ROLE OF THE CGIAR IN COCONUT RESEARCH

TAC SECRETARIAT

FOOD AND AGRICULTURE ORGANIZATION OF THE UNITED NATIONS

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1. Background

The 1986 priorities paper prepared by TAC concluded that coconuts were one of three priority areas requiring international support. The CGIAR adopted this recommendation from TAC at its meeting in Ottawa in May 1986. TAC was requested to explore further the desirability of establishing an international research initiative on coconuts, and the form such an initiative might take.

TAC has now considered:

(1) The current status and future trends for coconut within the context of the world fats and oils markets;

(2) The importance of coconut as a subsistence crop, as a cash crop, and as a component of long-term farming systems;

(3) Future needs and opportunities for research;

(4) Current research programmes;

(5) Possible options for an international research initiative on coconut;

(6) Possible institutional mechanisms by which such an initiative might be implemented.

2. TAC Assessment of Oilseed Research Priority

Consideration of coconut research by TAC originated in the 1986 Report on "CGIAR Priorities and Future Strategies" (CGIAR 1988). TAC identified the oilseed crops as a high priority area for research. The following extract from the report gives the rationale for the priority accorded to oilseeds in general and coconuts in particular by TAC at that time:

"Oilseeds are important sources of fat and protein, they enjoy a growing demand, they are a viable cash crop for small-scale farmers, and growing deficits have been projected for developing country regions. This priority was reflected in TAC's recommendation to increase resources to soybean and groundnut research. It also underlies TAC's recommendation of coconut as a possible new venture within the CGIAR. The oilseed crops are a large and diverse group. The two most important are soybean and groundnut. Other important sources of edible vegetable oils are two perennial crops, coconut and oil palm, and a number of annual crops with different regional significance, (sunflower, safflower, rapeseed, sesame and mustard). Cottonseed is also a major source of edible oil, although cotton is grown primarily for its value as a source of natural fiber.

The group is an excellent source of protein and fat and make an ideal complement to root crops, which are predominantly carbohydrate. They are used as whole seed, vegetable oil and animal feed (in the form of oil cake after oil extraction), and their by-products are used for fuelwood, mulch and industrial purposes."
Soybean, groundnut and coconut are important foods in their primary growing areas, are major cash crops in developing countries, provide employment in farm and processing industries, and earn valuable foreign exchange. Their processing has often been a first step to industrialization.

Increases in the developing-world production of oilseeds matched demand in the 1970s, but at very different rates for different crops. Oil palm production increased by 11% annually; sunflower, safflower and rapeseed by 5-7%; coconut by 2%; and sesame remained virtually stagnant. Trends indicate that total oilseed production will have to increase an average of 3.3% annually to meet demand to the year 2000. Although crops can substitute for one another, this is small comfort in regions such as Equatorial and Humid-West Africa where, based on recent trends, oilseed production will not meet demand.

The oilseeds which do not earn foreign exchange are of a lesser and largely local importance. Sunflower, safflower and rapeseed make relatively low contributions to the food supplies and economies of developing countries and are of much less national importance. In developing countries, sunflower is harvested from 3 m. ha, safflower from 1.2 m. ha; and rapeseed from 7.4 m. ha. Sesame is widely grown in a variety of conditions in the tropics and sub-tropics, mostly for domestic consumption; about 6.3 m. ha are harvested in developing countries; and India, Mexico and Venezuela have strong national research programmes for sesame.

TAC considers that none of the annual oilseed crops, soybean and groundnut excepted, is of sufficient global importance to justify the allocation of CGIAR System resources at present.

Oil palm, a perennial, is a major world oil crop, usually grown on plantations in rain forest areas of Southeast Asia, West Africa and Central and South America. Oil palm production is dynamic and highly competitive; in response to the demand for vegetable oil, production increased by 150% in the 1970s. Intensive private and public-sector research has led to considerable increases in yield per hectare and improved oil quality. Recently developed techniques for the vegetative propagation of the oil palm through tissue culture opens the way to cheap methods of raising large number of plantlets from elite clones. Internationally, research is done by IRHO and commercial interests. Colombia, Ecuador, Malaysia and Nigeria also have strong national programmes. TAC therefore considers that the need for production and post-harvest research are well addressed and do not require support from the CGIAR System.

