Networks for Conservation and Utilization of Plant Genetic Resources

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Abstract

Networks are commonly used to increase the effectiveness of international agricultural research by involving a number of individuals, organizations or countries in sharing information and other resources. Since its inception, IBPGR has been closely involved in setting up and managing at least 18 plant genetic resources (PGR)-based networks. This paper examines how PGR-based networks can be most effectively established and managed to strengthen the conservation and utilization of plant genetic resources. Four types of PGR-based networks are discussed: crop networks, regional networks, base collection networks and topic-based networks. A number of constraints that can reduce a network's effectiveness and a number of important priciples for effective, sustainable networks are examined. Of foremost importance are goals and objectives which are clear, measurable and shared by all network members. It is concluded that carefully established and managed networks can help to strengthen the conservation and utilization of plant genetic resources.

Introduction

Although individuals or organizations have been getting together to collaborate and to share information and resources for a very long time, the term "network" is a relatively recent one. A few decades ago "networking" was largely confined to technical matters such as telephone networks, but more recently networks in the areas of social affairs, business and research have developed (Pluknett *et al*., 1990). Agricultural research networks have been proliferating in recent years, and well over 100 such networks are now operating. These networks are seen as mechanisms for more efficient and cost-effective exchange of information and research results.

In the area of genetic resources, the so-called Beltsville report suggested in 1972 that an "international network of genetic resources centres" be developed under the auspices of the Consultative Group for International Agricultural Research (CGIAR) and associated with the Food and Agricultural Organization (FAO). This idea lead to the founding of the International Board for Plant Genetic Resources (IBPGR) two years later. Although the concept of a technical network of gene banks has been modified since then, IBPGR has continued to use networking as an important tool in carrying out its program. In this paper, a network is defined as a group of people, organizations or countries that agree to share information and other resources so that each derives greater benefit than had the resources been used in other way. This definition recognizes the self-interest of members necessary for their sustained participation in a network, and for achieving enhanced outputs through networking. At the same time, this definifion can encompass a wide variety of networks and levels of formality.

The purpose of this paper is to explore a number of concepts and concerns about agricultural reseach networks in general, and plant genetic resources networks in particular, to briefly classify and describe the networks in which IBPGR is involved, and to examine a number of important issues for the future

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that can improve the capability of networks to conserve and use plant genetic resources.

Network concepts and concerns

1 Typology

The concept of a wheel is often used to describe networks (Faris, 1991), with the participating individuals or organizations portrayed as points or nodes on the outer circle or rim, and the hub to carry out a coordinating function that promotes or organizes the network activities and strengthens links between countries represented by the nodes around the rim of the wheel. Networks of increasing complexity are illustrated in Fig. 1. The more mature and effective networks that involve National Agricultural Research Programs have developed effective subnetworks, or within-country networks to promote effective communication and exchange. The Asian Rice-Based Farming Systems Network, is an example of a network that fostered the development of within-country farming systems programs in over 20 countries throughout Asia.

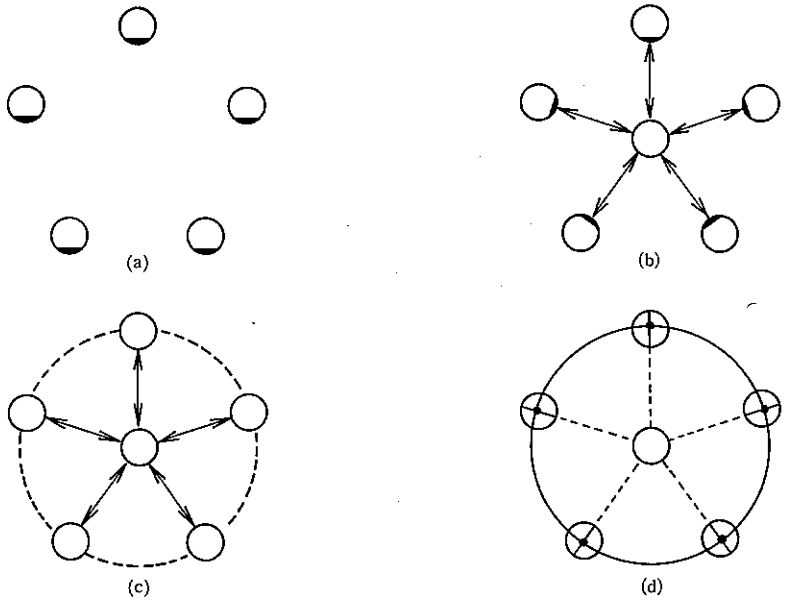

Fig. 1 Development of network linkages

a) The identification of common priorities among potential network members.
b) The development of a coordinating mechanism to promote exchange of information and materials through the "hub".
c) Increased collaboration among members (the rim effect).
d) As within-country sub-networks develop and country-to-country linkages became stronger, "hub" is reduced to a facilitating monitoring role.

