

**9th ICABR International Conference
on**

Agricultural Biotechnology: Ten Years Later

Ravello (Italy), July 6 to July 10, 2005

"Impacts of Strengthened Intellectual Property Rights Regimes on the Plant Breeding Industry in Developing Countries: A Synthesis of Five Case Studies"

D. Eaton (LEI, The Hague, Wageningen University and Research Centre, the Netherlands)

Niels P. Louwaars (Centre for Genetic Resources, The Netherlands, Wageningen University and Research Centre),

Robert Tripp (Overseas Development Institute, London, UK)

Victoria Henson-Apollonio (Central Advisory Service, CGIAR, Rome, Italy)

Ruifa Hu (Centre for Chinese Agricultural Policy, Chinese Academy of Sciences, Beijing, China)

Maria Mendoza (Bogotá, Colombia)

Fred Muhhuku (Agricultural Productivity Enhancement Programme, Kampala, Uganda)

Suresh Pal (National Centre for Agricultural Economics and Policy Research, Indian Council of Agricultural Research, New Delhi, India)

Joseph Wekundah (Biotechnology Trust Africa, Nairobi, Kenya)

Abstract

This paper, based on a World Bank-commissioned study, describes and evaluates initial experiences with strengthened IPRs (patents, plant breeders' rights systems and trademarks) in developing country agriculture, focusing on five case studies: China, Colombia, India, Kenya and Uganda. The implementation of IPR systems is assessed and the impacts on both private and public sector plant breeding organizations are presented. While the extent to which IPRs are promoting private sector seed development remains unclear, their introduction raises challenges for national agricultural research institutes as well as for agricultural policy in general. A number of lessons for policy makers are identified, including issues for ongoing monitoring.

Keywords: Intellectual property rights, patents, plant variety protection, developing countries, public agricultural research, TRIPS

1. Introduction

In the past few decades the subject of intellectual property rights (IPRs) has occupied center stage in debates about globalization, economic development and poverty elimination. This study concerns the strengthening of IPRs in the plant breeding industry and its effect on agriculture in developing countries. This strengthening is reflected in the growth in the number of countries that grant such rights, an expansion of the types of inventions that can be protected, and a broadening of the scope of protection offered by extant IPR systems. Central to the spread of IPR systems is the Agreement on Trade Related Aspects of Intellectual Property Rights (TRIPs 1993) of the World Trade Organization (WTO) requiring all WTO members to introduce a minimum level of protection for intellectual property in their national laws; and subsequent bilateral or multilateral trade agreements that call for further strengthening of IPR regimes in developing countries.

This paper presents an empirical analysis of the conduct and performance of IPR regimes for plant breeding in developing countries and attempts to draw useful lessons to guide national policymakers and donors who are concerned with establishing effective and relevant IPR systems. It is based on the findings of a study that was commissioned by the World Bank in late 2003 and carried out in 2004, primarily in five case study countries.¹ The present report summarizes the findings from the countries, includes relevant information from other developing countries, and draws lessons for policymakers who are concerned with designing appropriate IPR regimes for their countries. The report is structured as follows. The following section briefly discusses background and methods. This is then followed by three sections that summarise the results of the study with respect to the implementation of IPR systems, the impact on seed companies, and the impact on public sector breeding and seed production. The final section presents some lessons for policy makers and other stakeholders.

¹ The full study report is available at: <http://www.cgn.wageningen-ur.nl/pgr/images/IPRinbreedingindustry.zip> and a shorter version will be published as a World Bank report later in 2005.

2. Background and Methods

The wide variation in plant breeding capacities and seed industries among developing countries demands a case study approach for this research. The range of types of IPRs in force or contemplated, as well as the great variation in local institutions and farming systems, adds to the justification for a careful examination of a relatively few cases in terms of countries and crops. The choice of examples is constrained, however, by the fact that many countries have yet to establish an IPR regime for plant varieties. Because an assessment of the limited but varied experience requires in-depth fieldwork, a wide range of evidence had to be sought in a small number of developing countries that have started implementing IPR regimes in agriculture. Five case study countries were chosen to represent major segments of developing country agriculture, geographical spread, and level of experience with IPRs: China, India, Colombia, Kenya and Uganda. A team of nine researchers from Europe and the case study countries worked on the study. They reviewed the literature and developed interview protocols for the case study countries in order to obtain comparable sets of data. Interviews were conducted with large numbers of stakeholders in each country, representing public plant breeding and seed production, the private seed sector, IPR and regulatory agencies, and farmers and farmer groups (see Annex 1). Local data and reports were also collected and analyzed, and interviews were conducted with representatives and IP specialists of the commercial seed sector in industrialized countries.

3. Implementation of IPR Systems

The case studies indicate that there are still many issues to address with respect to the administration of plant variety protection (PVP) in developing countries, aside from the larger challenges posed by patents for biotechnological inventions. PVP has been (or is being) instituted in the case study countries in distinct ways. Although three of the four countries with PVP laws are members of UPOV under the 1978 convention (China, Colombia and Kenya), there are significant differences between them in the details of their legislation and in the actual performance of PVP. Much of the explanation for these differences is in the distinct characters of the national seed sectors. In addition, the historical development of support for PVP varies among countries. The major pressure for the initiation of PVP

came from the foreign horticultural industry in Colombia and Kenya. In China, the initiation of PVP was part of a wider policy to promote the development of the domestic seed industry and to establish a framework for interaction with foreign agricultural technology. The establishment of PVP in India had its major impetus from a well-developed private seed industry; the industry is large enough, and there is a similarly well developed civil society representing a range of rural interests, so that the public debate about the nature of PVP was open and extensive. In Uganda, on the other hand, neither the seed industry nor rural civil society organizations are well established. The debate about the nature of PVP has been restricted to a small committee of professionals dealing with both breeding and genetic resources. Many developing countries that currently face the establishment of TRIPs-compliant PVP will find themselves in situations similar to that of Uganda.

Once PVP legislation is in place, further adjustments of the scope of protection are possible. The moves in Colombia and Kenya towards restrictions on seed saving of protected varieties are a case in point. It remains to be seen how such modifications are interpreted and applied. Holders of plant breeder's rights may say that they would not pursue seed saving by smallholder farmers, but farmers in any country require assurances that seed saving restrictions will not be applied in an arbitrary or politically motivated manner.

Plant varieties are not covered by patent law in the case study countries, although China offers patents for some special types of varieties (particularly hybrids) through provisions for the patenting of breeding methods. Trademarks are commonly used in all case study countries to protect seed company names and marks, but not for official variety names. None of the case study countries have particular exemptions in their patent laws that bring the patent system in line with the PVP system when the scope of the patent includes a plant variety or a group of plant varieties. It is still unclear how the Farmers' Rights clauses in the Indian law will relate to the patent system when the latter will allow the patenting of products, such as genes.