Coconut, also a perennial, is not only a primary source of edible oil, but also of livestock feed and fiber and can be processed into a variety of end-products. Its contribution to food supplies is substantial. Cultivated widely in littoral regions of the world, it is especially important in Southeast Asia, India and the Pacific and Caribbean islands, but standards of husbandry and yields are generally low. The IRHO does research on the crop internationally and there are a number of significant national coconut research institutes and programmes - in India, Indonesia, Jamaica, Philippines, Sri Lanka and the South Pacific. Utilization research is done in developing countries and at specialized institutes in the developed countries.

TAC considers that the establishment of an international coconut research network
would provide a focal point for collaboration and for donor support. The value of coconut as an ecologically-sound food and cash crop suitable for small holder cultivation, the geographical diversity of its production, the potential for further research, the uncoordinated research effort to date, and the need to solve important disease problems are strong reasons for coordinating and strengthening present research efforts.

TAC considers that strengthened research for oilseeds in general is indicated. This is based on analyses of the projected increase in demand for vegetable oils, the deficit in these commodities already experienced by some developing countries, and the gap in international research on a number of potentially important oilseed crops. TAC recommends that the CGIAR System increase its effort on groundnut and soybean, as well as on maize (whose use as an oil crop may increase when other needs are met) and recommends the inclusion of coconut research in the CGIAR System as an additional activity.

Coconut is the oil crop most in need of international research support. International research on the crop is currently underfunded and it has the potential for high pay-off. Furthermore, coconut is a small-holder crop that is ecologically sound and offers a broad range of dietary, income and employment opportunities. It is not only a primary source of edible oil, but also of fiber and livestock feed, once it can be processed into a variety of end-products. Furthermore, there appears to be good research potential for coconut. TAC, therefore, encourage the creation of a research network to strengthen and coordinate coconut research and supports CGIAR System involvement in such a network.

3. Relative Priority of Coconut

Coconut is a major crop in the Papua New Guinea and the Pacific Islands, the Philippines, Indonesia, and South Asia. It is locally important in coastal regions throughout the remainder of Asia, in West and East Africa, Mexico, Central America and the Caribbean Islands. In addition to the value of its production for domestic use and export earnings in those areas, there are other reasons why coconut is appropriate for CGIAR support. There are:

(1) **Contribution to agricultural GDP in small countries:** Coconut makes a significant contribution to agricultural GDP and foreign exchange earnings in many countries. These include the Philippines (the major exporter), as well as 18 small island countries in the Pacific and 22 in Central America and the Caribbean. These small countries presently benefit little from the CGIAR System; they are unable to mount their own national coconut research program, yet they could participate in and benefit from an international effort. There are economies of scale in organizing coconut research on an international basis, to cater for the needs of these many small countries.

(2) **Intercropping systems/sustainability:** The coconut tree plays an important role in the sustainability of coastal lands and islands. Often it is the only species which is able to grow in these sandy, salty environments. It is the "tree of life" for the people who have to live in the harsh environments of the atolls and the poorer areas of Asia. If global warming occurs and sea levels rise, the coconut will be the one crop which will survive. Its nuts will float on the ocean and colonize new
atolls as they are formed. Coconut is important as an intercrop, and as a shade tree for animals, and for high value crops. Coconut is widely cultivated in home gardens throughout the humid tropics.

(3) Social aspects: Coconut plays a central role in village life by providing many items for food, shelter, and clothing. Coconut was introduced originally into the Pacific Islands by the ancestors of the Polynesians. It is central to the social aspects of community. Simple value of production statistics vastly underrate the central role of the coconut palm in village life throughout large areas of Asia and the Pacific especially.

3. Coconut Production

The coconut palm is believed to have originated in the Western Pacific. It is now a pan-tropical crop, grown on approximately 11.6 million ha in 82 countries. The main producers are the Philippines, Indonesia, India, Sri Lanka, Papua New Guinea and the Pacific Islands. Total world production in 1985 was 7.5 million metric tons of copra equivalent. Approximately 85% of production comes from Asia (13 countries) and the Pacific (18 countries). Coconut is also a locally important crop in 29 countries in Latin America and the Caribbean, and in 23 countries along the coasts of East and West Africa. The production statistics are summarized in Table 1.