2 Networks and consortia

As a network matures, and has established its credibility among members, donors and international organizations, there may be an advantage, to recognize the network legally as a consortium with more complex management at the "hub". Such an arrangement can facilitate externally funded contract research where one or more members contract to carry out specific research to further overall network effectiveness, or develop required technologies.

3 Levels of networks

Network members may participate in a network at three different levels.

1. Representational

Formal participation of a network member as a representative of his/her country. Such participation

is desirable when member countries agree to undertake collaborative activities that may commit several organizations within a country to carry out the agreed tasks and a commitment of national country funding.

2. Technical

Involvement of technical staff from network countries or organizations is necessary when more detailed workplans and activities are to be developed among collaborators who share specialized knowledge, such as on a particular crop, or on plant genetic resources. The International Network on Bamboo and Rattan (INBAR) is an example of a network that functions at both the formal and technical level. Members who are directors of government organizations meet formally to decide on network policy issues. Another group of technical experts meet separately to develop the technical activities of the network.

3. Topic-based

At an informal level, highly motivated individuals may wish to collaborate on a very specific topic, such as the physiology associated with seed drying. Such networks are often short term arrangements, but can achieve a rapid increase in knowledge. There are many examples of such informal collaboration. Collaboration to carry out research on *Lathryus*, described later in this paper, is one such example.

4 Key features

Agricultural research networks share certain key features.

1. Equality of membership.
2. Effective networks depend on clear and common *objectives*.
3. *Exchange* must take place, usually of information and/or of genetic materials.
4. Members must have the ability to utilize the material or information exchanged.
5. Formal networks usually require a steering or coordinating committee comprised of network members to decide on network activities and to monitor progress. A coordinator or coordination body may function as a "hub" for the network.
6. Networks tend to *evolve* as the interests and needs of their members change. Levels and complexity of a network as described above may change over time.

5 Concerns

Although the potential benefits of agricultural networks are widely recognized, as seen by their recent proliferation, a number of concerns about these networks have been raised.

1. Hub domination networks are based on a single technology generator or source. These are typical of some International Agricultural Research Centers (IARCs) that create networks in order to transfer or diffuse the technologies that they generate. Such center-dominated networks do not always emphasize capacity building in the national system. As a result, linkages between the central hub and the participating NARS organizations are emphasized, often at the expense of member-to-member linkages (Eyzaquirre, 1992). Domination by a few members with strong programs can also unbalance a network and lead to a loss of interest on the part of the less dominating members.

2. Biasing of national priorities that cannot afford to carry out independent research in all priority areas have the greatest potential to benefit from networks. Yet ironically, these countries have insufficient research resources to effectively participate in the numerous networks operating in their region. In many cases, the networks that they do join produce biases in allocating research resources. As an example, the author observed that in 1992 the National Oilseed research program in Nepal devoted 70% of its resources for groundnut improvement as a member of the ICRISAT-based CLAN network. However, an independent study has shown that groundnuts account for only 2% of the country's oilcrop area, and groundnuts have poor prospects for increased use as an oilcrop in the country. Eyzaquirre (1992) has suggested that the development and management of networks must be done from the National Program's (NP's) perspective and that regional networks rather than independent crop-based networks are needed that allow for more equitable participation and priority setting for small countries.

3. Sustainability

Networks have sometimes been set up without their members first deciding on how long the network should remain in existence, on the duration and level of funding expected from the donors, or of the long-

term involvement of the network founders. A clear understanding of goals and objectives of the network and of roles and responsibilities of the members is needed when the network is set up. In order to achieve long term sustainability, it must be clear to each member, to the founders and to donors that the benefits of working as a network are greater than by working any other way.

