

## *Towards the Sustainable Utilization of Plant Genetic Resources:*

### **Workshop Report**

### **Markets as a means of accessing crop genetic services and conserving agricultural biodiversity: towards an economic research proposal**

**April 1- 2, FAO Rome**

#### **I. Introduction**

The workshop on “*markets as a means of accessing crop genetic services and conserving agricultural biodiversity*” was held by the Agricultural and Development Economics Division of FAO (ESA) at FAO headquarters on April 1-2, 2004. The purpose of the workshop was to initiate a collaborative research program on markets, access to crop genetic resources and genetic diversity conservation. The specific objectives of the workshop were to:

1. Identify the potential for coordination between FAO, CGIAR Centers and other relevant research institutions in work on relationships between seed systems, the sustainable utilization of crop genetic resources and rural livelihoods, focusing particularly on local markets.
2. Develop a common conceptual framework for measuring market performance in terms of access to crop genetic resources and the services they provide to farmers, and analyzing the relationship to genetic diversity at various scales of analysis.
3. Agree upon a joint research agenda and initiate development of a proposal including key research questions, methodological approaches, study design, and site selection.

A primary motivation in initiating this research effort is to support the design of policies which will lead to the sustainable utilization of crop genetic resources. Recently, with the signing of the International Treaty on Plant Genetic Resources for Food and Agriculture, countries have committed to this policy objective, however it is not really clear how to attain it. Achieving sustainable utilization will require attention to both human welfare and environmental objectives: improving genetic resource accessibility and productivity to farmers, as well as the conservation of socially valuable genetic diversity. In this research effort we intend to focus on one aspect of the seed system – local markets – and evaluate their role and performance as a mechanism for the access and exchange of crop genetic resources, particularly among low income populations.

The proposed research program will be built upon a body of work on the economic analysis of seed systems currently being conducted by FAO and several of the CG centers, either collaboratively or individually. These include a set of studies undertaken in 2002-2004 under the FAO-Netherlands Partnership Program (FNPP) Access, Exchange and Sustainable Utilization of Agricultural Biodiversity Program. ICRISAT, CIMMYT,

IPGRI, and IFPRI all collaborated under this program on the analysis of various aspects of seed systems and their impacts on access to crop genetic resources, rural livelihoods and genetic diversity conservation. A list of the studies conducted under FNPP is provided in the appendix to this note.

This workshop report is organized as follows: the concept note for the workshop follows this introduction. This note provided the basis of much of the workshop discussion. Following the concept note, a summary of the workshop presentations and discussion is given, concluding with the log frame developed by the workshop participants. The report has four appendices: the workshop agenda, the list of participants, summaries from each of the CGIAR system participants of their ongoing work on seed systems, plant genetic resources and livelihoods and a list of seed studies conducted under the FAO Netherlands Partnership Program.

## **II. Workshop Concept Note**

### **A. Local Markets in the access, exchange and conservation of crop genetic diversity**

Seed systems are commonly defined as formal versus informal systems of seed exchange, based on the genetic characteristics of the seed in the transaction, rather than the transaction itself. Formal systems include the exchange of improved crop varieties whose seed is certified, while informal refers to systems of exchange of landrace varieties, mixes of improved and local varieties, and non-certified improved varieties. It is important to note that informal systems do frequently include market transactions, e.g. farmers purchasing seeds or grain in markets or from traders, while formal systems may often include non-market transactions: e.g. government or aid agency seed distribution programs and NGO seed interventions.

In this research effort we will focus on market transactions, particularly in local markets, and try to evaluate their importance in both formal and informal systems for some selected crops. We choose to focus on local market transactions because it is an important and not well-understood source of genetic resources to farmers, and it includes both formal and informal seed system exchanges. In addition recent seed system studies have indicated that local markets play a more important role in seed and CGR access for low income populations than was previously understood, although this varies by crop, as well as other factors which are still not well defined. Little research has been done on evaluating local markets as a means of accessing crop genetic resources, and the services they supply to farmers, and how the diversity associated with the market impacts accessibility and incentives to conserve genetic resources on farm. Research on markets in the seed system has focused primarily on the formal seed system, with little emphasis on the relationship to diversity conservation. Nonetheless this research will provide an important basis to work from and expand upon in this research effort.

Assessing the performance of different markets in terms of delivering genetic resources and relating this performance to seed system management is important to understand how

to design seed policies for sustainable utilization. One important aspect of the proposed research program will be to try to explain the variation of accessibility to CGR in local markets by analyzing the linkages with “upstream” parts of the seed system, including the agricultural research and development sector, and the seed regulatory environment. We know very little about how different agricultural and seed sector policies affect the diversity of genetic resources provided through markets and the accessibility of seeds. We do know that several types of market failures exist in markets for both seed and crop genetic resources, particularly with regard to low income farm populations. The development of varieties which meet the specific production and consumption demands of low income farmers are not likely to be developed under an increasingly privatized research and development system, as their commercial market potential is too limited. Rigid seed regulations which slow the release of new varieties, as well as prevent commercial distribution of non-certified varieties may also reduce availability of desired varieties. High transactions costs associated with obtaining information about genetic content and seed quality create high barriers to seed access among poor farmers. Emergency seed relief distributions may flood local markets and reduce their long term capacity to function, as well as reduce diversity by introducing a few varieties which are genetically uniform.

Another important aspect of the proposed research program is to analyze the relationship between local markets and the incentives to maintain diverse crop genetic resources in the field at the farm, community and regional levels of analysis. We still know relatively little about how markets impact the incentives to conserve diversity, although several studies have indicated that there is usually a strong relationship, which may be positive or negative. Taking these studies further and looking at why these relationships are found, and the degree to which it is consistent across crops and scales of analysis will provide important insights into the design of incentive measures to promote diversity conservation in the field.

## **B. Suggested Research Approach**

To analyze local market performance in terms of regulating access to crop genetic resources and providing incentives for the conservation of crop genetic diversity we propose three major research areas to focus upon:

1. An assessment of the performance of the market in terms of delivering access to genetic resources and the services they provide to farmers
2. An analysis of the factors which determine this market performance, including the level of diversity associated with the market and links to other parts of the seed system such as the commercial seed sector
3. An analysis of the impacts of market performance on measures of welfare and diversity at varying scales of analysis

### **1. Assessing market performance**

While it is fairly straightforward to measure market performance for seed per se, assessing their performance in terms of supplying crop genetic resources is more difficult. One key economic question of interest in evaluating market performance is the value to

farmers of the genetic resource being exchanged in markets via seeds and realized through utilization patterns on farm. These values are realized through the expression of crop traits: e.g. the productivity of the crop under high potential production conditions as well as under marginal conditions, the taste of the grain, the amount of stalk generated, etc. These are services which genetic resources provide to farmers, and which farmers base their crop variety and seed selection choices upon. The potential of crop genetic resources to provide these services is conditioned upon external factors including environmental conditions, as well as farmer cultural practices, so attributing value to the genetic content of seeds alone will be quite difficult. Experience with past studies has indicated that relating expressed traits as recognized by farmers to attributes valued by farmers as consumers or consumers is difficult. Problems with bundling, identification and aggregation are also likely to occur as we move up the market chain. At each node of transaction CGR traits or attributes are redefined and revalued in some sense, with different implications for crop biological diversity. These will all be important aspects to consider in assessing the access farmers have to genetic resources. Developing an approach to measuring these services is one of the key issues that will be raised in the research design workshop.

