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COMMISSION ON GENETIC RESOURCES FOR FOOD AND AGRICULTURE

A SUMMARY AND ANALYSIS OF EXISTING INTERNATIONAL PLANT GENETIC RESOURCES NETWORKS

by

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EXECUTIVE SUMMARY

Implementing the provisions of international agreements such as the Global Plan of Action (GPA) for the Conservation and Sustainable Utilisation of Plant Genetic Resources for Food and Agriculture and the International Treaty on Plant Genetic Resources for Food and Agriculture (IT PGRFA) is a major challenge for worldwide stakeholders in the conservation, sustainable use and equitable sharing of the benefits of plant genetic resources. Networks can provide an important mechanism to promote the synergy and collaboration required to deal with complex issues related to Plant Genetic Resources (PGR) conservation and sustainable use. Both the Global Plan of Action (Activity 16) and the International Treaty (Article 16) recognise and stress the importance of networks as mechanisms for their implementation. The long-term objectives of the GPA include ensuring that all countries "are served by active regional and international networks and an appropriate complement of crop-based, thematic and *in situ* oriented networks".

The aim of present study is to provide an overview and primary analysis of networks addressing PGRFA issues, and to provide options for next steps towards optimising the effectiveness of the role of networks in the implementation of the GPA and the IT PGRFA. It begins with a brief examination of different approaches to classifying networks, and discussion on the criteria used to analyse the networks, including criteria such as their objectives and activities, geographical coverage, crop or thematic focus, and membership. An overview of PGR networks, and global and regional *in situ*-oriented, crop-based and thematic networks is the provided, followed by consideration of the coverage of regional PGR and crop-based networks. The potential contribution of networks to the four main areas of activity of the GPA: *in situ* conservation and development; *Ex situ* conservation; Utilisation of plant genetic resources; and Institutions and capacity building, is examined in the context of five categories based upon their scope and objectives: regional PGR networks, crop-based networks, *in situ*-oriented networks, thematic networks, and (sub)regional fora.

The actual contribution of a particular network to the implementation of the IT-PGRFA and the GPA is, among other factors, heavily dependent on the effectiveness and efficiency of the network in achieving its objectives. It should be noted that information utilised for the present study was based on written sources, thereby limiting conclusions and recommendations to those that can be drawn without direct contact with the networks. Factors affecting the effectiveness and efficiency of networks were considered with support from relevant literature, and recommendations for future study involving direct contact with the networks are presented.

Coverage of Regional PGR networks and crop-based networks

The GPA (paragraph 254) recommends that for regional PGR networks, priority should be given to strengthening existing networks or integrating countries not presently served by them, and the establishment of new networks in regions where they did not previously exist. For all geographical subregions, PGR networks have now been established. However, in many cases, these networks are still very young and may need strengthening. Regional PGR networks often function under the umbrella of (sub)regional fora such as ASARECA and APAARI.

It was noted in assessing the coverage of regional PGR networks that the least developed Southeast Asian countries are not members of their subregional PGR network RECSEA-PGR. Some Eastern European countries are not yet included in the European PGR network, but do actively participate in ECP/GR activities. The Caribbean network CAPGERNet and the new Pacific PGR network both cover approximately half of the countries in their respective subregions.

Many of the countries observed to be not yet included in networks were small islands. The GPA recommended the establishment of a PGR network for the Indian Ocean Islands but most of these islands are now members of African networks. However, the fact remains that islands have special ecologies, and may face similar issues in the conservation and sustainable use of PGR. Interregional

collaboration between island-based networks might provide the opportunity for sharing experiences and discussing priorities on island-specific issues.

Regarding the coverage of crop-based networks, for the major crops outlined in the State of the World's PGRFA (SoW), most crops mentioned in the SoW as being important for food security in a particular region or subregion (see Chapter 1 and Annex 2 of the SoW in particular) were found to have networks operating in those (sub) regions.

In seeking to identify gaps in networking, considerable caution should be exercised, as in many cases projects and organisations may carry out networking activities although a formal network does not exist *per se*. In some cases, projects may build on the previous work of networks. Similar caution should be exercised in identifying overlaps: For some major crops, a considerable number of networks exist. However, the scope and/or focus of these networks may range considerably, making it difficult to ascertain overlaps without a more in-depth understanding of the issues addressed by the networks, their functioning, and complementarities and linkages between the networks.

Contribution of networks to the four main areas of work of the GPA

In situ conservation and development (GPA activities 1-4) is addressed by regional PGR networks and by the *in situ*-oriented networks such as the MAB world network of biosphere reserves. Thematic agroecology and community development-focused networks may also contribute significantly to the objectives of the GPA in this area, by promoting sustainable agricultural practices and more diverse agricultural ecosystems. Crop-based networks may in some cases also contribute to *in situ* conservation. In particular, seed networks may contribute to supporting on-farm management and improvement of plant genetic resources for food and agriculture, as well as assisting farmers in disaster situations to restore agricultural systems. In general, linkages between these different networks for *in-situ* conservation are not obvious, however recent developments (such as the Seville+5 recommendations of the MAB networks) may encourage improved linkages and collaboration. Regional PGR networks may wish to reassess their linkages with other networks focussing on *in situ* conservation and development.

Ex situ conservation (GPA activities 5-8) is addressed by the International Network of *Ex Situ* Collections under the Auspices of FAO. Crop-based networks are often closely linked with the in-trust collections held by the CGIAR as well as the improvement programmes of the Centres and NARS partners, providing a mechanism for collaborative testing and further development of germplasm materials (both CG and NARS). Regional PGR networks may contribute substantially to the *ex situ* conservation of PGR by linking partners that manage large PGRFA collections. The role of the international network of botanic gardens in conserving PGR is also well recognised.

Utilisation of Plant Genetic Resources (GPA activities 9-14) is primarily adressed by crop-based networks, which are generally strongly focused on the utilization of plant genetic resources and cooperative testing and development of improved materials. The focus of crop-based networks is often on the development of a particular crop, contributing in particular to increasing genetic enhancement and in many cases to base-broadening efforts. The contribution of crop networks to the sustainable use and conservation of a crop appears to be variable. For example, the Asian Network for Sweet Potato Genetic Resources (ANSWER) works towards the conservation and evaluation of sweet potato collections, whereas networks such as the Asian Maize Biotechnology Network (AMBIONET) focus rather on the development of improved varieties. Seed networks are important in supporting seed production and distribution. Regional PGR networks, as well as the networks on under-utilised crops and medicinal species, may contribute to promoting the development and commercialisation of under-utilised crops and species, as well as developing new markets for local varieties and "diversity rich" products.

Institutions and Capacity Building (GPA activities 15-20) activities are addressed primarily by regional fora and the regional PGR networks. Supporting national PGR programmes is a major focus

of the regional PGR networks. Regional and subregional fora are actively engaged in regional priority setting for agricultural research and development, and a number of regional priorities identified in these fora correspond closely with the priorities of the GPA. Regional fora often provide a supporting umbrella structure that helps to link different kinds of networks in a region. Linkages between different kinds of networks, as well as synergies within and between countries and regions, is an important issue that may require further study.

Exchange of information is one of the most important functions of all networks, and the harmonisation of databases and information systems, as well as building capacity for electronic communications, is an increasing priority for many networks. In addition, information networks such as WIEWS, SINGER, GRIN, and the European Central Crop Databases and EPGRIS project are examples of national, global and crop regional efforts to provide public access to information about genetic resources, to enhance understanding of the status of its genetic resources conservation and promote and facilitate their use. These activities contribute to the building of a Global Information system (activity 17 of the GPA and Article 17 of the International Treaty).

Important factors affecting the efficiency and effectiveness of networks

There may be a considerable discrepancy between the written objectives of a network and the day-to-day reality of its functioning. Some of the factors influencing the effectiveness and efficiency of network functioning include clarity of focus, financial aspects, balance of interests, capacity and the external operating environment of a network, as well as the network´s ability to adapt to change.

The only network studied that is financed completely through member contributions was ECP/GR. Some contribution by members to network activities, whether monetary or in kind, is important. Complete self-financing may only be possible in mature networks, and in most developing countries the potential for complete self-financing is heavily limited by the financial and political operating environment of the network. Expectations of member contributions should be balanced by an appreciation of capacity and resource constraints faced by network members.

The NARs, as well as the CGIAR centres, form the major basis for many of the networks studied. In many cases, CGIAR centres were involved in the initiative to establish networks, often in collaboration with FAO and other international institutions. While no comprehensive data on network membership was obtained, it was noted that network membership is dominated by the public sector, with some NGO and private sector membership. A number of crop-based networks (e.g. rootcrop, bean networks and fruit and vegetable networks) mention the promotion of private sector and NGO involvement, however actual membership of the networks appears to be generally limited to public sector and research institutions.

A feeling of ownership of the network by members is very important, and an important factor for a sense of ownership in a network may be the ability to determine important decisions, particularly relating to the distribution of funds. The question of ownership is closely linked to important questions of clarity of objectives and level of participation in the networks, factors for which in depth analysis would require further communication with people involved in the networks. These are important issues to address in further studies.

In addition to their organisational development, changes can occur in the needs of the network membership or its composition; the networks socio-political and economic environment; or even the "problem" or need that originally brought about the creation of the network. Networks therefore need to be adaptable to be sustainable. In order to adapt to change, networks need to plan for change and evolution, carry out regular monitoring of their activities and reassessment of their goals. A proposed framework for internal evaluation is included in the background study as Annex 1. For the further development of such a framework as a tool for networks, the networks themselves should be closely involved.

Need for further study

In order to provide a fuller insight into real functioning of the networks (and therefore into their real contribution to the implementation of the GPA and IT PGRFA), further studies are recommended involving fieldwork such as interviewing network members, users and other stakeholders. Such studies could be carried out on a regional basis and examine in particular the issues identified in this study, including issues of ownership and participation, the synergies and complimentarities between different kinds of networks, as well as overlaps that may reduce the efficient use of resources.

In examining the above issues, it should be recognised that all types of networks described have their own valid contribution to the implementation of the GPA and the IT PGRFA. No single type of network can be simply recommended as a blueprint for other crops and by other regions and institutions, as human diversity forms an essential background to both the development and the management of plant genetic diversity.

1. INTRODUCTION

The global framework for action on Plant Genetic Resources for Food and Agriculture (PGRFA), established with the adoption of the Global Plan of Action (GPA) for the Conservation and Sustainable Utilisation of Plant Genetic Resources for Food and Agriculture in June 1996, has recently been strengthened by the adoption of the International Treaty on Plant Genetic Resources for Food and Agriculture (IT PGRFA) by the Thirty-first Session of the FAO Conference in November 2001. The Treaty is the result of several years of negotiations to revise the International Undertaking on Plant Genetic Resources, in harmony with the Convention on Biological Diversity. It complements the existing Global Plan of Action, stating that "Contracting Parties should promote...effective implementation (of the GPA)" (Article 14).

Implementing the provisions of these international agreements is a major challenge for worldwide stakeholders in the conservation, sustainable use and equitable sharing of the benefits of plant genetic resources. Both the International Treaty and the Global Plan of Action emphasise the need for international co-operation and synergy among different sectors, in order to deal with the technical, social, economic, political and ethical issues which surround the management of plant genetic resources.

Networks can provide an important mechanism to promote the above-mentioned synergy and collaboration required to deal with complex issues related to PGR conservation and sustainable use. Both the Global Plan of Action (Activity 16) and the International Treaty (Article 16) recognise and stress the importance of networks as mechanisms for their implementation.

The Global Plan of Action recognises networks as important platforms for scientific exchange, information sharing, technology transfer, research collaboration, and for the determination and sharing of responsibilities for such activities as collecting, conservation, distribution, evaluation, and genetic enhancement of plant genetic resources. It notes that "by establishing links between those involved in the conservation, management, development and utilisation of plant genetic resources for food and agriculture, networks can promote exchange of materials on the basis of mutually agreed terms and enhance the utilisation of germplasm". In addition, it notes the role of networks in helping to set priorities for action, developing policy, and provide means whereby crop-specific issues and regional views can be conveyed to various organisations and institutions. The long-term objectives of the GPA include ensuring that all countries "are served by active regional and international networks and an appropriate complement of crop-based, thematic and *in situ*-oriented networks".

Article 16 of the International Treaty on Plant Genetic Resources for Food and Agriculture, concerning International Plant Genetic Resources Networks, states that **"**Existing co-operation in international plant genetic resources for food and agriculture networks will be encouraged or developed on the basis of existing arrangements and consistent with the terms of this Treaty, so as to achieve as complete coverage as possible of plant genetic resources for food and agriculture…" and that the Contracting Parties will encourage participation in the international networks of all relevant institutions, including governmental, private, non-governmental, research, breeding and other institutions.

The aim of present study is to provide an overview and analysis of networks addressing PGRFA issues, and to provide options for optimising the effectiveness of the role of networks in the implementation of the GPA and the IT PGRFA. The study was commissioned by FAO in the process of preparing document CGRFA-9/02/12, *International Plant Genetic Resources Networks*, for consideration by the ninth session of the FAO Commission on Genetic Resources for Food and Agriculture (CGRFA) of the further development of these networks, in the context of Article 16 of the International Treaty. Information on networks is drawn from a number of sources, including in particular the information assembled under sections 6.2.1, 6.2.2 and 6.2.3 of the State of the World's Plant Genetic Resources for Food and Agriculture (SoW), the network inventory carried out by IPGRI in 1999 and information available on the internet.

The study focuses on the actual and potential contributions of the regional PGR networks and global and regional crop-based networks to the implementation of the GPA and IT PGRFA. It also looks at the contribution of *in situ*-oriented and thematic networks, and the apparent linkages between different kinds of networks. The overview part of the study can be regarded as an update of an earlier study carried out by the International Plant Genetic Resources Institute (IPGRI) in 1999 (see section 2.2). For the purpose of the analysis, networks are examined based on criteria such as their objectives and activities, geographical coverage, crop or thematic focus, and membership. The study also examines briefly the issues of network effectiveness and efficiency, and attempts to provide some options for consideration concerning improving the functioning of networks and the real and potential synergies between them. Conclusions are drawn in relation to the actual and potential contribution of networks of the GPA and IT PGRFA, in particular regarding coverage of the networks and their objectives in relation to the activities and objectives of these international agreements. The study also formulates recommendations on next steps that might be taken towards improving the effectiveness of the role of networks in the implementation of the GPA and the IT PGRFA.

The study is limited in scope and the methodology did not involve interviews or similar approaches of information gathering from users and stakeholders of these networks. The information collected was based on a survey of the Internet and on other written sources, thereby limiting conclusions and recommendations to those that can be drawn without direct contact with the networks.

Section 2 of the present document begins with a brief examination of different approaches to classifying networks, and discussion on the criteria used as a basis for analysis. Section 3 provides an overview of PGR networks, and global and regional *in situ*-oriented, crop-based and thematic networks. Section 4 considers the coverage of regional PGR and crop-based networks, as well as the contribution of networks to the four main areas of activity of the GPA: *in situ* conservation and development; *Ex situ* conservation; Utilisation of plant genetic resources; and Institutions and capacity building, as well as examining a number of factors that are important for the effective and efficient functioning of networks. Conclusions and recommendations are presented in section 5.

2. APPROACHES TO ANALYSING NETWORKS

2.1 Defining networks

Networks are usually formed based on the principle that "two heads are better than one", i.e., to collaborate on complex issues that are more difficult to address on an individual basis. The complex issues surrounding plant genetic resources for food and agriculture that justify the need for collaboration are summarised by Watts (2000) as follows[1]:

- "The field of plant genetic resources is technically and scientifically complex, and many key questions have yet to be answered.
- Genetic research, particularly biotechnology, is undergoing a period of rapid growth and change.
- In this atmosphere, individual farmers, research scientists, institutions and governments have failed to satisfactorily address emerging problems by acting independently.
- Adversity increasingly characterises the debate as different factions struggle to gain rights to plant genetic resources.
- Differences between the amount of expertise, infrastructure, resources, information and power vary greatly among the different parties which have a stake in plant genetic resources conservation and use, for example, between developed and developing countries, or within countries between government and rural farmers and indigenous people, or between the public and private sectors.
- Many different groups and individuals have vested interests in plant genetic resources including plant breeders, agribusinesses, farmers, environmentalists, governments and international organisations".

The term "network" can refer to a wide range of different arrangements. Plucknett *et al*. (1993), for example, defined an agricultural research network as "an association of independent individuals or institutions with a shared purpose or goal, whose members contribute resources and participate in the two-way exchange of information and/or materials." They further state that two important characteristics of networks are their participatory management and decentralised nature. FAO (1992) defined a technical co-operation network as "a voluntary co-operative arrangement among institutions in two or more countries, set up for a period of at least several years, to carry out jointly certain specified activities (information exchange, research, training, exchange of personnel, etc.) for the purpose of direct exchange of relevant technologies, experience and information to address a common development problem. A network must include the concept of membership which makes a tangible contribution to its programme of activities".

A number of common characteristics emerge from the range of definitions for networks addressing PGR issues:

- voluntary membership
- common goals that address a complex problem better solved by more than one individual or institute
- two-way exchange of research results, materials, information, and/or technologies
- participatory management
- benefits to members from collaboration

The difference between a programme or project and a network is sometimes very difficult to define. In practice there are two main "lines" to draw in this context:

1) the level of formality (i.e., when does a working group/discussion group become a "network"?); and
2) the level of participation (i.e., at what point does information dissemination become networking? When can a project be considered a network?)

[1] Based on Gray's (1989) description of characteristics of difficult technical problems.

FAO (1992) notes ”an essential characteristic, which distinguishes networks from regional projects, is that they set out to maximise the use of indigenous expertise and resources available among the countries themselves and thus rely less on external inputs". Many projects and programmes also aim to maximise the use of indigenous expertise and resources available at a local level. However, this point draws attention to two important, (often unspecified) goals of most networks:

1) to continue for an unspecified amount of time (i.e., as long as there is a need for the network); and
2) to eventually operate autonomously, independent from (but still in collaboration with) the “parent” institution, and “owned” as fully as possible by members.

Networks that are referred to in the current study consist of those that address issues related to plant genetic resources and/or biodiversity, and contribute, or have the potential to contribute, to the implementation of the GPA and the IT PGRFA. The present study assumes a broad definition of the concept of networks and focuses on arrangements that exhibit the above characteristics, rather than networks with a particular structure. For this reason, the networking activities of (sub)regional agricultural fora such as ASARECA and APAARI are also considered relevant to the study.

The present study attempts primarily to provide a background for understanding and to some extent, categorising this range in order to provide a basis for further study. It is by no means a comprehensive survey and its limited scope has necessitated some noteworthy omissions, for example networks related to forest genetic resources that may also contribute to the objectives of the GPA and the Treaty. National networks are also not included in the study, although some of these networks, especially for larger countries such as India or the USA, may make a significant contribution to the implementation of the GPA and IT PGRFA at the regional level.

2.2 Information used to analyse networks

In 1999, IPGRI conducted a network survey to inventory genetic resources and related networks on behalf of the Systemwide Genetic Resources Programme (SGRP). The subsequent database of networks established by IPGRI provided a basis for the expanded database developed for the current study. In addition to the name of the network and contact details, the survey included questions on the year of establishment of the network, the geographic coverage, species covered, principle activities, whether there existed a document describing objectives, scope, key participants etc. The IPGRI survey also requested information on number of members and whether membership consisted of individuals, countries and/or institutions, as well as the role of the Consultative Group on International Agricultural Resources (CGIAR) in the network.

In order to further examine conditions for the functioning of networks, consideration was given to a number of questions derived from the “CATWOE“ (Customer, Actors, Transformation process, Weltanschauung, Owner, Environmental constraints) analysis used in soft systems methodology[2] to better understand the framework or organisational environment:

- What is the “problem“ addressed by the network and what are the desired results of having a network?
- Who “owns“ the network; i.e., who could stop the activities?
- Who carries out networking activities?
- Who are the beneficiaries of networking activities?
- What is the “worldview“ behind the purpose of the network? (This may be different for different sectors involved)
- What environmental constraints challenge the effective functioning of the network?

While in-depth analysis of these questions is beyond the scope of the current study, efforts were made in the context of these questions to obtain more information on:

[2] Further elaboration of this methodology can be found in Checkland, P.,1989, Soft Systems Methodology, in Rational Analysis for a Problematic World, edited by Jonathan Rosenhead, Wiley & Sons, Chichester.

- the overall objectives of the network
- how the network is funded
- the structure of the network
- further definition of membership, where possible, to the sectors involved (public, private or civil).
- background information on how the network started and why
- the maintenance of databases, production of newsletters and organisation of workshops.

In addition, some consideration was given to the "environmental" constraints, which may affect network functioning, such as the political environment and capacity of network members. The "CATWOE" framework may provide an interesting basis for further analysis of networks, and it is utilised in the proposed framework for internal evaluation presented in annex 1.

Information for the study was obtained from documents such as workshop reports, from discussions with staff at FAO, and from the Internet. It was not possible to obtain the above information for every network presented in the database, and while efforts have been made to provide accurate information, it is likely that some information may be outdated. In addition, the bulk of research was carried out through the Internet, thereby biasing the results towards those networks that are most visible electronically. It has been assumed that to a certain extent, presence on the internet may provide an indication of the activity level of a particular regional or global network: if the network does not have a website but is still very active, it is likely that at least the name of the network will occur in other documents posted on the internet. This assumption may not be true for all networks in less developed regions. It would also be unwise to assume the converse, as an attractive website may not reflect the activity level of a network, unless details of concrete activities are provided.

It should be stressed, therefore, that the current analysis, primarily based on available written information, reflects the goals of the networks rather than the actual status of network functioning. It does not report on the realised contribution of networks to the aims of the GPA and IT PGRFA, as this depends to a large extent on the effectiveness of the networks in meeting their objectives.

The primary focus of the present study is on the regional plant genetic resources networks and crop-based networks. For these networks, coverage has also been examined as far as possible within the scope of the study. Other kinds of networks (*in situ*-oriented, thematic networks and the regional fora) have been discussed less comprehensively, in the context of their actual or potential role in the implementation of the GPA and IT PGRFA.

2.3 Network classifications

Networks are by nature multi-faceted arrangements that can be examined from many different perspectives, and there are many different approaches to their classification (e.g. Smytolo & Koala 1993, Plucknett *et al.*, 1993). The following section attempts to provide insight into the most important characteristics of networks as a basis for the analysis to follow. For this purpose, three different approaches to classifying networks are presented. These classifications focus on technical descriptors, i.e. type of activities and scope and objectives respectively, or on social descriptors, i.e. organisational evolution. The third classification presented, focused on scope and objectives, is based on the network typologies referred to in the GPA (Activity 16). This classification has been used as a basis for the analysis, and is reflected in the summary table presented in section 4.1(Table 2). The other classifications have provided a conceptual basis for further refinement of the analysis.

2.3.1 Classification according to activities

The first classification, focussing on type of activities, is a modification by Plucknett *et al.* (1993) of the classification presented by the Special Program on African Agricultural Research (SPAAR). SPAAR categorises agricultural research networks into three typologies: *information exchange*

networks, *scientific consultation networks*, and *collaborative research networks*. Plucknett *et al.* (1993) describe a fourth category, *material exchange networks*, in addition to those presented by SPAAR. These classifications help to provide a conceptual background for consideration of the activities and *modus operandi* of different kinds of networks. It should be noted that most of the examples provided do not fit neatly into one category, emphasising the conceptual nature of such classifications.

Information exchange networks.
Information exchange networks organise and facilitate the exchange of ideas, methods, and research results among participants. Plucknett *et al*. (1993) note that despite their name, information exchange networks are often characterised by a one-way exchange of information. Information networks typically have a simple structure and are easy to establish, however it is often difficult to measure impact. This characterisation applies to a considerable extent to the two examples discussed in box 1.

It should be noted here that it is sometimes necessary to draw a distinction between the participants and beneficiaries of a network. In some cases, (e.g. SINGER, see box 1), information may be gathered in a participatory way through the collaboration of participants, but disseminated to beneficiaries of the network in one direction only.

Box 1. Examples of information exchange networks.

The World Information and Early Warning System on Plant Genetic Resources for Food and Agriculture (WIEWS), can be considered an information network. WIEWS has been established by FAO to foster information exchange among Member Countries, by gathering and disseminating information on PGRFA, and as an instrument for the periodic assessment of the State of the World's PGRFA. It presently consists of a number of relational databases; (1) a Global Network of Country Correspondents on PGRFA Information Exchange (officially nominated by Governments); (2) a repository directory of documents and proceedings related to the activities of the Global Network on PGRFA Information Exchange; (3) the Early Warning System on Genetic Erosion; and (4) the Global Plan of Action for the Conservation and Sustainable Utilisation of PGRFA (GPA). The scope of the information covered by the System is presently being expanded to include (5) the Seed Information System and (6) an Early Warning System for Monitoring Plant Genetic Erosion (presently in a design phase).