One of the factors affecting the initial size of demand for PVP will be the decision on the availability of protection for extant varieties. In many countries such a decision will be largely relevant to public varieties, although private varieties may be affected in some instances (such as certain popular, notified hybrids in India). If the

public institutes are able to meet the fees for initial DUS testing, this could result in a significant initial backlog of requests with little clear commercial purpose. It should be possible to separate situations in which DUS testing is pursued as part of a plan for seeking royalties and licenses from those instances where the public sector is simply trying to ensure that private individuals do not usurp the products of their research. It is not clear if the potentially high investment in maintenance fees for public varieties that remain off the shelf is a good investment. In addition, such redefinitions of the status of public germplasm that is already in use may upset relationships between the public and private sector, as the disputes over the amnesty in Kenya illustrate.

The ease of implementing PVP seems to be overestimated in several countries. It is incorrect to believe that once PVP legislation is in place the rules and consequences will be clear for all stakeholders, or that countries with similar legislation will have similar outcomes. In all cases, the conduct of PVP is still being tested and refined. Establishing a PVP law and putting it into practice are two separate challenges, and differences in the management of similar PVP regimes help explain differences in outcomes and impact. Countries require considerable time to experiment with the implementation of PVP and to understand the consequences.

An institution must be identified to manage PVP applications and the testing of varieties. The duties may be assigned to an existing agency, perhaps the one responsible for seed regulation, or a new institution may be created. There are advantages of integrating PVP with an existing seed regulatory agency, but also possible conflicts of interest. The agency must be seen to have sufficient independence; for instance, there are some concerns in India about the fact that ICAR will be assigned duties for DUS testing for its own varieties. Some parts of the private sector also have concerns about the security of deposited inbreds. In addition, the agency must be transparent in its interpretation of the rules.

There is not yet sufficient experience to draw conclusions from the levels of participation in the PVP system about the local resources required to manage PVP. In Colombia, a relatively small number of private OPVs of commercial crops (rice, cotton, and soybean) have sought protection and many of these are in production. In addition, a large number of horticultural crops have been granted PVP, but the DUS testing has been managed externally. In Kenya, very few private varieties of

agricultural crops have yet applied for protection, but there has been a deluge of applications for a range of public varieties (in response to an amnesty for extant varieties). This has required an extensive amount of DUS testing, but what proportion of these public varieties will attract maintenance fees remains to be seen. Kenya is also considering developing its own testing capacity for things such as ornamental crops, although it is not clear if this is an efficient use of resources. In China as well, there is a large, and continuing, demand for PVP, largely for public varieties.

Another factor affecting the demand for PVP is the level of application and renewal fees. The high number of applications in Kenya and China in the early years of PVP is not necessarily an indication of the levels of demand that will eventually emerge. Whether private companies or government institutes will be willing to pay application fees and yearly maintenance will depend on their experience in the market. In large countries with extensive seed markets, investment in PVP will be easy to justify; for smaller markets and niche varieties the justification will be more difficult. The fees are uniform, without regard to type of crop or seed market (so that the costs of protecting a rice OPV, a rice hybrid, and a common bean variety are all the same, despite significant differences in their potential earning power in the seed market.) There is not much difference in the costs of PVP between the 3 countries in the sample, despite significant differences in potential market size. (For the 3 countries it costs between \$1,200 and \$2,400 to register and protect a variety for five years.) In addition, the countries take quite different approaches to the adjustment in fees during the period of protection; in some cases fees are lower in the earlier years (presumably to encourage testing the market). As experience with PVP systems develops, it will be important to see how the fee schedules affect the willingness to seek protection for different crop types (e.g. high-value horticultural exports versus local grain crops).

Discussions about the level of fees charged for PVP are related to the question of whether a PVP authority can be expected to be self-supporting. If it cannot, then justifications for public investment are required. On the other hand, if it is self-supporting, care must be taken to ensure that revenues are not being generated by the enforcement of a protection system that encourages well-resourced applicants and locks out other candidates, such as smaller companies. Questions of financial independence (and of the appropriate level of fees) also depend on the relative

participation of public plant varieties (and the extent to which revenue is earned simply by moving money from one government agency to another). It was not possible to assess the degree of financial sustainability of the 3 case study PVP authorities in their early years of experience. The rapidly expanding Chinese PVP system is certainly not self-financing at this early stage in its career (despite the claim that the fees are relatively high; see Koo *et al.* 2003), while the Colombian system (which does its own testing on a very limited number of crops and earns substantial revenues from the protection of foreign-origin IP) would appear to be viable.

The PVP agency itself is rarely the body responsible for enforcement, and if PVP is to function efficiently concomitant enforcement capabilities and resources must be developed. The few infringement cases described in Colombia indicate that sanctions for violations are not defined and that the courts are not well prepared. Experience from China shows that it takes some time for the courts to develop requisite expertise in this area. In all cases, private and public plant breeders must recognize that the major responsibility for identifying violations and pursuing cases rests with them, implying additional investments of staff and resources.

Patents in the breeding industry do not require specific implementation needs apart from a capacity in the patent office to examine molecular biotechnology tools, methods and products. Countries can benefit from regional (e.g. ARIPO) or global (PCT) harmonization of application and substantive examination of applications. There is no or very little case law in the countries studied about the width of the claims, the scope of protection, etc. Enforcement of patents in the breeding industry can draw on the infrastructure in the case study countries for enforcing patents in other industries even though experiences differ among the countries.

4. Impacts of IPRs on Seed Companies

There has been significant private seed sector activity in many developing countries even before the establishment of national IP regimes for plant varieties. In these cases companies have tried to protect their products through other means (particularly through reliance on hybrids) and have rarely devoted many resources to the consideration of IP issues. The MNCs that see a market for their (patent-protected) GMOs form an exception. They have protected their inventions in the main markets

outside the OECD-countries where possible. With the advent of PVP laws, companies must now reconsider their strategies and investments in IP.

By far the most dynamic private seed sector in the sample (India) has grown and diversified without benefit of any PVP regime but in the context of quite liberal seed laws and in many cases through the use of hybrids as a way of appropriation (e.g. Pray & Ramaswami, 1990; Pray et al., 2001) . Colombia's private seed sector is more than two decades old, but private seed enterprises in the other three countries are the outcome of fairly recent policy changes that move away from public monopolies on seed production. Thus PVP is not a necessary condition for initial private seed sector development, but it may contribute to its growth and diversification. The nature and extent of this contribution will depend on the characteristics of the national seed system. The only major example of private domestic plant breeding in Colombia is for rice, and the establishment of PVP almost certainly encouraged the further development of the industry, which is based on OPVs. Foreign companies also market protected OPVs of soybean and cotton, but it is difficult to point to examples of the diversification of the private seed industry in Colombia due to PVP. It is even more difficult to identify any effects of PVP on the nascent private seed industry in Kenya, where the few products of private domestic breeding have yet to seek protection and the hybrid maize offered by MNCs may not have PVP. In Uganda, exclusive rights over public varieties given to local private companies have contributed to the emergence of local seed enterprises, and it is worth noting that this was done without any formal IP-legislation. Although the (foreign) horticultural industry pressed for the establishment of PVP in Colombia and Kenya, and the national regimes certainly provide added confidence and contribute to the perception of a better business environment for expansion, neighboring countries with similar ecologies but less developed PVP (e.g. Ecuador and Uganda) can still participate strongly in the industry. The course of private seed sector evolution in China will depend on a wide range of factors, and the role of IP is uncertain.