Another key economic aspect of evaluating market performance is an assessment of the costs farmers face in accessing seeds and the genetic services they may provide. These costs include the costs of obtaining information about the genetic content, quality and location of seeds, as well as the costs of transacting to acquire the seeds. Assessing the degree to which markets vary in terms of costs of seeds and genetic services over space and time will then allow for some measure of market articulation and performance.

Assessing market performance in access is relevant only in terms of meeting farmer demands, and thus some analysis of the pattern of crop variety trait demand by income groups will be necessary. This analysis can be built upon considerable work that has already been done on this topic.

Specific questions we might try to answer here include:

- a) How can we measure the value of crop genetic resources to low income farmers? Can we measure “genetic services”?
- b) How can we measure the cost of obtaining genetic resources as opposed to seeds in local markets?
- c) What is the demand for crop traits among low income farmers?
- d) How much variation is there among local markets in the cost of obtaining genetic services?

## **2. Determinants of market performance**

Once we obtain some measure of market performance in terms of providing access to genetic services, the next step is to try to explain this performance and why it varies. The relationship we are most interested in exploring here are measures of diversity and their

relationship to farm level access to CGRs, as well as the link between local markets and other parts of the seed system – such as commercial seed sector, government seed interventions etc.

Examining the relationship between diversity and the cost of accessing genetic resources in local markets will require some discussion on the relevant scale and unit at which diversity should be measured. Should diversity be measured at the market level? How exactly would such a measure be constructed? How should this measure be linked to the farm level outcomes? The units of valuation will need to be carefully defined together with geneticists. Nonmarket and market valuation will need to be used and transaction nodes clearly identified. These are some of the key issues that will need to be addressed in designing the methodology.

The impact of specific policies in the agricultural and seed sector can be explored in this research phase as well. One group of policies to look at are those which affect the attributes, traits and numbers of new crop varieties developed and distributed, ranging from intellectual property rights regimes over plant resources in the country, to variety release and certification procedures to seed market pricing policies etc. Broader policies such as the degree of market liberalization and integration into global markets are another potential group of policies to examine in light of impacts on local market performance.

Designing meaningful analytical approaches to understanding the nature of the impacts of policies on local market performance will also constitute a major topic for the planning workshop.

Specific questions that might arise in this area include:

- a) What are the determinants of differences in local market performance in terms of crop genetic resource delivery?
- b) In particular what is the role of:
  - the level of diversity exchanged through the market
  - linkages with commercial seed markets
  - IPR regime in place for PGR
  - seed regulatory framework
  - degree of commercialization of the crop – link to intl. markets?
  - emergency seed interventions
  - spatial location

### **3. Analyzing the impacts of market performance on livelihoods and diversity at varying scales of analysis**

The final phase of the analysis will be relating local market performance to measures of diversity and welfare at varying scales of analysis, which could include farm, community, market, regional, ecosystem etc. Interesting questions here are the impacts of genetic service cost differentials on farmer planting choices and returns to agriculture, comparing participants and non-participants in the market. Assessing the relationship between costs and who participates in the market is another key aspect of this analysis.

### Specific Questions:

- a) Considering seed for one particular crop: are there differences between market participants and non-participants in terms of returns to production of that crop? Are there differences in terms of degree of diversity maintained on farm?
- b) What determines whether people participate in the market or not? How much do the costs of participating vary among people located in the market area?
- c) Can we relate market performance to a market area level of diversity?

### **III. Summary of Workshop Presentations and Discussions**

*Day One: Presentations and discussion on the primary focus and concepts of the proposed research*

#### **A. Summary of CGIAR center presentations**

Each of the CGIAR participants to the workshop made a short power-point presentation about their work on seed systems, accessing plant genetic resources and conserving plant genetic diversity. The information from these presentations is summarized into 3 main categories: 1) conceptualizing and measuring diversity 2) assessing the determinants of crop genetic resource utilization on farm, and 3) assessing policy impacts on seed systems and patterns of CGR utilization. Key points made in the presentations in each of these categories is summarized below:

1. Conceptualizing and measuring crop genetic diversity
  - a) The concept of crop genetic diversity is functional, relating to the number and content of varieties in production as well as numbers of farmers who grow them and their distribution over time and space.
  - b) In assessing diversity, it is important to consider what, where and when - e.g. the characterization of the varieties and crops, their spatial and temporal distribution. It is also important to consider who maintains genetic resources, how diversity is conserved, and why – which leads to the next category
2. Utilization decisions – What drives crop and variety selection
  - a) The seed system, including both demand and supply side factors, including the type of exchange mechanisms, the scale at which they occur and the frequency and depth of exchanges are key determinants of utilization patterns.

- b) The seed system varies by crops, driven by differences in reproductive differences and degree of market orientation among other factors.
- c) Markets are an important part of the seed system, and their importance can vary over time (in good and bad years) as well as by crop. Markets have been found to be an important means of CGR access in times of stress.
- d) The seed system must be analyzed in the wider context of the overall farming system. Major differences occur between subsistence and commercial oriented systems.
- e) In assessing utilization patterns it is important to distinguish between the availability of crops and varieties (physical quantities present within a given location) their accessibility (the ability of farm populations to purchase or obtain through exchange) and utilization (what is actually planted).
- f) Market forces are not the only factors determining utilization decisions. Other important factors are trust (knowledge), security, risk management, financial constraints, pride, desire to experiment, loss of seeds. Cultural values can be important as well.

### 3. Policy impacts on CGR utilization

- a) Policy impacts are filtered through the seed system. Until now, most of the focus of policy impact on the seed system has been on the formal system, but the informal system is important as well. The informal system has been documented by social scientists, but it has not a major focus of economic research.
- b) Important factors to consider in the assessment of policy impacts on the seed system include:
  - The impact of regulations/institutions/policies on industry and farm level incentives to innovate, including intellectual property rights, market structures, labeling, and investment into agricultural research and development.
  - The scale at which regulations are implemented: regional versus national level regulation regimes
  - Seed variety release, certification and distribution policies and transactions costs within the system.
  - Regulations to promote conservation and the degree to which compensation mechanisms are included.

- Emergency seed relief programs and differing means of distribution.

### **B. Summary of key points in the discussion on the research concept**

Consensus was obtained among the participants that markets are a key component of the seed system and understanding their role in facilitating or reducing access to crop genetic resources and incentives to maintain crop genetic diversity is an important area where new research is needed. Markets, particularly local markets, are one part of the seed system where formal and informal systems meet, and analyzing this connection and how policies affect its outcomes is important to understanding of utilization patterns and their sustainability. The seed supply system is a critical determinant of utilization patterns and thus farmer access to CGR and in situ levels of diversity. Markets should be assessed vis a vis other components of the seed system in terms of facilitating access and diversity conservation.