WIEWS aims to integrate information related to PGRFA (mainly germplasm holdings and early warning mechanisms) and on crop varieties, as well as to enhance linkages with existing international, regional and national information repositories on PGRFA (e.g. SINGER; GRIN etc.) and on seed related issues to assist assessment processes and policy development. WIEWS is also being conceived to become a common repository, among Member Countries, for exchanging experiences, tracking achievements, and highlighting constraints and needs during the GPA implementation process.

The System-wide Information Network for Genetic Resources (SINGER) is the genetic resources information exchange network of the International Agricultural Research Centres of the CGIAR. It provides access to information on the collections of genetic resources held by the CGIAR Centres, comprising over half a million samples of crop, forage and tree germplasm of major importance for food and agriculture. SINGER links the genetic resources databases of the CGIAR Centres and allows simultaneous searches for information concerning the identity, source, characteristics and transfer of the genetic resources in the individual Centre collections. Information gathered by the network members is disseminated to stakeholders in plant genetic resources such as researchers, breeders, policy makers, conservers, etc.

While SINGER is provided here as an example of an information exchange network, in line with its primary goal of making information available to stakeholders, in many ways it could also be considered a collaborative research network. The SINGER network is highly participatory within its membership, which currently consists of the CGIAR Centres but is broadening to involve other

networks and institutions. Activities among the members include a range of activities such as sharing knowledge and raising funds, as well as harmonised and interlinked information systems.

Information exchange networks can provide an important contribution to the implementation of the GPA and article 17 of the IT PGRFA on the Global Information System on Plant Genetic Resources for Food and Agriculture, which states that:

> *Contracting Parties shall cooperate to develop and strengthen a global information system to facilitate the exchange of information, based on existing information systems, on scientific, technical and environmental matters related to plant genetic resources for food and agriculture, with the expectation that such exchange of information will contribute to the sharing of benefits by making information on plant genetic resources for food and agriculture available to all Contracting Parties.*

Other types of networks that have a broader focus often have information exchange functions which can also contribute to this process, for example the maintenance of databases and distribution of newsletters.

Scientific Consultation Networks

Participants in scientific consultation networks focus research on common priority themes, but conduct it independently. Plucknett *et al.* (1993) noted that scientific consultation networks are characterised by two-way communication, facilitated by researchers meeting at workshops and conferences to exchange ideas and to discuss progress and problems. Research is usually planned on a decentralised basis, and projects exist before researchers enter the network. The methodologies used in these projects need not be identical. Activities often include training. These networks are easy to establish because independent research projects already exist and need no realignment. The networks may be used to report findings and discuss conclusions on the reported research, and as a clearing-house or common channel for funding requests. Scientific consultation networks often aim to become, and thus may evolve into, collaborative research networks, but often the needs of participants are sufficiently met through consultation.

Many international and regional "working groups" could be considered as scientific consultation networks**.** These working groups often exist under the umbrella of a larger network. The working groups of the network PROMUSA provide one example, although these working groups also carry out collaborative projects (see box 2).

Box 2: PROMUSA working groups as Scientific Consultation Networks

A Global Programme for *Musa* Improvement (PRO*MUSA*), has been developed by INIBAP as a means to link the work carried out towards addressing the problems of export banana producers with those initiatives directed towards improving banana and plantain production at the subsistence and smallholder level. The global programme builds upon existing achievements and is based upon ongoing research initiatives. The programme is an innovative mechanism to bring together research carried out both within and outside the CGIAR, creating new partnerships between NARS and research institutes in both developing and developed countries. It is also hoped that PROMUSA will provide a suitable framework within which the private sector can be encouraged to actively participate in Musa research activities.

PROMUSA is officially a Global Programme rather that a network, however networking is the main *modus operandi*. Within the framework of PROMUSA, 5 working groups or sub-networks exist: Sigatoka, Nematodes, Fusarium, Virus and Genetic Improvement. The working groups identify

research priorities and strategies that include projects carried out by individual participants, in line with the concept of *scientific consultation networks*. However, they also identify collaborative projects involving a number of participants, depending on the work to be carried out.

Decision making within PROMUSA follows a 'bottom-up' approach and participating scientists are fully involved in this process. Decisions on programme activities are based on scientific priorities identified by programme participants, based on users' needs.

Collaborative Research Networks

In collaborative research networks, participants are involved in monitoring of problems and joint planning of research of mutual concern, and share tasks. Plucknett *et al*. (1993) noted that in this kind of network, research projects are planned and carried out using a uniform, agreed methodology. However, existing (as opposed to centralised) research facilities are used. Collaborative research networks are co-ordinated more tightly, and the roles of participants are well defined. The network often has a steering committee, organises monitoring tours and meetings, and conducts training courses. The establishment of this type of network often involves a founding document. Examples of collaborative research networks include the Asian Rice Biotechnology Network and the European Cooperative Programme on Crop Genetic Resources Networks (see box 3).

Box 3. Examples of collaborative research networks

The Asian Rice Biotechnology Network (ARBN) was established by IRRI in 1993 to provide a vehicle for collaborative research in rice biotechnology with universities and rice breeding institutes of the national agricultural research systems (NARS) in Asia. The ultimate goal of the network is to assist the NARS to apply biotechnology to meet their own national needs in rice varietal improvement. To achieve this goal, ARBN aims to improve the NARS' access to new biotechnology tools by facilitating co-operation with one another and with advanced laboratories. ARBN emphasises the value of collaborative research as a means of developing a capacity for biotechnology, including human resources, multidisciplinary teams, technology, infrastructure, and priority setting. The German Government's Bundesministerium für Technische Zusammenarbeit (BMZ) and the Asian Development Bank (ADB) provide project funding for the network.

The European Cooperative Programme on Crop Genetic Resources Networks (ECP/GR) provides another example of a collaborative research network. This network involves a number of crop-based and thematic working groups. Participants of the working groups jointly plan specific activities, in particular concerning regeneration, characterisation and evaluation of germplasm, as well as establishing joint databases and regional core collections. They agree on common descriptor lists and formats to be used for such activities. Usually participants undertake such activities for the germplasm maintained in their own collections.

Material exchange networks

Material exchange networks may be established to test crop germplasm or finished varieties in different environments, or to co-ordinate the testing, manufacturing and adaptation of agricultural machinery. This type of network has a more complex structure, typically including an advisory body, and conducts training and organises monitoring tours, in conformity with the dominant structure of collaborative research networks. Through international nurseries, plant breeders can get a reading on the performance of materials in a wide range of environments. Identical screening methodologies are used to enable results to be compared. The co-ordinator often plays a strong role, disseminating the trial materials and monitoring the results. Information on results flows back to nurseries so that they can decide on how to continue the trials. These nurseries are mostly co-ordinated by the international agricultural research centres because of the complex tasks of collecting and disseminating the results.

These networks can play an essential role in the international evaluation of research products. They sometimes develop into collaborative research networks. The International Network for the Genetic Evaluation of Rice (box 4) provides an example of a material exchange network.

Box 4. Example of a material exchange network.

The International Network for the Genetic Evaluation of Rice (INGER) is a global partnership in the exchange of rice germplasm and information, co-ordinated by IRRI. Originally, the network was set up as a means for IRRI to distribute its germplasm material to national centres for evaluation. The process soon developed, however, to a two-way exchange of materials and research, as national programmes involved developed their own lines, using IRRI materials as parents rather than simply as a source to select new varieties. Mutual feedback now gives direction to research on understanding of the environment and the development of improved germplasm. The Council for Partnership on Rice Research in Asia serves as the INGER steering committee, ensuring that INGER effectively addresses the needs and priorities of NARES. More than 21,000 breeding lines and varieties of rice developed in countries around the world have been exchanged and evaluated through INGER over the years, and more than 350 INGER-distributed genetic materials have been released as 530 varieties in 62 countries. These countries that directly utilised INGER materials have saved 2-5 years of research time and resources.[3]

[3] Source: INGER website, for more information see http://www.irri.org/ingerforeword.html

2.3.2 Classification in the context of organisational evolution

A common thread in the description of networks is the fact that the organisational structure of networks is not static, but may evolve through a series of development phases. The organisation evolves through time, growing in size and developing its decision-making processes along the way. Based on work in public and private sector organisations, Watts (2000) noted that the practical benefits of applying the concept of organisational evolution to networks stems from the fact that organisations tend to behave in characteristic ways in each development stage. "For example, the ability to recognise the development stage and understand the likely future progression of an organisation could help managers formulate effective strategies, identify risks and opportunities, and manage organisational change". This approach, although focussing on organisations, can also be applied on networks. Networks are, in theory, the "ultimate participatory organisations" (Watts 2000), in that their purpose is to bring together the resources, knowledge, staff, and facilities of interested stakeholders to solve problems that are too complex or large for any one individual or institution to solve on their own. Table 1 presents a summary by Watts (2000) of Greiner´s model of organisational development.[4]

Table 1: Summary of Greiner´s model of organisational development

	Phase 1 Creativity	***Phase 2 Direction***	***Phase 3 Delegation***	***Phase 4 Coordination***	***Phase 5 Collaboration***
Organisational structure	Informal	Centralised and functional	Decentralised	Line staff and product groups	Matrix of teams
Management style	Individualistic, technical entrepreneurs	Directive, capable business manager	Delegative	Oversight	Participative
Emphasis	Creating a product and a market	Growth in number of employees and budget	Field to field contacts, increase in customer responsiveness	Increased efficiency of allocation of resources	Rapid problem solving and reorientation
Communication	Informal and frequent	Formal and impersonal by title and position	Infrequent, from top to bottom of the organisation	Through reports, planning systems and reviews	Focused on problem solving and social controls
Management relationships	Little or no differentiation between organisational levels	Upper managers set direction and lower managers carry it out	Greater responsibility delegated to field level, higher level managers manage by exception based on periodic field reports	Headquarters staff initiate company wide programs of control and review; capital expenditure carefully parcelled out	Key managers work together to focus on major problems

Care must be taken not to interpret such classification rigidly. Networks may have reasons to develop in either direction, or remain in a certain phase at any given time. Alternatively, some networks remain informal, while continuing important work, and others are begun on a very formal level. One example of a highly formal network is the International Network of *Ex Situ* Collections under the Auspices of

[4] The original article was written by Greiner in 1972 and updated for publication in 1998: Greiner, Larry E. [1972] 1998. "Evolution And Revolution As Organizations Grow." *Harvard Business Review*. May-June 1998.

FAO. The level of formality of this network is related not only to its evolutionary stage but also directly to its function. In contrast, a working group of scientists on a less "political" subject, for example utilisation of fodder genetic resources, may be able to network effectively for many years without taking on a more formal status.

The evolutionary pattern suggested for organisations in Table 1 can, however, be recognised in the development of a number of PGR networks. According to the model of Greiner, organisations (or networks) often start as an informal group of people brought together by a common interest, and later go through phases of centralisation and decentralisation. Structures and control develop and change. Watts selected four networks to study in more detail as representatives of stages 1-4 of organisational development:(1) the Lusophone Initiative, a young, informal network of eight countries; (2) the Forest Seed Research Network, a slightly older network of 22 research institutions with a "centralised and functional" organisational structure; (3) COGENT, the international coconut network which has 36 member institutes and a decentralised and geographical organisational structure, and (4) ECP/GR, which works through line staff and crop-based or thematic sub-networks.

ECP/GR, the oldest and largest network examined by Watts, has the most complex organisational structure, with approximately 40 member countries and numerous institutions involved from each member country. Watts' initially classified ECP/GR as being in the "Coordination" phase, but also noted that ECP/GR may be considered as moving into the next phase of "Collaboration" (see table 1).

2.3.3 Classification according to scope and objectives

For the purpose of this study, we have discriminated between the four categories of relevant networks as referred to in the GPA (Activity 16), according to their scope and objectives: regional PGR networks, crop-based networks, *in situ*-oriented networks, and thematic networks. We have included a fifth category of the regional fora such as APAARI, whose networking activities are considered relevant to the study. This classification has been used to provide a framework for analysing the networks described in section 3, and is summarised in Table 2. It is considered useful for the purpose of discussing the contribution of networks to the GPA and IT PGRFA, as it takes into account the objectives of the network, and provides for further analysis according to regional and crop coverage, as well as type of activities.

These categories can be described as follows:

Regional PGR networks
Regional PGR networks play a major role in the conservation and to some extent in the utilization of plant genetic resources, as also apparent from their objectives. They tend to focus primarily on conservation; genebanks and plant genetic resources collection holders take a central position. Within the framework of conservation, these networks often address many issues featuring in the Global Plan of Action and their agenda may involve a wide array of activities concerning collecting, regeneration, characterisation, evaluation and documentation of genetic resources, as well as research, training, policy support to governments, and public awareness-raising. Many of the networks refer explicitly to the GPA in their documentation.

Crop-based networks
As an early category of plant genetic resources networks, crop-based networks are strongly user-oriented. Breeders and researchers play a central role, and the conservation of germplasm is achieved through its utilisation, as plant genetic resources are often instrumental in increasing productivity. These networks focus less on policy aspects, although the exchange of germplasm may be an important activity. For the purpose of the current study, seed networks are also described within this category, although they could also be considered thematic networks.

In-situ oriented networks
In situ-oriented networks often derive their mandates or inspiration from global organisations and mandates and/or from international agreements. In many cases, the gap between efforts towards the conservation of natural and agricultural biodiversity is still very wide. However, a growing number of networks that traditionally focus on the conservation of natural biodiversity have now developed attention for the interactions between agro-ecosystems and natural ecosystems, and for the role of natural elements in agro-ecosystems. A number have also recently developed or are developing strategies relating to agrobiodiversity.

Thematic networks
This type of networks includes a wide range of arrangements to address specific themes, which could potentially be classified into numerous sub categories. Some thematic networks, such as the West African Farming Systems Research Network and the Consortium for the Sustainable Development of Andean Ecoregion (CONDESAN), are heavily focused on sustainability of ecosystems, and often take an integrated approach, combining conservation and development goals, and paying attention to all components and integration levels of agro-ecosystems and interactions between these components. In some cases, the focus of the network may be on development and transfer of a particular technology, such as the Technical Cooperation Network on Plant Biotechnology in Latin America and the Caribbean (REBIO). Others are directly focused on aspects of biodiversity and plant genetic resources, for example the Southern African Botanical Diversity Network and the African Ethnobotany Network. Thematic networks are sometimes characterised by a strong field orientation or regional linkages (e.g. CONDESAN). Policy aspects and public awareness raising play an important role. The background of these networks can be very diverse, however civil organisations (e.g. NGOs) are often strongly represented.

(Sub) Regional Fora
(Sub) Regional Fora have NARS membership and aim to contribute to the enhancement of agricultural and rural development in their (sub) region, through fostering agricultural research and technology development and by strengthening collaboration. These fora often have a broad scope, not specifically focussing on the conservation and utilization of plant genetic resources, but dealing with this topic as part as a broader agenda to develop agricultural capacity in a particular region.

It should be noted when considering the above classifications that not all networks fit neatly into a category. Many crop-based networks, for example, may focus on more sustainable production in the utilisation of genetic resources and therefore share objectives with thematic networks (e.g. IRRI's rice research consortiums). In addition, regional fora may form an umbrella for regional PGR networks, and the latter may in some cases (e.g. ECP/GR, SPGRC) form an umbrella for crop-based networks. The above classification should, therefore, be considered a typology useful for conceptualising the contributions of networks to the GPA and the IT PGRFA, rather than a rigid classification system. The main characteristics of these typologies are also summarised in Table 2, and these are used as a framework for the analysis presented in chapter 4.

3. OVERVIEW OF THE CURRENT STATUS OF NETWORKS

The following section attempts to provide an overview of networks related to the conservation and sustainable use of plant genetic resources for food and agriculture, in the context of the GPA and IT PGRFA. It is by no means a comprehensive inventory of all networks that carry out activities related to PGRFA, but seeks rather to paint a picture of the situation and provide a reference for the analysis to follow.

Section 3.1 provides a generalised overview of the global and regional frameworks for PGRFA activities, including the regional fora and the regional PGR networks. Section 3.2 provides an overview of the crop-based networks studied by crop or groups of crops. Sections 3.3 and 3.4 provide a number of examples of *in situ*-oriented networks and thematic networks surveyed, in order to provide a picture of the range of networks that can contribute to the goals of the GPA and IT PGRFA.

3.1 Overview of relevant global and regional frameworks and regional PGR networks

3.1.1 Global frameworks and networks

The main global framework for the conservation, sustainable use and equitable sharing of benefits arising out of plant genetic resources is the Global System for the Conservation and Sustainable Use of PGRFA, overseen by the Commission on Genetic Resources for Food and Agriculture (CGRFA). The objectives of the Global System are to ensure the safe conservation and promote the availability and sustainable use of plant genetic resources, for present and future generations, by providing a flexible framework for sharing the benefits and burdens. Components of the Global System include codes of conduct and guidelines (such as the International Code of Conduct for Plant Germplasm Collecting and Transfer and those on genebank standards and genebank regeneration decision guidelines), the State of the World's PGRFA, the Global Plan of Action, the original International Undertaking, the World Information and Early Warning System, the international network of ex-situ collections, and thematic, crop and regional networks. The new IT PGRFA results from several years of negotiations to revise the International Undertaking on Plant Genetic Resources, in harmony with the Convention on Biological Diversity, and compliments and strengthens this system.

The Global System is complemented by the CGIAR System-wide genetic resources programme, which links the work of the 16 CGIAR centres on genetic resources in five thematic areas: Policy, Public awareness, Information (through SINGER), Knowledge and technology, and Capacity building.

Ex situ collections of the 12 CGIAR centres and COGENT are now held "in trust for the benefit of the international community" by FAO and the CGRFA, within the International Network of *Ex Situ* Collections under the Auspices of FAO. *Ex situ* resources are also held in the international network of botanic gardens around the world, linked through the activities of the International Association of Botanic Gardens (IABC) and Botanic Gardens Conservation International (BGCI). The International Association of Botanic Gardens is a worldwide organisation affiliated to the International Union of Biological Sciences (IUBS) as a commission of the International Association of Botanical and Mycological Societies (IABMS). The association aims to promote international co-operation between botanic gardens, arboreta and similar institutes maintaining scientific collections of living plants and to promote documentation and exchange of information, living plants and specimens conservation, as well as the study of taxonomy, and the introduction to cultivation of appropriate plants of benefit to the community.

The Global Forum on Agricultural Research (GFAR) provides an important global linkage for the Regional/Sub-regional Fora (RF/SRF), such as AARINA for West Asia and North Africa, APAARI for the Asia/Pacific region, the CAC Forum for Central Asia and the Caucasus, FARA for Sub-Saharan Africa, and FORAGRO for Latin America and the Caribbean. GFAR was founded in 1996 by representatives of the developing-country national agricultural research systems (NARS), advanced

research institutions (ARIs), regional and subregional organisations, universities, non-governmental organisations (NGOs), farmers' organisations, the private sector, international agricultural research centres (IARCs), and the donor community. GFAR aims to promote a Global System for Agricultural Research to reduce poverty, achieve food security, and conserve and manage biodiversity and natural resources. Its goals are to:

- "Facilitate the exchange of information and knowledge;
- Foster cost-effective, collaborative partnerships among the stakeholders of agricultural research and sustainable development;
- Promote the integration of NARS and enhance their capacity to produce and transfer technology that responds to users' needs;
- Facilitate the participation of all stakeholders in formulating a truly global framework for development-oriented agricultural research;
- Increase awareness among policymakers and donors of the need for long-term commitment to, and investment in, agricultural research"[5].

GFAR concentrates on five high-priority areas in agricultural development: information and communication technologies; support to regional fora and NARS sub-regional groupings; genetic resource management, biotechnology and intellectual property rights; natural resource management and agro-ecology; international co-operation for agricultural research on commodities outside the CGIAR mandate. The first two priorities are more institutional in nature as they are crucial to ensuring the full and equal participation of all GFAR stakeholders. The other three areas, unanimously recognised as critical, urgently need specific action programs based on new partnerships and strategic alliances.

3.1.2 European frameworks and PGR networks

The main plant genetic resources network in Europe is the European Cooperative Programme for Crop Genetic Resources Networks (ECP/GR). This network was founded in 1980 on the basis of the recommendations of the United Nations Environment Programmes (UNEP), the Food and Agriculture Organisation of the United Nations (FAO) and the Genebank Committee of the European Association for Research on Plant Breeding (EUCARPIA). The secretariat is held at IPGRI. ECP/GR is a collaborative programme among 35 European countries, operating through ten broadly focused networks that deal with groups of crops or general themes related to plant genetic resources. The main implementation of the Networks' activities is through Working Groups. Working Group members are nominated by the National Coordinators and are responsible for representing the activities and interests of their country with regard to the specific crops or themes addressed by the Working Groups.

A networking arrangement for Nordic-Baltic Cooperation on plant genetic resources was established in 1994, following the disintegration of the Soviet Union, when the caretaking of plant genetic resources at the Vavilov institute (VIR) deteriorated drastically due to lack of funding. Three co-ordinators have been appointed with the task to build up national PGR networks in Estonia, Latvia, and Lithuania. More than 18 institutes are now linked to national programmes for the preservation and management of PGR. Following the model of the Nordic Gene Bank, joint Baltic activities are now carried out in several crop-specific Working Groups on Cereals, Forage crops, Vegetables, Fruit trees/Berries, Spices/Medicinals, and Potatoes. Funding is provided for the network by the Nordic Council of Ministers.

The European System of Cooperative Research Networks in Agriculture (ESCORENA) is a form of voluntary research co-operation among interested national institutions involved in research in food and agriculture and related fields. It was established in 1974 by FAO and research institutions from European countries. The System is serviced by FAO and some networks jointly by FAO and CIHEAM. Each network is composed of co-operating institutions and/or individual researchers

[5] See the GFAR website at http://www.egfar.org

working on the same or similar subjects. Within the network, they agree on the joint research project, divide tasks and objectives and set a time frame. Cooperative research projects stem from national research programmes and priorities and are financed by participating national institutions. The System is composed of thirteen co-operative research networks including crop-based networks for flax, cotton, soybeans, sunflowers, nuts, pastures and fodder crops, olives and rice, and an ad-hoc working group on oat diseases. ESCORENA networks are also integrated into or collaborate with other systems designed to further co-ordination and collaboration in agricultural research, such as the Global Forum for Agricultural Research (GFAR), the Association of Agricultural Research Institutions in the Near East and North Africa (AARINENA), the European Forum on Agricultural Research for Development (EFARD) and the International Service for Agricultural Research (ISNAR).

An example of an intergovernmental framework for short-term networking activities in Europe is provided by the European Cooperation in the field of Scientific and Technical Research (COST) programme, which allows the co-ordination of nationally funded research on a European level. COST "Actions" are networks of co-ordinated national research projects in fields that are of interest to a minimum number of participants (at least 5) from different member states. The Actions are defined by a Memorandum of Understanding (MoU) signed by the Governments of the COST states wishing to participate in the Action. Currently 25 Actions are running on subjects related to agriculture and biotechnology. The duration of an Action, however, is generally limited to 4 years. COST has a geographical scope beyond the EU and most of the Central and Eastern European countries are members. Its goal is to ensure that Europe holds a strong position in the field of scientific and technical research for peaceful purposes, by increasing European co-operation and interaction in this field. COST provides a useful tool to further European integration, in particular concerning Central and Eastern European countries.

3.1.3 Sub-Saharan African frameworks and PGR networks

The Forum for Agricultural Research in Africa (FARA) is conceived as a facilitating and coordinating mechanism. Regional research and development priorities are based on the priorities defined at subregional level by the three Sub Regional Organizations (SROs) namely: ASARECA, CORAF/WECARD and SACCAR.

In East and Central Africa, the Association for Strengthening Agricultural Research in Eastern and Central Africa (ASARECA) is a non-political organisation of the National Agricultural Research Institutes (NARIs) of ten countries: Burundi, D. R. Congo, Eritrea, Ethiopia, Kenya, Madagascar, Rwanda, Sudan, Tanzania and Uganda. It aims at increasing the efficiency of agricultural research in the region so as to facilitate economic growth, food security and export competitiveness through productive and sustainable agriculture. ASARECA carries out its activities through regional research networks, programmes and projects. The East African Plant Genetic resources network (EAPGREN) was established in November 1997 under the umbrella of ASARECA, partly in response to the subregional synthesis report on East Africa prepared for the GPA, which identified many opportunities for regional collaboration. Its mission is to harness, conserve and promote greater use of plant genetic resources for food security, improved health and socio-economic advancement of the rural communities. Among the regional priority activities identified was the need for development of an information and documentation system that would enable harmonisation and ease of exchange of plant genetic resources data and general information. The network's activities started in early 2001.