Many of the producing countries are small island countries in the Pacific, Caribbean and Indian Oceans. Coconut is both their primary subsistence crop, and their only significant source of export earnings. In many island countries it provides 50% or more of total export earnings. There are few (if any) alternative crops able to substitute for coconut in these ecosystems.

Coconut is predominantly a smallholder crop, with at least 96% of total world production coming from smallholdings of 0.5-4.0 ha (Table 1). It is an ecologically sound crop. It is able to grown in harsh environments, such as atolls, high salinity, drought, or poor soils. It plays an important role in the sustainability of often fragile ecosystems in island and coastal communities.

Coconut is used as a source of food, drink, fuel, stock feed and shelter for village communities. It is also a cash crop, able to be used to produce many items for sale, at either the local, national, or international level. About 70% of the total crop is consumed in producing countries.

The main internationally-traded products are copra, coconut oil, copra meal, and desiccated coconut. The major exporter is the Philippines. The main buyers are the USA, Japan and the European Community countries. Prices for coconut products have, on average, been decreasing over the past 20 years, in line with other vegetable oil crops.

4. Future Needs and Opportunities for Coconut

The opportunities are:

(1) The increasing demand for oils and fats and animal feed sources, particularly in developing countries as incomes rise;
The ability of the coconut tree to produce a wide variety of food and non-food products, additional to the traditional products of copra, coconut oil and copra meal.

The key problems are:

1. The low productivity of many coconut trees due to their age and poor nutrition. The world average yield of 500 kg/ha/year of copra equivalent has not improved in at least 25 years;
2. The failure of many replanting programme designed to replace old trees which are beyond their productive life span (about 60 years);
3. The fluctuating productivity due to variable environmental conditions;
4. Inefficient handling and processing, with a low farm-gate price to smallholders.

The needs are:

1. To increase the productivity of the crop by the use of locally adapted high-yielding, pest and disease tolerant varieties in any replanting or new planting schemes;
2. To increase the productivity of existing plantings by encouraging better agronomic practices, including the control of diseases, insects and weeds, use of fertilizers, and identification of profitable and sustainable inter-cropping systems;
3. To develop improved methods of handling and processing coconuts;
4. To diversify the coconut products traded and actively promote new products in the marketplace, so as to utilize fully the potential of the crop.

5. Rationale for Further Research

The rationale for further research on coconut is based on:

1. The increasing importance of domestic consumption of coconut in producing countries to meet the growing demand for vegetable oils and fats;
2. The continuing price premiums paid for the lauric acid oils (coconut and palm kernel oil), primarily for their industrial uses in soaps and detergents. This provides an opportunity for increasing coconut oil exports, if the productivity of the crop and the continuity of supply could be improved;
3. The declining competitiveness of coconut, which means it is presently unable to take advantage of the expanding vegetable oil market and is losing ground to other crops. Research is required to make it more competitive by increasing its productivity in a manner analogous to what has occurred with oilpalm. Oilpalm is grown mainly on plantations and the research is supported mostly by private interests. Since the millions of smallholders dependent on coconut are not able to organize a similar research effort, coconut needs to be championed by the international development community;
Virtually all the benefits from coconut research accrue to developing countries. On the grounds of efficiency, investments in coconut research are likely to offer a high rate of return. On distributive or equity grounds, virtually all of the benefits of coconut research accrue to developing country producers and consumers. Over half of the benefits accrue directly to producers in developing countries (who are almost all smallholders). The remaining benefits accrue to consumers in developing countries.

The role of coconut as the major tree-crop component in several agroforestry systems throughout the world. Its wide use in home gardens is probably not reflected in official statistics for area under cultivation, volume of production and total value of production. Coconut is said to grow either within the sound of the sea, or the sound of the village.

Its role in the sustainability of often fragile ecosystems in coastal areas and islands.

The need for income security for smallholders. The present price fluctuations are partly a result of erratic supply. Research should aim at develop technologies to stabilize production (including varieties able to yield under poor environmental conditions, such as drought) and thus contribute to regular income levels for coconut producers, and the reduction of poverty.

6. Research Efforts

6.1. Current Programmes

Coconut is a scientifically neglected crop, relative to other crops of similar importance. This neglect persists despite the fact that there is a history of coconut research going back to the early 1900s. Davis et al. (1987) identified 193 scientists working on coconut, of whom 103 were in Asia, 48 in Africa, 32 in Latin America and 10 in Oceania.