A strong focus of the research should be on assessing the relationship between markets and crop genetic diversity, both negative and positive. Equally important is a focus on assessing the impact of markets on farmer access to crop genetic resources and the incentives to adopt new varieties, particularly in the context of introducing improved varieties. Addressing how markets do or do not generate incentives for obtaining new varieties, renewing seeds of existing varieties and maintaining the production of traditional varieties is one critical area to be addressed by the research.

Ensuring that the research stays focused on policy interventions was a key concern in the discussion. In particular, to make sure the results contribute to implementation of the ITPGR and to help policy makers realize objectives of sustainable utilization more broadly was felt to be a critical aspect of the research outcome.

The set of presentations and subsequent discussion indicated that the impact of seed systems, and specifically markets, on utilization patterns can be expected to vary over several important categories including: the reproductive nature of the crop, the location and farming system the crop is grown under, the degree of commercialization, and the production/market conditions prevailing at the time. Distinguishing between good years and bad years is thus critical in assessing the role and performance of markets. Understanding factors driving utilization patterns and ultimately farmer access to crop genetic resources and in situ levels of diversity requires analysis at community, market and ecosystem scales of analysis to complement work being done at the farm household level. Market impacts on utilization thus can be expected to vary over both space and time, and both within and among crops. Likewise, measuring diversity and its relationship to markets needs to be considered over spatial as well as temporal dimensions.

Several types of policies, institutional arrangements and regulations affect the functioning of seed systems, including markets. These include intellectual property rights, seed variety release and registration regulations. Specific interventions and shocks affect the functioning of the seed system and markets and these need to be analysed as they may



lead to permanent modifications of the seed system. In addition, studying these interventions is one way to understand the relationship between the seed system in general, markets particularly and utilization patterns for crop genetic resources.

The key agreements regarding the overall research focus can be summarized into the following points:

1. Assessing the impact of markets on farmer's access to CGR, and the implications for welfare and diversity is the focus of the proposed research effort.
2. Understanding the relationship between markets and crop genetic diversity is a key focus of the work, both as a way of characterizing and explaining the variation in markets, and as an outcome at the farm level.
3. An explicit link to policy is required in the research design.
4. Local markets have the following characteristics:
  - a) important determinants of access in informal systems
  - b) represent a confluence point of formal & informal systems
  - c) an unclear relationship with on farm crop genetic diversity
5. Links exist between various components of the seed system including:
  - a) Agricultural R&D
  - b) Seed industries/Producers
  - c) Markets
  - d) Farm level

*Day two*

### **C. Moving towards a research design**

In order to move towards more concrete issues in the research design the workshop broke into working groups to consider specific questions which were then presented to the entire group. The primary topics addressed in the working groups were how markets should be defined in the context of this study, how their performance should be assessed, how genetic diversity should be measured and how the policy focus should be incorporated into the research design. The reports of the working groups are summarized below:

#### ***1. How to define the market?***

Considerable discussion was held on how to define the market – e.g. what kinds of boundaries should be set on the concept for this analysis. A key issue was the desire to focus on “local” level transactions, which would involve the farmer as a purchaser. This implies looking at the retail, rather than wholesale level in marketing. Another important issue raised was the definition of the transaction: are only cash transactions relevant or should barter exchanges also be included? Should cash transactions between two neighboring farmers be included? Several different ideas were put on the table about how to resolve this issue.

One clear consensus that emerged was that this research should focus on markets and their relationship to farmers, implying research work at the farm level as well as the site of the transaction (which may or may not be the same). One suggestion was made to identify the various sources from which farmers get seeds, and use this information to define what would be considered the market, as well as the relevance of the market in the overall seed system. Another suggestion was to define what would definitely not be considered a local market transaction, and define markets relative to this. Another option put forward similar to the first was that of identifying a local market at the community level through the exchanges in the informal seed system. Once that was done, the idea would be to move one step further and look at only cash transactions within the overall domain of informal system transactions.

In response to these suggestions it was noted that quite a few studies of seed sources have already been done, and it would be better to focus on areas and issues which have not been well studied. It was suggested that retail level exchanges (e.g. farmer as purchaser) is where the greatest gap in information lies, and this is where the research should focus. However, one objection to focusing only at the retail level was that the policy focus might be difficult to maintain and thus the focus should be more on how policies affect various channels of supply and the potential for substitution or competition among them.

From the rich discussion it became clear that there is a wide variety of market types and these will play very different roles and produce different effects on access and diversity. Therefore it was agreed that using the generic term of “local markets” was not useful in defining the research focus, but instead a set of market typologies would be developed and used in defining the boundaries of the research program.

The next issue addressed was how to approach the development of market typologies and eventually the assessment of their performance. An outline of the key factors to consider was proposed by one of the working groups and follows below:

Markets are defined using the three concepts of:

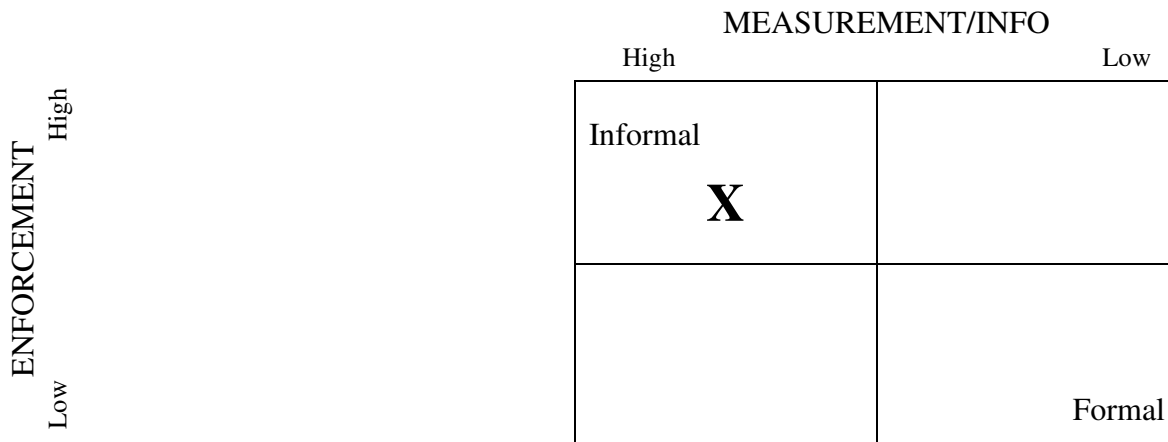
- a) *Structure*
- b) *Conduct*
- c) *Performance*

a) To identify *market structure* information is needed on:

- the number of buyers and sellers;
- the cost of entering into and exiting from the market
- the homogeneity of products with regard to their costs, similarity
- the frequency of exchanges

- the transaction costs, defined as the cost of enforcement and measurement (mainly linked to information).

Dividing transactions costs into high and low levels can be used to develop a rough categorization of markets, as shown in the figure below. Where any particular market would fall in this scheme would depend on a number of variables, including other aspects of market structure, as well as the crop under consideration and specific local conditions. Measurement and information costs are more likely to vary by crop, whereas enforcement costs can be expected to vary more by locality.