Seed companies tend to take advantage of PVP and patents when it helps protect them against competitors gaining access to their materials. Thus OPV rice varieties are regularly protected in Colombia (as are cotton and soybean). Hybrid maize is not protected in Colombia because the hybrids are relatively secure. Similarly, OPV barley has sought protection in Kenya, but private hybrid maize

varieties have yet to apply for PVP. In addition, those OPV crops that seek protection are ones that are grown in commercial systems, where variety and seed quality are important and where seed cost is a relatively small proportion of costs of production. Where hybrids are used in diversified seed industries, such as India and China, hybrids attract the majority of interest for PVP.

PVP systems can also limit farmers' seed saving and hence provide additional incentives for private seed provision, but there are no instances of this as yet in the case study countries except for the flower industry where on-farm production of planting materials is fairly adequately regulated by the breeders. The two cases where there is movement in this direction in field crops are Colombia and Kenya, and in each case specific complaints contribute to the argument for change. In Colombia there is a considerable amount of seed saving and informal commercial sale of farm-produced rice seed and the industry would like to control this; a new resolution limits seed saving to farms below a certain size. In Kenya, there are complaints that wheat farmers save and trade the majority of their seed, rather than buying commercial stocks, and Kenya proposes making its regulations compliant with UPOV 1991. In these two cases, the specific instances are related to relatively large-scale commercial agriculture where the extra costs to farmers of obligatory seed purchase will probably be acceptable, but the changes in law and regulation open the door to much wider control of seed use without any obvious mechanism for discretion. In both cases authorities admit that it would be difficult to enforce such requirements with smallholders (as well as being politically sensitive), and at this admittedly early stage the evidence points to these limitations on seed saving as merely strengthening already existing seed production rather than providing incentives for diversification. Any control on seed saving is explicitly ruled out in the Indian law, and this is one of the reasons why the majority in the private seed industry does not predict any PVP-derived expansion in investment in OPV seeds.

The question whether IPRs will create a shake-out in the industry at the cost of the smaller companies can not yet be answered in the case study countries. Such increasing concentration in the industry could be due to the costs associated with protection (which is one of the reasons why smaller companies in Kenya don't yet pay attention to PVP). The situation in India, with many small seed companies in operation, deserves particular attention. In addition, restricted access to technology

might become a bottleneck for smaller companies. One way to deal with this is the formation of company consortia for access to (public) technology. There is at least one example in India, and the idea has also been discussed in Latin America. Alternatively, technology providers may change their business approach to license their technology to a wide number of local companies instead of marketing the seeds themselves.

While it is assumed that the powerful multinational companies will be able to protect their interests both with and without IPRs, medium-sized local companies have much to gain from a secured market provided by license contracts or their own PVP-protected varieties. The introduction of PVP could be helpful in stimulating these companies' contribution to a diversified seed supply (Srinivasan, 2004).

Most local seed companies start with the multiplication and marketing of public varieties. In most of the case study countries, a second step towards developing in-house breeding capacity is also visible. This evolution may lead towards accessing public breeding lines rather than public varieties, as is observed in India. The response of the public system is discussed in the following section.

5. Impacts of IPRs on Public Sector Plant Breeding and Seed Production

IP policies in national agricultural research institutes (NARIs) may address three types of goal: revenue collection, recognition of achievement, and technology transfer. These goals may not always be compatible, and the development of adequate policies for the NARIs is a difficult task. The establishment of PVP regimes comes at a time when public agricultural research in developing countries is being asked to take much more responsibility for revenue generation. Among the case study countries, India is an exception, where revenue generation is encouraged but not compulsory (and ICAR revenue flows back to the treasury). These demands for revenue generation are not entirely explained by the emergence of PVP, but administrators certainly see the possibility of earning income by licensing their varieties and other inventions as an important response to the challenge of achieving greater financial self-sufficiency. The public sector appears to be a major supporter in the push towards PVP in most countries. The degree to which such royalties can fulfill that promise depends on farmer demand for public varieties, the efficiency of the domestic seed

delivery system, and the ability of public breeders to compete with their private sector counterparts.

In Colombia there is little evidence so far of potential revenue generation from public breeding. In Kenya, the fact that most of the maize hybrids grown by farmers are products of public breeding would indicate the possibility of substantial revenues, but the domestic and foreign private plant breeding sector is expanding rapidly. In Uganda, public plant breeding has not yet resulted in a widespread use of public varieties by farmers, and because it concentrated on OPVs until recently it has not contributed to the nascent seed industry. The private sector is still insignificant in terms of breeding. In India, although the vast majority of hybrid seed is now the product of private plant breeding, huge areas of wheat and rice are planted to public varieties, and even though only a fraction of that area is planted to purchased seed, the royalties could be significant. But it would appear that there are no plans at present to shift away from the practice of selling breeder seed to any legitimate seed producer. In China, the system is in a state of flux, as public breeding institutions for major crops are making the transition to take partial responsibility for revenue generation. As there are substantial quantities of public varieties of many important field crops grown with purchased seed (especially hybrid rice and maize), the revenue generating possibilities are substantial. But public funding and broader mandates are also important.

In summary, the expectations of NARI management for the amounts of revenue that can be generated are quite high. For comparison, the income of universities in the USA from intellectual property rights is approximately 2-3% of their annual turnover (J. Barton, pers. comm.). Income from PVP on plant varieties is likely to be more predictable than patent-based revenues (Fischer and Byerlee, 2001).

The degree to which a PVP system can help generate income for NARIs depends to a large extent on whether NARIs can keep control of plant breeding skills and resources for commercially important crops. The experience of India in the past two decades is instructive; as policy changes encouraged the emergence of private plant breeding, the expertise for commercial (largely hybrid) seed crops began to shift from the public to the private sector, even for supposedly 'marginal' crops like sorghum and pearl millet. As the private seed sector developed in India, NARI staff were hired away, and the private sector now offers an attractive alternative for recent

graduates. Even where public sector research leads the way, as in hybrid rice, the commercial potential soon attracts resources (and results) to the private side.

The current situation in China is more difficult to characterize. Large companies are investing in breeding activities, particularly for hybrid maize and rice, and breeders from public institutes are getting involved. By helping to generate revenues, PVP is providing the institutes with resources that can be shared with breeders as an incentive for them to stay. The large investments in the application of biotechnology by CAAS may also be providing a scientific and prestige-related counterbalance to the lure of the private sector, where many companies do not yet have such resources. Thus there are uncertainties about the extent to which the private sector will be able to offer alternative employment to the best plant breeders.

In the smaller countries in the sample, the ability of the NARI to retain plant breeding personnel and resources in the face of an expanding private seed sector is much more in doubt. In Uganda NARO is struggling to maintain its maize breeding program. In Kenya KARI's traditional partner, the Kenya Seed Company (KSC), is now a rival, with a separate breeding program, and other domestic companies are assembling their own breeding resources. The emergence of PVP thus comes at a time when there are many uncertainties about the role of NARIs vis-à-vis the private sector in terms of mandate crops and the division of labor between upstream and downstream research.

