The%20African%20Fruit%20Fly%20Initiative>

[108] As mentioned earlier there is a distinction between most improved and traditional crop varieties in this regard that has major significance in questions of seed supply.

[109] I.e. the economic concept of the 'time-value' of money is important to smallholder farmers and precludes most medium- to long-term investments.

[110] Usually hanging seed above the cooking fire so that it is consistently smoked.

[111] Problems relating to alien species are adequately dealt with elsewhere but the potential scope of the problem should be borne in mind. It is estimated that a 'minimum benchmark' for the economic impact of alien species, excluding weeds and pest control costs, in the USA between 1905 and 1991 is US$97 billion (1991 US$). United States Congressional Office of Technology Assessment 1993 at 68.

[112] The Government of Kenya is currently investigating the matter but at the time of writing there is no report on its conclusions.

[113] Miller and Rossman at 218.

[114] It is also possible that the interest of Kitui's farmers in organic solutions derives, at least in part, from disenchantment with reliance on synthetic products and the idea that they will solve all agricultural problems and renewed recognition of the need to base pest control strategies on understanding of ecosystems. Miller and Rossman suggest that modern science has arrived at a similar conclusion, even though it may have done so in a rather more expensive manner than farmers. Miller and Rossman at 217.

[115] Beyond Silent Spring at 61. The tying of pesticides with the products of biotechnology is generally aimed at providing similar benefits, particularly environmental and health safety from lower levels of insecticide and herbicide use, while also frequently having the added bonus of horizontal integration in the industry since the majority of the world's main agricultural biotechnology corporations are, or were, also the main agrochemical producers.

[116] Id at 62. 1996 Estimate.

[117] Id.

[118] As with pharmaceuticals, most countries require the registration of pesticides as a safety measure. Registration procedures usually require the provision information such as toxicity and stability data, which is often considered commercially sensitive.

[119] Id.

[120] Miller and Rossman at 220

[121] The phenomenon of focusing on favoured technical fields and neglecting others has been labelled as 'market-niche development'. *Multilateral Trade Negotiations on Agriculture: A Resource Manual* at 7 (FAO, 2000).

[122] In many cases no longer even legal for use in their countries of origin, DDT being the most obvious example of this.

[123] Beyond Silent Spring at 61.

[124] Although this cannot be ruled out as the indiscriminate use of inorganic fertilisers has had serious negative impacts on soil biodiversity, and thus agriculture, on numerous occasions. Miller and Rossman at 218.

[125] It should be noted that, even more then with seed, the absence of delivery services by manufacturers increases costs for suppliers and farmers while also limiting supply.

[126] Kenya has made efforts to encourage the use of utility models, or petty patents, for traditional knowledge but its industrial property legislation is potentially very broad on the question of isolation and purification depending on administrative

interpretations of invention vs. discovery. Peru has recently (June 2002) introduced specific legislation on the protection of traditional knowledge and generally has a more restrictive approach on the patenting of biological material.

[127] This was the primary concern of many in the alleged scandal involving the Red Maasai sheep, which is naturally resistant to worms, in Kenya. See Kikechi.

[128] Currently Kenya does, at least in theory, while Peru does not.

[129] One farmer in Kenya stated that the government, through the local District Commissioner, originally provided his cassava variety around 1940.

[130] Menon at 101.

[131] Where recognised, authors' rights, the right to recognition and to the integrity of a work, may be the key interest of authors rather than strict copyright.

[132] Computer software, where the idea and its expression are inextricable, may be an exception to this.

[133] TRIPs Section 7, Article 39.

[134] TRIPs Article 39(3).

[135] When Pakistani rice farmers wished to challenge RiceTec's patent on basmati rice the American law firm they contacted required a UK£300,000 deposit to accept the case. The Guardian, 15 September 1999, quoted in *A Recipe for Change: Food Security – The Key Issues for the WTO Ministerial Conference, Seattle, November, 1999* (ActionAid briefing pack, 1999).

[136] See Riley at 3.

[137] Pardey et al. IRRI and the CGIAR did not capture any of this benefit as they did not claim rights over the varieties in question.

[138] Future Harvest

[139] Given the global consolidation witnessed in agroindustry this is understood in the international context and thus even relatively powerful national entities fall into the category of small to medium.

[140] Riley at 3.

[141] Crucible (1994) at 10.

[142] The first patent granted, now lapsed, to a Kenyan organisation was in 1994 and covered a protein. Technically whole plants or animals may also be patentable under Kenyan law as the only explicit exclusion is for plants eligible for plant variety protection.

[143] Riley at 3 and Correa at 2.

[144] Heisey at 15.

[145] Marquis.

[146] Heisey at 15.

[147] See Visser et al.

[148] Shoemaker at 41.

[149] India has recently combined PVP and Farmers' Rights legislation and other countries are considering similar initiatives.

[150] UPOV 1991, Article 14(5)

[151] UPOV, Article 14(5)(a)(ii) and 14(5)(b)(ii)

[152] UPOV 1991, Article 14(5)(b)(i)

[153] Rangnekar at 22.

[154] Riley at 2.

[155] See European Patent Office

[156] There are already reports of Monsanto purchasing shares in South African rural agricultural cooperatives. Dr. Susan Arstall, personal communication.

[157] See Shoemaker at 36.

[158] Heisey at 15.

[159] Shoemaker at 37.