*b) and c)* Assessing the *conduct and performance of markets* can be considered together, as they refer to how buyers and sellers behave in the markets and how successful they are in their actions. Conduct can be assessed through indicators of performance which typically include:

- prices
- quantities
- number of crops exchanged
- number and share of varieties exchanged
- variety characteristics (attributes) exchanged

- seasonal and annual stability
- timeliness (seeds available at the right time)

## **2. *How to define diversity?***

A second key issue the group considered was how to define diversity and measure it in the context of markets. The group agreed to define genetic diversity using the three main concepts generally used for diversity assessments: the quantity, identity (uniqueness) and distribution of diversity. These would be assessed using measurements of genetic evenness, distinctiveness and turnover.

The issue of looking at the genetic diversity also at community level rather than just at farmers' level was also raised. The specific analysis suggested was to focus on how the amount of diversity present in the marketplace impacts farmers within the community or marketing area. How does this diversity affect prices and varieties planted in that community, what are the distributional impacts within the community. Keeping these concepts in mind, it will be necessary to have an inventory of diversity in the selected area. Possibly the inventory should be done *ex-ante* and *ex-post* to an intervention or shock to the system.

The group also considered the idea of whether the concept of genetic services as defined in the concept note was useful, and if it is operational. There was consensus that the idea is useful, but it has proven very difficult to develop empirical measures. It was suggested that aside from the three main categories proposed in the concept note (i.e. risk management, consumption preferences and production/return objectives) there are many other possible categorizations and definitions and an agreement on this respect is needed in developing the research conceptual framework and design further. It was suggested that farmers are looking for specific attributes through genetic services and it is the use of these attributes *in their environment* which actually generates the value, and so this location effects of the value must be taken into account.

## **3. *How to incorporate a strong policy focus into the research design?***

This issue was discussed at some length by the group. It was agreed that the research proposal must have clear and focused policy questions to answer in order to be policy relevant. The research should provide information to policy-makers on barriers to the adoption of new varieties, effective interventions to promote diversity and compensation mechanisms for diversity conservation.

Four questions were proposed to the group to guide the research effort and ensure a strong policy focus of the work:

- a) Do markets reflect, enable, restrict farmer's access (including knowledge/information) to crop genetic diversity and under what conditions?

- b) How does access to diversity impact on rural poor people's livelihoods and overall crop genetic diversity in the system?
- c) If increased access to diversity via the market provides farmers with opportunities to improve their livelihoods, then how could targeted policy measures better support this process?
- d) If increased farmer access to diversity via the market makes possible the sustainable management of crop genetic diversity how could targeted policy measures better support this process?

The group agreed to adopt these questions to guide the research effort and used them in developing the project workplan presented in section V.

Sample design and selection was another prominent means suggested to ensure the policy focus of the research. One suggestion that was put forward several times was the selection of areas where markets are an important part of the seed system, in order to ensure relevance.

Several issues were suggested for consideration in designing a policy relevant study design:

- a) Focus on centers of crop diversity and origin and where there has been some introduction of modern varieties from outside the area;
- b) Compare subsistence vs. market oriented areas for similar crops;
- c) Identify area where there's a willingness to be innovative among policy-makers
- d) Identify areas where complementarities exist in multiple cropping systems;
- e) Identify areas with complementarities between in-situ and ex-situ conservation;
- f) Identify the demand for seeds and their attributes for a given crop within a particular farming system
- g) Develop a typology of seed market based on key actors in the system
- h) Consider various types of crop reproduction system (self or cross pollinating or clonally propagated).

#### **IV. Next Steps**

The group sketched out a series of steps that need to be taken in order to operationalize the research plan. Most of these are included in the workplan in the following section. The participants agreed that upon receipt of the workshop report they would seek confirmation of an interest to participate from their institutions, as well as some indication of the level and nature of the intended participation. FAO will also solicit participation from other potential partners in the research effort. Once the interest of various partners in the effort is clear, FAO will proceed to develop a proposal for funding, with inputs from various partners.

In order to build upon the rich work already completed or in progress on seed systems at the various CG centers, the group also decided that a systematic review of this work

would be useful. This review would be used to identify potential research sites as well as approaches, methods and findings. In addition, identification of key gaps in the work would be a focus of this comprehensive review.

The review should include an assessment of a set of standard issues across all studies. The workshop participants suggested the following factors be considered in designing the review:

1. Parameters that describe the seed system:

- a) Types of transaction: Commercial, formal, informal
- b) Identification and analysis of key institutions involved
- c) Type of interventions (NGOs, public investment, emergency relief, etc)
- d) Channels actors in the system
- e) Participatory breeding programs
- f) Type of intellectual property right regime on CGRs

2. Social science instruments/methods used to collect data:

- a) key informant
- b) participatory observation
- c) sample survey with formal survey instrument
- d) other (specify)...
- d) if more than one, list all

3. Other disciplines applied in the research and describe instruments used

4. Unit of analysis:

- a) household
- b) village
- c) individual
- d) country
- e) region
- f) other (specify)
- g) if more than one, list all

5. Information on crop genetic resources

- a) Level of disaggregation of the data
  - 1) variety name
  - 2) morphology
  - 3) improvement status (specify)
  - 4) local uses/ethnobotanic characters
  - 5) other indicators of genetic distinctness
- b) variety data disaggregated by trait, and if so, how trait is measured
- c) identify any diversity indicators used

6. Accumulated knowledge and information collected about markets across the production to consumption chain, keeping the focus on local and national markets and cross-border or regional markets managed by national or local market agents.

## V. Project Workplan

<b>TITLE: Markets as a means of accessing and conserving crop genetic diversity</b>	
<b>OVERALL GOAL</b>	
To assess the potential role of specific policies through markets on farmers' access to CGR and the implications for welfare and diversity	
<b>PROJECT OBJECTIVES</b>	
1. Assess the role of markets in reflecting, enabling, restricting farmers' access (incl. knowledge/information) to crop genetic diversity .	
2. Assess how access to diversity impacts on rural poor people's livelihoods and overall crop genetic diversity in the system.	
3. To evaluate targeted policy measures to better support the process, if increased access to diversity via the market provides farmers with the opportunities to improve their livelihoods.	
4. To evaluate targeted policy measures to better support the process, if increased access to diversity via the market makes possible the sustainable management of crop genetic diversity	
<b>OUTPUTS AND ACTIVITIES</b>	
Outputs and Activities	Responsibilities
<b>Output 0:</b> Start-up work	
<i>Activity 0.1:</i> Literature review	Lead author: Economist (markets, seed system, genetic diversity and livelihood) (FAO consultant )
<i>Activity 0.2:</i> Develop market typologies	Market/institutional specialist (FAO consultant based on literature review takes primary lead; in collaboration with CG experts
<i>Activity 0.3:</i> Develop interdisciplinary conceptual model and hypothesis (with main economic focus)	Market/institutional specialist (FAO consultant) in collaboration with lit review, develop conceptual framework in collaboration with CG experts (start in July/August to be done by end of the year)