The advent of PVP and the increased use of patented technology in agricultural research place an additional burden on NARI administrations to establish IP policies and procedures. Most NARIs in the study are moving very slowly in this direction, hampered by a lack of experience and resources. In most cases IP policies are still being drafted. Skills required for activities such as the pursuit and enforcement of PVP, organizing patent applications, and understanding freedom to operate, are in short supply and in any case would not be fully employed in most NARIs under current circumstances, but they are all required at certain key junctures in NARI technology development. In this regard, there is a difference between the national and provincial level institutes of the academies of agricultural science in China. The former generally have much more resources to assist scientists with IPR matters, in particular patent applications.

Another administrative challenge is the management of royalties received by the NARI. Decisions must be made about sharing such income more widely within the institute (to support less commercial research but at the risk of diluting the incentives offered by the royalty system). There is also understandable pressure that some part of the royalty earnings from a protected variety or a patented technology go to the scientists responsible for the innovation. In any public research system this can create potential inequalities, but in some developing country NARIs these could be quite problematic. In Kenya, for instance, a small share of the royalties (in line with proposals from the plant breeders association) from a widely-used maize hybrid could dwarf the breeder's normal salary and significantly jeopardize the institute's incentives for research in other crops. There are also more mundane administrative challenges. For instance, if NARIs hope to earn income from the sale of source seed, they need an efficient and transparent service in place. Such a system exists in some Indian NARIs, but is less well established in some of the other case study countries.

A major problem with revenue generation from PVP is that the potential opportunities are patchy. There is a danger that this heterogeneity may be translated into inequitable and questionable public research resource allocations. Why, for instance, should hybrid rice research earn much more than wheat research just because of differences in seed systems? Although it makes sense to assign research resources to crops and problems for which there is high farmer demand, commercial seed systems often provide imperfect signals of that demand. There are already indications that these signals from the seed system and associated PVP are making their marks on NARI priority setting. This can be seen with the case of hybrid rice in Hunan and Guangdong provinces, as well as with the longer running approach to vegetable breeding in China. NARO in Uganda is encouraged to concentrate on research where commercial contracts or PVP will provide revenue, and KARI's calculations for income are based on hybrid maize.

International agricultural research centers (IARCs, or Future Harvest Centers) have policies on IP that stipulate that the Centers can protect inventions and materials under the condition that this protection will ensure that the subject material will be available to stakeholders; in such situations provisions will be negotiated in the licenses with the intent that such material will be given out royalty-free for use for the poor. Centers are committed to having their products reach the smallholder farmer at

little or no cost. Several centers have some staff assigned to IP with legal background, plus access to CAS-IP, in order to improve IP Management practice and to also focus on product development and distribution issues. Resources are however limited and the increasing pressure to show impact at the local level will stretch current capabilities.

The IP issue is central in the balancing of relationships between seed companies and NARIs. As IARCs develop wider relations with domestic commercial seed sectors, and NARIs place increased emphasis on earning royalties from their germplasm, IARCs have to balance between giving materials directly to seed companies or going through NARIs that can earn royalties. In many countries, companies seem to prefer direct relation with the IARCs. When IARCs can earn royalties on their materials, they find themselves in the same position as NARS with regard to possibilities that opportunities for revenue generation may affect priorities. Contrasting examples are provided with CIAT's rice and ICRISAT's sorghum.

The growth of the private seed industry (and the demise of many parastatal seed companies) would seem to provide a more effective link between public plant breeding and farmers' fields, with the added incentive of royalty earnings. However, many public varieties do not attract the interest of commercial seed enterprises, and this encourages NARIs to organize their own seed production and marketing. Such temptations are clearly evident in some of the smaller NARIs in the study. In addition, many NARIs still find themselves with obligations to public seed production efforts. The problem is that in most countries the conventional private seed sector does not have the incentives to produce and market the full range of public sector varieties for which there may be farmer demand, such as beans, but the public sector has shown itself incapable of organizing an efficient alternative. In China, the old system of seed production and distribution by public companies is shifting quickly to dominance by private companies. Few public breeding institutes are expanding into seed production, with the exception of the Institute for Vegetables and Fruits (IVF) of CAAS which has long produced and marketed its own seed.

6. Lessons

Because many of the principal IPR systems have only been in place a few years (or are still in the final stages of approval), and because the incentives provided

by any IPR regime usually interact with various other factors, it is difficult to identify unambiguous conclusions regarding the possible contributions and concerns that IPR regimes might present for plant breeding in developing countries. Despite the preliminary nature of the report's conclusions, we believe that the analysis points to a number of significant lessons that need to be presented and disseminated.

In general, there are several priorities for careful monitoring. These include assessing the extent to which IPR regimes (and other policy changes) in particular countries influence the priorities and products of public plant breeding, affect the structure and concentration of the domestic seed industry, and determine the options available to smallholders.

Although it is possible to conclude that this study only examines the very partial implementation of relatively weak IPR regimes, it is important to bear in mind that the case study countries capture a good deal of the wide range of experiences among developing countries with large populations of resource-poor farmers who have established IPRs for plant breeding. Political realities, limitations in administrative resources, and varied economic incentives in most developing countries indicate that it is unrealistic to expect rapid establishment and effective enforcement of the type of IPR regimes that are found in some industrialized countries.

Specifically-tailored IPR regimes are possible because of the range of options that are available for providing the types of incentives that many believe (incorrectly) to be associated only with uniform and rigid IPR regimes. Although IPR regimes must be developed at the national level, and much donor effort should support individual processes of debate, design, and implementation, there are also issues related to international public goods that require attention.

A further issue that requires attention at the international level is access to some of the basic tools and processes of biotechnology. In many cases, plant breeders in developing countries are using tools and processes that are protected in the North through patents, and they are uncertain of the possible legal implications for the new varieties that they might develop aided by such technology, as well as the status of the agricultural products grown from these varieties. In addition, there is lack of clarity about access to certain technologies (and supporting information) that have, or will

soon, go out of patent protection and are presumed to enter the public domain. Concerted attention at the international level is required.

PVP and patents are not the only (or even necessarily the most effective) instruments available to policymakers to help provide incentives for plant breeding and seed production. Particularly in countries where neither public nor private plant breeding has yet to have a substantial impact on the majority of farmers, the establishment and enforcement of effective seed laws and support for contract law and responsible business practices are likely to offer more immediate incentives. Trademark protection may be an underrated IPR in the debate, but is highly valued by the private seed sector.