A recent document (Centers' Directors' Committee, 1992) raised the above concerns and emphasized the need to achieve a bottom-up approach in developing and managing networks so that national programs can derive greatest benefit.

The Involvement of IBPGR/International Plant Genetic Resoureces Institute (IPGRI) in Plant Genetic Resources (PGR) Networks

A PGR network can be seen as a specialized type of agricultural or forestry research network. A PGR network includes a specific component concerned with advancing or conserving plant genetic resources in its objectives and operation.

The newly published IPGRI Strategy, IPGRI 1993 has a clearly stated mission to "Advance the conservation and use of plant genetic resources for the benefit of present and future generations". Four objectives have been formulated to carry out this mission: 1) assist countries, particulary developing nations, to assess and meet their needs for plant genetic resources conservation and strengthen links to users; 2) strengthen and contribute to international collaboration in the conservation and use of plant genetic resources; 3) develop and promote improved technologies; and 4) provide an information service on plant genetic resources. Networks can be effective tools to help achieve all these objectives.

Networking, and networks have formed an important role in IBPGR's programs since its inception. A recent meeting of the Program Planning and Review Committee of IBPGR in June 1993, described 18 PGR networks which IBPGR has established. These fall into 2 major categories, called regional and crop networks, which are discussed below. In addition, the base collection network and topic-based networks will be briefly described.

1 Regional networks

Seven regional networks have been established with IBPGR support in different regions of the world. Although these regional networks have developed rather independently in the different regions, they share many features in common (Table 1). By focussing on a region, common problems or priorities can be more readily identified. Specific needs of different countries can also be more readily taken into account when few countries, in a single eco- or geographic region, share a network. Donor funding for specific activities in these regional networks appears to be somewhat easier to obtain than for global networks. Although the regional network members represent their respective countries, technical working groups formed under these networks take responsibility at the technical level for executing and monitoring specific activities in most of the regional networks. The technical working groups are generally crop-focussed.

In the newer networks (REMERFI, REDARFIT, TROPIGEN and WANANET) IBPGR staff are required to be closely involved in a coordinator's role. This high level of IBPGR staff involvement would also seem justified since several of these networks have objectives which are similar to, or identical with IBPGR's objectives in the region. Experience in networks of longer standing networks (RECSEA) indicates that IBPGR staff time may still be needed well after a network has been established to continue to facilitate networking arrangements, provide advice, help locate other sources of funding and integrate network activities with the other activities of IBPGR as well as with those of other relevant organizations.

Some regional networks (SADC and RECSEA) are associated with within-country national committees that include a variety of government, university, and NGO organizations concerned with plant genetic resources. These national committees have the potential to serve both as "ears" in better assessing country needs, as well as "arms and legs" in carrying out the designated network activities. Although all networks are concerned with collection, conservation, documentation, exchange and use of germplasm, achievements vary across networks, only in the ECP/GR networks have central databases been compiled which contain the germplasm holdings of several of the crops of the network countries.

Table 1 Regional networks supported by IBPGR

1)	Network Name	SADC Regional Network	REMERFI (1) REDARFIT (2) TROPIGEN (3)	WANANET	ECP/GR	RECSEA
2)	Region	Southern Africa	Mesoamerica (1) Andes (2) Amazon Low-land (3)	West Asia and North Africa	Europe	S E Asia
3)	Number of countries	10	7 (1) 5 (2) 8 (3)	20	26	5 members 3 observers
4)	Do members represent their countries?	Yes	Recognition awaited	Yes	Yes	Yes
5)	Crop-specific sub-networks or activities	Yes	Proposed	Yes	Yes	Yes (previously operating)
6)	Within-country committees or sub-networks	Yes	No	Recom-mended	In some countries	Yes
7)	Consultation level in developing activities	National Committees	With members	With members	With members	With members
8)	Closeness of IBPGR involvement	—Board member —Funding —Advise	Full coordination role	Full coordination role	Coordina-tion & Advise	Formerly as coordinator
9)	IBPGR staff inputs	Moderate	Heavy	Heavy	Heavy	Moderate
10)	External funding	Yes	Yes	Yes	By member countries	Not at present
11)	Particular feature of network	Regional genebank-based network	Eco-region based networks	Strong and complex hub	Trans-cends political boundari-es in Europe	Potential strength in national committees