<b>Output 1:</b> Assess the role of markets in reflecting, enabling, restricting farmers' access (incl. knowledge/information) to crop genetic diversity	
<b>Activity 1.1:</b> Market case studies selection/research design	FAO & Collaborative partners
<b>Activity 1.2:</b> Case studies (field work)	Collaborative partners
<b>Activity 1.3:</b> Compare case studies	FAO in collaboration with partners
<b>Output 2:</b> Assess whether access to diversity via market impacts rural poor people's livelihoods and overall crop genetic diversity in the system.	
<b>Activity 2.1:</b> Farmers and communities case studies selection/research design (linked to activity 1.3 )	FAO & Collaborative partners
<b>Activity 2.2:</b> Case studies (field work)	Collaborative partners
<b>Activity 2.3:</b> Compare case studies	FAO in collaboration with partners
<b>Output 3:</b> Identify constraints and assess policy measures to better support the process, if increased access to diversity via the market provides farmers with the opportunities to improve their livelihoods.	
<b>Activity 3.1:</b> Identify constraints	FAO in collaboration with partners
<b>Activity 3.2:</b> Assess policies to alleviate constraints (within case studies)	FAO in collaboration with partners
<b>Activity 3.3:</b> Comparative analysis and synthesis of policies affecting markets and seed systems (from results of case studies)	FAO in collaboration with partners
<b>Output 4:</b> Identify constraints and assess policy measures to better support the process, if increased access to diversity via the market makes possible the sustainable and dynamic management of crop genetic diversity.	
<b>Activity 4.1:</b> Identify constraints	FAO in collaboration with partners
<b>Activity 4.2:</b> Assess policies to alleviate constraints (within case studies)	FAO in collaboration with partners
<b>Activity 4.3:</b> Comparative analysis and synthesis of policies affecting markets and seed systems (from results of case studies)	FAO in collaboration with partners

## **Appendix I: Workshop Agenda**

Thursday, April 1

- 9:00 Welcome of workshop participants (Prabhu Pingali, Director ESA)
- 9:15 Self-introduction of participants
- 9: 25 Objectives of the workshop, key conceptual issues and work program (Leslie Lipper, ESAE)
- 9:45 Presentations by CG centre participants briefly describing relevant on-going work programs or concepts
- IPGRI (Toby Hodgkins, Pablo Ezaguirre)  
IFPRI (Melinda Smale; Bonwoo Koo)  
CIMMYT (Mauricio Bellon, Michael Morris)  
ICRISAT (Richard Jones)  
CIP (Charles Crissman)  
CIAT (Louise Sperling)
- 10:30 *Coffee Break*
- 10:45 Continuation of presentations
- 11:15 Presentation on International Treaty on Plant Genetic Resources for Food and Agriculture and Implications for Seed System Research (Àlvaro Toledo AGD)
- 12:00 Summing up of morning sessions
- 12:30 Lunch
- 14:00 Recap of proposed conceptual framework
- 14:15 Facilitated discussion on concepts and approaches to the research plan as presented in the concept note to the meeting (2 working groups)
- 15:45 *Coffee break*
- 16:00 Summary of discussion:  
Which changes need to be made to the presented framework?  
Where does the work of each WS participant fit into the framework?  
What are key conceptual areas to focus on in designing the research?
- 17:30 Adjourn
- 19:30 Group dinner

Friday, April 2

8:45 Recap of first day

9:00 Break out groups on specific research areas (depends on results of day 1 as well)

A. Approaches to measuring genetic resource access in markets

B. Approaches to analyzing impacts of upstream seed system components on markets

C. Relevant scales of analysis for measuring diversity

10:30 *Coffee Break*

11:30 Report from breakout groups

12:30 or 13:00 *Lunch*

14:00 Break out groups continued.

15:00 Report of break out groups

15:30 Facilitated discussion on work plan

17:00 Summing up

## Appendix II: List of participants

<b>Participant</b>	<b>Institution</b>	<b>Email</b>
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## **Appendix III: On going Work of CGIAR centres**

### **A. CIAT**

#### **PROMOTING SEED SECURITY:**

##### ***A Brief Introduction to CIAT/AFRICA's Work on Seed Systems***

CIAT/Africa engages in two distinct seed system strengthening thrusts. One focuses on new variety and seed enterprise promotion and has grown out of the challenges encountered in increasing small farmers' access to preferred bean varieties (program shorthand: "*Reaching 2 million farm households with new bean varieties*"). The other thrust has been developed in response to the growing reality that,-- due to drought/flood, war/civil strife crop disease outbreak and/or poverty-- large numbers of African farmers are living daily with the effects of an acute disaster or chronic stress and suffer from potential seed insecurity (program shorthand: "*Seed Systems Under Stress*"). Given the FAO-hosted meeting context—on crop diversity-- it is the second thrust which is sketched below.

#### **Seed Systems Under Stress Program**

This program has been developed in response to the growing awareness that every country in which CIAT works in Africa has experienced drought, flood, civil/war (or a combination of the above) in the last 10-15 years. Working solely on 'stable' non-stressed systems would limit options for obtaining sustainable seed system strengthening, and for reaching some the more distressed populations. Coupled with the turbulence, there have been massive injections of seed (and germplasm assistance), with much of the activity not having been based on adequate understanding of the full range of seed systems farmers count on for sustainable livelihoods. "Aid" rather than strengthening systems is, in many cases, destabilizing them.

CIAT and partners feel they have important attributes which allow them to intervene into these stress scenarios. They have been conducting rigorous research on the seed systems farmers use since the mid 1980's, (in Kenya, Uganda, Rwanda, Ethiopia, Tanzania, Malawi, Zambia and Burundi)—and have 'baselines against which to assess the effects of crisis'. In the same period, they have been comparing/contrasting strategies to actively strengthen farmers seed systems (experimenting with seed production, diffusion and even variety selection models)--- and have identified several 'better bet' options. CIAT (again with central partners) also pioneered effective agricultural research center response in crisis contexts with the Seeds of Hope intervention post-war and genocide in Rwanda. There, an inter-institutional response {among 8 IARCS and 8 NARS) guided emergency seed procurement; assessed the effects of war effects on seed and varietal security; and helped reconstruct scientific infrastructure and human research resources.

#### **Role for Research**

Five principal research-related activity clusters are involved in shaping the 'Seed Systems Under Stress' Program

- Assistance in shaping emergency relief (particularly seed and germplasm based assistance)
- Analysis of the effects of different types of disaster (war, drought, flood, crop disease outbreak) on seed system functioning (including effects on varietal diversity)

- Evaluation of emergency operations so as to refine further practice of seed system maintenance and strengthening
- Work with policymakers so as to institutionalize 'better practice' guidelines
- Development of robust assessment tools to be used during and post disaster : to diagnose strengths/weakness of surviving systems; and to target response

While CIAT-facilitates this research, development, and policy-oriented work, it is not a primarily CIAT program *per se*. Its success has been contingent on its links with many direct collaborators (including , *inter alia*, the East Africa and Southern African bean networks, SADC SSN, and GRC), NGOS (Catholic Relief Services, World Vision International, Action Aid, etc) , co-IARC collaborators and International Humanitarian Practitioners (of which FAO and the Office of Foreign Disaster Assistance/USAID are key).