The introduction of transgenic varieties in developing countries presents special challenges, but does not necessarily imply the adoption of extraordinarily strong IPR regimes. Limited experience to date has shown that in the absence of IPRs for GM plant varieties and biotechnological inventions, MNCs have resorted to biosafety regulations in an attempt to protect their technology (e.g. India). Biosafety organizations are however not appropriate for such purposes, and policymakers can offer an appreciable contribution by limiting an expansion of the role of biosafety regulations and by creating a clear division of responsibilities among various agencies for regulating the use of GM varieties. In many cases, the enforcement of existing seed laws can offer an appreciable improvement in limiting unauthorized sale of GM seed. In some cases, controls over output markets for GM crops may provide a significant level of protection. None of this implies that PVP or relevant patent law should not also be pursued for GM varieties but indicates that GM varieties, on their own, are not a sufficient rationale for establishing overly rigid IPRs; other types of regulation may be effective (or indeed a prerequisite), particularly in the early stages of development of GM seed markets. Nonetheless, further research should concentrate on the extent of IP protection necessary for stimulating the development of GM varieties where desired.

With respect to implementation, the challenges of adequate enforcement for IPRs in plant breeding should not be underestimated. There is very little legal capacity in most countries to support IPR regimes for plant breeding. Although the application procedure for PVP may be quite straightforward, for instance, neither IPR-holders nor

courts appear to be prepared for addressing cases of infringement. The experience of the case study countries is that the enforcement of PVP is often difficult, undermining confidence in the system. Implementation of IPR regimes must include attention to strengthening the court system's knowledge of IPRs in plant breeding, and the ambitions and scope of any IPR system must be consistent with the capacities of the legal system, including contract enforcement. Developing such legal capacities is not only a technical issue but also a process of institutional development that requires political commitment.

There is furthermore a danger that the implementation of IPR regimes for plant breeding will proceed using standard models rather than taking account of the specific circumstances of individual countries. For the establishment of PVP, there are a number of important parameters that require careful consideration. These include: the designation of which species are to be covered; fee structures (and possible subsidies or differentiation by crop); the nature of the breeder's exemption for use of protected varieties; and the implications for farmers' abilities to save, exchange and sell seed in accordance with local custom. For patents the choices are similar: which processes and products are patentable (e.g. sequence information or only functional genes) and the scope of protection, including the restrictions on the free use by breeders and by farmers. For trademarks, the key question is whether a variety name can be protected.

IPR regimes in plant breeding should provide incentives for diversifying and strengthening plant breeding and seed production. This implies that policymakers cannot consider IPR regimes in isolation from wider issues of national agricultural policy. Three relevant concerns here are the future of public agricultural research, the development of a robust domestic seed sector, and the empowerment of farmers.

The role of NARIs is a subject of considerable debate in light of generally declining national budgets and the growth of the private sector. Many NARIs are uncertain of whether to complement or compete with the private sector and hence are confused about how to take advantage of IPRs (Fischer & Byerlee, 2001, 2002). Policymakers need to set clear guidelines in this area. NARIs need to distinguish between using IPRs in order to control the use and delivery of their varieties, on the one hand, and seeing IPRs as a contributor to institute budgets through royalty

collection, on the other. In the former instance, there may be cases where the assignment of some type of IPR is necessary to provide a seed company with sufficient incentives to deliver a public variety to farmers. In the latter instance, many NARIs look upon IPRs as a way to counterbalance reduced public funding for research and show a keen interest in the opportunity to earn revenue on existing and new varieties. In some cases this interest is translated into a shift in priorities towards research that is most likely to earn royalties. However, most NARIs seem to have little knowledge about the costs of obtaining and enforcing IPRs, and there is little realistic assessment within the NARI's of their capacity to compete with the private sector in producing commercially viable products (or in rewarding and maintaining staff for this task).

The use of IPRs depends on negotiations between right holders and users of technologies. There is no sign of equality in negotiations anywhere in the world for access to technologies for R&D or for use of protected products. Individual parties, especially NARIs are no match for the legal and negotiation skills and resources of major technology firms. NARIs need assistance to formulate IP policies and strengthen their legal and negotiation capacities. National and international platforms for institutional IP-managers may provide opportunities to exchange experiences and promote institutional learning.

The strategies that NARIs adopt for utilizing IPRs will depend on answers to fundamental questions about the role of public sector agricultural research. These questions are beyond the scope of this study, but experience in the case study countries highlights that the issues deserve more attention from policymakers. For instance, they must recognize that the maintenance and development of public scientific capacity requires attention to an appropriate mix of incentives (professional, public service, and monetary) and that the way NARIs choose to interpret IPR regimes determines how these incentives are presented. Different approaches to shaping relations with the private sector as a technology provider or distributor may be taken into account in this debate, from license contracts to joint ventures or full privatization of (parts of) the public research system. IPRs play an important role in these relationships.

IPR regimes will only be effective when there is an enabling environment for the growth of commercial agriculture. Policies need to be in place that support the type of information provision, contract enforcement, business practices and credit availability that stimulate agribusiness development and that encourage private seed production and plant breeding. Although many national seed and plant breeding sectors have experienced significant recent development, and judicious use of appropriate IPR instruments can facilitate further growth, there are still serious challenges with respect to delivering useful varieties, particularly of non-hybrids and so-called 'orphan crops' to smallholders. The combination of limited and isolated markets with widespread seed saving means that even fairly strong IPR regimes are unlikely to elicit commercial interest in the near future. On the other hand, there is sufficient evidence that public seed provision schemes are generally ineffective. Therefore policymakers must find ways of combining (largely) public plant breeding, appropriate formal seed delivery (most likely private or cooperative), and support to local seed diffusion mechanisms, to serve the farmers dependent on these crops.

There are no indications in the case study countries of PVP unduly contributing to a concentration in the seed sector that leads to monopolistic behavior. But early experiences in biotechnology patents in the case study countries are insufficient to establish any evidence for concentration. The vast number of transgenics in the pipeline in both the (inter-)national private and public sectors calls for a critical assessment of the developments in the coming years. Monitoring could be done on the number of seed suppliers for any crop; the number of competing proprietary key technologies (e.g. insect resistance) in crops; the development of the levels of 'technology fees' relative to seed costs, etc. This is an area in which industrialized countries could provide some useful guidance given their longer experience in monitoring and regulating anti-competitive practices, including in agricultural input markets, in particular.

References

Fischer, K. & D. Byerlee, 2001. *Managing Intellectual Property and Commercialisation in Public Research Organisations*. SASKI Good Practice Note, Washington, The World Bank, 17 p.