Key to acronyms :
SADC : Southern African Development Committees
WANANET : West Asia and North Africa Plant Genetic Resources Network
REMERFI : Mesoamerican Network on Plant Genetic Resources
REDARFIT : Andean Network on Plant Genetic Resources
TROPIGEN : Amazonian Network on Plant Genetic Resources
ECP/GR : European Cooperative Programme for Crop Genetic Resources Networks
RECSEA : Regional Committee for South East Asia

In the Asian region, RECSEA can be used as an example of a regional genetic resources network. RECSEA first began functioning as a committee of IBPGR in 1975, bringing together country representatives from Thailand, Philippines, Indonesia, Malaysia and Papua New Guinea. With strong funding support, some impressive results were achieved. National Plant Genetic Resources Committees were formed in each participating country. Over 28,000 collections were made and shared among the 5 member countries. For example, a regional field gene bank for bananas was established in the Philippines on behalf of all RECSEA members. A RECSEA newsletter (later to become the IBPGR regional newsletter) was established. Support channelled through RECSEA was used to established or strengthen gene banks in each participating country. During 1984-1987, working groups were set up to address the conservation of food legumes, tropical fruits, roots and tubers, maize sugar cane, and coconut and oil palm. Posters were displayed and meetings were held to raise public awareness about plant genetic resources in these countries. As this committee makes the transition to a network, IBPGR is working with RECSEA in assisting with communications, helping to seek funds and in making links with other IBPGR regional projects.

2 Crop networks

The concept of crop networks in IBPGR has been implemented since 1989. The primary objective of a crop network is to ensure the conservation of the particular crop gene pool (including wild relatives) by obtaining commitments from the network members to look after parts or all of the collection, and to link conservation of the crop gene pool with improved use. Central databasing of the collections held by different members of the network is seen as being essential for the safe conservation, duplication and use of the germplasm. Each crop network is to include a variety of specialists who will study the gene pool in detail to understand its genetic structure, taxonomy or to identify genes for specific useful traits, and to identify the need and locations for further collecting. To date, 11 crop networks have been established with support from IBPGR, namely: beta, musa, rice barley, coconut, cassava, sweet potato, okra, maize, medics and groundnut. IBPGR support for such networks is committed only for the initial network meetings, whereupon the network is expected to become self-sustaining. However, as with regional networks, experience has indicated that continued support from IBPGR may be required in order to insure that activities undertaken in crop networks are sustained.

The conservation of the available *ex situ* collections has been largely undertaken, or is underway, by the members of these networks. The databasing and analysis of the databased accession information has been completed for the deta network germplasm, and to a lesser extent in the other crop networks.

Further details on crop networks funded by IBPGR can be found in a presentation by Perret (1992). A set of priciples for the organization of crop and regional networks as agreed by the June 1993 meeting of the Program Planning and Review Committee (PPRC) of IBPGR is found in Table 2.

Table 2 Principles for the organization of regional and crop networks

1	A network must have quantifiable objectives.
2	Concrete action plan with agreed activities, time table and mechanism to measure progress is required.
3	Participating countries/organizations must accept the agreed commitments.
4	Participants must be willing to share agreed/designated germplasm and information.
5	A realistic plan for sustaind funding is needed.
6	A steering/governing body (ies) with members having a representational role should be established.
7	A coordinator must be empowered with a clear responsibility and with the resources (time and funds) to carry out a facilitator role to serve the network.
8	The development of a central database of germplasm holdings to serve the network is very important.

3 Base collection network

By 1990, IBPGR had concluded agreements with gene banks around the world to maintain regional or global collections of close to 100 species of economic plants with orthodox seeds and 10 vegetatively propagated species (IBPGR Annual Reports, 1989, 1990). This so-called base collection network is now being merged with the FAO International Network for *Ex situ* Base Collections. This merger should avoid duplication of efforts and help clarify the legal status of these collections. In this sense, the network of base collections is more of a legal framework than a network as defined above. The regional and crop networks can complement the base collection network by providing a mechanism and a stimulus for the exchange, and maintenance of both the base and the active collections. As the principle of national sovereignty and the acceptance of germplasm as a national resource becomes widespread, genetic resources collections will likely be held in a large number of national country gene banks. If this occurs, more effective PGR networks can help to coordinate the conservation and use of these dispersed collections.