### **Ongoing Seed Systems under Stress- Related Projects**

*“Assisting disaster-affected and chronically-stressed communities in East and Central Africa: focus on small farmer seed systems. USAID-funded.*

Implemented jointly by CIAT, Catholic Relief Services (CRS) and CARE, Norway , this project aims to develop diagnostic tools to assess the effects of a stress (natural or manmade) on agricultural and seed systems and to analyze the effectiveness of varied support strategies in lessening constraints Action-oriented fieldwork evaluating on- the-ground implementation has been carried out in East, Central and South Africa (Ethiopia, Zimbabwe, Burundi, Kenya, Uganda, Malawi, and Mozambique) Case studies and a set of Project Briefs distinguish among interventions appropriate to acute versus chronic seed stress situations and address the various challenges of achieving seed security related to: seed availability; seed access; and seed utilization features.

### **Seed System Security Assessment Tool Development. USAID-funded (April 2004)**

This program continues the development of comprehensive tools to assess seed system functioning quickly. For use in acute and chronic stress contexts, on a regional and country-wide scale, these thinking aids are partially desk-based and partially involved team-based on the ground assessments.

*"Seed Aid and Germplasm Restoration in Disaster Situations: Synthesis of Lessons Learned and Promotion of More Effective Practice.. 'IDRC-funded'*

This project analyzes trends in the broader picture of both seed aid and germplasm restoration practice, and their possible interconnections. Reviewing 25 cases of the 'classic intervention (through documentation, interview and select field visit), it aims to analyze 'state of the art' and provide a base for improving practice over the next decade. With an emphasis on Africa (with select examples worldwide), over 15 organizations are involved in synthesizing current practice , and raising awareness globally of options for moving forward seed and germplasm-related interventions.

## **Select (recent) Publications of Interest**

CIAT/CRS/CN

2004 Seed Systems and Seed Relief: An Annotated Bibliography. Prepared for under USAID-funded Project:

Sperling, L. and D. Cooper

2003 Understanding Seed Systems and Strengthening Seed Security. Background Paper prepared for conference: "Effective and Sustainable Seed Relief." A Stakeholder Workshop. FAO, Rome, 26-28 May 2003

C. Longley and L. Sperling, eds.

2002 Beyond Seed and Tools: effective support to farmers in emergencies, Disasters 26(4) Overseas Development Institute: Humanitarian Practice Network.

## **B. CIMMYT's Work on Seed Systems: A Short Description**

The study of seed systems both formal and informal has been and continues to be an important component of CIMMYT's research agenda. This interest is not academic, but of practical nature in order to improve the impact of CIMMYT's works both in terms of plant breeding and germplasm conservation, particularly on farm. The focus of the current work on seed systems is on maize.

The work on formal seed systems is well summarized in Morris (1998), where formal maize seed systems are described and analyzed. A framework is presented to analyze and understand the status and evolution of the maize seed industry. The functions and processes of the seed industry are described, as well as a series of country case studies that include both developed and developing countries are presented.

CIMMYT is involved in several studies, as well as action oriented research on seed systems with multiple partners in different parts of the world. The activities include: (1) studies of both the formal and informal seed sector; (2) training and consultation, emphasizing the technical aspects of successful maize hybrid and OPV production; (3) production and supply of foundation seed, to enable seed enterprises and farmers associations to get varieties into the market more quickly and efficiently); and (4) specific projects where CIMMYT works more directly with National Programs and non-governmental organizations (NGOs), the private sector, farmers associations, and farmers involved in maize seed production. Highlights of some key projects are presented below.

The project 'Collective Action for the Conservation of On-Farm Genetic Diversity in a Center of Crop Diversity: An Assessment of the Role of Traditional Farmers' Networks' explored the possible role of collective action among small-scale farmers in managing and maintaining genetic resources in Oaxaca, Mexico, a center of maize diversity. The results showed that, while there is a well-developed local seed supply system based on sets of social relationships and involving multiple types of transactions, there is no evidence of collective action. Most farmers rely on and prefer to select and save seed from their own harvests. There are seed flows, however, and most seed transactions take place among people with social links, but not within a well-defined group. There are no specialized suppliers of seed, either individuals or groups. Most transactions are bilateral and while the most common transaction is the sale and purchase of seed, this is not done for profit but out of a sense of moral obligation. The system is based on the creation of trust, which is needed because seed is not transparent—that is, it is not possible to fully predict the plant phenotype that may result from a given seed simply by looking at the seed, and farmers perceive a very high genotype-by-environment interaction. The local seed system of these farmers is resilient but able to innovate as well. Interventions to support the conservation of landraces on farm, based on specialized networks for seed that rely on collective action, may not work.

As part of an agreement with FAO, we are currently implementing a project to develop quantitative indicators of market and non-market costs associated with accessing crop genetic resources and to apply these indicators in an empirical study to assess the



determinants of the variation in access costs and their impacts on household welfare and crop genetic diversity. An ethnographic study to develop the indicators has been completed and we are in the process of developing the empirical study on the determinants of the variation in the cost of accessing seeds and services from crop genetic resources.

CIMMYT partnered with the Kenya Agricultural Research Institute (KARI), the National Agricultural Research Organization (NARO), Uganda, several leading non-governmental organizations, and diverse farmer groups in the project “Strengthening Maize Seed Supply Systems for Small-Scale Farmers in Western Kenya and Uganda.” Its aim was to strengthen maize seed supply in western Kenya and Uganda. The work focused on various sites in these two regions where smallholder farmers are not served by the commercial seed sector, for which promising improved varieties exist, and where there is potential capacity for seed production and dissemination. This project improved the capacity of KARI and NARO to produce breeder and foundation seed. Through extensive and participatory on-farm trials, farmers have identified improved maize cultivars of interest and their feedback and that of researchers has been widely shared to promote and facilitate the release and production of suitable seed. Trials also demonstrated and disseminated the efficacy of improved agronomic practices, especially in soil fertility management for maize production. Farmers and farmer groups are now participating in on-farm seed production of varieties of their choice, with quality control authorities in Kenya and Uganda. The capacity to produce quality seed has been enhanced through training for more than 120 participants in both countries. Project participants have developed and obtained funding for a second phase that will improve the sustainability of community seed production, among other things by focusing on quality control and marketing.

The “Southern African Drought and Low Soil Fertility project” (SADLF) aims to provide resource-poor farmers in the Southern Africa Development Community (SADC) with access to improved access to maize varieties that are better adapted to their bio-physical and socio-economic conditions. As part of the SADLF project, six studies were concurrently carried out in Malawi, Tanzania, Zambia and Zimbabwe to assess the marketing and utilization of improved maize seed among smallholders farmers. A synthesis study shows that in the study areas, both formal and informal seed systems coexist. It analyzes the factors that influence the demand for seed of improved varieties and the constraints that farmers face to obtain them. It makes recommendations to serve the seed needs of resource-poor better.

Morris, M. L. (ed.) 1998. *Maize Seed Industries in Developing Countries*. Boulder and Mexico, D.F: Lynne Rienner Publishers and CIMMYT.

### **C. CIP: Potato and sweet potato seed systems as a means of accessing crop genetic resources and conserving agricultural biodiversity**

Poorly developed seed systems are a major constraint to improving potato and sweetpotato productivity globally. Since its beginning, CIP has significant research investments in various components of seed systems. Most are in potato seed systems. Sweetpotato systems are more rustic and robust, relying on vine cuttings as planting material. Potato and sweetpotato are vegetatively reproduced crops. As such there are several special characteristics that can be limiting. These include: low multiplication rate (for potato), easy disease transmission, and the high bulk, perishability and cost of seed.