- Fischer, K. & D. Byerlee, 2002. Managing Intellectual Property and Income Generation in Public Research Organisations. In. Derek Byerlee & Ruben Echeverría (Eds). *Agricultural Research Policy in an Era of Privatization*. Oxon & New York, CAB International, pp227-244.
- Koo, B., P.G. Pardey, K. Qian, and Y. Zhang. 2003. *The Economics of Generating and Maintaining Plant Variety Rights in China*. Washington, International Food Policy Research Institute (IFPRI). EPTD Discussion Paper No. 100. 40 p.
- Louwaars, N.P., R. Tripp, D. Eaton, V. Henson-Apollonio, R. Hu, M. Mendoza, F. Muhhuku, S. Pal, and J. Wekundah, 2005. *Impacts of Strengthened Intellectual Property Rights Regimes on the Plant Breeding Industry in Developing Countries: A Synthesis of Five Case Studies*. Centre for Genetic Resources, the Netherlands, Wageningen University and Research Centre, Overseas Development Institute, London, UK. Available at <http://www.cgn.wageningen-ur.nl/pgr/images/IPRinbreedingindustry.zip>
- Pray, C.E. & B. Ramaswami, 1990. *A Framework for Seed Policy Analysis in Developing Countries*. International Food Policy Research Institute, Washington D.C, 1990
- Pray, C.E., B. Ramaswami, and T. Kelley, 2001. "The Impact of Economic Reforms on R&D by the Indian Seed Industry." *Food Policy*, 26:587-598.
- Srinivasan, C.S., 2004. "Plant Variety Protection, Innovation and Transferability: Some Empirical Evidence." *Review of Agricultural Economics*, 28(4): 445

Annex 1: List of persons interviewed for the study:

General

Peter Button - UPOV Secretariat Geneva
Stuart Coupe, ITDG
Jean Donnenwirth – International IP Manager Pioneer, EU-office
Krieno Fikkert – office for Plant Breeder’s Rights, MoA, The Netherlands
Jean-Christophe Guache – Managing Director, Limagrain
Rolf Jördens – UPOV Secretariat Geneva
Gisbert Kley – board member DSV-Lippstadt
Peter Lange – Director KWS-Einbeck
Manfred Pohl – patent attorney (Patline) representing KWS
Michael Roth – Monsanto St. Louis
Gary Thoenissen – Rockefeller Foundation

Participants of workshops in Wageningen and Washington

J. Barton, Stanford Law School, Standord CA, USA
D.Byerlee, World Bank, Washington DC, USA
H. Ghijsen, BayerCropScience, Gent, Belgium
J. Hardon, Foundation Agromisa, Wageningen, The Netherlands
P. Heisey, USDA, Washington DC, USA
A. King, International Food Policy Research Institute, Washington DC, USA
B.-W. Koo, International Food Policy Research Institute, Washington DC, USA
S. Kumar, Michigan State University, East Lansing MI, USA
M. Maredia, Michigan State University, East Lansing MI, USA
E. Pehu, World Bank, Washington DC, USA
C. Pray, Rutgers University New Brunswick NJ, USA
R. Rajalathi, WorldBank, Washington DC
G. Tansey, Hebden Bridge, UK

China

IP Organisations + other Government offices, China

HE Yuefeng State Intellectual Property Office (SIPO) = patent office
LI Yianmei State Intellectual Property Office (SIPO) = patent office
LUI Bo, PVP Office, MoA
SUN Junli, PVP Office, MoA
SUN Xue Mei, MoA GMO Biosafety Office
LIU Hai Peng, MoA GMO Biosafety Office
Ren Gang, Trademark Office
Hua Jie, Trademark Office
HU Li, Trademark Office
SUN Yongjian Ministry of Science and Technology (MOST)
CHEN Linghao Ministry of Science and Technology (MOST)
WANG Jie State Environmental Protection Agency (SEPA)
CAI Li State Environmental Protection Agency (SEPA)
XUE Dayuan State Environmental Protection Agency (SEPA)

Public Sector Research Organizations, China

LI Ruiyun, Institute for Vegetables and Flowers, CAAS

WANG Qinfang, Biotechnology Research Institute, CAAS
WANG Kunbo, Cotton Research Institute, CAAS; Anyang, Henan Province
GUO Xianmuo, Cotton Research Institute, CAAS; Anyang, Henan Province
XING Chaozhu, Cotton Research Institute, CAAS; Anyang, Henan Province
ZHAO Xinhua, Cotton Research Institute, CAAS; Anyang, Henan Province
LIU Jinhai, Cotton Research Institute, CAAS; Anyang, Henan Province
YUAN Longping, Hunan Hybrid Rice Research Center (HHRRC)
WAN Yizhen, Hunan Hybrid Rice Research Center (HHRRC)
ZHANG Yuzhuo, Hunan Rice Research Institute
ZHAO Zhenghong, Hunan Rice Research Institute
LI Xiaofang, Guangdong Rice Research Institute
WANG Feng, Guangdong Rice Research Institute
HUANG Qing, Guangdong Rice Research Institute
HUANG Nongrong, Guangdong Rice Research Institute
BAI Song, Guangdong Rice Research Institute
LIANG Jingcai, Guangdong Academy of Agricultural Science (rice)
CHEN Qinling, Guangdong Academy of Agricultural Science (rice)
LUO Shaojia, Zhejiang Academy of Agricultural Science (rice)
LU Hongxing, Zhejiang Academy of Agricultural Science (rice)
CHENG Shihua, China National Rice Research Institute
HU Huiying, China National Rice Research Institute
FU Qiang, China National Rice Research Institute
NI Jianping, China National Rice Research Institute
YAO Haigen, Jiaying Agricultural scientific institution (Zhejiang) (rice)

Private Companies, China

ZHOU Weihua, China National Seed Group Company (rice, maize, cotton, vegetables)
ZHANG Mengyu, China National Seed Group Company (rice, maize, cotton, vegetables)
CUI Yingji, China National Seed Group Company (rice, maize, cotton, vegetables)
HAN Yaomin, China National Seed Group Company (rice, maize, cotton, vegetables)
HAN Gengchen, Beijing Origin Seed Technology Inc (maize)
ZHAO Yuping, Beijing Origin Seed Technology Inc (maize)
WANG Weizhong, Doneed Seed Company (D'long) (rice, maize, cotton, vegetables)
WANG Li, Doneed Seed Company (D'long) (rice, maize, cotton, vegetables)
Monsanto, China office
YANG Yuanzhu, Yahua Seed Academy (rice)
FAN Xiaobing, LongPing High-Tech Seed Corporation (rice)
TANG Buocheng, Biocentury Transgene (China) Co. Ltd (Bt cotton)
LIU Fenghua, Biocentury Transgene (China) Co. Ltd (Bt cotton)
ZHENG Aizhong, Biocentury Transgene (China) Co. Ltd (Bt cotton)
WANG Zhongyu, Gold Sun Agricultural China Co. Ltd (Maize, Rice)
LIU Shukun, Gold Sun Agricultural China Co. Ltd (Maize, Rice)
LI Degnhai, Shandong Denghai Seeds Co., Ltd (maize)
LIU Jingguo, Shandong Denghai Seeds Co., Ltd (maize)
WANG Tianxiang, China Trademark & Patent Law Office Co. Ltd (Patent Agent)

Others, China

P. Gooren, Royal Netherlands Embassy, Agricultural Counsellor and attaché

R. Konijn, Royal Netherlands Embassy, Agricultural Counsellor and attaché
Seed shops, Anyang, Henan Province

Colombia

IP institutions & other Government offices, Colombia

Ana Luisa Diaz National Coordinator, Plant Breeders Rights and Seed Production

Giancarlo Marcenaro, Deputy Superintendent for Industrial Property

Alix Céspedes de Vergel, Patent Office Director

María del Socorro Pimiento, Trademark Office Director

Luis Angel Madrid, Head of the Colombian Delegation for the Free Trade Area of the Americas (FTAA) on IP issues