The Genetic Resources Network for Western and Central Africa (GRENEWECA) was formed in 1998 under the auspices of CORAF, in response to recommendations from a regional meeting on the implementation of the Global Plan of Action. The Sub-regional Forum CORAF/WECARD (the West and Central African Council for Agricultural Research and Development), includes Benin, Burkina Faso, Cameroon, Cap Verde, The Central African Republic, Congo, Côte d'Ivoire, Gabon, Gambia, Ghana, Guinea, Guinea Bissau, Mali, Mauritania, Niger, Nigeria, D.R. Congo, Senegal, Sierra Leone,

Chad, and Togo[6]. WECARD/CORAF is a discussion forum with the objectives to a) facilitate the exchange of information and experiences, b) promote partnerships, c) identify and formulate common research themes, d) identify innovative projects and e) organise research partnerships at the sub-regional level, and as such provides a framework for a number of networks in the region.

In Southern Africa, the SADC Plant Genetic Resources Centre (SPGRC) was established in 1989 by The SADC Member States as a non-profit inter-governmental institution. SPGRC keeps the SADC base collection, which involves the maintenance of the long-term storage facilities, and provides co-ordination of PGR work within the region. Regional integration in agricultural research and training in the region is provided by the Southern African Centre for Cooperation in Agricultural and Natural Resources Research and Training (SACCAR), established in 1984 by the Southern African Development and Coordination Conference (that would be formalised in 1992 into the Southern African Development Community. SACCAR runs a number of regional programs and serves as a focal point where donors, agricultural research institutes, and interested individuals can obtain information on agricultural research and training activities in SADC.

3.1.4 Central and West Asian and North African frameworks and PGR networks

The Regional Forum AARINENA (Association of Agricultural Research Institutions in the Near East and North Africa) aims to foster development of agricultural research in the Near East and North Africa region. It seeks to a) promote the exchange of agricultural scientific and technical experience, b) strengthen national agricultural research capacities for providing timely and necessary data and information to policy-makers, c) and establish appropriate collaborative research and training programmes in accordance with the identified regional, bilateral and/or national needs and priorities. For the Central Asia and Caucasus (CAC) region, the CAC Agricultural Research Forum was recently launched (2000) by the NARS leaders in the eight CAC countries, to provide similar support and linkages. Activities developed so far consist of a Collaborative Research Program on Sustainable Agricultural Development, including a number of research projects initiated on management and organizational issues related to germplasm conservation and enhancement.

Two networks on Plant Genetic resources now exist in the region: the West Asia and North Africa Plant Genetic Resources network (WANANET), which has been working since 1992 to strengthen national programs in the area of plant genetic resources, and a new regional network, the Central Asia Trans Caucasian Network (CATCN-PGR), was set up in 1999 with full official representation from member countries in nine thematic and crop working groups.

3.1.5 Asia, the Pacific and Oceania frameworks and PGR networks

Four plant genetic resources networks exist in the Asia-Pacific region: EA-PGR (East Asia), RECSEA-PGR (Southeast Asia), SANPGR (South Asia), set up between 1990-1993, and a recently established network on plant genetic resources in the Pacific. Membership in these networks is open to countries. IPGRI hosts the secretariat for these networks, and the IPGRI-APO Newsletter for Asia and the Pacific is used for dissemination of general information. These networks aim to strengthen national programmes, share information, enhance collaboration in the region on PGR issues, identify conservation strategies, provide training and promote public awareness.

The Asia-Pacific Association of Agricultural Research Institutions (APAARI) plays a catalytic role in order to facilitate the effective functioning and co-ordination of the large number of networks in the Asia-Pacific region that exist in addition to the above mentioned PGR networks, in particular networks in crops and areas which cut across countries and on problems of wider interest to NARS.

[6] NB although both ASARECA and CORAF/WECARD cover “Central Africa” the only country member shared by CORAF and ASARECA is the Democratic Republic of Congo.

3.1.6 American frameworks and PGR networks

Networking for agriculture in the Latin American and Caribbean region is co-ordinated under the general umbrella of the Regional Forum of Agricultural Research and Technological Development (FORAGRO), for which the Technical Secretariat is hosted at IICA. FORAGRO aims to contribute in assisting Latin American and Caribbean countries to generate or access necessary technology on their own or through strategic alliances, and to apply such knowledge to the achievement of food security and sustainable and equitable development, based on the dynamism of a competitive agro-industry which generates employment opportunities in the new millennium[7]. The Forum is an open and participatory mechanism; promotes research and innovation networks; is inclusive, in terms of the public and private actors that make up the NARS; facilitates dialogue and consultation among these actors; represents and defends the positions of the Region; and promotes joint actions and ventures, strategic alliances and articulation with research initiatives in other parts of the world. The sub-regional fora or so-called "PROCIs" (Programas cooperativos de investigación y transferencia de tecnología) in the four LAC subregions: Mesoamerica (PROCITROPICOS); the Andean region (PROCIANDINO); the Southern Cone (PROCISUR); and the Caribbean (PROCICARIBE); are some of the key constituents of a Regional Research and Technology Development System. FORAGRO interacts with other initiatives worldwide, particularly the Global Forum on Agricultural Research (GFAR).

Each of the "PROCIs" in turn provide an institutional framework for the integration and co-ordination of agricultural research at the national and regional levels with linkages to international organisations, including a number of specialised networks. These include the Mesoamerican Network of Plant Genetic Resources (REMERFI) the Andean Plant Genetic Resources Network REDARFIT (under PROCINANDO), the Red Amazónica de Recursos Fitogenéticos TROPIGEN (under PROCITROPICOS), and the Caribbean Plant Genetic Resources Network CAPGERnet (PROCICARIBE).

For the Latin American subregion, a Regional Integrating Mechanism (RIM) initiative to facilitate integration of activities on plant genetic resources was established in 1998, during the regional meeting for the implementation of the GPA. It is intended as a mechanism to co-ordinate activities and develop subregional or regional project proposals attending specific needs within the region. This mechanism is further described in the context of linkages between networks (section 4.2.5).

PROCINORTE provides the North American equivalent for the recently formed Plant Genetic Resources Network for North America (NORGEN) that includes Canada, USA and Mexico.

3.2 Overview of crop-based networks

It is often stated (e.g. in the State of the World's PGRFA (SoW) 1996) that only 30 crops "feed the world". Wheat, rice and maize alone provide more than half the global plant-derived energy intake. A further seven crops or commodities – sorghum, millets, potatoes, sweet potatoes, soybean and sugar cane and beet bring the total to 75% of the energy intake. Cassava, bananas and plantains, and beans (*Phaseolus*) are also of major importance to food security in one or more subregions. This section provides a general overview of the networks addressing issues related to major groups of crops as well as fruit and vegetables, forages and rangeland crops, under-utilised crops and seeds, focusing primarily on the above-mentioned major crops as outlined in the SoW (1996).

It is important to note that only regional and international networks are included in this study. National networks and national, regional or international research projects or programmes are not included.

[7] Source: FORAGRO website http://www.iicanet.org/foragro/

3.2.1 Cereal networks

Wheat networks
Wheat is the world's most widely cultivated crop, covering a harvested area of 219 million ha. Wheat is important to food security in all subregions, especially in Central and West Asia and the South Mediterranean (SoW 1996).

At the international level, ICARDA's International Germplasm Testing Network disseminates advanced lines, parental lines and segregating populations of barley, durum wheat, bread wheat, lentil, kabuli chickpea, faba bean, vetches and chicklings developed by ICARDA, CIMMYT, ICRISAT and national programmes. Feedback from NARS assists in developing adapted germplasm and provides a better understanding of interactions between genetic material and the environment and of the agroecological characteristics of major production areas.

In East and Central Africa, the Eastern and Central Africa Maize and Wheat (ECAMAW) Research Network, is one of the 16 regional networks that operate under the auspices of the Association for Strengthening Agricultural Research in East and Central Africa (ASARECA). Support and guidance for this network is provided under CIMMYT´s long running Eastern Africa Cereals Program (EACP), which is now in its final phase. CIMMYT considers that the new network has helped scientists in eastern Africa realise greater economy, productivity, quality, and efficiency in maize and wheat research: More than 95% of all of the research and extension projects approved by ECAMAW's Steering Committee have been executed successfully, and the structure of the research network makes it possible for researchers to receive feedback from peers in the region to improve their experiments and increase research efficiency. A special feature of the EACP/ECAMAW collaboration is agronomy research targeted at farm-level problems that must be resolved to promote long-term agricultural productivity in the region. These include soil fertility problems and the parasitic weed, *Striga*, which is a serious threat to maize production. Research is also carried out on economic issues, and improved maize and wheat is also delivered through the network. Another special feature of EACP and ECAMAW is an emphasis on empowering the region's women farmers as well as sensitising the researchers (male and female) that work on their behalf. ECAMAW, supported by the EACP, launched a series of gender analysis and training initiatives in collaboration with the Centre for Women Studies and Gender Analysis (CWSGA), Egerton University, Kenya.

The SADC Maize and Wheat Improvement Research Network (MWIRNET) was organised through the SACCAR Board, a SADC Committee co-ordinating agricultural research, and was established in June, 1994. The network includes about 200 individuals and institutions and has a steering committee composed of representatives from each of the SADC countries. The aim of the network is to facilitate and strengthen maize and wheat research in the SADC region. The Network holds maize and wheat workshops approximately every two years, and a newsletter disseminates summaries of new research findings in the region to members. MWRINET also administers a small grants program for collaborative research and supplies.

Ninety percent of the world's durum wheat area is found in the Mediterranean region. Durum wheat is a traditional and important food crop in the region; its grain is used in a number of food products consumed by rural households, e.g. pasta, couscous, burghul and frike (roasted green wheat), and in some areas is preferred for home bread making. Most of the area is still planted to landraces, though the newly developed stress-tolerant durum cultivars are beginning to be adopted by dryland farmers. The durum wheat improvement program at ICARDA has developed a durum research network in the Mediterranean region between South Europe, West Asia and North Africa (WANADDIN), established in 1996 with the aim of supporting national durum research and exploiting the comparative advantages in each durum-producing country, and as a means of decentralising ICARDA's durum breeding and research in stress physiology, biotic stresses, and grain quality.

ICARDA also has a number of smaller, topic-focused wheat networks operating under the Nile Valley and Red Sea Regional Program (NVRSRP) which address specific production issues such as water use efficiency in and thermotolerance in wheat, wheat diseases and socio-economic issues.

In Europe, networking for wheat genetic resources is carried out through the ECP/GR cereals network and wheat working group.

Maize networks
Maize is particularly important to food security in Central and South America and most regions in Africa. The gene pool consists of one main cultivated species, *Zea mays*, and several related wild genera (SoW 1996).

In Southern, Eastern and Central Africa wheat and maize are addressed together by ASARECA´s ECAMAW network and the SADC Maize and Wheat Improvement Research Network (MWIRNET), described above. In the Western and Central African region, the Africa maize collaborative research network (WECAMAN) was formed in 1987 under the auspices of the IITA Semi-Arid Food Grains Research and Development (SAFGRAD) project, with IITA as co-ordinator. The strategy has been to exploit the strength of the strong NARS (lead centres) in research personnel, infrastructure, and ecological potentialities for the generation of technologies that can be shared with the other network member countries, particularly the weaker NARS. Major emphasis is placed on the screening and development of technologies that can alleviate the major constraints to production. Selected maize scientists visit national maize programs in order to discuss maize research and methodologies for solving problems related to maize production and productivity. The Network provides a forum for national scientists to test elite varieties and other technologies within the region. The goal of the network is to increase maize production, and the productivity of farmers, in the Savannah zone of West and Central Africa, with the goal of increasing food security and farmers' incomes. According to a 1993 study by Sanders *et al*.[8], there has been substantial impact from research on maize in West and Central Africa. For example, in Ghana, the area under improved maize cultivars increased from 20% in 1982 to 55% in 1991. From 1985 to 1992, the annual social benefits from maize research ranged from $5.5 million to $84 million with an estimated internal rate of return of 73%. According to the same study, WECAMAN has been a major mover of technologies developed by diverse sources. In the countries examined, approximately half of the maize had been in SAFGRAD trials. WECAMAN has also funded community level seed production schemes in Burkina Faso, Benin, Cameroon, Mali, Togo, Cote d'Ivoire and Ghana. A large number of farmers in network member countries received training on improved techniques of seed production and post-harvest handling. The community seed production project has had significant positive impact on the availability of good quality breeder and foundation seed of early and extra-early varieties in the member countries. Also, the availability of good quality seed has resulted in high adoption of the early and extra-early varieties.

In Central and South America, CIMMYT´s Regional Maize Program (PRM) was established in 1977 together with the Swiss Agency for Cooperation and Development (COSUDE) to enhance research and technological development on maize in Central America. The aim of this network is to foster synergies among the regions national Agricultural Research Programs; a international agricultural research centre of excellence and a co-operation agency with long term perspectives. During the last two decades, the network has helped to integrate the efforts of agricultural research systems in the member countries, with the purpose of liberating new maize varieties, adapted to local conditions. In 1996 the collaboration promoted by PRM was evaluated, focusing on the impact of the release of 140 varieties in participating countries, steaming-up from PRM-based collaboration and genetic material from CIMMYT. The study estimated the impact arising from releasing these varieties in Central America and Panama and the Caribbean at more than US $70 million. This impact was possible in spite of low rates of adoption (between 7 and 45%). The study also showed that only a third of the impact resulted from individual efforts of participating institutions. The remaining two thirds was assigned to spillovers resulting from collaboration promoted by PRM. The Latin American maize

[8] Referred to on the IITA website at http://www.iita.org/partner/network.htm

regeneration project (LAMP) also involved 7 countries in maize germplasm conservation in the region.

In Asia, the Asian Maize Biotechnology Network (AMBIONET), was established in 1988 and forms a partnership between national agricultural research systems in China, India, Indonesia, the Philippines and Thailand, and CIMMYT. AMBIONET is a collaborative research and training network aimed at building the biotechnology capacity of national maize programs in Asia. The focus of the Network is on the application of biotechnology tools to maize improvement and their integration into conventional breeding efforts in highly focused collaborative research programs. The Tropical Asian Maize Network (TAMNET) also works to strengthen hybrid maize technology in the Asia-Pacific region.

Rice networks
Rice is extremely important for food security in Southeast Asia, East Asia, the Indian Ocean Islands, West Africa, the Caribbean and South America (SoW 1996). Two CGIAR centres are focused on rice: IRRI and WARDA. IRRI is involved in most of the rice networks mentioned in this section.

At the international level, the International Network for Genetic Evaluation of Rice (INGER) is a partnership among NARs in various rice growing countries in the world and the International Agricultural Research Centres such as IRRI, WARDA, and CIAT (see section 2.1.4). The long-running Rockefeller Foundation International Programme on Rice Biotechnology has also provided a basis for international networking between scientists, although the programme is no longer active. During the program's 17-year lifetime, it linking fledgling national rice biotechnology efforts directly to advanced research institutes in the United States, Europe, Japan, and Australia. More than 400 (primarily Asian) rice scientists were trained in this manner. The successful linkage of research in cutting-edge biotechnology with the training of rice scientists often produced long-term collaborative relationships that outgrew dependence on Foundation support and continue today (such as the IRRI-managed Asian Rice Biotechnology Network).

The Rice-wheat Consortium for the Indo-Gangetic Plains, for which CIMMYT hosts the secretariat, includes NARS of Bangladesh, India, Nepal, and Pakistan, and the CGIAR centres CIMMYT, IRRI and ICRISAT. Its focus is on research and technology transfer, in order to enhance productivity and sustainability of intensive rice wheat cropping systems in the Indo-Gangetic Plains. Multidisciplinary, collaborative research involves social, biological, and physical scientists.

IRRI carries out networking activities through three research consortiums: The Upland Rice Research Consortium (URRC); the Rainfed Lowland Rice Research Consortium (RLRRC) and the Irrigated Rice Research Consortium (IRRC). The URRC and the RLRRC focus on upland and rainfed lowland rice respectively. The IRRC is the home for downstream research in irrigated rice systems, to facilitate the implementation and exchange of technology with the NARS. It consists of workgroups on nutrient management (RTOP), hybrid rice (HRNet), weed ecology, rodent management, water savings and impact (to conduct participatory research, evaluate projects and assist in achieving impact).

In 1995, FAO and IRRI jointly established the International Task Force on Hybrid Rice (INTAFOHR). Task Force members include Bangladesh, China, France, India, Indonesia, Japan, Myanmar, the Philippines, Sri Lanka, Vietnam, CIAT, FAO and IRRI. The network aims to intensify collaborative strategic research on hybrid rice and strengthen the public and private hybrid seed industry and linkage between hybrid rice research centres and hybrid seed industries, and to promote the free exchange of germplasm, information and data from on-going research and development programmes concerning hybrid rice among interested partners, provision of training, monitoring tours and workshops, and the provision of expertise and consultancy services in research and hybrid seed production. The network is also supported by the International Rice Commission (IRC) and the Rice Development Programme (RDP).

The Asian Rice Biotechnology Network (ARBN) was established by IRRI in 1993 to provide a vehicle for collaborative research in rice biotechnology with universities and rice breeding institutes of the national agricultural research systems (NARS) in Asia. The ultimate goal of the network is to assist the NARS to apply biotechnology to meet their own national needs in rice varietal improvement. To achieve this goal, ARBN improves the NARS' access to new biotechnology tools by facilitating co-operation with one another and with advanced laboratories. ARBN emphasises the value of collaborative research as a means of developing a capacity for biotechnology, including human resources, multidisciplinary teams, technology, infrastructure, and priority setting. Project funding for the network is provided by the German Government's Bundesministerium für Technische Zusammenarbeit (BMZ) and the Asian Development Bank (ADB).

In the LAC region, the Latin American Fund for Irrigated Rice (FLAR) is an autonomous institution created in 1994 through the efforts of rice associations from Brazil, Colombia and Venezuela, and with the help of CIAT and IRRI. FLAR aims to contribute to the generation of new technologies that lead to a more competitive, efficient and cost-effective rice sector in Latin America, resulting in lower consumer prices and lower environmental impact. The Fund began work in 1995 and currently has 11 members: 10 countries of Latin America and CIAT.

At the request of member countries, a Technical Work Group on Hybrid Rice for Latin America and the Caribbean (GRUTHA) was jointly established by CNPAF/EMBRAPA (Brazil), FEDEARROZ (Colombia) and FAO in 1994 at CNPAF/EMBRAPA, in Goiás, Brazil. The main objective of GRUTHA was to promote the exchange of experience, scientific information and germplasm on hybrid rice among the participating countries, and members included Brazil, Chile, Colombia, Cuba, Ecuador, Mexico, Peru, Venezuela and Uruguay, with France (French Guyana), China and U.S.A as observers. During their third meeting in September 1999, member countries of GRUTHA agreed to merge their group's activities with other Working Groups to form the Working Group on Advance Rice Breeding (GRUMEGA), reorienting the activities of the group towards population improvement of rice.

The Caribbean Rice Industry Development Network (CRIDNET), a PROCICARIBE network, aims is to increase the productivity in the cultivation and marketing of regionally produced rice so that Caribbean rice can improve its competitive position in the international market place while optimising regional self-sufficiency. The network works to develop and strengthen national programmes, including extension services, by ensuring that all members of the industry participate and contribute to the national programmes, distribution of improved varieties (planting material), training of farmers and extension officers on improved production and post harvest systems, information sharing and the dissemination of information on improved production, post harvesting and marketing systems to end users.

In Africa, the potential for sustainable area expansion of rice cultivation is greatest in the lowlands. It is estimated that there are 20 million ha of inland valleys in West Africa alone, of which only about 15% are currently cultivated. If the share of cultivated lowlands doubled and were put into rice production, this would represent a doubling of total rice area in West Africa, and would still leave some 70% of lowlands in their natural state. The Technical Cooperative network on wetland development and management/inland valley swamps (WEDEM/IVS) was established by RAF in 1988 in Ghana, with the objectives to promote the development and use of inland valley swamps for increased food production, as an alternative to slash-and-burn shifting cultivation systems in Sub-Saharan Africa. The network is also one of the inter-regional and regional networks on rice and field projects supported by the International Rice Commission (IRC) and the Rice Development Programme (RDP). CORAF also supports a rice network in West Africa.

While research on tropical rice varieties (*indica*) is covered by international organisations such as the International Rice Research Institute (IRRI), the Centro Internacional de Agricultura Tropical (CIAT) and the West Africa Rice Development Association (WARDA), the FAO Inter-regional Cooperative

Research Network on Rice in the Mediterranean Climate Area, Mediterranean rice varieties (*japonica)* are addressed by an ESCORENA network known as MED-rice. MED-rice was created in 1990 by FAO with the collaboration of INRA and National Agricultural Research Centres (NARS), with the objective to promote scientific exchanges among rice scientists working in the Mediterranean area and in the other world regions with Mediterranean climate. The network is also one of the inter-regional and regional networks on rice and field projects, supported by the International Rice Commission (IRC) and the Rice Development Programme (RDP).

An East, Central and Southern Africa Rice Research Network Rice Research Network (ECSARRN) is also being developed under ASARECA.

Sorghum and millets networks
Sorghum and Millets are dual-purpose crops (human consumption and animal feed) and are important staple foods in Africa and in South Asia. Sorghum is mainly produced for human consumption in Africa and India, and for animal feed in the US and China.

There are two sorghum and millets combined networks in Africa, one for Eastern and Central Africa (ECARSAM) and one for Southern Africa (SMINET). ECARSAM is a new network, begun in 2000, which carries out germplasm exchange and research on utilisation, commercialisation and markets for sorghum and millets. Membership of ECARSAM is mixed, including 10 countries, ICRISAT, the International Sorghum and Millet Collaborative Research Support Program (INSTORMIL), NGOs, other networks in Southern and West Africa, and the private sector. The SMINET network was started as part of ICRISAT Sorghum and Millet Improvement Programme (SMIP), and its activities are aimed at achieving exchange of, and impact from the technologies developed and NARS capacities built by SMIP. It is also involved in, and provides support to, a farmer participatory breeding program in Namibia.

Sorghum and millets are addressed separately in West and Central Africa (WCA) through West and Central Africa sorghum research network (WCASRN/ROCARS) and the West and Central African Millet Research Network (WCAMRN/ROCAFREMI). The millets network, WCAMRN, focuses on millet research, production, and natural resource management in millet-based cropping systems of semi-arid western and central Africa. The network also provides training for NARS scientists and research fellowships for African students. It works to establish dialogue with farmers, extension services, NGOs and the private sector.

The West and Central Africa sorghum research network (WCASRN) involves 18 countries and was launched as a collaborative research network in 1995, at a regional workshop of sorghum-producing countries of WCA, held in Mali, benefiting from earlier networking arrangements such as the SAFGRAD network and a regional sorghum "pole" created by member countries of the Inter-State Committee for Drought Control in the Sahel (CILSS). The network effectively broadened the “pole” concept to include all the sorghum-producing countries of WCA. The overall objective of the WCASRN network is to improve the production, productivity, and utilisation of sorghum, including assisting member countries with research and extension and strengthening linkages among sorghum researchers for exchange of plant genetic materials, technologies, and research information, improving capacities and facilitating the improvement of sustainable sorghum-based production systems in WCA countries. Partners in the network include end users of sorghum and sorghum products in member countries, ICRISAT, USAID, INTSORMIL, CIRAD, and INSAH.

The INTSORMIL Collaborative Research Support Program (CRSP) based in the USA, is a research organisation focused on education, mentoring, and collaboration with host country scientists in developing new technologies to improve sorghum and pearl millet production and utilisation world-wide.

The Cereal and Legumes Asia Network (CLAN), co-ordinated by ICRISAT, aims to improve the well-being of the Asian farmers by improving the sustainable production and productivity of crops,

including sorghum and millet. IITA, ILRI and CIMMYT,ICRISAT,ICARDA,IRRI are involved in this large network that includes 13 countries and over 1100 scientists. Its activities include germplasm exchange, training, collaborative research and information exchange. The network works to develop bilateral (ICRISAT-NARS) research work plans in Asia, with full partner involvement at all stages.

ICRISAT is also involved in the Latin American Commission of Sorghum Researchers Network (CLAIS), which works in Colombia and Brazil. The network distributes ICRISAT germplasm and has identified lines, which combine higher yield performance with tolerance to the South American tropical savannah's acid soils.