There are several national research programmes in each of the coconut-growing regions of the world. The current research programmes are summarized in Table 2. In Asia, there are programmes in the Philippines (Philippines Coconut Authority and several universities), Indonesia, India, Sri Lanka, Malaysia, Thailand, China and Vietnam. In Oceania, there are several small but active programmes, including those in Papua New Guinea (Cocoa and Coconut Research Institute), Solomon Islands, Vanuatu, Fiji and Western Samoa.

In Latin America, the main research programmes are in Brazil, Jamaica, Trinidad, and Mexico. Currently, there is no breeding programme in Latin America, despite the existence of some lethal diseases which are limiting production. There is a germplasm collection in Jamaica, established when a major international effort was made on lethal yellowing disease.

In Africa, the major programme is in Cote d'Ivoire, at the Marc Delorme Coconut Research Centre established in 1951. This station is managed by IRHO on behalf of the Government of Cote d'Ivoire. There is also an active programme in Tanzania, and several smaller programmes elsewhere in Africa.
The only coconut research programme which operates in several countries is that of the Institut de Recherches pour les Huiles et Oleagineux (IRHO). IRHO manages the world’s major coconut breeding station in the Cote d’Ivoire, and a smaller station in Vanuatu, as well as laboratories in France. IRHO also has staff stationed with national programmes in several countries, including the Philippines, Indonesia, Brazil, and Fiji. IRHO’s research activities have been concerned primarily with addressing the needs of replanting programmes, particularly by the production and evaluation of new hybrids, and establishing their nutritional requirements. IRHO’s best available hybrid has a yield potential of 6 tons copra/ha (compared to the current world average of 0.5 t/ha).

The International Board for Plant Genetic Resources (IBPGR) has supported several germplasm collections of coconut. It has also commissioned research on coconut embryo culture and in vitro crop preservation.

FAO and UNDP have supported several coconut research and development projects which have included a component of research support for the national programme. Bilateral donors support a range of individual projects (Table 2).

There is laboratory-based research on coconuts in several industrialized countries in both the private and the public sector. The major efforts have been in Europe on tissue culture (UK and France), and post harvest technology (UK). The EC has recently established a small Secretariat in Paris (BUROTROP) to coordinate and support European-supported research on coconuts and oil palm, and to improve the linkages between such research and bilaterally-funded development projects in producing countries. This European initiative on oil crops research is complementary to any CGIAR initiative in coconut research, and should facilitate participation by scientists and research institutes in Europe in collaborative, international research on coconuts. The priority area established by BUROTROP in its first year is oil palm in Africa.

The Australian Centre for International Agricultural Research (ACIAR) is sponsoring collaborative research between Australian scientists and coconut researchers in Oceania, and the Philippines, on coconut improvement, particularly germplasm collection and exchange, tissue culture and virus/viroid diseases (cadang-cadang and foliar decay disease).

The dearth of strong national coconut research programmes is a serious situation for the crop, given that it is the stated policy of many governments to increase coconut production, by rehabilitating and/or replanting existing areas and planting new land, where available. The implementation of these policies will require substantial, long-term financial investments.

Many small and large-scale coconut replanting programmes have been initiated, often with external financial assistance by grants from bilateral or multilateral development agencies or development bank loans. These replanting programmes require an adequate research base, so that appropriate technical decisions are made as to what is the best available planting material, and what are the accompanying management practices to allow the material to achieve its yield potential. Pest and disease control and nutritional requirements are important components of this package. An understanding of the socio-economic factors which influence farmers to replant or not, and how to provide a source of income until the new trees come into bearing, is also important (and often neglected in many schemes).
The major problems with the current research efforts are that with few exceptions, the national coconut research programmes are seriously understaffed and underfunded. Even in the major producing countries in Asia, the national programmes are not supported in a manner commensurate with the economic importance of the crop to the country.

There are, however, several national programmes which could contribute substantially to any international initiative on coconut research, if suitably supported. The Marc Delorme Research Centre in Cote d'Ivoire has a substantial germplasm collection and a number of promising hybrids, the result of some thirty years of research. Any international initiative needs to find a way to build on the substantial financial and scientific investment at this station to enable it to continue to contribute to coconut research internationally.