Juan Lucas Restrepo, Former Viceminister of Agriculture

Ricardo Torres, General Coordinator of Research Project on ‘Policy Design on Access and utilization of genetic resources’

Santiago Perry Santiago Perry, Head of Corporación para el Desarrollo Participativo y Sostenible de los Pequeños Agricultores Colombianos, CDPSPA

Public sector research organisations, Colombia

Corporación Colombiana de Investigación Agropecuaria, CORPOICA

Luis Arango, Executive Director

Toto Díaz, Deputy Director for Strategic Research

Andrés Leignelet, General Coordinator, Management and Technology Innovation Program

Jorge Suárez, Seed Coordinator

Víctor Núñez, Director Biotechnology Unit

Alba Marina Cotes, Researcher, Integrated Pest Management Unit

Centro Internacional de Agricultura Tropical, CIAT

Aart van Schoonhoven, Director, Science Park (AgroNatura)

Zaida Lentini, Plant Biologist/ Geneticist, Biotechnology Unit & Rice Project

Cesar Marinez, Rice breeder

Stephen Beebe, Head, Bean Project

Edith Hess, Head, Information and Communications Unit

Joe Tohme, Head, Agrobiodiversity and Biotechnology Unit

German Arias, Head Legal Office

Rafael Posada, Head, Impact Project

Daniel Debouck, Head of Genetic Resources Unit

Private Sector, Colombia

Luis Sanin, Executive Director Fondo Latinoamerica de Arroz de Riego, FLAR

Andres Toro, Colibri Flowers S.A.

Eduardo Villota, Director General, Semillano Ltda & Head of Asociación Colombiana de Semillas, ACOSEMILLAS & Head of Latin American Federation of Seed Associations (FELAS).

Luis Enrique Acevedo, Royalty Administration International, Latin America

Sabina Cajio, Auditor Royalty Administration International, RAI

Rafael Aramendis, Regulation Manager for Andean Region, Central America and the Caribbean

Jose I. Bolaños, Andean Research & Development Coordinator & Andean Biotechnology Research Coordinator

Gustavo Mejia & others, Unique Latin Roses LTDA (Esmeralda Farms Holding)
Pablo Robledo, Attorney PBR

Farmers' association, Colombia

Augusto del Valle, Head of Federación Nacional de Papa FEDEPAPA

India

IP institutions & other Government offices, India

H C Bakshi, Joint Controller of Patents and Designs, Patent Office, New Delhi

Ms. Premlata, Assistant Registrar, Trademark Office, New Delhi

DR K K Tripathi, Advisor (IPR), Department of Biotechnology, Ministry of Science and Technology, Government of India, New Delhi

Prem Narain, Joint Secretary (Seeds), Ministry of Agriculture, Government of India, New Delhi

S V Singh, Director (Seeds), Ministry of Agriculture, Government of India, New Delhi

Babu Rao S, Managing Director, Andhra Pradesh Seeds and Development Corporation, Hyderabad, Andhra Pradesh

Public research organizations, India

Indian Council of Agricultural Research

Dr Mangala Rai, Director General, Indian Council of Agricultural Research, New Delhi

Dr G Kallou, Deputy Director General (Crops and Horticulture), Indian Council of Agricultural Research, New Delhi

Dr S Nagarajan, Director, Indian Agricultural Research Institute, New Delhi.

Dr J P Mishra, Assistant Director General (Intellectual Property Rights), Indian Council of Agricultural Research, New Delhi

Dr G S Dhillon, Director, National Bureau of Plant Genetic Resources, New Delhi

Dr K R M Swamy, Director-in-charge and Head, Division of Vegetable Crops, and other Heads of the Division and senior scientists, Indian Institute of Horticultural Research, Bangalore, Karnataka

Dr P Singh, Director, and senior scientists, Central Institute of Cotton Research, Nagpur, Maharashtra

Dr M Ilyas Ahmed, Scientist-in-charge of hybrid rice program, and Scientist-in-charge, biotech programs, Directorate of Rice Research, Hyderabad, Andhra Pradesh

State Agricultural Universities

Dr Kulkarni, Nodal scientist for IPR, and Dr P. H. Ramanjini Gowda, scientist with seeking patent for his innovation, University of Agricultural Sciences, Bangalore, Karnataka

Dr A Padmaraju, Director Research, Andhra Pradesh Agricultural University, Hyderabad, Andhra Pradesh

Other public research organizations

Dr Rakesh Tuli, Scientist Bt transgenic program, National Botanical Research Institute (Council of Scientific and Industrial Research), Lucknow, Uttar Pradesh

International Centre for Research in the Semi-Arid Tropics, ICRISAT

Dr Dyno Keatinge, Deputy Director General,

B Hanumanth Rao, IPR Officer, scientists of crop improvement programs

C L L Gowda, S Nigam, C T Hash, K N Rai, scientists of crop improvement programs
J H Crouch, F Waliyar, scientists of biotechnology program.

Private seed sector, India

Seed companies

Uday Singh, President, Seed Association of India, and Managing Director, Namdhari Seeds, Dr N Anand, Director Research, Namdhari Seeds, Bangalore, Karnataka
Raju Barwale, President, Association of Seed Industry, and Managing Director, Maharashtra Hybrid Seed Company Ltd (Mahyco), Mumbai, Maharashtra
R V Kaundinya, Managing Director, and A R Sadananda, Director Research, Emergent Genetics India, Hyderabad, Andhra Pradesh

Dr M J Vasudeva Rao, Senior Vice President, Advanta India, Bangalore, Karnataka

Dr M Vinod Kumar, Manager (Regulatory issues), Proagro Seeds/Bayer Crop Science, Gurgaon, Haryana

Raman Modi, General Manager, and rice breeders, Hybrid Rice International (Proagro group), Hyderabad, Andhra Pradesh

L P Aurangabadkar, Director Research, Ankur Seeds, Aurangabad, Maharashtra

R S Arora, Managing Director, Century Seeds, New Delhi

Dr Y Yogeswara Rao, President, Andhra Pradesh Seedmen Association and Managing Director, Vikky's Seeds, Hyderabad, Andhra Pradesh

M Prabhakar Rao, Managing Director, Nuziveedu Seeds, Hyderabad, Andhra Pradesh

P S Dravid, President, JK Seeds, Hyderabad, Andhra Pradesh

Dr N K Singh, Head Product Development and Dr A Gopinath, Manager, Syngenta India, Pune, Maharashtra

Vinod G Broker, Managing Directors, Pocha Seeds, Suyash Seeds, and Prakash Navalakha, Navalakha Seeds (small seed companies in Pune)

Dr A S Kataria, Director, Seed Association of India, New Delhi

Private agricultural biotech companies

R D Kappor, National Regulatory Manager, and P P Reddy and H H Basappa, plant breeders, Monsanto India, Bangalore, Karnataka

Dr Koen Wentink, Chief Logistics, and Dr K R Rajyashri, Director Research, Avesthagen, Bangalore, Karnataka