Other cereals networks
The ECP/GR also has working groups on barley and a*vena,* and IPGRI provides the secretariat for a buckwheat network on the Asia-Pacific region. Limited information was found on an International Barley Genetic Resources Network.

3.2.2 Rootcrops networks

Cassava (Manioc) networks
Cassava is essential to food security in most regions in Africa, and is also very important in South America. The genepool consists of the cultivated *M.esculenta* and at least 80 wild *Manihot* species.

The global Cassava Biotechnology Network, started in 1990, brought together institutions and individuals for research and the application of biotechnology to cassava priority constraints. The network has recently undergone some changes in the context of a debate on whether strong regional networks or a global network work more effectively. DGIS recently stopped funding the global network but set up a LAC branch for the network. The CBN network has a strong membership base and continues communications although finances are now limited. The Fifth International Scientific Meeting of the Cassava Biotechnology Network, entitled Constraints and Solutions for Improving Cassava, was held on 4 - 9 November 2001.

The Cassava Molecular Diversity Network (MOLCAS) also operates at the global level and aims to characterise, using molecular markers, genetic diversity in cassava and wild relatives for conservation, and breeding purposes. CIAT and IITA contribute to the network, which is funded by the International Program for the Chemical Sciences (IPICs), University of Uppsala.

In Africa, Cassava issues are addressed by the regional rootcrop networks EARRNET (East Africa) and SARRNET (Southern Africa). These active networks aim to increase utilisation of cassava and sweetpotato in their respective regions. The goal of EARRNET includes to facilitate the utilisation and commercialisation of cassava through developing suitable acceptable technologies for use by different stakeholders. Consultations have been carried out with stakeholders and partners on the network's operational framework to enable it change from production to a market oriented research as envisaged in the ASARECA strategic plan. SARRNET has traditionally worked primarily with smallholder farmers and NARS in the SADC region but is now also expanding its horizons to all stages of the cassava production system and working with different stakeholders, linking research, extension, producers, consumers and markets. Efforts have been made by CORAF and IITA to initiate a network in West Africa based on earlier work by CORAF on roots and tubers. This network, CEWARRNET, has a basic document and indications of interest from many sides, however funding has not yet been secured and activities are hence very limited.

In the LAC region, the Latin American and Caribbean Consortium to Support Cassava Research and Development (CLAYUCA) network brings together stakeholders from different sectors (research institutes, universities, NGOs, producer groups, etc) to generate, transfer and exchange technologies, information and scientific knowledge related to cassava production and processing. Research priorities are defined by members and project funding sought through the network. Also in Latin America, the Manihot Genetic Resources Network, convened by CIAT, is a small network of mostly breeders and

researchers working on cassava genetic resources. In addition, Procicaribe recently launched the Caribbean Roots and Tubers Network (CAROT). Started in 2001, this network works on yam and sweet potatoes.

The Asian Cassava Research Network (ACRAC), convened by CIAT, is a network of research institutes primarily concerned with cassava breeding. In the late 1990s a drop in technical and financial support from CIAT resulted in a drop in network activity, although some national programs continue with their own selection work[9].

In 2000, participants to a Validation Forum agreed to adopt the implementation proposal for a Global Cassava Development Strategy (GCDS). The strategy consists in a systematic approach to identifying opportunities and constraints at each stage of the commodity development cycle from production to consumption, and can be considered a framework for technical co-operation in research and technology transfer and for future debates on global issues affecting cassava. It is recognised that a GCDS requires a coalition of stakeholders including cassava producers and their organisations, governments and policy makers, donors, technical and research institutions and their networks, NGOs and their networks, and the private sector. The Cassava Strategy Coordination Group, chaired by FAO, will consist of the former Cassava Advisory Group (FAO, IFAD, CIAT, NRI, CIRAD, IITA). The Coordination group will be directly linked to regional and international networks.

Sweetpotato and potato networks
Sweet potato (*Ipomoea batatas*) is important to food security particularly in West, East and Central Africa, the Caribbean and the Indian Ocean Islands. Potato is important to food security particularly in America (North and South) and Europe. The centres of origin of these crops are in the Americas, where more than 300 different wild Ipomoea species exist. Of the approx. 200 wild tuber-bearing Solanum species, about 60% are located in Peru and Bolivia.

In Latin America and the Caribbean, the Programma Regional Cooperativo de Papa (PRECODEPA) aims to promote the use of appropriate technologies for the sustainable production of potatoes in Central America, the Caribbean and Mexico. The network operates with technical backstopping from CIP and CONSUDE financing. Activities are focused on common problems and include IPM, genetic improvement, seed production, industrialisation and processing, under the crosscutting themes: Cost-efficiency, sustainability, integration of R&D-extension-production-market, and integrated crop management.

Subregional networks also exist for potato germplasm evaluation in the Andean region (PRACIPA) and in the Southern Cone countries (PROCIPA). In addition, Procicaribe recently launched the Caribbean Roots and Tubers Network (CAROT). Started in 2001, this network works on yam and sweet potatoes.

In Africa, rootcrops are addressed by SARRNET in Southern Africa and PRAPACE (the Regional Potato and Sweetpotato Improvement Programme) in East and Central Africa. PRAPACE was established in 1982 to link the potato programs of Burundi, D.R. Congo and Rwanda, and now has 10 member countries and works on potatoes and sweetpotatoes. The mandate of SARRNET is basically applied/participatory research and development on cassava and sweetpotato including demand - led processing and utilisation. Aspects as human resources development tool (training), information and technology exchange and institutional capacity building within SADC governments are also the focus of SARRNET. Its main applied research objectives are in the fields of the development and /or introduction and evaluation of improved germplasm, managing pests and diseases through an ecologically sustainable plant protection (ESPP) approach, surveying production systems, development and dissemination of post harvest technologies and the establishment of multiplication and distribution systems for improved planting materials alongside marketing issues.

[9] This information was obtained from comments provided by the coordinator to IPGRI in 1999 in the context of their network survey.

The Asian Network for Sweetpotato Genetic Resources (ANSWER) was formed in 1996 by the 11 member countries (China, India, Indonesia, Japan, Korea, Malaysia, Papua New Guinea, Philippines, Sri Lanka, Thailand, and Vietnam) and is supported by CIP and IPGRI. It aims to enhance co-operation between participant countries for the conservation and evaluation of sweetpotato collections, and works on characterisation, description and the exchange of information related to Asian sweetpotato collections.

The Asian network Users' Perspectives With Agricultural Research and Development (UPWARD) works with rootcrops including potato and sweetpotato. Its activities are based on three thematic areas: Production systems, genetic resources, and processing, marketing and consumption. "Production systems" priorities include documentation of indigenous production systems with emphasis on rootcrops, users' soil resource management, integrated and community-based management of pests and diseases affecting rootcrops, seed supply, and home gardening for family food security. "Genetic resources" priorities include conservation of rootcrop germplasm and associated indigenous knowledge, participatory varietal evaluation, community-based genebanks, and promotion of biodiversity conservation through home gardening. UPWARD emphasises direct involvement by end-users and intermediate agencies in agriculture-related innovations to ensure its acceptance and sustainability, including farming families and communities, household-based livestock and food processing enterprises, traders and consumer groups.

Two other Asian networks exist that deal with potato and sweetpotato, the Asian Sweetpotato and Potato Research and Development (ASPRAD) and the Southeast Asian Programme for Potato Research and Development (SAPPRAD).

ECP/GR Industrial Crops and Potato Network was promoted in the context of the EU project "Genetic Resources of Potato including conservation, characterisation and utilisation of secondary potato varieties for ecological production systems in Europe". The project aimed to co-ordinate potato genetic resources within the EU, minimise duplication of inputs and maximise the availability of germplasm and its information. The project finished in 2000, however the general goals of the EU-project will be continued by the ECP/GR Working Group on Potato. The network developed two databases, one for potato cultivars (Solanum tuberosum ssp. tuberosum), and one for related Solanum species (wild and primitive species).

Other rootcrops
Networks were also found for taro (TANSAO in Southeast Asia and Oceania), and yam (South Pacific Yam Network).

3.2.3 Legumes (except forages) networks

Common bean and related species (Phaseolus) networks[10]
Beans are particularly important to food security in Central America and Africa (West, East and Southern) (SoW 1996). This is reflected in the geographic focus of bean networks, with the Programa Regional de Investigación en Frijol (PROFRIJOL) operating in Central America, Mexico and the Caribbean, and the Pan-African Bean Alliance brings together the Southern and East African bean networks SABRN and ECABREN.

These networks are all closely associated with CIAT, and they and their predecessors had their origins in the CIAT Bean Program, established by the CGIAR in 1974. The Pan-Africa Bean Research Alliance (PABRA) was formed in 1995 to catalyse efficiencies through collaboration on common issues by the Eastern and Central Africa Bean Research Network (ECABREN) and the Southern Africa Bean Research Network (SABRN), as well as to formalise the participatory planning of CIAT's supporting activities and to facilitate communication with a donor group. Pan-Africa technical

[10] Most information on the bean networks was kindly provided by Caesar Cardona of CIAT

working groups bring together experienced scientists to advise the steering committees on the state of knowledge, progress in regional research and new priorities.

ECABREN was established in 1996 through the merger of two regional networks at the request of the ASARECA Committee of Directors (CD). The two networks were RESAPAC (Reseau d'AmeIioration de Phaseolus en Afrique Centrale) working in Burundi, Democratic Republic of Congo and Rwanda; and EABRN (East Africa Bean Research Network), which operated in Ethiopia, Kenya, Madagascar, Mauritius, Sudan, Tanzania and Uganda. It is focused on improving household incomes and food security, through the development, adoption and transfer of sustainable production and processing technologies. The original networks were formed in response to the first regional meeting on beans in Africa held by CIAT in Malawi in 1980, which recognised a lack of consistent, focussed and collaborative efforts on this crop. Prior to this, bean research and development generally had received low priority. ECABRN is now drawing on the complementary strengths of both networks. The Network's members are Burundi, DR. Congo, Ethiopia, Kenya, Madagascar, Rwanda, Sudan, Tanzania (N and NW only), Uganda and CIAT. Their respective bean co-ordinators make up the Steering Committee, which governs the Network and responds to ASARECA's CD. The Network's co-ordinator was competitively recruited by CIAT from the region under the guidance of ASARECA.

While countries are represented in ECABREN governance by co-ordinators from NARIs, some sub-projects are executed by universities in the private sector, NGOs and other extension agencies are partners in others. Farmer research groups are specific partners in participatory projects, and individual farmers collaborate on trials and surveys in may others. Bean traders have also been surveyed. Beans are primarily a small-farmer crop and, in most countries, are produced by women who have been the main participants and beneficiaries of ECABREN.

The Programa Regional de Investigación en Frijol (PROFRIJOL) works towards improving the socio-economic development of families in rural areas, by sustainably improving the productivity of beans, in the countries of Central America, Mexico and the Caribbean. The Coordination Assembly of the network is constituted primarily of co-ordinators of national bean programmes.

The Bean/Cowpea Collaborative Research Support Program (CRSP), a research and training program that supports international research partnerships to increase the availability of beans and cowpeas, includes participants from the Latin America/Caribbean region, Africa and the U.S., who work in collaborative projects concentrating on all aspects of food handling from improved production technologies or strategies through food processing and the development of value-added products especially for urban markets. Informal collaboration exists between the CRSP and the bean networks. For example, In a recent meeting, areas of mutual interest and collaboration, and areas where duplication should be avoided, were identified with Profrijol. The collaborative work with CRSP extends to Africa.

Soybean networks

Soybean is grown over a harvested area of 66 million hectares. It is a major contributor to human calorie intake in the Americas, Europe, and Caribbean and the Pacific (SoW 1996).

Few networks were found for this crop through the information available in the completion of the present study. The main network found focusing primarily on soybean is the European Cooperative FAO Network on Soybean Research. The objective of the Network is to develop and maintain close co-operation among national research institutions for the improvement of locally adapted soybean genotypes, cropping systems and soybean use for food and non-food use. The Network was established in 1976 and at that time reflected the interest in soybean production and research in Europe. During the first fifteen years of its activities, the Network was considered an example of a successful international research co-operation and as a factor that contributed to significant increases in yields, and in general to soybean production in Europe. However, since 1991 activities of the Network started to decline, in parallel with the sharp decline in soybean production in Europe. During the 1996-98 period the Network focused on seeking new uses to this declining crop in Europe,

adaptation of genotypes to new cultural practices, application of soybean cropping to soil improvement, studies on *Bradyrhizobium* symbiosis and improvement of quality for food and non-food uses.

The Cambodia, Lao PDR, Vietnam Vegetable Collaborative Research Network (CLVNET) also includes soybean. Network activities include germplasm exchange, information exchange, integrated pest management, and socio-economic survey.

Other legumes
Other networks found dealing with legumes include the ECP/GR Grain Legumes Network, the North African Faba Bean Research Network, and the Cereal and Legumes Asia Network (CLAN).

3.2.4 Fruit networks

Banana and Plantain (Musa spp.) networks
Banana and plantain are important to food security in Africa (West, East and Central) and the Caribbean (SoW). Networking for bananas is primarily carried out by the International Network for the Improvement of Banana and Plantain, which has been operating since 1985 as an international organisation with a mission to sustainably increase the productivity of banana and plantain grown on smallholdings for domestic consumption and for local and export markets. The need for urgent action at the global level on banana genetic resources was highlighted in the mid-1980s by the spread of a destructive fungal disease of banana (black Sigatoka) in Africa and Latin America.

A Global Programme for *Musa* Improvement (PRO*MUSA*), has been developed by INIBAP as a means to link the work carried out towards addressing the problems of export banana producers with those initiatives directed towards improving banana and plantain production at the subsistence and smallholder level. INIBAP has established the world's largest *Musa* germplasm collection, from which material is distributed freely world-wide, and has put in place a system for the safe movement of these varieties. It compiles and distributes *Musa* research methodology and information.

INIBAP has a small headquarters staff in Montpellier, France and regional offices in the four major banana-growing areas of the world. The organisation operates as a research and information service through a networking approach, co-ordinating and catalysing research carried out by its partner's world-wide. Operating through regional networks enables participants to determine regional priorities and agree on collaborative research and development activities, as well as supporting and strengthening national *Musa* research programmes. Key partners include the national programmes, which collaborate in the framework of regional networks, and the advanced research laboratories, which carry out INIBAP-supported research.

INIBAP's objectives are focused on information and research for improved cultivars and the conservation and use of *Musa* diversity, on strengthening collaboration and partnerships at all levels, and on strengthening the capacities of NARs. These objectives are complimented and focused by the objectives of the four regional networks:

- The Latin America and the Caribbean Network (LACNET) was established in 1987 as INIBAP's first regional network. In 2000 this network was relaunched as *MUSA*LAC, the Plantain and Banana Research and Development Network for Latin America and the Caribbean, and now operates under the framework of FORAGRO (Foro Regional de Investigación y Desarrollo Tecnológico Agropecuario para America Latina y el Caribe). 14 national research and development institutions, as representatives of their countries and 4 regional/international institutions (CATIE, CIRAD, IICA, INIBAP)) signed the new Constitutional Agreement of the *MUSA*LAC Network. The general objective of *MUSA*LAC is to increase productivity and competitiveness of the plantain and banana agroalimentary chain by developing scientific and technological activities, strengthening national research and development systems, and prioritising and co-ordinating actions in Latin America and the Caribbean.

- The Asia and Pacific Regional Network of INIBAP (ASPNET) was established in 1991, initially with 5 NARS and 1 institutional member. At present, there are 11 NARS and 2 institutional members. The network operates under the guidance of a Regional Advisory Committee and has been especially involved in supporting *Musa* germplasm collection, conservation and evaluation. The network co-ordinates regional collaboration and communication among *Musa* researchers, as well as assisting in the intra-regional exchange of information.
- The Banana Research Network for East and Southern Africa (BARNESA) was established by NARS under the auspices of ASARECA. It is governed by a Steering Committee, which is composed of the directors of national, regional and international banana programmes from the region, while INIBAP provides the secretariat. BARNESA seeks to increase food security and farm incomes for subsistence farmers in the region. To achieve this, BARNESA facilitates capacity building and information exchange between banana researchers, while at the same time assisting members of the network to access donor support for regional and national research agenda. Activities of the network include co-ordination of region-level banana research activities, facilitating *Musa* information exchange between stakeholders, strengthening NARS capacity to conduct banana research, assisting NARS to solicit and access donor funding, and facilitating the dissemination of improved banana management technologies.
- MUSACO (Réseau *Musa* pour l'Afrique Centrale et Occidentale) was established in 1997. At the invitation of WECARD (West and Central African Council for Agricultural Research and Development), 10 NARS along with representatives from IITA Nigeria, Centre de recherches régionales sur bananiers et plantains (CRBP) Cameroon and INIBAP met and agreed to form the network, for which INIBAP provides coordination and the secretariat**.**

Other fruit networks

A Global Citrus Germplasm Network (GCGN) was formally constituted in 1997 at an international technical meeting organised by MECINET (the Mediterranean Citrus Network). The network functions under the aegis of the FAO and involves national institutions as well as the existing regional and inter-regional networks dealing with citrus genetic resources conservation and utilisation. This includes the existing regional and inter-regional citrus networks MECINET, the Inter-American Citrus Network (IACNET), the Network of Services for Citrus Rehabilitation in Asia (NeSCRA), and those under constitution (Asia-Pacific and Sub-Saharan Africa). The Network aims to link and strengthen on-going networking initiatives dealing with citrus genetic resources exploration, conservation and utilisation, encourage participation in such initiatives, as well as promoting new undertakings.

REMUFRUT (Red Mundial de Frutales Tropicales) is a global network on Tropical and Subtropical Fruit (TSTF) genetic resource conservation, evaluation and utilisation. It was established in 1998 under the auspices of FAO in an international meeting organised by MESFIN (Mediterranean Selected Fruits Inter-country Network). The major goal of the network is to link different initiatives in different parts of the world dealing with TSTF (including under-utilised fruits) genetic resource exploration, conservation and utilisation. It also aims to play a major role in harmonising ongoing networking initiatives in different regions of the world.

The structure of the global network includes SEANUC and WANANET in Africa; Under-utilised Tropical Fruits in Asia Network (UTFANET), RECSEA-PGR in the Asia-Pacific region; MESFIN in the Mediterranean; and CARIFRUT; the Red Latinoamericana de Frutales Tropicales (RELAFRUT); REMERFI and TROPIGEN in the Americas.

In addition, a West Africa Tropical and Sup-tropical Fruits Genetic Resources Network (WAFNET), was established by ICUC in 1998 in collaboration with FAO. ECP/GR also has a Fruit Network.

3.2.5 Sugar cane and beet networks

Sugar is a major contributor to human calorie intake in all regions except West and Central Africa. Two networks were found on sugar cane, "Sélection variétale de la canne à sucre en réseau", (CIRAD) in West Africa, and the West Indies Sugar cane Breeding and Evaluation Network (WISBEN).

The World Beta Network (WBN) was founded by commercial and public researchers concerned about losses of these genetic resources and under-utilization of the collections containing these resources. It was organized in 1989 by IPGRI as an attempt to bring researchers, curators, and germplasm users from both developed and developing nations together to help manage and plan research to solve problems involving Beta genetic resources. The WBN is limited to the Northern Hemisphere. Participating regions are Europe, North America, Asian and North African countries.

3.2.6 Forages and rangeland crops networks

Forages include a wide range of cultivated and wild species in the temperate and tropical areas, such as fodder trees and shrubs, legumes, grasses and herbs. About 20 species of legume are considered as important fodder crops at the global level. Gaps in gene pool coverage have been identified for marginal rangeland forages, frost-tolerant fodder trees in tropical highlands, species from temperate lowlands and highlands and marginal areas in the Near East.

The FAO/CIHEAM Inter-Regional Cooperative Research and Development Network for Pastures and Fodder Crops was established in 1977 as an FAO European research network. Close cooperation with CIHEAM institutes involved in pasture and fodder crops research resulted in the establishment of the joint FAO/CIHEAM sponsorship of the Network in 1995. At the same time the Network was enlarged to become Interregional, including now also members from FAO's Near East Region. The network has three working groups on Mountain Pastures, Lowland Grasslands, and Mediterranean Forage Resources. The ECP/GR also has a Forages Network.

In the WANA region, ICARDA's Dryland Pasture and Forage Legume Network works to forge communication links among pasture, forage and livestock scientists. The network also includes scientists from Europe, USA, and Australia.

The African Feed Resources Network (AFRNET) was founded in March, 1991 to undertake research on pasture and forage in order to improve animal nutrition. Its inception followed a merger of two networks affiliated with the former International Livestock Centre for Africa (ILCA): the Pasture Network for Eastern and Southern Africa (PANESA) and the African Research Network for Agricultural By-Products (ARNAB), which had pan-African coverage. These two networks merged with the West and Central African Feed Resources Network (WECAFNET) and another CIRAD-operated network. The Network aims to bring together African scientists who are interested in conducting research on enhanced animal nutrition achieved through improved pasture, forage, and agricultural by-products. Its approximately 500 members include researchers, extension officers, and private sector representatives from sub-Saharan Africa.

The SAFORGEN network of forest species in Sub-Saharan Africa also has a young sub-network on fodder tree species.

An FAO regional working group also exists for East Africa, including Kenya, Uganda, and Tanzania. This is one of the Working Groups established by the FAO "Grassland Group", on the basis of similarity of ecological conditions and production systems. These working groups assist with exchange of information thus avoiding duplication of research efforts, and can speed up application of results in the field. Meetings are held regularly, as well as training courses on specific topics, and

some funds are provided to finance research priorities, identified by the Grasslands Group, for the development of grazing and feed resources. The FAO Regional Working Group on Grazing and Feed Resources for S.E. Asia is a member of the Southeast Asia Forage and Feed Resources Research and Development Network (SEAFRAD), and an FAO regional working group also exists for Temperate Asia (Bhutan, India, Nepal, Pakistan).

In the LAC region, three FAO regional working groups for Chaco (Argentina, Bolivia, Paraguay), Campos (Northern Uruguay, North-eastern Argentina, Southern Brazil, Southern Paraguay) and Patagonia and Cool Temperate Grasslands (Southern Chile and Argentina) address Forage and Feed Resources issues.

In addition to the above networks, two relevant global crop-specific networks were found: The International Leucaena Research and Development Network (LEUCNET), a scientific consultation/information network which aims to provide a structure to enhance collaboration and communication between scientific and extension groups working on research, development and promotion of leucaena for the benefit of rural communities around the world, and the Lathyrus Genetic Resources Network coordinated by IPGRI.

3.2.7 Vegetable networks

The Asian Vegetable Research and Development Centre (AVRDC) facilitates five regional networks: The ASEAN-AVRDC Regional Network on Vegetable Research and Development (AARNET) covering Southeast Asia, the South Asian Vegetable Network (SAVERNET) covering all of South Asia; The Cambodia, Lao PDR, Vietnam Vegetable Collaborative Research Network (CLVNET); the Collaborative Network for Vegetable Research and Development in Southern Africa (CONVERDS), with 10 member countries in southern Africa; and the Collaborative Network for Vegetable Research and Development in Central America (REDCAHOR) linking seven countries in Central America and the Caribbean. A sixth network, the Asian Vegetable Research Network (AVNET), which includes Indonesia, Malaysia, Philippines, and Thailand, is now self-operating.

A network specifically focused on the family C*urcurbitae* was formed in 1994. The Curcurbit Network aims to disseminate news of recent developments concerning curcurbits; to promote the conservation and understanding of curcurbits through education and research, and to foster communication among curcurbit workers through the networks newsletter and website. ECP/GR also has a vegetables network.

PROCICARIBE also has a new vegetable network, the Caribbean Vegetable Network (CARIVEG).

3.2.8 Under-utilised crops networks

Two Asian networks deal respectively with under-utilised fruits and vegetables: Under-utilised Tropical Fruits in Asia Network (UTFANET), and Under-utilised Traditional Vegetables for Asia and the Pacific Network (UTVAPNET). These are both programmes of the International Centre for Under-utilised Crops (ICUC) and part of its major programmes. UTVAPNET is still a relatively young network, established by ICUC in 1999 in collaboration with FAO. UTFANET was established by ICUC in 1995 with the co-operation of CSC, APAARI and FAO. It aims to facilitate close partnership between National Agricultural Research Systems (NARS) and related institutions in the region that are working on tropical fruit trees. The objectives of UTFANET are: Improvement of economic and social development through increase in production of tropical fruits, through conservation and use of genetic resources; assemblage and dissemination of relevant information; improvement in propagation, production and management; appropriate and efficient post production technologies; and improved farming systems and nutrition as well as strengthening local, regional, and international capabilities through appropriate training. The UTFANET regional office has now been established at the PCARRD headquarters in Laguna, Philippines. UTFANET promotes collaborative research on agreed topics in the region with individual countries taking lead roles in areas where they have comparative

advantages. It also collaborates with existing networks like PROSEA and those of IPGRI and ICRAF in the conduct of documentation and dissemination, research and development and training activities.