4 Topic-based networks

Many informal research networks are in operation, made up of individual scientists who agree to collaborate in order to solve a specific research problem more efficiently. Examples are standardizing of a research protocol among collaborating scientists so that results can be easily integrated and widely applied, and multidisciplinary research to understand and solve complex problems such as the nature, distribution and elimination of the neurotoxin in the *Lathryus* genus, which presently involves molecular geneticists, physiologists, taxonomists, biochemists and agronomists, in Europe, Asia, and North America in an informal network of scientists eager to understand and solve this problem (Clayton Campbell, 1992 personal communication). Very little or no formal organization is necessary for such networks to achieve their objective. As an international organization dependent on collaboration, IBPGR is in a good position to foster such informal, short term networks.

Networks in the future

The present transition of IBPGR/IPGRI towards greater emphasis on development and use of genetic resources for humankind, is a good opportunity to examine how networks might be most effectively organized and managed in order to advance the conservation and use of plant genetic resources. Many of the following points are elaborations of the principles listed in Table 2 above.

1 Developing a sustainable basis for collaboration through networking

Collaboration must be developed through a process of identifying common elements in the priorities of both National Programs and IBPGR (Fig. 2). If this process is not carefully carried out, a feeling of the network being "top down" or "not useful" is likely to occur among some of the network members or with IBPGR.

IBPGR's priorities are already set out in the Strategy, Medium Term Plan and in IBPGR's projects and activities set. However, National Programs' priorities may not be so clearly identified or stated. Different levels of the national programs (i.e. Government, research, NGO, farmer groups) may have differing priorities. IBPGR can assist in helping national programs to identify their priorities through :

1. Visits to national programs, developing checklists of national program status, supporting national workshops.
2. Developing databases for joint use.
3. Enlisting the services of other institutions, particularly ISNAR who have focussed its efforts on helping national programs assess their priorities.
4. Encouraging the development of viable national committees for plant genetic resources that include representation from all levels of national programs.

The area of overlap between IBPGR's priorities and National programs' priorities is the area which has potential for networking. Ideally, this process should take place with all network members before the network is established. Technological priorities as well as policy priorities should be developed. For example, in the past, PGR networks have accepted that germplasm is the "common heritage of mankind"

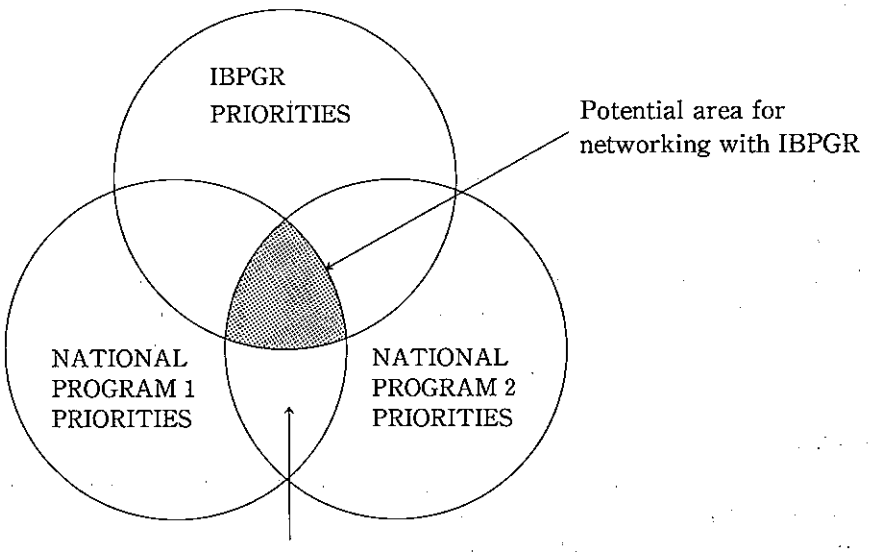

Fig. 2 Identification of areas for networking between IBPGR and National Programs

and these networks operated on the principle of unrestricted exchange. As the UNCED Biodiversity Convention, which recognizes the "national sovereignty" of PGR comes into effect, part of the priority assessment in a national program should include its willingness to exchange germplasm among network members.

2 Developing measurable objectives, a time frame and specific workplans

Clear objectives and workplans are essential to ensure that the areas of common interest are clearly specified, that each member knows what is expected of him/her, what the expected benefits are, and that progress is monitored. A time frame can help specify the length of time members, IBPGR or donors can expect to be involved in specific activities or in the network. Periodic reviews can help to ensure that the network remains flexible in responding to changing conditions. Joint reviews should be carried out by the network stakeholders.