The center of genetic diversity for potatoes is in the Andes and for sweetpotato in central America with a secondary center in the southern SE Asian islands. Varietal use and seed systems differ in the centers of diversity from the rest of the world.

Successful seed certification systems require large numbers of individuals and institutions working in close cooperation and a minimal regulatory environment. Successful informal systems require skilled and specialized farmers, an appropriate agro-environment and traditional consumers, confident of informal quality standards. Most examples of successful informal systems are in the centers of genetic diversity.

The vast majority of potato and sweetpotato farmers in developing countries rely on self supply for their planting material. For potato next in importance as a source of seed are output markets where small tubers are sold as seed. The third source is informal seed systems followed very distantly by formal systems. CIP has a very large body of research describing formal and informal seed systems, production technologies, system management and seed policy.

Potato and to a lesser extent sweetpotato production systems can experience remarkable varietal stability. Russet Burbank (the potato used for frozen French fries) was released over a century ago and currently occupies the largest area in the US. This varietal stability limits the successful introduction of new varieties and we speak of a window of opportunity for introductions in production zones still experiencing varietal turnover or without a dominant variety. A global survey of developing country potato breeding programs found only 500 varieties released between 1927 and 1998. Given low multiplication rates, seed systems are the major introduction route for new varieties from CIP or other formal breeding programs. There are examples of escapes becoming important but they are rare.

CIP has looked at factors affecting germplasm introduction and selection and varietal release (often very slow) and farmer adoption, abandonment, and turnover. A current study is investigating factors affecting potato diversity in northern Peru. Studies in the 1980's in Rwanda and Kenya looked at farmer criteria for adoption maintenance and abandonment of introduced versus local potato cultivars.

The dominance of self supply and informal seed systems implies that varietal persistence comes from systems that select cultivars with special biotic, abiotic, cultural or market survival characteristics. Outside the centers of genetic diversity, most potato farmers are commercially oriented. In the Andes, more and more subsistence oriented farmers are selling to the market. Native cultivars with survival characteristics under subsistence production systems may lose their place in commercial systems. There are

current projects that target niche market development of native potatoes with the intent to add survival characteristics to those they already possess.

CIP has used its ex-situ genebank in Lima to replace lost native cultivars to villages in the Andes. Cultivars are mostly lost during bad climatic events (El Niño droughts or floods) though some are lost in the conversion to commercial farming.

In addition to potatoes and sweetpotatoes, CIP has a decade's experience in preserving the biodiversity of other Andean root and tuber crops. Approaches used there include the use of ex-situ and in-situ genebanks, niche market development and promotion, production technology improvement, seed system strengthening and product development.

## **D. A summary of ICRISAT's research on seed systems**

### **Introduction**

During the past 10-15 years, liberalization of macroeconomic, trade and sectoral policies has had profound consequences for smallholder farmers throughout the world but particularly in sub-Saharan Africa. The seed sector has not been unaffected by these changes with governments largely withdrawing from the formal seed sector in favor of commercial seed companies. For some crops – especially hybrids and high-value crops where there is an assured product market - farmers now have a broader choice of varieties and suppliers than they did previously, but for others the withdrawal of the state has left a vacuum with few alternative suppliers.

On-farm, households are diversifying into tradable and high-value crops that can be readily marketed and give quicker returns to capital and labor investments. Furthermore farm communities are organizing into a wide range of self help groups that can be built on to play an effective role in market oriented agriculture. Quality seed of improved varieties are urgently required if smallholders farmers are to compete in high-value niche markets where grades and standards are the language of trade. There is a need for new and innovative institutional arrangements between the increasingly diverse range of actors along the supply-chain to ensure that seed supply is addressed in a sustainable and cost-effective way. This requires continued public investment in crop improvement, a more flexible policy environment than presently exists in many countries, and greater coordination between development players.

Research under this theme will examine policy constraints to the supply and delivery of quality seed of improved varieties including the anticipated problems related to marketing of transgenic materials, and pilot initiatives will be designed and implemented with partners as part of an action-research program from which lessons can be drawn for scaling-up.

### **Goal**

To increase the productivity and profitability of farming systems through sustained use of improved crop varieties.

### **Purpose**

1. To increase the adoption of improved crop varieties - including those developed through the application of biotechnology - by smallholder farmers through the adoption of enabling seed policies by national governments and regional organizations.
2. To develop institutional innovations between public and private – sector stakeholders that sustain demand for seed of publicly-developed improved varieties.

### **Outputs [Indicators are in brackets]**

1. Code of conduct on emergency/relief seed in chronic crises adopted by donors and humanitarian agencies [*Seed needs assessment and distribution methodologies*]

2. Regional release of improved varieties adopted by regional organizations and national governments [*Statistical procedures, GIS maps and seed catalogs*]
3. Revolving funds for source seed of publicly-developed improved varieties that meet regional and national demand established [*Financial and technical management recommendations*]
4. Pilot strategies that sustain demand for improved publicly-developed varieties designed, tested and documented [*Comparative case studies*]
5. Improved varieties developed through the use of biotechnology tools adopted [*Comparative case studies*]

## E. IFPRI-IPGRI Economics Research on Biodiversity and Seed Systems

Melinda Smale and Bonwoo Koo

IFPRI's research on biodiversity and seed systems is conducted jointly with IPGRI through the global research program entitled "Genetic Resources Policies."<sup>1</sup> In the first phase of the biodiversity research we emphasized the development of methods and tools to support the identification of "promising candidates" for on farm conservation. Influenced by earlier work with CIMMYT colleagues, we employ the concept that the genetic resources embodied in seed are impure public goods to define "promising candidates" as geographical locations where the expected contribution of farming communities and their cultivars to crop biological diversity is high (conferring public value) while they also benefit from maintaining it (appropriating private value). We have experimented with revealed and stated preference methods for valuing crop genetic resources, their diversity, and their attributes. We are now "closing the book" on a set of case studies that applied these methods with various crops and sites in Asia, Latin America, and Africa.

We have recognized the ecological problem of "scale" in biodiversity measurement. We have also realized that the institutional arrangements and policy mechanisms that convey economic incentives for local conservation of crop biodiversity function through seed systems, which embody genetic resources and enable their exchange. We began by broadening our definition of the seed system to include all the channels through which farmers acquire genetic materials and information about those materials, outside of, or in interaction with, the commercial seed industry.<sup>2</sup> We think of incentive mechanisms broadly as related to the demand or supply of biological diverse crop genetic resources embodied in seed. When product markets are less fully developed or they are incomplete, the demand for seed is derived from the agricultural household's demand for both consumption attributes and agronomic traits that suit the technology and physical features of the farm. In semi-subsistence agriculture, purchases of improved seed may be periodic, and most of the seed is reproduced from the harvests of the previous

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<sup>1</sup> Presently, our research investigates only crop biodiversity—that is, the biological diversity within (infra-) and among (inter-) species of crop plants. The biological diversity of crops encompasses phenotypic as well as genotypic variation, including cultivars recognized as distinct by farmers and varieties recognized as genetically distinct by plant breeders.