In Africa, under-utilised crops are addressed by the Southern and Eastern African Network on Under-utilised Crops (SEANUC), also an ICUC network, established in 1995 together with FAO and the Commonwealth. Efforts are underway by FAO to establish a Network of Traditional Crops for Southern African Countries. The network will seek to establish the state of indigenous under-utilized cereals and pseudocereals, grain legumes, vegetables and root and tuber crops in the region. It will also recommend priority species for exploration, collection, conservation, evaluation and utilization.

The MEDUSA network on Identification, Conservation and Use of Wild Plants in the Mediterranean region was established in 1996, by CIHEAM and its constituent MAICh. The objectives of the network are the identification of naturalised plants of the Mediterranean region, the creation of an Interactive Regional Information System (IRIS); and the preliminary evaluation of the conservation status and potential utilisation of these plants in agriculture as alternative minor crops.

No underutilised crop networks (or medicinal plants networks) were found in the Americas.

3.2.9 Other crop networks

Regional networks were also found for coffee (two African networks and one for Central America, the Domenican Republic and Jamaica), coconut (COGENT), cotton (An ESCORENA network exists and CIRAD mentions cotton networks for the Southern Cone countries, a CORAF network, a Mediterranean network and the South East Asia Cotton Research Consortium), flax (an ESCORENA network), and oilseed crops (safflower, sesame, sunflower). Global networks exist for cactus pear, nuts, mushrooms, and olives.

In addition, a number of networks were found relating to medicinal plants, including a Global network on medicinal plants (MEDPLANTS) that arose out of an IDRC-convened international workshop of medicinal plant organizations and stakeholders in November 1999. Regional medicinal plants networks include the Asian Network on Medicinal and Aromatic Plants (ANMAP), the SAFORGEN Medicinal Tree Species Network, the Medicinal and Aromatic Plants Programme in Asia (MAPPA) and the Natural Products Research Network for Eastern and Central Africa (NAPRECA).

3.2.10 Seed networks

While a great number of seed associations provide many linkages on a regional and global level, networks are particularly important for addressing the needs of developing countries and the role of the informal seed sector, which provides for 80 - 90 percent of the seed and planting materials needs of farmers in developing countries[11].

In West Africa, the West Africa Seed Network (WASNET) addresses issues in the seed planting and material sector and brings together seed personnel from West Africa in a structure, which will encourage them to work together to strengthen national and regional seed industry development[12]. WASNET is now operating under CORAF.

An SADC seed security network (SSSN) was officially launched in July 2001 at a meeting with the SADC Seed Focal Points in South Africa, with interim support from the Government of the Republic of Austria including support to prepare a proposal to extend the network for five years[13]. SSSN will

[11] Source: FAO Regional networks on seed policies and programmes see http://www.fao.org/ag/AGP/AGPS/seed/PPFORA/sforaEN.htm

[12] WASNET newsletter no.8, October 2001

[13] Source: SADC Seed Security Network. Report of the SADC regional seed sector stakeholder workshop, Nyanga Highlands, Zimbabwe, January 28-29, 2002.

aim to increase food security through increased seed security and better disaster preparedness in the SADC region, addressing in particular the needs of resource poor farmers.

In the West Asia and North Africa region, the WANA Seed Network co-ordinated by ICARDA works to encourage stronger regional seed sector co-operation, exchange of information, regional consultations, and intercountry seed trade. Countries involved in the network are Algeria, Morocco, Iraq, Cyprus, Turkey, Iran, Jordan, Syria, Egypt, Sudan, Libya, Yemen, Lebanon, Tunisia, Ethiopia, Pakistan, Saudi Arabia.

Recently, two regional seed networks and two consultative fora have been formed under the *aegis* of FAO by member countries at regional meetings (1998-2000). These networks have been formed in response to issues revealed at these meetings that undermine the effectiveness and sustainability of seed programmes in developing countries. These are: the African Seed Network (ASN) for Sub-Saharan Africa; the Seed Network for Asia and the Pacific (SNAP); the Consultative Forum on Seed for the Near East and North Africa (CFS-NENA) and the Seed Consultative Forum for Latin America and the Caribbean (SCF-LAC). All these entities will be supported by Scientific and Technical Working Groups (STWG), to find solutions to the issues identified as mitigating the proper development of seed production and distribution, hence limiting the access of resource-poor farmers to seed, suited to their needs. The development of one more network was discussed at the last of the regional technical seed meeting for the East European Countries and Countries In Transition, held early in 2001.

One of the primary aims of these FAO fora is to facilitate communication among regional seed and crop genetic resources networks. Many crop-based networks address seed security issues and communication and collaboration with these networks should be carefully planned to avoid duplication of efforts and competition for resources. In light of the number of seed networks starting within a short period of time, coordination is especially important.

3.3 Examples of in situ-oriented networks

The following networks are provided as important examples of the kind of *in situ*-oriented networks that can potentially contribute to the goals of the GPA.

In situ conservation of plant genetic resources is promoted on a global scale by networks such as UNESCO's World Network of Biosphere Reserves. The Man and the Biosphere (MAB) programme of UNESCO arose out of the 1968 Conference on the Conservation and Rational Use of the Biosphere. The biosphere reserve concept was a key component for achieving MAB's objective to strike a balance between the apparently conflicting goals of conserving biodiversity, promoting economic and social development and maintaining associated cultural values. To carry out the complementary activities of nature conservation and use of natural resources, biosphere reserves are organised into three interrelated zones, known as the core area, the buffer zone and the transition area. The World Network of Biosphere Reserves fosters exchanges amongst biosphere reserves - for example, research results or experience in resolving specific issues - and facilitates co-operative activities, including scientific research and monitoring, environmental education and specialist training. It is supported by regional or sub-regional networks such as in East Asia, or thematic networks, for example for research on biodiversity. The creation of new sub-networks such as these is encouraged. Progressively, it is intended to link all biosphere reserves through modern communication channels.

Many protected areas exist throughout Europe that may contribute to the *in situ* conservation of plant genetic resources. These are designated as nature reserves, forest reserves, nature parks, natural monuments, etc. To co-ordinate this range of networks, the Council of Europe has been engaged in networking these areas in both member and non-member States. Existing or planned networks include the European Network of Biogenetic Reserves; the Pan-European Ecological Network for the implementation of the Pan-European biological and Landscapes Diversity Strategy (to be established

by 2005); and the Emerald network of Areas of Special Conservation Interest (ASCIs). For EU member States Emerald network sites are those of the EU Natura 2000 network.

3.4 Examples of thematic networks

Thematic networks can cover a very wide range of topics related to plant genetic resources. The networks here are included in order to provide examples of the kind of contribution made by thematic networks.

An international level voice for farmers' organisations is provided by the International Federation of Agricultural Producers (IFAP), a world-wide farmer's network. The organisation was founded in 1946 and currently has a membership of 89 national farmers' organisations in 68 countries around the world, including 36 developing countries. Almost all the agricultural producers in industrialised countries and over 500 million farmers in developing countries are represented in IFAP. IFAP is governed by a World Farmer' s Congress, which brings together farmers of the world every two years. An Executive Committee meets every six months to co-ordinate the work of the Federation and monitor progress. The organisation is financed by voluntary contributions from its farmer organisation members, and also receives development assistance to fund its developing countries activities. IFAP has General Consultative Status with the Economic and Social Council of the United Nations. IFAP's mission is to develop farmers' capacity to influence decisions that affect them at both the domestic and international levels. Its objectives include acting as a forum in which leaders of national farmer's organisations can meet to exchange information and co-ordinate action to further mutual interests; information and advocacy for farmers, and promoting farmers organisations. Specialised Committees address particular groups of commodities, regional issues and groups of farmers with particular needs (e.g. women, developing countries). IFAP also carries out development work through its Development Cooperation Committee. The current focus of IFAP's policy work is to improve the position of farmers in a rapidly changing environment, characterised by globalisation, liberalisation and changes in what is expected from agriculture. Membership in IFAP is open to any organisation or combination of organisations recognised by the Federation as being representative of family farmers at the national level.

The Biodiversity Action Network (BIONET) was established in 1993 at a meeting of NGOs in the USA in response to the need for an NGO network on biodiversity issues. BIONET's mission is to advocate the effective implementation of the Biodiversity Convention world-wide, primarily through co-ordinated, joint NGO programs and information dissemination designed to catalyse governmental action. At present, BIONET is technically composed of U.S. NGO members. A long-term goal is gradually to expand globally.

In Europe, the Pan European Network on Genetic Indicators of Biodiversity, promoted by the Istituto Agronomico per l'Oltremare (IAO) of Florence, Italy, and the Vavilov Institute for General Genetics (VIGG), which act as sub-Regional focal points, seeks to promote the exchange of information and technical information, experiences and skill between western and on the eastern countries of Europe concerning Population Genetics, Molecular Biology, Applied Biometry and Statistics. The network is developed as a dedicated website of Internet, hosted by the promoter's servers at Florence and at Moscow.

The European Plant Biotechnology Network (EPBN) was launched in 1998 in order to promote networking and the exploitation and dissemination of results from the currently running pan-European research projects in this sector. These are expected to bring improved food products for health, stress tolerant and disease resistant plants for agriculture, biodiversity monitoring for the environment, etc. The network brings together almost 400 EU funded laboratories. As the aim of this network is to improve co-ordination of research activities and produce synergies, added value is expected for the individual participants, the Member States, European industry and society. Through the Biotechnology Programme1 the European Union currently funds 45 different projects in plant

biotechnology, involving 394 laboratories in 20 countries. Combined, these projects represent a total research investment of ECU 150 million. Examples of activities of this network include contact meetings with industry, the organisation of entrepreneurial workshops, a technology brokerage service, the production of public information material and the co-ordination of a European Plant Biotechnology Week. The EU Biotechnology Programme will provide ECU 426,000 to fund EPBN.

The Southern African Botanical Diversity Network (SABONET) was established as a capacity-building network of southern African herbaria and botanic gardens with the objective of developing local botanical expertise. SABONET is primarily implemented by UNDP as a GEF funded project, executed by South Africa's National Botanical Institute (NBI). Activities include regional training courses for staff in herbaria and botanical gardens, workshops, collaborative collecting expeditions in various under-collected areas of the region, and computerisation of plant specimens in herbaria and living collections in botanical gardens.

In the Andean subregion, development themes including the preservation of natural resources and biodiversity conservation are managed by watershed by the Consortium for the Sustainable Development of the Andean Ecoregion (CONDESAN), consisting of more than 75 research institutions, universities, NGOs, businesses, producer groups, and government agencies.

A network on Technical Cooperation Network on Plant Biotechnology in Latin America and the Caribbean (REDBIO) was established by FAO in the early 90´s after a regional survey at the request of countries. The aim of the network was to accelerate the process of adaptation, generation, transfer and application of plant biotechnology to contribute to the solution of crop production constraints and genetic resources conservation for the countries of the Region. The objectives of the network are to disseminate the advances of the plant biotechnology applied to the genetic improvement of food crops, especially of the transgenic food crops, and their impact in agricultural production, and its normative regulation; to constitute a technical forum or the elaboration of national and regional projects on policy on intellectual property rights, ethics and biosafety and their interrelationships with food security and the conservation of biodiversity of cultivated food crops; to exchange technical and scientific information; to support research initiatives in the academic and private sectors; to promote modern forms of information exchange; to present and discuss research results obtained by young professionals at academic and research institutions members of the network; and to debate the socio-economic and environmental impacts of biotechnology applications.

4. CONTRIBUTION OF NETWORKS TO THE GPA AND IT PGRFA

This section attempts to analyse as far as possible the contribution of the networks studied. Table 2 provides and outline of the general characteristics of networks in the five categories: Regional fora, regional PGR networks, crop-based networks, *in situ*-oriented networks and thematic networks.

The first section (4.1) provides a discussion of the geographic coverage of the regional PGR networks and the coverage of networks related to major crops as outlined in the State of the world's plant genetic resources for food and agriculture (SoW) 1996. Thematic and in-situ oriented networks, as well as the relevant regional fora, are discussed in the subsequent section (4.2) as these were examined primarily from the perspective of their potential contribution to the GPA and IT PGRFA. An analysis of the coverage these networks was beyond the scope of the current study, since these categories are more diverse in objectives, status and scale, and the available data do not allow for such analysis. Section 4.2 provides an overview of the actual or potential contribution of the five classifications of networks to the four main areas of activity of the GPA.

4.1 Coverage of the networks

4.1.1 Regional PGR networks

The GPA (paragraph 254) recommends that for regional networks, priority should be given to strengthening existing networks or integrating countries not presently served into them, and to establish new networks in the following regions:

a) Pacific
b) Caribbean
c) CIS states of Central Asia
d) West and Central Africa
e) East Africa
f) Indian Ocean Islands
g) Black Sea, or Caucasus.

All of the above regions are now covered by regional PGR networks.

The most recently initiated network is the Pacific PGR Network, established in May 2001 with an initial focus on documentation of PGR in the Pacific. Currently 11 of the 22 Pacific Island nations (excluding Australia and New Zealand) are members of the network and other Pacific countries have been invited to join. Australia and New Zealand have financially supported the initiation of the network, however neither country is currently a member. The scientific capacity of these two countries might be of considerable value to the network should they decide to join.

In South-east Asia, RECSEA-PGR members are Indonesia, Malaysia, Philippines, Thailand, Singapore and Viet Nam. The least developed countries of Lao, Myanmar, Cambodia and East Timor, as well as Brunei Darussalam, are not part of any PGR network, neither are they members of APAARI which links many of the crop-based networks. Further investigation may be required to determine the main limiting factors to network membership in this sub-region and its relationship to scientific capacity of the countries involved. China, the Democratic People's Republic of Korea, the Republic of Korea, Japan and Mongolia are members of the Regional network for conservation and utilization of plant genetic resources in East Asia (EA-PGR). The South Asia Network on Plant Genetic Resources (SANPGR) includes six countries of the South Asia region, namely, Bangladesh, Bhutan, India, Nepal, Maldives, and Sri Lanka.

In the Central and West Asia and North Africa Region, the CIS states of Central Asia and Caucasus are now covered by the Central Asian and Transcaucasian Network on Plant Genetic Resources (CATCN-PGR), which includes Armenia, Azerbaijan, Georgia, Kazakhstan, Kyrgyzstan, Turkmenistan, Tajikistan and Uzbekistan. WANANET addresses PGR issues in the West Asia and North African subregion.

Table 2: General characterisation of networks and their contribution to the objectives of the GPA and IT

Type of network	*Origins and scope*	*Role of parent institution*	*Objectives and activities*	*Membership and linkages*	*Structure and financing*	*Potential strengths*	*Potential weaknesses*	*Potential contribution to the GPA and IT*
Regional fora e.g. APAARI, SACCAR	Created by NARs to provide a general framework for agricultural research and development in the region. Good geographic coverage. (Sub)regional basis.	Horizontal linkages with FAO and CG centres.	• To strengthen NARS • to facilitate technology transfer and enhance rural development • to promote partnerships and communication • to promote sustainable development Usually policy oriented	Members are NARs. Linkages with GFAR and often good linkages with regional PGR networks. Part of the pubic domain	Formalised, high level networks. Usually financed by member NARs (including from core funding of NARS), sometimes by donors.	State support Continuity Global linkages	Over centralisation, bureaucracy Some danger of lack of focus on the sustainability of agricultural production.	All areas, but especially utilisation of PGR and Institutions and Capacity building
Regional PGR networks e.g. ECP/GR, GRENEWECA	Networks established by NARS with support by IPGRI, in the context of GPA implementation. Many young networks Good geographic coverage. (Sub)regional basis.	All facilitated by IPGRI, strong linkages with FAO and other CG centres.	To strengthen national PGR programmes and efforts of NARs regarding PGRFA. PGR management in general. Sometimes showing explicit focus on major regional crops or crop originating in the region. Wide focus on research and training. Usually not policy and awareness oriented	Members includes NARs Part of the public domain Linkages with NARs, and regional agricultural R & D fora and networks, as well as with crop-specific networks.	Steering committees; secretariats; Major support role by IPGRI (secretariat and/or coordination) Member- and donor-funded	State support Clear role to implement the GPA.	Over centralisation, bureaucracy Danger of unclear objectives and/or lack of focus. Complex functioning May not link well with crop specific, thematic and *in situ*-oriented networks in the region unless they are a sub network of the PGR network.	Activity 16 of the GPA/Article 16 of the IT on networking. Contribute to all aspects, but particularly *Ex situ* conservation and Institutions and Capacity building

Type of network	*Origins and scope*	*Role of parent institution*	*Objectives and activities*	*Membership and linkages*	*Structure and financing*	*Potential strengths*	*Potential weaknesses*	*Potential contribution to the GPA and IT*
Crop-based networks e.g. SAVERNET, CLAYUCA, REMUFRUT	Networks arise more directly out of a need or opportunity identified by stakeholders. Often older than general PGR networks Although still in majority regional, a considerable number of global networks have evolved.	Regular support from parent organisations involved (usually CG). Involvement of CG dominant for major crops.	• To increase productivity and /or social development • To improve conservation, exchange, research on conservation, research on utilisation (in any combination). Focus on exchange and use. Usually not policy and awareness oriented with the exception of under-utilised and medicinal plants.	Can include broad mix of membership from a range of sectors, depending on crop and objectives of the network. Associations with FAO, and CG centres. Links to general PGR networks not always apparent. Sometimes regional networks merge together or collaborate into a global framework network or programme.	Structure of the network tends to be looser, often primarily run by a steering committee. Supports on voluntary basis. Usually donor funded, and/or based on inputs in-kind.	Less institutionalised than general PGR networks. Also, interests more direct.	Coordination by European institutions/ CG over represented. Potential conflicts of interest between different stakeholders Potential lack of continuity due to donor funding.	*Ex situ* conservation Utilisation of plant genetic resources (of a particular crop or group of crops).

Type of network	*Origins and scope*	*Role of parent institution*	*Objectives and activities*	*Membership and linkages*	*Structure and financing*	*Potential strengths*	*Potential weaknesses*	*Potential contribution to the GPA and IT*
***In situ*-oriented networks e.g. MAB networks, EMERALD.**	Networks often arise out of efforts to co-ordinate conservation areas and/or policies in a particular region/globally in accordance with international agreements.	Often in the framework of a strong regional or global organisation e.g. UNESCO, Council of Europe.	• To coordinate and communicate between sub networks • To standardise good practices; • To forge linkages and information dissemination Policy and awareness oriented	The official members are usually other networks or the protected areas themselves. Governments (e.g. ministers of environment) usually strongly involved.	Financed by donors/ parent organisation Secretariat facilitates communication, development of new sub networks	Public appeal Clear conservation goals in line with the CBD	Lack of linkages with sustainable utilisation	*In situ* conservation of PGRFA
Thematic networks e.g. AFNETA, REDBIO.	Usually created by interest groups and stakeholders, often bottom-up initiatives. Some regional, some global networks.	Sometimes connected to a parent institute, may be an NGO	• To promote a particular (development) theme Often strongly policy and awareness oriented	Usually public and civil membership. Private sector involvement in some cases, depending on the issue.	Often informal networks with minimal financial resources. Funding often from donor agencies and/or NGOs.	Field level impact High level of commitment	General theme of the network may be vague. Often not very visible. In some cases, lack of access to formal expertise	*In situ* conservation of PGRFA Utilisation of plant genetic resources Capacity building.

The Nordic-Baltic collaboration on PGR of the Nordic Genebank connects Estonia, Latvia and Lithuania. Most countries of Europe are members of the European Cooperative Programme on Crop Genetic Resources Networks (ECP/GR) except for Bosnia and Herzegovina, and a number of islands and very small countries. Some Eastern European countries are not yet members of ECP/GR, i.e. Moldova, Ukraine, Belarus and the Russian Federation, but do participate in ECP/GR activities.

The country coverage of the PGR networks is fairly complete in Africa and in the Americas[14]. The Genetic Resources Network for Western and Central Africa (GRENEWECA) and the East African Plant Genetic resources network (EAPGREN) are recently initiated PGR networks in Africa. The establishment of these networks completes the coverage of Africa in terms of PGR networks, together with the long-running SADC Plant Genetic Resources Centre (SPGRC), established in 1989. The only countries not member of a PGR network in this region are St. Helena, Comoros, Uganda, Réunion, and the Central African Republic. The Democratic Republic of the Congo is a member of all 3 networks. Regarding the Indian Ocean Islands, Mauritius and Seychelles are now members of GRENEWECA and SPGRC respectively. Réunion is not currently a member of a PGR network, however it lies between Madagascar, a member of EAPGREN, and Mauritius, as mentioned, a member of SPGRC. Considering the special nature of island ecologies, these islands may wish to strengthen links on PGR between themselves and/or with the new Pacific network and/or CAPGERnet (see below) as they develop, for collaboration on island-specific issues.

In South America, an ecoregional approach has produced an abundance of PGR networks: The Genetic Resources Subprogram PROCISUR covers the Southern Cone countries, and Andean Plant Genetic Resources Network (REDARFIT) and the Amazonian Plant Genetic Resources Network (TROPIGEN) address PGR issues in the Andean and Amazonian ecoregions respectively. Venezuela, Peru, Columbia, Ecuador and Bolivia are members of both REDARFIT and TROPIGEN. Bolivia is a member of all three networks and Brazil is a member of both TROPIGEN and PROCISUR. The only countries that are not members of networks in the South American region are the Falkland islands and French Guiana. The Mesoamerican Network of Plant Genetic Resources (REMERFI) covers all countries in Central America except for Belize, which is a member of CAPGERnet (see below). GTZ recently stopped funding REMERFI and efforts are being made by the countries involved to take over funding the coordination of the network.

The Caribbean Committee for the Management of Plant Genetic Resources (CMPGR) was established in 1993, and has recently been transformed into a full PGR network under PROCICARIBE: CAPGERNet. 13 of the 24 Caribbean island nations, as well as Belize, are members of this network. A number of parallels are apparent between CAPGERnet and the new Pacific island network, including island ecologies and potential language limitations: As the networks develop, they may wish to consider the benefits that might be obtained by sharing experiences.

In North America, NORGEN was recently established to formalise linkages between the PGR programmes of Canada, the USA and Mexico. Other countries in the North American region Greenland, Saint-Pierre-et-Miquelon, and Bermuda are not currently members of a PGR network.

In general, coverage of the PGR networks is now quite comprehensive. However, many of these networks are still very young and may require support to reach their full potential for contributing to the goals of the GPA and IT PGRFA.

The above analysis raises a number of questions that may require further attention. In particular, some countries are members of three regional PGR networks, while others are not members of any network though there may be well-established networks in their region. The motivation for a country to join or not join a PGR network may require further study, including in particular the actual and perceived benefits of becoming a member. In addition, further study may be required on the internalcoordination and/or resource implications for those countries that are member of more than one PGR network.

[14] Assessment of country coverage is based on UN population prospects database at http://esa.un.org/unpp/

4.1.2. Crop-based networks

Most of the major crops mentioned in the SoW as being important for food security in a particular region or subregion, now have relevant networks operating in those regions. Fewer networks were found for soyabean and sugar cane through the sources available for the present study. Particular consideration should therefore be given to investigating the coverage of these crops in regions where they are important, in the context of the proposed regional studies.

While in general, regional presence of crop-based networks reflects the crops important to food security in a region, in some cases it may also reflect an opportunity to develop a particular crop in a new area, thus contributing to economic development and/or food security. A number of networks exist in Asia for potato and sweetpotato, for example, reflecting increasing production in this region rather than the origin or the importance of the crop to food security in the region according to sources such as the SoW.

Networks related to the major crops outlined in the SoW, in particular rice, wheat, maize, millets and sorghum, cassava, sweetpotato and potato, beans, and banana and plantain, are almost all initiated by, or closely connected with, the CGIAR centre mandated to address the crop in question, in many cases in collaboration with FAO and regional fora such as APAARI and ASARECA.

The crop-based networks cover most but not all crops listed in Annex 1 of the IT PGRFA. In seeking to identify gaps in networking, however, considerable caution should be exercised, as in many cases specific projects may carry out networking activities, although a formal network does not exist. In some cases, projects may build on the previous work of networks. For example, the only network identified for cowpea, the West African network RENACO, has ceased operating due to a halt in funding. However, a new project (PRONAF) based on this network has recently been launched. In addition, the Bean/Cowpea Collaborative Research Support Program (CRSP) is a research and training program that supports international research partnerships to increase the availability of beans and cowpeas, including participants from the Latin American/Caribbean region, Africa and the U.S.A.