3 The wider benefits of networks

The potential of networks as organizational mechanisms to strengthen conservation and use of PGR and in developing specific technologies has been mentioned above. A network can also increase the impact of trainess once they have returned to their home country and become active in the network, and can serve effectively to identify needs for regional training, information, publications or public awareness focus.

4 Regional rather than global networks

Regional networks have advantages over global networks, as they facilitate the identification of members' needs including communality in the needs and objectives of countries within the region. It is easier to manage a smaller regional network and effectively respond to members' needs. The crop networks may move under the different regional networks, and managed by specific working groups in each region. A global focal point for each of 15 crop commodities, initiated during a recent PPRC meeting which IBPGR has now identified, can be expanded to specify the other priority commodities or groups. This focal point would serve to identify specific cross-regional linkages, and strengthen the interaction between regional networks and new research findings in other parts of the world, including activities managed from IBPGR Rome headquarters.

5 Standardized databasing

Databasing or germplasm accessions should continue to be an important component in both regional and crop networks (or working groups within a regional network). Databasing would be increasingly carried out at the regional level, and standardized databases on germplasm accessions will help to ensure that information as well as germplasm can be accessed by members of different regional networks.

6 Improving links with use

National programs' priorities are likely to be concerned with improved use, including consumption and use of the final product, marketing, processing and economic assessments. Donors are particularly interested to see that aspects of use are included in any project or network that they fund. Methods for increasing the development impacts and better use of a particular commodity using a "Production to consumption systems approach" has been described by Zulberti (1991) on a country basis and suggested by Riley (1992) as approach for a network. IBPGR is an institution with a comparative advantage to specialize in PGR-related activities and can effectively complement other organizations in achieving wider development goals. As an example, IBPGR support may be given to help strengthen the genetic resources component of a network that is already functioning. The International Bamboo and Rattan Network (INBAR), now based in Delhi, is primarily concerned with improving the utilization and production of these non-timber forest species. IBPGR is now set to provide complementary support for reasearch in genetic diversity that can help in better planning of extractive reserves and *in situ* conservation. The Government of Japan is providing generous financial support to enable these activities to take place. Incorporating such linkages with consumption and use should help meet the wide areas of national program priorities and sustain their active involvement in the network.

The lack of use of gene bank accessions in many national programs is a topic of direct concern to IBPGR. It has been suggested that increased characterization and evaluation of accessions and supplying this information to the breeder or user of the germplasm, will increase use. The development of core collection has been suggested as another way to make it easier for germplasm collections to be used (Hodgkin, 1991). Wilkes (1992) has suggested that joint efforts in pre-breeding of indigenous germplasm, involving breeders and gene bank staff, is required in order to incorporate indigenous genetic material into elite lines. There is growing interest to focus activities at the farmers' or community level where conservation and use are naturally integrated. Networks are well-placed to carry out such collaborative activities aimed at increasing the use of germplasm in gene banks.

7 Funding of networks

The European ECP/GR network has been now fully financed by network member countries since 1986. However, other networks which include country members with foreign exchange problems will find it difficult to finance activities for which foreign exchange is required. Although network members should be encouraged to finance activities that take place within their own countries, external finance may be required particularly to pay a coordinator's salary, air tickets or research equipment that requires foreign exchange. As pointed out above, networks which successfully link conservation with use, are more likely to attract donor funding.

Acknowledgements

The presentations and suggestions provided by IBPGR colleagues including Yawooz Adham, Frank Attere, Jan Engels, Emile Frison, Toby Hodgkin, Masa Iwanaga, Armando Okada, Pierre Perret, Mark Perry and Lyndsey Withers, both during and after the PPRC meeting in June 1993, form the basis of much of this paper. Their inputs are gratefully acknowledged.

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Discussion

Yonezawa, K. (Japan): By the expression "measurable objectives", do you mean that the cost and benefit of the objectives can be clearly evaluated in advance?

Answer: Yes, we feel that measurable objectives need to be agreed to as a network begins. All members must agree to the objectives. As the work agreed to in the network is carried out, periodic reviews of progress through an evaluation can help each member as well as donors to see what the network has accomplished and how it has benefited the members.