<sup>2</sup> Typically, the notion of seed system in economics has been limited to the "formal" seed industry for developing, multiplying, and distributing finished varieties as certified seed, which can be publicly and privately-funded, and organized in different ways. For example, maize seed industries are thought to develop along a path from pre-industrial organization to the maturity stage, characterized by entirely commercial organization with plant variety protection, patents, and various financing arrangements (Morris, Rusike and Smale, 1998). The notion of a farmer-based seed system, termed "informal," is documented extensively by other social scientists, ethnobotanists and geographers, but is most often treated separately by economists as marginal or vestigial to the development process (Zimmerer 2003; Thiele 1999; Sperling and Loevinsohn 1993). These channels include various farmers' organizations, weekly markets and social networks. Farmers' seed management consists of variety choice, selection of seed to planted the next season, seed storage, and seed transfers, exchanges, or mixtures (Bellon, Pham and Jackson 1997; Louette 1994; Smale and Bellon 1999). Variety choice may include either those saved and selected for many generations on farms (traditional, ancestral, or landrace types), or modern varieties (hybrids or improved open-pollinated varieties). Seed selection may include mass selection practices or farmer breeding, as well as re-use of hybrids or other commercial varieties.

seasons or the stocks maintained by community members, who may or may not trade seed with other communities. Social structure and norms shape the seed exchanges and genetic resources flows within and among communities. When markets are fully developed, the demand for seed is derived from the final and intermediate product demand of processors and consumers. When commercial markets are large enough, they support a commercial seed industry.

The structure of local exchange of seed and genetic resources is highly location-specific. To address these issues at the local level we began with a case study in India conducted by Latha Nagarajan with the support of ICRISAT. We used a combination of tools and instruments. In India we have also examined the new legislation, which includes the provision of variety protection to farmer-breeders as a form of Farmers' Rights.

We also recognize that local seed systems and norms of access to the genetic resources they embody must then be understood within the context of national and international agreements. With IPGRI's Genetic Resources Policy Initiative, we are working to improve our understanding of how to test hypotheses about the effects of different ways of vesting control over genetic resources among stakeholders on their use. These include, for example, *nom d'origine*, *sui generis* IP laws designed to protect local breeds and plant varieties, PVP, patents, and national access laws which would require the consent of the community of users and the national government as a precondition to collection and use of the materials located on lands under the community's control.

We are now synthesizing country case studies into a comprehensive global analysis of plant breeders' rights. We are investigating the level of R&D investment for crop improvement, the size and structure of the national seed market, and regulatory or institutional aspects that influence seed market performance. For highly bred crops (maize, wheat and rice) included in Annex I of the International Treaty, we plan to estimate the monetary size of the contribution made by "donors" (farmer, breeder, country) from an individual variety (or landrace) through pedigree analysis. After estimating the size and attribution of benefits as a basis for discussions, we will then proceed to examine the pattern of utilization, possible mechanisms for benefit sharing (as Farmers' Rights), transactions costs, and the benefits and costs of its implementation at the regional and global scales.

Partially funded, ongoing seed systems research:

- Seed systems and the biological diversity of millet crops in Andhra Pradesh and Karnataka, India (with ICRISAT, some support from FAO)
- Policies to enhance food security and improved nutrition through on-farm conservation of crop biodiversity in western India (CIDA, with IIMA, SRISTI)
- Empowering Sahelian Farmers to Leverage their Crop Diversity Assets (IFAD, with FAO and other partners)
- Plant Breeders' Rights case studies in China, Brazil and the U.S.

**F. Seed systems and the maintenance of crop diversity.**  
**International Plant Genetic Resources Institute, Rome, Italy**  
Devra Jarvis, Pablo Eyzaguirre and Toby Hodgkin

Recent work on seed systems by the International Plant Genetic Resources Institute (IPGRI) has focused on understanding the ways in which they can be investigated and analysed, their operation, and their importance in the maintenance of traditional crop varieties in production. The work has been concerned with formulating a minimum set of diagnostics to determine whether a seed system fulfils a series of functions so that healthy, viable seed of the preferred variety is available to farmers, at the right time, under reasonable conditions and in ways that ensure that land and labour resources can be used optimally. This includes an analysis framework that is concerned with (1) the germplasm base - the varieties in the system, their characteristics, the selection processes involved in their maintenance, the extent of their cultivation, and the processes involved in introducing new materials; (2) seed production and quality - the production and maintenance of good quality seed, seed production practices, storage procedures, and preparation for sowing (3) seed availability and distribution - ways of accessing seed, the extent to which farmers save, exchange, or purchase seed, market systems and government involvement, and (4) the knowledge and information available - the ways in which knowledge of materials and practices are maintained and made available, obtaining and disseminating new knowledge of new materials.

Partners in a number of different countries have investigated the relationship between the seed systems of a range of crops and the management of diversity on farm and in home gardens. Work has included analysis of factors affecting the (a) maintenance of seed systems, (b) the movement of diversity in and out of the systems and (c) temporal changes in the systems (flows, turnover, and selection holding the system together). These investigations constitute part of larger multidisciplinary programmes on the maintenance of crop diversity in agricultural production systems that are concerned to understand when traditional crops and varieties are maintained, by whom, how and for what reasons. These studies have also begun to examine the genetic diversity consequence of these factors in terms of maintaining diversity in production systems including analyses of gene flow, effective population size, bottlenecks, mating system, the effect of stochastic events, temporal aspects and trends, bridging seasons, and seed storage and viability. Finally, IPGRI with its national partners are exploring ways of scaling up actions that help maintain seed system function. These include: institutional strengthening, support to nodal farmers or seed cooperatives, policies changes, improving purity of preferred landraces, seed cleaning, and improving seed health and quality.



**Appendix IV: List of seed studies conducted under the FAO Netherlands Partnership Program**

Title	Lead/Collaborator	Country/Region	Crop	Status
Seed system impacts on farmer welfare and agricultural biodiversity	FAO ESAE/IPGRI	Ethiopia	Sorghum, Wheat	Data collected; analysis in progress
Millet Diversity and Seed Systems: A Case Study in Andhra Pradesh and Karnataka, India	IFPRI/ICRISAT	India	Millet	in progress
Transactions Costs in Small Scale Farmer Maize Seed Systems	CIMMYT/FAO ESAE	Oaxaca Mexico	Maize	in progress
The Impact of HIV/AIDS on gendered information flows around seeds amongst rural producers	ICRISAT/ FAO LINKS	Chokwe District Mozambique	various	draft completed
Impact of seed trade liberalization on access to and exchange of agro-biodiversity	ICRISAT	East Africa, West Africa and S. Africa	various	completed
Empowering Sahelian farmers to leverage their biological assets	IPGRI/IFPRI/ FAO AGPS	Mali, Niger, Burkina Faso	various	in progress
Determinants of farm level crop diversity in Ethiopian Highland Grain Farming Systems	IFPRI/ILRI FAO ESAE	Ethiopia	grain	completed; paper on ESA website and IFPRI working paper series