For some major crops, a number of networks may exist in a particular region. The scope and focus of these networks ranges considerably, making it difficult to ascertain overlaps without a more in-depth understanding of the issues addressed by the networks, their functioning, and complementarities and linkages between the networks. An example is the rice networks: many networks exist, however they focus on varying aspects of rice production, from improvement of hybrid rice yields (e.g. INTAHFOR, GRUMEGA); to rice biotechnology (e.g. the Asian Rice Biotechnology Network); germplasm exchange and development (e.g. INGER); and sustainable production (e.g. the IRRI consortiums). Most rice research is on tropical rice varieties (*indica*), however the MED-rice network concentrates on Mediterranean rice varieties (*japonica*). Networks may also focus on a particular development issue that is linked to a specific crop: for example, considerable potential for sustainable area expansion for rice production has been identified in the inland valleys in West Africa, of which only about 15% are currently cultivated. The development and use of inland valley swamps in West Africa is being promoted through the WEDEM/IVS network.

A diverse range of networks also exist for Cassava. The recent adoption of a Global Cassava Development Strategy (2000), to be directly linked to regional and international networks, may provide a basis for better coordination of and/or communication between the networks, as well as the identification of gaps, overlaps and opportunities. It is recognised that such a strategy requires a coalition of stakeholders including cassava producers and their organisations, governments and policy makers, donors, technical and research institutions and their networks, NGOs and their networks, and the private sector. It may also be appropriate to approach IFAP, as the only global farmer's network, to participate in the implementation of such a strategy.

4.2 Focus of the networks

The following section provides an overview of the actual or potential contribution of the five classifications of networks to the objectives of the GPA and IT PGRFA, based on common areas of focus. Although some attempt is made in this study to assess general trends in the objectives and activities of the different networks and their contribution to the implementation of the GPA and IT PGRFA, further study would be needed to assess the contribution of individual networks, including further details on activities, as well as the effectiveness and efficiency of the networks in meeting their objectives.

Article 16 of the IT PGRFA states that "the Contracting Parties will encourage, as appropriate, all relevant institutions, including governmental, private, non-governmental, research, breeding and other institutions, to participate in the international networks". While no comprehensive data on network membership was obtained, it was noted that network membership is dominated by the public sector, with some civil and private sector membership. A number of crop-based networks (e.g. rootcrop networks, bean networks and fruit and vegetable networks) mention the promotion of private sector and NGO involvement, however actual membership of the networks appears to be generally limited to the public sector and research institutions.

The overview is provided in the context of the four main areas of activity of the Global Plan of Action: *In situ* conservation and development, *Ex situ* conservation, Utilisation of Plant Genetic Resources, and Institutions and Capacity building.

4.2.1 In situ conservation and development

The four priority activities of the GPA in this area are:
1. Surveying and inventorying plant genetic resources for food and agriculture
2. Supporting on-farm management and improvement of plant genetic resources for food and agriculture
3. Assisting farmers in disaster situations to restore agricultural systems
4. Promoting *in situ* conservation of wild crop relatives and wild plants for food and agriculture.

Conservation of plant genetic resources is a priority for all regional PGR networks. *In situ* conservation is specifically mentioned in the objectives of REMERFI, PROCISUR, and RECSEA-PGR. WANANET, ECP/GR and SADC have working groups that focus on *in situ* conservation of PGRFA. The regional PGR networks seem to be in a good position to undertake such efforts since *in situ* conservation and development often requires an ecosystem approach that is more difficult to achieve in the crop-based networks.

Although formally not a network, the global IPGRI *in situ* project shows many network features. It has national partners in Burkina Faso**,** Ethiopia**,** Hungary**,** Mexico**,** Morocco**,** Nepal**,** Peru**,** Turkey and Vietnam, and aims to strengthen the scientific basis of *in situ* conservation of agricultural biodiversity to understand the effects of farmer decision-making, agro-ecosystems and population structure and breeding systems on the genetic diversity of local cultivar population over time. These countries were included because each was within a region of primary diversity for crop genetic resources with worldwide importance; and each has traditional farming communities, which maintain plant genetic resources. The countries all have national programmes organized to conserve crop resources, which include *ex situ* conservation facilities, and all indicate a strong interest in developing a national capacity to support *in situ* conservation. In each country, strengthening the relations of formal institutions with farmers and local-level institutions to promote on-farm conservation is a major concern. Communication networks between participating countries are an anticipated outcome of the project.

Likewise, the Community Biodiversity Development and Conservation Programme (CBDC) carries out many networking activities to strengthen the ongoing work of farming communities in conserving

and developing *in situ* agricultural biodiversity. The global CBDC initiative, currently in its second phase, was developed by governmental and non-governmental organisations (GOs and NGOs) involved in agricultural initiatives in Africa, Asia and Latin America, in cooperation with Northern partners.

While the focus of crop-based networks is in general directed at use, a few crop-based networks have a broader focus and also work towards *in situ* on-farm conservation of their mandate crops. Examples include ANSWER (sweet potatoes) [15] and INIBAP (bananas and plantains). Seed networks often contribute to assisting farmers in disaster situations to restore agricultural systems. Networks on underutilised crops and medicinal plants may contribute to surveying and inventorying plant genetic resources for food and agriculture. Some pasture and forage networks may also contribute to the *in situ* conservation of their genetic resources, especially where efforts are made to utilise indigenous vegetation (e.g. FAO working groups).

Arguably some of the main network contributors to on-farm *in situ* conservation are to be found amongst the thematic networks, such as for example the Latin American conservation agriculture network RELACO. The more holistic viewpoint taken by such networks will often include consideration of biodiversity in the context of its production ecosystem. The role of these networks in supporting on-farm management and improvement of plant genetic resources for food and agriculture, and the *in situ* conservation of wild crop relatives and wild plants, is often overlooked and may bear further investigation.

Major *in situ*-oriented networks noted were primarily those focused on nature conservation, including for example the UNESCO-MAB World Network of Biosphere Reserves and the planned Pan-European Ecological Network that will include the Natura 2000 and EMERALD networks established under the Birds and Habitats directives and the Bern Convention, respectively. While these networks are primarily focused on nature conservation, they can contribute to the *in situ* conservation of wild crop relatives and wild plants for food and agriculture. In addition, a number of biosphere reserves are either wholly or partially World Heritage Sites[16] and this may include agricultural heritage. An example of this is the Pyrenees-Mont Perdu reserve, a mountain landscape that spans the contemporary national borders of France and Spain. Amongst other outstanding natural features, the site is also a pastoral landscape reflecting an agricultural way of life that was once widespread in the upland regions of Europe, but now survives only in this part of the Pyrenees.

The "Seville + 5" International meeting of experts on the implementation of the Seville Strategy for Biosphere Reserves, held in Spain in October 2000, resulted in a number of recommendations that may work towards closing the gap between conservation and sustainable use. The final recommendations, after examination by the MAB Council at its 16th meeting in November 2000, include recommendations on biosphere reserves as models for land management and approaches to sustainable development, biosphere reserves for *in situ* conservation of genetic resources and rehabilitation / reintroduction of species, and biosphere reserves for developing quality economies (see box 5).

[15] The 3rd nternational orkshop of ANSWER, organised in collaboration with IPGRI, CIP, the National Institute of Agrobiological Sciences, and the Central Research Institute for Food Crops, focused on exploring the potential of *in situ* (on-farm) conservation of sweetpotato genetic resources in sia (Indonesia, October 2001), resulting in 9 recommendations to carry out for the 2001-04 period of ANSWER activities. See http://www.eseap.cipotato.org/answer/index.htm for more information.

[16] see http://www.unesco.org/mab/BR-WH.htm

Box 5. "Seville+5" Recommendations for the UNESCO-MAB World Network of Biosphere Reserves

The first priority task recommended by the meeting was that the

"MAB Secretariat should co-ordinate with the Secretariats of the relevant multi-lateral environmental agreements (e.g. the Convention on Biological Diversity) to promote biosphere reserves as instruments for their implementation at the national level, as possible through MAB National Committees. Guidelines should be prepared to harmonize research initiatives concerning the different conventions, for implementation at the national level".

Recommendations under "Biosphere Reserves for developing quality economies**"** include that "The MAB Secretariat should investigate and develop propositions for ways to utilise biosphere reserves for the conservation and sustainable development of agricultural activities, so as to increase agro-biodiversity".

Recommendations under biosphere reserves for *in situ* conservation of genetic resources and rehabilitation / reintroduction of species include:

- "Biosphere reserve coordinators should contact their scientific committees/associated local scientific institutions to inventory the potential of their biosphere reserves as in situ gene pools of wild and/or domestic species, especially as complements to ex situ gene banks, in consultation with IPGRI and FAO. Biosphere reserve coordinators should ensure that the size and zonation of the biosphere reserve should be revised as appropriate to meet these special conservation needs.
- The scientific committees of biosphere reserves should set up projects on conservation and/or rehabilitation of genetic resources. Local NGOs and community interest groups can often provide the initial support and workforce, however such projects should engage the support of government authorities and national science foundations to ensure the projects' long-term sustainability and economically viable livelihoods of the populations concerned.
- Whenever appropriate permanent plots should be established for monitoring the progress in these projects and to provide viable primary data for the local, national and global scientific community.
- Biosphere reserve coordinators should use the WNBR to facilitate exchanges of experience in such projects, for example through the regional networks, web sites, and the MABnet".

The Pan-European Ecological Network may also include agricultural areas; one example is the Territorial Systems of Ecological Stability (TSES) agricultural areas included in the Slovak network. These are extensively managed small-scale arable farming areas and horticulture as well as extensively managed grasslands, and the network aims to protect species and habitats as well as maintaining unique landscapes and to maintain or improve hydrological functions, control erosion, and in general maintain or improve environmental quality.

4.2.2 Ex situ conservation

The four priority activities of the GPA in this area are

5. Sustaining *ex situ* collections
6. Regenerating threatened *ex situ* accessions
7. Supporting planned and targeted collecting of plant genetic resources for food and agriculture
8. Expanding *ex situ* conservation activities

Ex situ collections of the 12 CGIAR centres and COGENT are now held "in trust for the benefit of the international community" by FAO and the CGRFA, within the International Network of *Ex Situ* Collections under the Auspices of FAO. This network was established in 1989 in response to a call from the CGRFA, in line with Article 7.1(a) of the International Undertaking on Plant Genetic Resources, because of lack of clarity regarding the legal situation of the *ex situ* collections. Twelve

centres of the Consultative Group on International Agricultural Research (CGIAR) signed agreements with FAO in 1994, placing most of their collections (some 500,000 accessions) in the International Network. The CGRFA monitors the implementation of the agreements and the Centres of CGIAR are invited to report to its biennial sessions. The close linkages between the crop-based networks and the CGIAR centres implies that most of the materials exchanged in the networks related to major crops either originated in CGIAR collections or may be developed by NARS and subsequently exchanged back to the CGIAR. Regional PGR networks also contribute to the *ex situ* conservation of PGR, and often link partners that manage large PGRFA collections.

Ex situ resources are also held in the international network of botanic gardens around the world, linked through the activities of the International Association of Botanic Gardens (IABC) and Botanic Gardens Conservation International (BGCI). According to data compiled by IABG and BGCI, there are approximately 1490 botanic gardens in the world. Together, they hold almost 50% of the world's vascular flora species. They are not uniformly distributed as 61% are in Europe, the former USSR and the United States, but they do cover 187 countries, which leaves only 44 countries (half in Africa) without a single botanic garden. An extensive range of conservation facilities and techniques are employed by these gardens.

In general, botanic gardens maintain a vast amount of intra-species diversity, however genetic diversity may be limited if few specimens are maintained per species. It is estimated that 47% of the botanic gardens (about 700) maintain special collections - sometimes called 'national' – approximate the concept of collections of germplasm under cultivation, as each taxon is represented by a number of specimens. Of these collections, 120 are of agricultural interest[17]. Future studies may wish to consider the actual or potential role of national botanic gardens in PGR networks.

4.2.3 Utilisation of Plant Genetic Resources

9. Expanding the Characterisation, Evaluation and Number of Core Collections to Facilitate Use
10. Increasing Genetic Enhancement and Base-broadening Efforts
11. Promoting sustainable agriculture through diversification of crop production and broader diversity in crops
12. Promoting development and commercialisation of under-utilised crops and species
13. Supporting seed production and distribution
14. Developing new markets for local varieties and "diversity rich" products.

Crop-based networks are primarily focused on the utilization of plant genetic resources. They are the only types of networks where a significant private sector membership was noted, especially the root crop networks and some rice networks. The germplasm exchange, testing and utilisation carried out by these networks contributes significantly to activities 9 and 10. For the major crops, materials either originate in the CGIAR collections or are developed by network members, and in either case are usually exchanged back to the CGIAR. In fact, a number of networks were established primarily for the purpose of distributing CGIAR material for utilisation and field-testing, and a two-way exchange developed as the network matured (e.g. INGER). AVRDC exchanges germplasm in a similar fashion with its vegetable networks. ICARDA's International Germplasm Testing Network facilitates exchange of wheat germplasm as well as germplasm of a number of non-major CGIAR-mandated crops, including barley, durum wheat, bread wheat, lentil, kabuli chickpea, faba bean, vetches and chicklings developed by ICARDA, CIMMYT, ICRISAT and national programmes. Most AVRDC vegetable networks are also involved in germplasm exchange.

Fruit networks, as well as networks for minor and underutilised crops, are more often closely associated with FAO and IPGRI than those related to most major crops (except rice). Most fruit networks are involved in germplasm conservation and exchange. For underutilised crops, the Rocket

[17] Source: CGRFA Background Study Paper no.5: Information on *ex situ* collections maintained in botanic gardens. Available at http://www.fao.org/ag/cgrfa/docs.htm#bsp[17]

Network, the Under-utilised Traditional Vegetables for Asia and the Pacific Network (UTVAPNET), Under-utilised Tropical Fruits in Asia Network (UTFANET) and Southern and Eastern African Network on Under-utilised Crops (SEANUC) all mention germplasm exchange as an activity. The World Beta Network, Cactusnet and the Global Network on Mushrooms are involved in germplasm conservation and exchange for their respective crops. Networks on pasture and forage crops are mostly involved in germplasm exchange, although the FAO Regional Working Group on Grazing and Feed Resources focus more on sustainable production including the use of indigenous resources, thereby contributing to *in situ* conservation.

Crop-based networks often support seed production and distribution for their crop. A number of specialised seed networks also exist, as noted in chapter 3. The work of crop-based and seed networks appears to be coordinated to some extent. However, future regional studies may wish to examine the coordination of the work of these two groups of networks more closely.

Many thematic networks promote sustainable agriculture, often through the diversification of crop production and broader diversity in crops. A number of crop-based networks also focus on sustainable production, for example IRRI's rice research consortiums. In a few cases, utilisation of genetic resources may be integrated into an *in situ*-oriented network such as the Pan-European Ecological Network, in the context of sustainable agriculture.

Regional PGR networks, as well as the networks on under-utilised crops and medicinal species, contribute to promoting the development and commercialisation of under-utilised crops and species, as well as to the development of new markets for local varieties and "diversity rich" products. No networks on under-utilised crops were found to exist in the Americas. However, work on underutilised crops may be covered by the PGR networks in the region.

In summary, there are a wide range of networking initiatives which have the potential to contribute to the activities under this section. Assessment of the actual contribution of these many initiatives to the GPA and IT-PGRFA, as well as the identification of gaps and overlaps, may only be possible through smaller scale, more in depth studies which include consideration of the effectiveness and efficiency of each relevant network.

4.2.4 Institutions and Capacity building

15. Building strong national programmes
16. Promoting networks for plant genetic resources for food and agriculture
17. Constructing comprehensive information systems for plant genetic resources for food and agriculture
18. Developing Monitoring and early warning systems for loss of plant genetic resources for food and agriculture
19. Expanding and improving education and training
20. Promoting public awareness of the value of plant genetic resources for food and agriculture conservation and use.

Supporting national PGR programmes, as well as promoting public awareness of the value of plant genetic resources for food and agriculture conservation and use, are a major focus of the regional PGR networks.

Regional fora are actively engaged in regional priority setting and in formulating regional and sub-regional strategies in agricultural research and development. In some cases this has led to the emergence of networks and of other forms of regional/subregional cooperation. In most cases the Regional Fora provide support to and linkages between networks. Research Networks supported by APAARI, for example, include the Asian Network on Sericulture Research and Development, the Asian Network on Oilseed Crops, the Asia and Pacific Regional Network of INIBAP (ASPNET), the Asia-Pacific Network on Research and Development of Rainfed Agriculture, the Asian Network on

Medicinal and Aromatic Plants, the Asian Rice Biotechnology Network (ARBN), the Asian Sweetpotato and Potato Research and Development (ASPRAD), the Cereals and Legumes Asia network (CLAN), the International Network for Genetic Evaluation of Rice (INGER) , the Rice - Wheat Consortium (RWC), as well as the South Asian Vegetable Network (SAVERNET), the Tropical Asian Maize Network (TAMNET) and the Under-utilised Tropical Fruits in Asia Network (UTFANET).

Issues related to the implementation of the GPA are a priority for all regions (See box 6).

Box 6: ***Links between the GPA and Regional and CS priority setting by regional fora***[18]

In October 2000 all regional fora agreed to revisit, update and refine their regional priorities in making a special effort to involve all categories of stakeholders in this process, given the convergence of interest with CGIAR regional/subregional priority setting and in order to assure a more participatory approach and to integrate civil societies´ concerns and priorities. This reflects "the increasingly diversified institutional infrastructure of agricultural research and the new role being played by the NGOs, the private sector and farmers´ organisations, who are joined by the NARS, IARCs and ARIs in this endeavour".

Agrobiodiversity in general and the issues related to the implementation of the GPA are considered a priority for all regions.

llustrative links between the GPA and Regional and CS priority setting:

GPA activity areas 1-4: *In situ* conservation and development
- Collection and documentation of indigenous knowledge on conservation and use of plant genetic resources (All regions and CS)
- *In situ* conservation strategies and the sustainable use of native at-risk species, recovering local knowledge (All regions and CS)
- Developing and evaluating truly participatory farmer-led research methodologies (APAARI, FARA, FORAGRO &CS)

GPA activity areas 5-8: *Ex situ* conservation
- Eco-regional survey, exploration and collection of endemic, endangered, neglected and traditional cultivars (All regions and CS)
- Bioinformatics and management of germplasm banks (All regions)
- Strengthening regional networks of genetic resources (All regions)

GPA activity areas 9-14: Use of Plant Genetic Resources
- Sustainable use and conservation of biodiversity and agrobiodiversity (All regions and CS)
- Utilisation of underutilised crops (All regions)
- Identification, isolation and characterisation and use of genes of interest (i.e. disease or stress resistance) for breeding programmes (All regions)

GPA activity areas 15-20: Institutions and Capacity Building
- Policy advocacy on IPR/IPP and sharing of genetic resources and of their benefits (All regions and CS)
- Implementation of Biosafety regulations and risk assessment for decision making (All regions)
- Human Resource Development and capacity-building efforts (All regions and CS)

[18] All information in this box originates from the document: Regional Priorities and Emerging Global Programmes: A Preliminary Report on a Stakeholder Dialogue. Rome, GFAR Secretariat, August 2001(Draft under review).

Exchange of information is one of the most important functions of all networks. This is usually carried out through workshops and meetings, newsletters, and electronic communication (internet and email). Most established, longer running networks have regular meetings and workshops from which they publish the results, a newsletter and a website. In many cases, regional fora such as APAARI support regional PGR networks in the region by hosting a website for the networks or maintaining information about the network on their own website.

Over 25 networks were noted that could be classified as "information networks" on a regional or global scale. It is likely that a considerably greater number exist at varying levels of formality. Efforts were only made to gather information on the most visible networks. The most global of these is the System-wide Information Network for Genetic Resources (SINGER), which links the genetic resources databases of the CGIAR Centres. Information networks are generally easy to start and less limited by national or regional boundaries than more formalised networks. The FAO World Information and Early Warning System on Plant Genetic Resources (WIEWS) aims to integrate information related to PGRFA. Little mention of early warning mechanisms by other networks was noted, however, with an exception being the International Network on Cactus Pear, which plans to establish a basic germplasm information system for network members, following WIEWS criteria.

Information exchange is also a priority of regional fora. EGFAR, the Electronic Global Forum on Agricultural Research, is being developed as the electronic information and communication system of the GFAR stakeholders, including a NARS Database on Institutional Web Links and the development of Regional Agricultural Information Systems (RAIS) for each region.

Information systems are a major area of focus for almost all the regional PGR networks. An interesting example is WANANET, which is currently being changed into a "virtual" working environment. It is hoped that this new approach in networking will allow national programs in the region to communicate electronically, so as to exchange information and experiences more efficiently and cost-effectively. A survey across WANA was carried out in 1999 to assess and upgrade country capacities in electronic communication. Another example is the European Commission-funded European Plant Genetic Resources Information Infra-Structure (EPGRIS) project, a three-year concerted action coordinated by Plant Research International, Centre for Genetic Resources, the Netherlands. The central search catalogue will be created at the ECP/GR Secretariat, and the European Inventory will automatically receive data from the National Inventories, effectively providing access to all *ex situ* PGR information in Europe. The RIM network in Latin America is also focusing initially on capacity for information exchange in the region.

Several crop-based networks also maintain, or plan to develop, regional databases related to their crops. In particular ECP/GR has developed many such regional crop databases. In other cases network members contribute to the databases maintained by the CGIAR centres. For underutilised crops and medicinal plants, information gathering and exchange is often a primary goal of the network.

Thematic networks tend to be less involved in collecting and documenting data that fit descriptor list formats. For technical networks such as REDBIO, email discussion may also be an important activity. The Southern African Botanical Diversity Network (SABONET) specifically focuses on capacity building of professional plant taxonomists, plant diversity specialists and horticulturalists in 10 countries of Southern Africa. It maintains the PRECIS Specimen Database (Pretoria National Herbarium (PRE) Computerised Information System), which is used by almost 60% of herbaria in the region.

One of the major issues arising from this section is that of compatibility between the different information systems, and in particular coordination of efforts to build capacity in this area.

4.2.5 Linkages between the networks

The introduction to the GPA states that "Activities related to *in situ* conservation, to *ex situ* conservation, and to utilisation of plant genetic resources for food and agriculture are, to a large extent, carried out in parallel without adequate linkages and coordination. A Global Plan of Action should aim at improving this situation".

Caution should be exercised in judging linkages between networks before conducting a more in depth analysis at a regional level. However, figure 1 provides an initial schematic concept of the perceived linkages between the five network typologies, as far as possible within the scope of the present study. Dashed lines represent linkages that are uncertain or could potentially be strengthened. Regional fora, such as ASARECA and APAARI, usually have contact with the major regional crop-based networks and regional PGR networks, as well as any major agro-ecology networks in the region. These fora may support networks by assisting with information dissemination and organizing regional priority setting consultations. In Asia, for example, three PGR networks and over 20 crop-based networks were found, as well as numerous thematic networks. APAARI includes on its website information on the three PGR networks, as well as the more established crop-based and thematic networks in the region. To some extent, however, APAARI is limited in its ability to provide a regional perspective on agricultural issues by limited membership of only 17 countries in the Asia-Pacific region. In East Africa, almost all crop-based related networks and the new PGR network found during the course of the study are listed on the ASARECA website. In some cases, network coordinators are selected by the regional fora (e.g. ASARECA, SACCAR).