Dr K K Narayanan, Managing Director, Metahelix, Bangalore, Karnataka

NGOs/FO, India

Dr Anil Gupta, Professor, Indian Institute of Management, Ahmedabad, Gujarat, and Executive vice chairperson, National Innovation Foundation and Sristi

Dr M D Gupta, Senior researcher, Suri Sehgal Foundation, ICRISAT, Patancheru, Hyderabad

Dr A Nambi, IP expert, MS Swaminathan Foundation, Chennai, Tamil Nadu

Mr Akkineni Bhavani Prasad – Farmers' Association of Andhra Pradesh, Hyderabad

Kenya

IP-institutions and other government offices, Kenya

Spencer Mathioka, Actg Director, KIPI

Reuben Lang'at, Patent Examiner, KIPI

Stanley Atsali, Patent Examiner, KIPI

Eunice Njuguna, Lawyer, Kenya Industrial Property Institute

C.J. Kidera, Managing Director, KEPHIS

M.O. Gunga, Examiner of PVP, KEPHIS
J.J. Gichuki, Deputy Director PBR, Ministry of Agriculture
Prof. Kingoriah, Executive Secretary, National Council for Science and Technology
Solomon Kuria, Trade officer, Ministry of Trade Kenya Government

Public research institutes, Kenya

Kenyan Agricultural Research Institute

Romano Kiome, Director
Betty Kiplagat, Legal Officer
J.A. Ochieng, Assistant Director Crops (Maize breeder)
Jane Ininda, Maize breeder
Dr. Kahi Ngugi, Senior Bean Breeder
J. B. Kamau, Cassava breeder
Kiarie Njoroge, Maize Research Coordinator
Dr. Kabiro, Centre director, KARI-Tigoni
G. Ombakho, Maize breeder, KARI-Kitale
L.F. Ragwa, Assistant Director Seed Unit
Ben Odhiambo, Biotechnology Coordinator

Universities

Levi Akundabweni, Chairman, Dept of crop science, University of Nairobi
Prof. Ogada, Moi University Holding, Moi University

International organisations

Stephen Mugo, IRMA Coordinator, CIMMYT
Dr. Majiwa, Programme Manager, African Agricultural Trust Fund
Richard Boadi, Legal counsel, African Agricultural Trust Fund
Nancy Muchiri, Public Relations Officer, African Agricultural Trust Fund

Private sector, Kenya

Obongo Nyachae, Executive Secretary, Seed Traders Association Kenya (STAK)
Saleem Esmail, Chief Executive Officer/Maize breeder, Western Seed
Graig Nelson, Marketing Manager, Pannar Seed Co.
Valentine Miheso, Seed Sales Manager, Monsanto Kenya
Johnson Thaiya, Seed Operations Manager, Monsanto Kenya
Mosses Onim, Proprietor, Lagrotech Seed Company
S. Omamo, Production manager, Lagrotech Seed Company
Peter Rukwaro, Production manager, Valentine Flowers
Samwel Gathara Kiarie, Representative, Pioneer Seed Company in Kenya
Charles Nga,nga, General Manager, Faida Seed
Francis Ndambuki, Research Manager Maize, Kenya Seed Co.
Peter Veal, Regional Representative, Syngenta Company
Wilfred Munyao, Farm/propagation Manager, Sian Roses
Sunders, Production Manager, Magana flowers
J. Kamau, Production Manager, Magana flowers
John Njenga, Lead Auditor & Activity CEO, Kenya Flower Council
Francis L. Oyatsi, Deputy Managing Director, Kenya Seed Company
Rose Kauri, Company Secretary, Kenya Seed Company
Hosea Sitienei, Sales Manager, Kenya Seed Company
James Boit, R&D Manager, National Cereals and Produce Board
Bruce Mc Arthur, Country Manager, Seed Co

NGOs/FOs Kenya

Caleb Wangia, Winrock International: Seed Production & distribution

Mercy Karanja, Chief Executive, Kenya National Federation of Agricultural Producers

Leonard Nduati Kariuki - KENFAP Nairobi, Kenya

Philip Kiriro - East African Farmers Union - Nairobi, Kenya

Uganda

IP-institutions and other Government offices

Ltd.Bayiga, Fiona: Senior State Attorney/ Assistant Registrar, Ministry of Justice.

Mugoya, Charles: Uganda National Council for Science & Technology.

Bazaale, Joseph: Head, National Seed Certification Services, Ministry of Agriculture [MAAIF].

Kyazze Lubega, Jean: Law Reform Commission, Ministry of Justice.

Public research organizations

National Agricultural Research Organisation NARO

Otim Nape, George: Ag. Director General, NARO.

Aluma, John W.: Deputy Director General, Research, NARO.

Bigirwa, George: Head of Maize Research Program, NAARI/NARO.

Imanywoha, Justus: Maize Breeder, NAARI/NARO.

Kyetere, Denis: Maize Breeder & Director of Research, CORI/NARO.

Ogen, Michael: Bean Breeder, NAARI/NARO.

Opio, Fina: Director of Research, NAARI/NARO.

Sserunjogi, Lustus: Cotton Breeder & Director of Research, SAARI/NARO.

Wasswa, Mulumba: In-charge National Genetic Resources, NARO.

University

Rubaihayo, Patrick: Professor, Makerere University.

International organisations

Abebe, Demessie: Association for Strengthening Agricultural Research in Eastern & Central Africa [ASARECA].

Kirkby, Roger: Head, CIAT Uganda.

Private sector

Gareeba Gaso, Emmanuel: General Manager, Uganda Seeds Ltd.

HiteshPanchmatia: MD, Bon Holdings Ltd – Cotton.

Kaijuka, Chris: Managing Director, FICA Seeds Ltd.

Kashaija, Steven: Cottco Uganda Ltd – Cotton.

Lutaaya, Yassin: Local Seed Merchant, Rakai District, Uganda.

Mugisa, Boniface: Seed Manager, Monsanto International, Uganda.

Ndemo, Job: Country Manager, Kenya Seed Company, Uganda.

Mulumba, Stanley: Uga Rose Ltd – Flower Firm.

Okot, Josephine: Chair, Uganda Seed Trade Association & GM Victoria Seeds Ltd.

Paku & Ravi: Dunavant Cotton, Uganda.

Pandya, Kashap: Xpressions Ltd – Flower Firm.

Rodneys, Nicolai: General Manager, NASECO Seeds Ltd.

Rutten, John: FIDUGA Flower Firm & Chair, Uganda Flower Exporters Association [UFEA].

Peter Benders, Mairye Estates – Magic Flowers
Yan Krul: Mairye Estates – Magic Flowers.

NGOs/FOs

Chemisto, Wilson: Kapchorwa Commercial Farmers Association, Uganda.

Kagweri, Florence: Bakusekamajja Women Farmers Group, Iganga District, Uganda.

Kambale, Daniel: Kasese Farmers Group, Uganda.

Mayiga, Rosemary,: Community Enterprise & Development Organisation [CEDO]

Gonza, Peter, Community Enterprise & Development Organisation [CEDO]

Mpeirwe, Arthur: Program Manager, IPR & Biotechnology Policy, ACODE