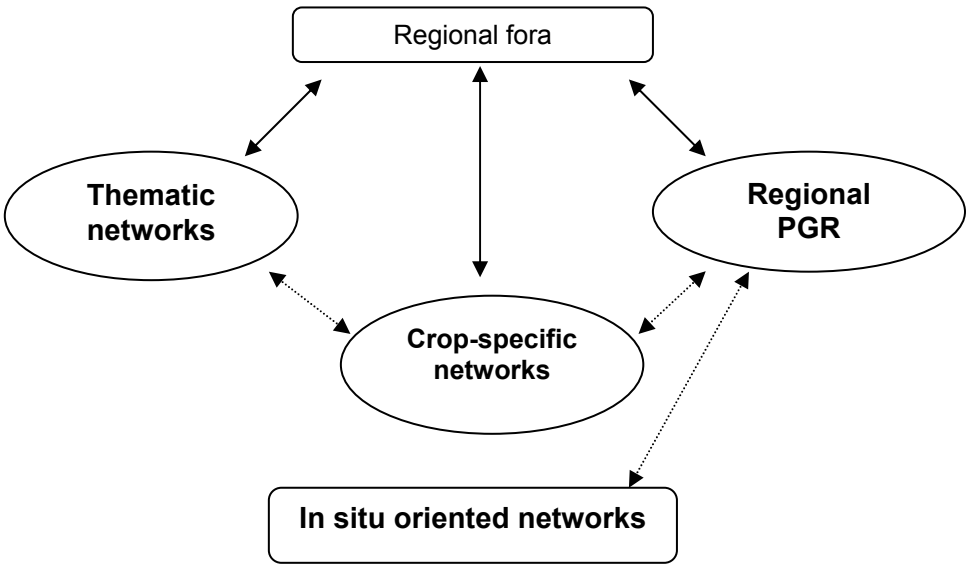
Linkages between regional PGR networks and crop-based networks were not obvious during the course of the study, with the exception of networks and working groups included in the structure of the PGR networks (e.g. the ECP/GR crop networks). It is understood that the PGR networks are generally informed of the activities of crop-based networks and tat some networks form strategic alliances on specific issues. The main linkages between these types of networks, however, appear to be through regional fora or through the CGIAR centres. The focus of these networks is often very different, as regional PGR networks tend to focus on conservation and crop-based networks on use. Likewise, linkages between regional PGR networks and thematic networks were not obvious, except where the thematic network forms a part of the PGR network. As discussed in section 4.2.1, strengthening linkages between regional PGR networks and *in situ*-oriented networks may contribute to the *in situ* conservation of agricultural biodiversity. Further regional-level studies could examine collaboration between PGR networks and other networks in the region in more depth, in order to identify linkages in need of strengthening to optimise resources available towards common objectives.

One example of efforts to link PGR networks in a region is the RIM network (see box 7). This mechanism is focused only on PGR networks.

No interregional networks were found during the study except for those focused on the Mediterranean ecoregion. Interregional interaction can provide important benefits, especially in terms of capacity building and exchange of information on research areas of mutual interest. The level of interregional interaction between networks could also be investigated in future regional-level studies.

Linkages between relevant networks, their functioning, and the communication and synergies they provide or could potentially provide between different groups working towards the conservation and sustainable use of PGRFA is an important area for future study, as well as the further examination of the linkages and synergies between the different kinds of relevant networks, both within and between countries and regions.

Figure 1: Perceived linkages between the five typologies.



Box 7: Integrating regional implementation of the GPA

For the Latin American subregion, a Regional Integrating Mechanism (RIM) initiative to facilitate integration of activities on plant genetic resources was established in 1998, during the regional meeting for the implementation of the GPA. It is intended as a mechanism to co-ordinate activities and develop subregional or regional project proposals attending specific needs within the region.

The idea for an integration mechanism stemmed from the concept of a "network of networks" with focal points for each subregion. In some cases the original subregional representatives were coordinators of the regional networks. Subsequent meetings, however, noted a lack of fluidity in communication and all the national GPA focal points became members of the network. The national focal points then nominated subregional focal points.

The main issue that stands out in this process is one of balance of interests: National focal points are nominated by governments, rather than by institutes. A perceived problem in linking networks directly for the purpose of regional priority setting for the GPA, is that they often represent the views of institutes instead of governments. i.e., not the national PGR programme. The converse, however, may also be considered a problem where issues decided on by the networks are of a technical nature.

RIM activities include bi-annual meetings of subregional representatives and a meeting of national representatives at least once every three years. All subregional PGR networks are invited to attend these meetings as observers. Two project proposals have been developed, relating to characterisation of material that needed regeneration in *ex situ* collections in the region and the establishment of a regional information system to connect and exchange information between gene bank stations at regional level. As countries insisted in the regional character of the project, it was agreed to develop them in modules that could be presented independently for funding to donors.

4.3 Factors affecting the effectiveness and efficiency of networks

The potential contribution of a particular network to the implementation of the IT PGRFA and the GPA is heavily dependent on the effectiveness and efficiency of the network in achieving its objectives. An IDRC study on networks (Smytolo &Koala 1993) noted that "It is not easy to recognise and foster the appropriate conditions for networking formulation, sustainability of dissolution, or to ensure that network resources are used efficiently and effectively"…and also added " There are relatively few multidisciplinary networks which operate efficiently". This indicates that there may often be considerable discrepancy between the written objectives and the day-to-day reality of network functioning. Although a network structure may appear to be place, much depends on its proper use to effectively contribute to the GPA and IT PGRFA implementation.

A number of authors (e.g. Plucknett *et al.* 1993, Starkey 1996) have addressed the major challenges faced by agricultural research networks, and the factors that have the greatest bearing on whether they are able to work effectively towards their goals.

4.3.1 Clarity of focus and planning

Some networks are started with a good deal of promise but lacking a clear definition of what they hope to achieve. If objectives are not clearly defined, it is impossible to ensure that participants are included who wish to further these objectives. Networks need specific goals in order to develop dynamic, monitorable programmes, with distinct targets that can be met, ensuring that participants can work towards the same ends and thereby increasing the potential for good participation and a feeling of ownership.

4.3.2 Balance of interests.

Problems such as domination of the network by donors, or over centralization of the network, can mean that the intended participants in the network have less say in the network activities. Care must be taken to identify stakeholders and beneficiaries of the network in line with clear objectives, and ensure that they have a voice in the direction of the network and a role in monitoring and/or evaluation of the network. The trend for those providing financial input to have the greatest voice in the direction of the network should be balanced by the understanding of the importance of member ownership. Networks with a strong feeling of ownership among members often survive in the face of financial limitations, through the contributions of members in time and resources.

Likewise the balance of public, private and civil sector involvement should be kept in line with the objectives of the network. An important question to ask when analysing networks, is - whose priorities are reflected in the objectives of the network, and is this reflected in whether or not the objectives are carried out?

The CATWOE framework presented in section 2.2 may assist in further examining these factors. It is included in the framework for analysing effectiveness and efficiency proposed in Annex 1.

4.3.3 Financial aspects

Networks often suffer from lack of funds for network activities and coordination. In addition, networks are often funded as projects, receiving support for 3-4 year periods, which is often difficult to renew. Networks are often begun as projects and financed in short-term project cycles of 3-4 years. This can sometimes lead to networks becoming inactive as the project cycle ends and the money runs out. Examples of this phenomena are plentiful, (e.g. the Regional Network on Cowpea RENECO in Latin America). Longer running networks such as INGER may have greater capacity to deal with a drop in funding: the considerable reduction in support to this network has resulted in reorganisation rather than inactivity. Another example is the Mesoamerican PGR network REMERFI: GTZ recently

stopped funding this network and efforts are being made by the countries involved to take over funding the coordination of the network.

Box 8 presents three cases of well-established networks funded in different ways: 1) ECP/GR, which is self funding, 2) SPGRC, for which funding was planned over a period of 20 years at the start of the network, and 3) SAVERNET, which was planned in phases that coincided with the project cycle of its donor, the Asian Development Bank.

Networks are seldom completely self-funded. The contribution that can be expected from network members may be dependant on many factors related to the capacity and the external operating environment of a network, including whether or not the NARS themselves in the region are self-funding. A country in civil war, for example, cannot be expected to contribute any time or resources to network activities even if they constitute a longer-term priority for the country.

Box 9 provides an example of CIAT´s approach to networking for beans in Africa. The bean networks have maintained internal bye-laws by which the network steering committee expects to see minimum contributions by NARS members to each proposed subproject of between 30-50%, including equivalent staff time. Some contribution to the work of the network ensures that the activities are really a priority to the members, and may increase the feeling of ownership in the network.

One factor not addressed in the information available from literature, and not readily obtained for the networks described in this study, concerns the total available budget and its distribution over various budget items. Attempts to measure the efficiency of a network should take into account (1) what funds are needed and used to obtain certain results and to reach specified goals, and (2) how the distribution of the total available budget over specific budget items relates to achieving network goals.

Gathering data on this important aspect was beyond the scope of the current study. However, at the individual network level, efforts to monitor and analyse current budget allocation could be made in order to improve network outputs. In addition, it may be possible for specific donor organisations to study the efficiency of network functioning by comparing the outputs of similar networks, taking into account the major variation in costs of staff and facilities from region to region.

Box 8: Financing networks – three cases

Case 1: Very few networks attain the goal of being financed completely by their members, and this may only be possible in mature networks. ECP/GR is one network that has attained this goal. The network is entirely funded by the country members and its work is implemented within the existing budgets and structures of the member organisations. This creates a member-led organisation that is responsive to member will. It also limits the work of ECP/GR to what can be carried out with resources that members are willing to commit to the network from their own national budgets.

Case 2: For most other networks and for all networks in the early stages of evolution, an external donor is needed. The short project cycle funding can be a problem for networks. One example of donors coming together to avoid this problem is provided by the SADC Plant Genetic Resources Centre (SPGRC). SPGRC was established in 1989 to promote and co-ordinate a regional network of plant genetic resources. This network, from its inception, received funding from the Nordic countries of Denmark, Finland, Iceland, Norway and Sweden and the SADC countries. The funding arrangement spans twenty years, with the contributions from the Nordic benefactors progressively decreasing while that from the SADC partners increased correspondingly, to the extent that after the project phase, all funding will be from the SADC countries. The Nordic genebank provided consultancy while IPGRI has provided research support and scientific backstopping, supplied publications and other informational material, as well as given material support, throughout the ten-plus-year lifetime of the centre.

Case 3: Another, perhaps more broadly replicable possibility is for the network to utilise the project cycle to consciously "phase" its evolution. The fact that networks "evolve" naturally and the need for periodic reassessment can, if carefully planned, be worked into a cycle of 3-4 years. SAVERNET, the South Asia Vegetable Research Network Phase I (SAVERNET-I) commenced with the organisation of joint planning meeting held in 1992 in Bangladesh. The final workshop of SAVERNET-I was conducted in Nepal in 1996. The main objective of SAVERNET-I was to strengthen vegetable research and development of Bangladesh, Bhutan, India, Nepal, Pakistan and Sri Lanka through the establishment and operation of a co-ordinated research and training network. The success of phase I as demonstrated by the identification of improved varieties and technologies was well recognised by the Asian Development Bank. A study published by the Asian Development Bank in December 2000 estimated the total economic surplus for AVNET (another AVRDC network planned along similar lines) and SAVERNET at about $17.88 billion with an average IRR of 91 percent. The high returns at AVRDC are attributed to the large areas grown of the target crops in South and Southeast Asia, the high per unit value of vegetable crops, and the large yield gains derived from the regional research results. As a result of the request from all the participating countries, the joint proposal for SAVERNET-II was approved by the Bank in 1997. Currently the national partners are continuing network activities without funding from donors.

4.3.4 Capacity and the external operating environment of a network

Network efficiency is also a function of available human resources and facilities. Capacity for efficient organisation and quality research may be limited by lack of funds and environmental constraints, however one of the benefits of networks is their function in bringing together countries and institutions with different capacities, and supporting and training the weaker members. Poor quality research can also result from communication difficulties, poor information management, and poor feedback through lack of motivation. An atmosphere of questioning and self-criticism is required.

One of the primary environmental constraints on a network may be the political environment. National and international networks have to operate within the political realities of the country or region. Levels of bureaucratic involvement in networks vary considerably by country. Political constraints must be addressed according to the situation, but in general governments can greatly assist the functioning of networks by allowing them a degree of autonomy consistent with technical rather than a political

status. Bernard (1996) notes that "b*y encouraging co-operation among research institutions and demonstrating positive results, networks can facilitate and encourage political commitment to a strong national programme. National capacity is also strengthened through the development of a critical mass of national researchers and through access to regional expertise."*

Language can also be a limitation in some regions. This is usually surmountable but requires an atmosphere of mutual respect, resources for translation, and in particular the clear definition of methodology and terminology. In some cases networks are organised along language barriers to avoid potential problems.

Box 9. Evolution processes and the bean networks[19]

CIAT Bean Program, established by the CGIAR in 1974, pioneered a strategy for grouping countries into regional research networks having agroecological and socio-economic affinities, to facilitate the development and transfer of new technologies across a large area in a more efficient and economical manner. In Africa, the first regional bean network was established in the Great Lakes Region (RESAPAC) in 1984. The Eastern and Central Africa Bean Research Network (ECABREN) was established in 1996 through the merger of the two regional networks EABRN and RESPAC at the request of the ASARECA Committee of Directors (CD), and now form a member of the Pan-Africa Bean Research Alliance (PABRA), formed in 1995 to catalyse efficiencies through collaboration on common issues by ECABREN and the Southern Africa Bean Research Network (SABRN). These networks have benefited from such reorganisation and cross-fertilisation. Pan-Africa technical working groups now bring together experienced scientists to advise the steering committees on the state of knowledge, progress in regional research and new priorities.

CIAT depends on the regional networks as much as the NARS to develop and test new technologies. The networks also facilitate the development and exchange of technologies within/among NARS members. Greater across-network exchange of new technologies is evolving as the networks mature and strengthen.

The networks function as voluntary associations among national agricultural research systems (NARS) and with CIAT, and have a common objective to increase bean productivity in particular agro-ecological zones and/or socio-economic regions. All decisions on technical priorities, resource allocation, and assessment of research progress are the responsibility of the regional Steering Committees (CIAT contributes one member to these committees). Policy decisions concerning network activities are determined by regional committees of NARS Directors. Research planning is done through participatory Project Planning by Outputs (PPO), which gives individual scientists and other groups, such as extension agents and local NGOs, a sense of ownership and identification with the network. The core set of activities within a network is collaborative research, organised as regional sub-projects, and led by selected NARS scientists from institutions offering comparative advantages for a particular line of research.

Regarding funding, the bean networks have maintained internal by-laws by which the network steering committee expects to see minimum contributions by NARS members to each proposed subproject. These have varied between 30-50%. To be fair to NARS contributing valuable staff time, NARS in kind contributions in time is valued highly. Even more important to a sense of ownership in the network may be the ability to determine important decisions, particularly relating to the distribution of funds. The strong sense of ownership felt by the steering committees of these networks may be indicated by the fact that they often continued their meetings to late in the night over a number of years in making these decisions. One important indicator of ownership in a network may be whether self-governing networks are able in practice to turn away poor proposals from their own member countries and allocate funding based on the merit of a proposal.

[19] Information on bean networks was kindly provided by CIAT staff Caesar Cardona and Roger Kirkby

The situation concerning bean research in Africa is very different today than it was ten years ago. The networks and their steering committees are now seasoned in network management, and the research sub-project mechanism has become institutionalised. Increasingly, coordination of the networks is being turned over to local management. The first network to be devolved was SABRN in 1994, followed by RESAPAC in 1995. ECABREN became self-managing in 1996. The natural evolution of the networks towards self management is fully supported by CIAT, the donors, and the regional directors. CIAT staff note from experience that for the networks to be successful after devolution, there must be in place three critical components:

1. a commitment by the donors for continued support to the networks;
2. commitment by the NARS to conduct high quality research and to exchange the results with other member countries; and
3. a continuous supply of new technologies and research inputs by CIAT scientist to the NARS in a frequent and participatory manner.

4.3.4 Ability to adapt to change

An important characteristic of networks is the fact that they are not static. They are in a state of continuous evolution in a changing environment, and therefore need to be adaptable. Networks evolve according to member's needs, the resources available and the kinds of contact established. Changes can occur in the needs of the network membership or its composition; the networks external environment; or even the "problem" or need that originally brought about the creation of the network.

Box 3 provides an example of CIAT's approach to networking for beans in Africa. These networks have undergone numerous transformations, mergers and renamings, however new networks, while creating a new focus, are built on the linkages and knowledge base of their predecessors. These networks, while preserving close links with CIAT, have gradually built up the capacity for greater autonomy.

One common problem, mentioned above, is a change in the way a network is funded. Another common problem is that changes in leadership and staff can destabilise the network. Delay in the appointment of a new co-ordinator, in particular, can create a lack of continuity, particularly dangerous in the early stages of the network.

In order to capitalise on opportunities and mitigate threats to the network that result from change, it is essential for networks to identify and build on strengths and deal with problems as they evolve, before they become serious. This requires regular monitoring and evaluation of the relevance of a networks goals and activities in relation to the needs of its members, its resources and its environment. Internal monitoring can be carried out by the network co-ordinator or steering committee, or in a more participatory style through workshops, provided they are organised with good representation of the membership and periodically review the networks goals, mandate and objectives as well as its research profiles.

Monitoring and evaluation is often carried out externally by donors, however the more this is carried out by members, the more say they will have in the future direction of the network. As noted by Bernard (1996): "The more evaluation is made explicit as a function of membership, the more likely it is that iterative planning and adaptive execution will happen. For networks, the willingness of members (or clients) to help define direction, monitor and adjust operations and interpret the success of tasks constitutes *ownership*, another condition identified as critical to successful implementation of social innovation." If all stakeholders are involved in monitoring, evaluating and planning, communication can be clearer and change processes can be dealt with more efficiently. If the goal of the parent institute and/or donor is that the network become gradually more autonomous, this requires careful planning and a transparent approach.

Plucknett *et al*. (1993) summarises important "principles for success" for agricultural research networks, based on an earlier study (Plucknett, 1990) that examined an evaluation of principles considered important for successful networks by eight authors and organisations:

- ***Clear definition of the problem.*** Without this the network becomes unmanageable and time is wasted as network members work on subjects that are not relevant.
- ***Problem widely shared***. If a problem is recognised as a major one by many parties, donors tend to be interested in funding a network on it, since the potential impact is great.
- ***Self interest.*** Participants should directly benefit from networking activities. If institutes also benefit, they are more likely to support the participants and allow them time and resources for networking activities.
- ***Founding document.*** A baseline study that explores the scope of the problem and identifies key participants is essential for scientific consultation and collaborative research networks. Donors may be willing to donate seed money for a feasibility study that may lead to a network.
- ***Realistic research agenda.*** In a well functioning network, each participant is responsible for a piece of the research puzzle that accords with his or her capacities. Unrealistic goals sap motivation.
- ***Participants involved in network management.*** Participants should be involved in establishing priorities and planning research. Self-governance should be stimulated from the beginning.
- ***Stable membership.*** This promotes continuity and a collegial atmosphere. Valuable time is lost when a constant stream of new members have to be informed of networking procedures.
- ***Strong leadership***. Dissatisfaction is less likely to occur when a leader is elected rather than imposed. If leadership changes too frequently, the network's cohesion suffers. However, when a network is mature it is easier to change leaders without disrupting activities.
- ***Regular meetings.*** These foster the exchange of new ideas and techniques. Meetings are especially important in multidisciplinary networks. However, if meetings are held too frequently, they drain resources needed for research.
- ***Collaborators contributing resources.*** If participants contribute their own resources tot he research effort, this is a good indicator of their commitment. Collaborators should no be bought: prolonged and heavy subsidies are not a good idea.
- ***External funding.*** This is needed for coordination, travel, meetings, etc. Seed money may be needed in the pre-network phase. Especially in developing countries, funding facilitates travelling.
- ***Training.*** This is necessary to upgrade capabilities and bridge gaps in expertise between partners at the start of a network, or between new and old members.
- ***Flexibility.*** Networks need to be flexible to respond to changing research and farming environments. They need self-criticism and periodic correction.
- ***New ideas.*** These are vital to prevent stagnation. New ideas can be generated by linking with other institutions/initiatives.

The above principles are included in the proposed framework for evaluation presented in Annex 1.

5. CONCLUSIONS AND RECOMMENDATIONS

5.1 Network coverage of PGR issues

- For all geographical subregions, PGR networks have now been established. Regional PGR networks often function under the umbrella of regional fora, which may add to the continuity of the networks, but may also lessen their flexibility in strategy development and planning.
- One noticeable gap in country coverage is the fact that the least developed Southeast Asian countries are not members of their subregional PGR network RECSEA-PGR. Some Eastern European countries are not yet included in the European PGR network, but do participate in ECP/GR activities. In addition, the Caribbean network CAPGERNet and the new Pacific PGR network do not yet cover all countries in their respective subregions.
- It was noticeable that many of the "countries" not yet included in networks were small islands. The GPA had recommended the establishment of a PGR network for the Indian Ocean Islands, however these islands are now mostly members of African networks. However, the fact remains that islands have special ecologies, and may face similar issues in the conservation and sustainable use of PGR. Interregional collaboration between island-based networks might provide the opportunity for sharing experiences and discussing priorities on island-specific issues.
- In many cases, PGR networks are still very young. Only a limited number of networks seem to practise binding agreements on joint project implementation and material exchange. A gradual development of networks, to include such agreements as part of network functioning, may substantially add to the implementation of the GPA and the IT PGRFA.
- Regarding the coverage of crop-based networks, for the major crops outlined in the State of the World's PGRFA (SoW), most crops mentioned in the SoW as being important for food security in a particular region or subregion (see Chapter 1 and Annex 2 of the SoW in particular) were found to have networks operating in those (sub) regions.
- In seeking to identify gaps in networking, considerable caution should be exercised, as in many cases projects may carry out networking activities although a formal network does not exist *per se*. In some cases, projects may build on the previous work of networks. Similar caution should be exercised in identifying overlaps. For some major crops, a considerable number of networks exist. Likewise, the Latin American region appears to have a large number of PGR networks. However, the scope and/or focus of these networks may range considerably, making it difficult to ascertain overlaps without a more in-depth understanding of the issues addressed by the networks, their functioning, and complementarities and linkages between the networks.
- Co-ordination of activities and networks into global programmes or networks may help in avoiding possible duplication and overlap of activities and efforts. However, care should be taken that the global objectives of such programmes are flexible and do not negatively affect the local relevance of network objectives.
- Thematic networks that address on-farm management of PGR, such as the agro-ecology and community development focused networks, seem to be poorly integrated into the global efforts to implement the GPA. It is recommended to pro-actively involve the organisations participating in such networks in the general efforts toward implementing the GPA and IT PGRFA, for example by offering the organisations in these networks an improved access to materials, expertise and facilities, (e.g. through collaboration with other networks), and to facilitate their functioning, where needed.
- The NARs, as well as the CGIAR centres form the major basis for the networks described. In most cases, CGIAR centres were involved in the initiative to establish networks, often in collaboration with FAO and other international institutions. This observation points to the great contribution of the CG centres, as well as to a specific threat, i.e. a high dependence on CGIAR centres' support and the risk of lack of long term sustainability for these networks if they are formed on a narrow

institutional basis. A similar risk can be deduced from the high donor involvement in establishing and implementing these networks. These risks may be greater in the case of the more formalised and resource-intensive regional PGR networks than in the case of some of the less formal, low-input crop-based networks.

- While no comprehensive data on network membership was obtained, it was noted that network membership is dominated by the public sector, with some NGO and private sector membership. A number of crop-based networks (e.g. rootcrop, bean networks and fruit and vegetable networks) mention the promotion of private sector and NGO involvement, however actual membership of the networks appears to be generally limited to public sector and research institutions. It is recommended that where, possible private and civil sector involvement in networks is promoted, including by the networks themselves.

5.2 Networks contribution to the implementation of the GPA and IT PGRFA

- *In situ conservation* is addressed by regional PGR networks and by the *in situ*-oriented networks such as the MAB world network of biosphere reserves. Thematic agroecology and community development focused networks may also contribute significantly to the objectives of the GPA in this area, by promoting sustainable agricultural practices and more diverse agricultural ecosystems. Crop-based networks may in some cases also contribute to *in situ* conservation. In general, linkages between these different networks appear to leave considerable room for improvement, however recent developments (such as the Seville+5 recommendations of the MAB networks) may encourage improved linkages and collaboration. Regional PGR networks may wish to reassess their linkages with other networks focussing on *in situ* conservation and development.
- *Ex situ conservation* of PGR is addressed by the International Network of *Ex Situ* Collections under the Auspices of FAO, which includes the collections of the CGIAR centres and COGENT. Crop-based networks are often closely linked with these collections, providing a mechanism for testing and further development of CGIAR materials. Regional PGR networks also contribute to the *ex situ* conservation of PGR, and often link partners that manage large PGRFA collections, even exceeding those of the CG in total size. The latter observation points to possible options for regional PGR networks to coordinate and monitor the *ex situ* conservation of collections in the region. The role of the international network of botanic gardens in conserving PGR is also well recognised.
- Crop-based networks are generally strongly focused on the *utilization of plant genetic resources* and cooperative testing and development of improved materials. The focus of crop-based networks is often on the development of a particular crop, contributing to genetic enhancement and in many cases to base-broadening efforts. Crop networks may, however, be primarily focused on the development of a particular crop and not necessarily on its conservation or even its sustainable use. While crop development (breeding) and conservation need not be contradictory objectives, it may not be taken for granted that the presence of a crop network implies a contribution to the conservation or sustainable use of the crop's genepool. Crop-based networks may wish to revisit their objectives and strategies to evaluate their contribution to conservation and sustainable use, within the limitations of their focus on crop development. Regional PGR networks, as well as the networks on under-utilised crops and medicinal species, contribute to promoting the development and commercialisation of under-utilised crops and species, as well as developing new markets for local varieties and "diversity rich" products. In addition, seed networks are important in supporting seed production and distribution.
- *Institutions and capacity building issues.* Supporting national PGR programmes, as well as promoting public awareness of the value of plant genetic resources for food and agriculture conservation and use, are a major focus of the regional PGR networks. Regional and subregional fora are actively engaged in regional priority setting in agricultural research and development. A number of priorities identified correspond with the priorities of the GPA. Regional fora often

provide a supporting umbrella structure that helps to link different kinds of networks in a region. Linkages between different kinds of networks and between regions may require further study. For this purpose, it may be useful to consider the potential strengths and weaknesses of different kinds of networks indicated in Table 2.

- Exchange of information is one of the most important functions of all networks, and the harmonisation of databases and information systems, as well as building capacity for electronic communications, should be recognised as a major priority. SINGER, WIEWS, and the European Central Crop Databases form divergent examples of global and regional networks to link activities of network partners in the area of information exchange.

5.3 Funding

- Some contribution by members to network activities, whether monetary or in kind, is important. The level of contribution by members(particularly in terms of in-kind contributions that are less limited by resource constraints) may reflect the level of "ownership" of network activities, both positively and negatively. In addition, the cost of local staff time to a network is in many cases more cost-effective than the time of staff in the parent institution. However, expectations of member contributions should be balanced by an appreciation of capacity and resource constraints faced by network members. A country in civil war, for example, cannot be expected to contribute any time or resources to network activities even if they constitute a longer-term priority for the country.
- While (partial) member funding may present the only long-term sustainable alternative for PGR networks, this may not currently be a realistic option for many networks. In particular where members are developing-country NARS, financial resources are often a serious constraint. Donor support for PGR-related networks is likely to lead to a more sustainable network if support is provided on a medium-term basis, particularly in the early stages of network development. Agreements should be made with members that plan for and/or safeguard additional financial resources to replace donor funding in future.
- It may be important for networks to actively search and increase options for funding mechanisms and technical support between members or member governments. For this purpose networks need to be able to provide evidence of impacts, and to plan for project cycles. Donors, in their turn, should be transparent in whether networks will receive funding, under which conditions, for which objectives, and (potentially) for how long.

5.4 Additional parameters influencing network functioning

- A feeling of ownership of the network by members is very important. Ownership is closely linked to important questions of decision-making and participation in the networks, factors for which in depth analysis would require further communication with participants. The functioning of networks may be heavily dependent on the commitment of few dedicated individuals, in particular for those networks, for example some crop-based networks, which have been less institutionalised. The existence of a funded secretariat, though a separate budget or on the overhead of the hosting institution, may be of major importance. Steering committees may be an important structure to improve the strategic decision making for reaching network objectives and the planning of network activities. These are important issues to address in further studies.
- Networks need to plan for change and evolution, carry out regular monitoring of their activities and reassessment of their goals. A proposed framework for internal evaluation is included as annex 1. For the further development of such a framework as a tool for networks, the networks themselves should be closely involved.

- All types of networks described have their own valid contribution to the implementation of the GPA and the IT PGRFA. It should be realised that no single type of network, whether from a specific crop or region, or from the CGIAR centres can be simply recommended as a blueprint for other crops and by other regions and institutions. Networks are based on communication between people, and human diversity forms an essential background to both the development and the management of plant genetic diversity.

5.5 Areas for further study

- A major limitation to the depth of analysis provided by this study was the fact that the expanded database developed for the purposes of this study was primarily based on available written information, and therefore reflects the goals of the networks rather than the actual status of network functioning. In order to provide a fuller insight into real functioning of the networks (and therefore into their real contribution to the implementation of the GPA and IT PGRFA), further studies are recommended involving fieldwork such as interviewing network members, users and other stakeholders. Such studies could be carried out on a regional basis and examine in particular the issues identified in this study, including issues of ownership and participation, the synergies and complimentarities between different kinds of networks, as well as overlaps that may reduce the efficient use of resources. A framework is proposed in annex 1 to further examine network effectiveness and efficiency.

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7. FURTHER READING: CASE STUDIES OF NETWORKS AVAILABLE ON INTERNET

GFAR case studies *available at http://www.egfar.org* (under partnerships) including:

- Strengthening Hybrid Maize Research Activities in the Asian Region through Tropical Asian Maize Network (TAMNET)
- PRECODEPA: Potato regional Program
- South African Development Community (SADC) Plant Genetic Resources Centre: Its Role and Achievements in PGR Management
- Rice-Wheat Consortium in the Indo-Gangetic Plains: An Ecoregional Partnership in South Asia
- RELACO - Latin American Network on Sustainable Agriculture
- CLADES: Consorcio latinoamericano sobre Agroecologia y Desarollo (The Latin American Consortium on Agro-ecology and Development)
- Development of an Agro-ecological Research Network for Organic Vegetable Production and Marketing
- CORNET - Coffee Research Network
- The International Bambara Groundnut Network (BAMNET): A Network Approach for a Partnership in R&D of a Neglected and Under-utilized Crop
- PROMUSA: A Global Program for Musa Improvement
- BUROTROP: A Global Network for the Development of Research on Tropical Perennial Oil Crops

The world conference on Horticultural Research (WCHR) case studies on Networking and Global programmes. *available at http://www.agrsci.unibo.it/wchr/wc2/indexwc2.htm*

- *Webster, T.* EUFRIN, Network experience on vegetable in Europe.
- *Baudoin, W.* RADHORT, Network experience on vegetable in West Africa
- *Lastra, R.*, Williams D.E., IPGRI support of networking activities in Americas related to fruits and horticulture
- *Zandstra H., Scott G.J.* A Global Research Agenda for Horticultural crops: CIP and the role of roots and tubers
- *Tsou, S.C.S., Shanmugasundaram S.* AVRDC'S global vegetable network strategies
- *Frison E.A., Collins W.W., Sharrock S.L.,.* PROMUSA: A first experience of global programme in horticulture.

UPWARD

CGIAR Systemwide Program on Participatory Research and Gender Analysis for Technology Development and Institutional Innovation (in preparation). Study Tour Case. FPR-IPM Study Tour and Learning Workshop on Farmer Participatory Research and Participatory Learning for Integrated Pest Management 4-8 Sept. 2001, Chiang Mai, Thailand. *Soon available at http://www.prgaprogram.org/pnrm/fpr-ipm/fpr-ipm_files/frame.htm*

Additional further reading:

USAID 1996. An Evaluation of Regional Research Networks for Cassava, Beans, Agroforestry, Potatoes and Sweet Potatoes. A collaborative research programme in East Asfrica among National and International Research and Development Agencies (USAID Project 698-0478, Policy, Analysis, Research, and Technical Support). Submitted to: US. Agency for International Development, Bureau for Africa. Office for Sustainable Development, Productive Sector Growth and Environment Division.

LIST OF ACRONYMS

AABGA	American Association of Botanical Gardens and Arboreta
AARINENA	Association of Agricultural Research Institutions in the Near East and North Africa
AARNET	ASEAN-AVRDC Regional Network on Vegetable Research and Development
ACRAC	Asian Cassava Research Network
ADB	Asian Development Bank
AFNETA	Alley Farming Network for Tropical Africa
AFRNET	African Feed Resources Network
AMBIONET	Asian Maize Biotechnology Network
ANMAP	Asian Network on Medicinal and Aromatic Plants
ANSWER	Asian Network for Sweetpotato Genetic Resources
APAARI	Asia-Pacific Association of Agricultural Research Institutions
APAN	Asia-Pacific Agroforestry Network
ARBN	Asian Rice Biotechnology Network
ARIs	Advanced Research Institutions
ARNAB	African Research Network for Agricultural By-Products
ASARECA	Association for Strengthening Agricultural Research in Eastern and Central Africa
ASN	African Seed Network
ASPACO	Asia-Pacific Co-operation for the Sustainable Use of Renewable Natural Resources in Biosphere Reserves and Similar Managed Areas
ASPNET	Asia and Pacific Regional Network of INIBAP
ASPRAD	Asian Sweetpotato and Potato Research and Development
AVNET	Asian Vegetable Research Network
AVRDC	Asian Vegetable Research and Development Centre
BARNESA	Banana Research Network for East and Southern Africa
BGCI	Botanic Gardens Conservation International
BIONET	Biodiversity Action Network
BMZ	Bundesministerium fur wirtschaftliche Zusammenarbeit und Entwicklung
CAC	Central Asia and Caucasus
Cactusnet	International Network for Technical Cooperation on Cactus Pear
CAPGERnet	Caribbean Plant Genetic Resources Network
CARIFRUT	Caribbean Fruit Network
CARIVEG	Caribbean Vegetable Network
CAROT	Caribbean Roots and Tubers Network
CATCN-PGR	Central Asia Trans Caucasian PGR Network
CATIE	Centro Agronómico Tropical de Investigación y Enseñanca
CATWOE	Customer, Actors, Transformation process, Weltanschauung, Owner, Environmental constraints
CBN	Cassava Biotechnology Network
CD	Committee of Directors
CEWARRNET	Central and West Africa Root and Tuber Crops Research Network
CFS-NENA	Consultative Forum on Seed for the Near East and North Africa
CGIAR	Consultative Group on International Agricultural Research
CGRFA	Commission on Genetic Resources for Food and Agriculture
CIAT	Centro Internacional de Agricultura Tropical
CIHEAM	Centro Internacional de Altos Estudios Agronómicos Mediterráneos
CILSS	Inter-State Committee for Drought Control in the Sahel
CIMMYT	Centro Internacional de Mejoramiento de Maiz y Trigo
CIP	Centro Internacional de la Papa
CIRAD	Centre de coopération Internationale en Recherche Agronomique pour le Développement
CLAIS	Latin American Commission of Sorghum Researchers Network
CLAN	Cereal and Legumes Asia Network
CLAYUCA	Latin American and Caribbean Consortium to Support Cassava Research and Development
CLVNET	Cambodia, Lao PDR, Vietnam Vegetable Collaborative Research Network
CMPGR	Caribbean Committee for the Management of Plant Genetic Resources
CNPAF/EMBRAPA	Centro Nacional de Pesquisa de Arroz e Feijão (EMBRAPA)
COGENT	International Coconut Genetic Resources Network
CONDESAN)	Consortium for the Sustainable Development of the Andean Ecoregion
CONVERDS	Collaborative Network for Vegetable Research and Development in Southern Africa
CORAF	Conseil Ouest et Centre Africain pour la Recherche et le Développement Agricoles
CORRA	Council for Partnership on Rice Research in Asia
COST	European Cooperation in the field of Scientific and Technical Research
COSUDE	Swiss Agency for Cooperation and Development
CRIDNET	Caribbean Rice Industry Development Network
CRSP	Collaborative Research Support Program
CS	Civil Society
DGIS	Directorate General for International Cooperation (Netherlands)
EABRN	East Africa Bean Research Network
EACP	Eastern Africa Cereals Program
EA-PGR	Regional network for conservation and utilization of plant genetic resources in East Asia
EAPGREN	East African Plant Genetic resources network
EARRNET	East Africa Root Crops Research Network
ECABREN	Eastern and Central Africa Bean Research Network
ECAMAW	Eastern and Central Africa Maize and Wheat Research Network
ECARSAM	Eastern and Central Africa

ECP/GR	European Cooperative Programme for Crop Genetic Resources Networks
ECSARRN	East, Central and Southern Africa Rice Research Network Rice Research Network
EFARD	European Forum on Agricultural Research for Development
EFNCP	European Forum on Nature Conservation and Pastoralism
EGFAR	Electronic Global Forum on Agricultural Research
EMBRAPA	Empresa Brasileira de Pesquisa Agropecuária
EPBN	European Plant Biotechnology Network
EPGRIS	European Plant Genetic Resources Information Infra-Structure
ESCORENA	European System of Cooperative Research Networks in Agriculture
EU	European Union
EUCARPIA	European Association for Research on Plant Breeding
FAO	Food and Agriculture Organisation of the United Nations
FARA	Forum for Agricultural Research in Africa
FLAR	Latin American Fund for Irrigated Rice
FORAGRO	Regional Forum of Agricultural Research and Technological Development
GCGN	Global Citrus Germplasm Network
GEF	Global Environmental Facility
GFAR	Global Forum for Agricultural Research
GPA	Global Plan of Action
GRENEWECA	Genetic Resources Network for Western and Central Africa
GRIN	Germplasm Resources Information Network
GRUMEGA	Working Group on Advance Rice Breeding
GRUTHA	Technical Work Group on Hybrid Rice for Latin America and the Caribbean
GTZ	Deutsche Gesellschaft für Technische Zusammenarbeit
IABC	International Association of Botanic Gardens
IABMS	International Association of Botanical and Mycological Societies
IACNET	Inter-American Citrus Network
IARCs	international agricultural research centres
ICARDA	International Center for Agricultural Research in the Dry Areas
ICRAF	International Centre for Research in Agroforestry
ICRISAT	International Crops Research Institute for the Semi-Arid Tropics
ICUC	International Centre for Under-utilised Crops
IDRC	International Development Research Centre
IFAD	International Fund for Agricultural Development
IFAP	International Federation of Agricultural Producers
I□A	International Institute of Tropical Agriculture
IK	Indigenous Knowledge
ILCA	International Livestock Centre for Africa
INGER	International Network for the Genetic Evaluation of Rice
INIBAP	International Network for the Improvement of Banana and Plantain
INSAH	Institut du Sahel
INTAFOHR	International Task Force on Hybrid Rice
INTSORMIL-CRSP	International Sorghum and Millet Collaborative Research Support Program
IPBN	Indigenous Peoples' Biodiversity Network
IPGRI	International Plant Genetic Resources Institute
IPM	Integrated Pest Management
IPUF	Indigenous Plant Use Forum
IRC	International Rice Commission
IRRC	Irrigated Rice Research Consortium
IRRI	International Rice Research Institute
ISNAR	International Service for Agricultural Research
IT PGRFA	International Treaty on Plant Genetic Resources for Food and Agriculture
IUBS	International Union of Biological Sciences
LAC	Latin America and the Caribbean
LAMP	Latin American maize regeneration project
LCA	Lusophone Countries of Africa
LEUCNET	International Leucaena Research and Development Network
MAPPA	Medicinal and Aromatic Plants Programme in Asia
MECINET	the Mediterranean Citrus Network
MEDUSA	network on Identification, Conservation and Use of Wild Plants in the Mediterranean region
MESFIN	Mediterranean Selected Fruits Inter-country Network
MOLCAS	Cassava Molecular Diversity Network
MUSACO	Réseau *Musa* pour l'Afrique Centrale et Occidentale
MUSALAC	Latin America and the Caribbean Network (Banana)
MWIRNET	SADC Maize and Wheat Improvement Research Network
NAPRECA	Natural Products Research Network for Eastern and Central Africa
NARS	national agricultural research systems
NeSCRA	Network of Services for Citrus Rehabilitation in Asia
NGOs	non-governmental organisations
NORGEN	Plant Genetic Resources Network for North America
NRI	Natural Resources Institute
NVRSRP	Nile Valley and Red Sea Regional Program
OECD	Organization for Economic Co-operation and Development
PABRA	Pan-Africa Bean Research Alliance
PANESA	Pasture Network for Eastern and Southern Africa
PCARRD	Philippines Council of Agriculture Forestry, and Natural Resources Research & Development

PEN/GIB	Pan European Network on Genetic Indicators of Biodiversity
PGRFA	Plant Genetic Resources for Food and Agriculture
PRACIPA	subregional potato network for germplasm evaluation in the Andean region
PRAPACE	Regional Potato and Sweetpotato Improvement Programme in East and Central Africa
PRA	Participatory Rural Appraisal
PRECIS	Pretoria National Herbarium Computerised Information System
PRECODEPA	Programma Regional Cooperativo de Papa
PRM	Regional Maize Program
PROCI	Programas cooperativos de investigación y transferencia de technología
PROCIANDINO	Programa Cooperativo de Investigación y Transferencia de Tecnología Agropecuaria para la Subregión Andina
PROCICARIBE	Caribbean Agricultural Science and Technology Networking System
PROCINORTE	Programa Cooperativo en Investigación y Tecnología para la Región Norte
PROCIPA	subregional potato network for germplasm evaluation in the Southern Cone countries
PROCISUR	El Programa Cooperativo para el Desarrollo Tecnológico Agropecuario del Cono Sur
PROCITROPICOS	Programa Cooperativo de Investigación y Transferencia de Tecnología para los Trópicos Suramericanos
PROFRIJOL	Programa Regional de Investigación en Frijol
PROMUSA	Global Programme for *Musa* Improvement
PRONAF	Projet niébé pour l'Afrique
PROSEA	Plant Resources of South-east Asia
R&D	Research and Development
RAIS	Regional Agricultural Information Systems
RECSEA-PGR	Regional Co-operation in South-east Asia on Plant Genetic Resources
REDARFIT	Andean Plant Genetic Resources Network
REDBIO	Technical Cooperation Network on Plant Biotechnology in Latin America and the Caribbean
REDCAHOR	Collaborative Network for Vegetable Research and Development in Central America
REDECO	Ecoregional Network for Latin America
RELACO	Latin American conservation agriculture network
RELAFRUT	Red Latinoamericana de Frutales Tropicales
REMERFI	Mesoamerican Network of Plant Genetic Resources
REMUFRUT	Red Mundial de Frutales Tropicales
RENACO	Regional Network on Cowpea
RESAPAC	Reseau d'AmeIioration de Phaseolus en Afrique Centrale
RIM	Regional Integrating Mechanism
RIMISP	Red Internacional de Medología de Investigación de Systemas de Producción
RLRRC	Rainfed Lowland Rice Research Consortium
RWC	Rice-wheat Consortium for the Indo-Gangetic Plains
SABONET	Southern African Botanical Diversity Network
SABRN	Southern Africa Bean Research Network
SACCAR	Southern African Centre for Cooperation in Agricultural and Natural Resources Research and Training
SADC	Southern African Development Community
SAFGRAD	Semi-Arid Food Grains Research and Development
SAFORGEN	sub-Saharan Africa Forestry Network
SANPGR	South Asia Network on Plant Genetic Resources
SAPPRAD	Southeast Asian Programme for Potato Research and Development
SARRNET	Southern Africa root crops research network
SAVERNET	South Asia Vegetable Research Network
SAVERNET	South Asian Vegetable Network
SCF-LAC	Seed Consultative Forum for Latin America and the Caribbean
SEAFRAD	Southeast Asia Forage and Feed Resources Research and Development Network
SEANAFE	Southeast Asian Network for Agroforestry Education
SEANUC	Southern and Eastern African Network on Under-utilised Crops
SEASAKNet	Southeast Asian Sustainable Agriculture Knowledge Network
SGRP	Systemwide Genetic Resources Programme
SICTA	Sistema de Integración Centroamericano de Tecnología Agrícola
SINGER	System-wide Information Network for Genetic Resources
SMINET	Sorghum and Millet Improvement Network
SMIP	Sorghum and Millet Improvement Programme
SNAP	Seed Network for Asia and the Pacific
SoW	State of the World's Plant Genetic Resources for Food and Agriculture
SPAAR	Special Program on African Agricultural Research
SPGRC	SADC Plant Genetic Resources Centre
SSSN	SADC seed security network
TAMNET	Tropical Asian Maize Network
TANSAO	Taro Network for SouthEast Asia and Oceania
TOFNET	Trees On-Farm Network
TROPIGEN	Red Amazónica de Recursos Fitogenéticos
UNDP	United Nations Development Programme
UNEP	United Nations Environment Programme
UNESCO	United Nations Educational, Scientific and Cultural Organization
UNESCO-MAB	UNESCO Man and the Biosphere programme
UPOV	International Union for the Protection of New Varieties of Plants
UPWARD	Users' Perspectives With Agricultural Research and Development
URRC	Upland Rice Research Consortium

USAID	United States Agency for International Development
UTFANET	Under-utilised Tropical Fruits in Asia Network
UTVAPNET	Under-utilised Traditional Vegetables for Asia and the Pacific Network
WISBEN	West Indies Sugar cane Breeding and Evaluation Network
WAFNET	West Africa Tropical and Sup-tropical Fruits Genetic Resources Network
WANA	West Asia and North Africa
WANADDIN	Southern Europe, West Asia and North Africa Dryland Durum Improvement Network
WANANET	West Asia and North Africa Network for Plant Genetic Resources
WARDA	West Africa Rice Development Association
WASNET	West Africa Seed Network
WBN	World Beta Network
WCA	West and Central Africa
WCAMRN/ROCAFREMI	West and Central African Millet Research Network
WCASRN	West and Central Africa sorghum research network
WECAFNET	West and Central African Feed Resources Network
WECAMAN	Africa maize collaborative research network
WECARD	West and Central African Council for Agricultural Research and Development
WEDEM/IVS	The Technical Cooperative network on wetland development and management/inland valley swamps
WIEWS	World Information and Early Warning System on PGRFA
WNBR	World Network of Biosphere Reserves

ANNEX 1: PROPOSED FRAMEWORK FOR INTERNAL ANALYSIS TO IMPROVE THE EFFECTIVENESS AND EFFICIENCY OF NETWORKS

In order to analyse networking activities, it is useful to first define the parameters which define these activities. The following „root definitions" have been adapted from the „CATWOE" analysis used in soft systems methodology[20]:

- What is the „problem" addressed by the network and what are the desired results of having a network?
- Who „owns" the network; i.e., who could stop the activities?
- Who carries out networking activities?
- Who are the beneficiaries of networking activities?
- What is the „worldview" behind the purpose of the network? (This may be affected by sectors involved)
- What environmental constraints face the network?

1. Strengths and weaknesses of the network

In analysing the strengths and weaknesses of your network, it may be useful to consider each of the factors described above as important to the efficiency and effectiveness of the network (based on Plucknet *et al.* 1993, Watts 2000). The answer to these questions is unlikely to be "yes" or "no", it is hoped rather that they will form a basis for consideration of the strengths and weaknesses of the network.

Success factor	***Comments***
Clearly defined "problem" *Are the purpose and objectives of the network clearly defined and agreed upon by the members?*	
Problem widely shared *Is the problem addressed by the network recognised as a major issue by many parties?*	
Founding document *Does an authoritative founding document exists for the network that defines the problem and a strategy for addressing it?*	
Strong self interest *Does the network have mechanisms for assessing the changing needs of the members and evolving in response to those changing needs?*	
Collaborators commit resources *Does the network expect, provide the means for, and recognise the contribution of resources (staff, facilities, membership dues, etc) by network members?* *Is external funding balanced by resources committed by network members?*	
Participants involved in management *Are there effective means by which network members are involved in network management and decision-making, either directly or through representation?*	
Realistic research agenda *Does a realistic work plan exist that is agreed upon by all the participants and contains concrete activities that will be undertaken by the members?*	

[20] Source: soft systems methodology, see Checkland (1989)

Strong leadership *Is the leadership of the network elected by participants?* *Is leadership competent and stable?*	
Stable membership *Are the terms of membership defined?* *Is the membership of the network relatively stable?*	
External funding *Is external funding channelled toward activities that help the network meet its goals, objectives, and established program of work?* *Is the source of funding kept informed on the progress and impact of the network?*	
Training *Is training carried out by the network to upgrade capabilities and bridge gaps in expertise between partners at the start of a network, or between old and new members?*	
Regular meetings *Do regular meetings take place which serve as for a for collaborative problem solving, including establishing or validating overall principles and work programmes as well as sharing scientific concerns and research results?*	
Communication and new ideas *How diverse are the inputs of ideas into the network – do they include other institutions, different sectors, etc?*	
Flexibility *What capacity does the network have to recognise and adapt to change? For example, does the network carry out regular monitoring and evaluation?*	

Based on the above, what are the strengths and weaknesses of the network?

Strengths	***Weaknesses***

2. Opportunities and threats to the network

In considering opportunities and threats to the network, it is necessary to consider the changes likely to take place both in the external environment and in the network itself.

What changes are likely to take place…	***Comments***
With the „problem“ addressed by the network or the aims of the network?	
With the „owners“ the network?	
With those who carry out networking activities (especially the leadership of the network)?	
With the beneficiaries of networking activities?	
In the „worldview“ behind the purpose of the network? (This may be affected by sectors involved)	
In the external environment of the network?	

Considering your network as an evolving organisation, what stage of “evolution” would you consider might fit the present operations of the network? What are the likely developments in terms of structure and functioning, and level of participation in the network?

Based on the above, and considering the strengths and weaknesses of the network, what are the opportunities and threats to the network?

Opportunities	***Threats***