The key problems with the current research effort are that most of the national programmes are not well supported financially, neither by government nor by the industry; especially, they lack continuity of funding from both national and external sources; they lack sufficient appropriately trained staff and suitable facilities; they are not addressing adequately the major problems facing the crop; they are not producing sufficient substantive results directly relevant to smallholders; nowhere are the needs of the crop worldwide being addressed; and there are presently no means by which small producing countries, who are unable to mount their own research effort, are able to gain access to new technologies, including higher yielding varieties.

6.2. Future possibilities

Research results in recent years suggest that there are areas from which there could be a high rate of return on research investments. Appropriate methods will be required for the transfer of new technologies to smallholders, if these returns on research investments are to be realized. Coconut hybrid breeding in several countries over the past 30 years has demonstrated that hybrids are capable of yielding up to 6 tons copra/ha/year, under favourable conditions (cf. world average yield of 500 kg/ha/year). Progress has also been made in the identification of the causal agents of diseases of previously unknown etiology, such as cadang-cadang disease in the Philippines and Lethal Yellowing in the Caribbean. Nutritional studies have shown that coconut responds to fertilizer application, particularly potassium and chlorine. Intercropping and the use of cattle under trees has shown that the total productivity of the coconut lands can be improved, while still maintaining the long-term sustainability of the system.

These promising results from only a few programmes suggest that a well-organized and adequately funded international research effort could yield high returns on the investments. The long-term nature of coconut research, the history of discontinuity and lack of support in its funding, the prospects of high returns from research investments, and the likely distribution of research benefits to smallholder producers, make coconut a particularly suitable target for an international research initiative.

7. Priority Research Areas for International Support

7.1. Research priorities

The priority research areas to be addressed by an international effort are:
Germplasm improvement (collection, conservation, breeding and evaluation)

Disease and pest control

Sustainability of coconut-based farming systems

Post-harvest handling and utilization

Socio-economics.

7.2. Germplasm improvement

The key areas requiring research are:

7.2.1. Germplasm collection and conservation

The critical need is to establish a coconut germplasm collection under international auspices. Such an international collection would be best built around one primary site, with several sub-sites to duplicate different portions of the collection in different parts of the world. The collection would be managed by a Coconut Germplasm Research Unit, established under international auspices. It would involve sponsoring both the establishment of a new field-based collection and to duplicate parts of the collection elsewhere by providing additional support to some existing collection in Asia, Africa, the Pacific, Central and South America and the Caribbean.

The primary site of the new international collection should be in the Asia/Pacific region, as this is believed to be the centre of origin of the crop, in a location free of lethal diseases, and out of the typhoon region. From a scientific perspective, Indonesia would be a suitable location for the primary site of the international collection.

7.2.2. Inter-country testing of natural selections and hybrids

There is a long-established need for the inter-country comparison of the best available material from different countries. Suitable protocols need to be developed to enable results from trials in different countries to be compared.
7.2.3. **Biotechnology**

**Cell and tissue culture:** One technology that would be a valuable adjunct to coconut breeding is tissue culture. Embryo culture techniques have been established (with support from IBPGR) which can be used in germplasm collecting in the field. Limited success has been reported with clonal propagation. Several laboratories have reported the clonal propagation of a few palms. None are able to replicate coconut palms on a routine basis. Clonal propagation would enable the rapid propagation of high yielding trees.

Techniques also need to be established for cryopreservation to enable the long-term, in vitro storage of germplasm, and reduce the need for large and expensive field-based collections to preserve coconut germplasm.

Regeneration and transformation systems are required for coconut, in order to establish systems by which useful genes could be introduced into the plant by genetic engineering.

**Genetic mapping of coconut:** A genetic map of coconut, based on the use of RFLP markers would be valuable for coconut breeding programmes, especially for complex characters such as drought tolerance.

**New diagnostics:** Suitable indexing methods need to be developed to enable the safe exchange of germplasm. Modern diagnostics, based on monoclonal antibodies or nucleic acid probes could be prepared in suitably-equipped laboratories, for the major coconut diseases.

7.3. **Disease and pest control**

The priority diseases, important in all coconut-growing areas are:

* **Phytophora palmivora**
* Lethal diseases
* Virus/viroid diseases (such as cadang-cadang)

Of the lethal diseases, mycoplasma diseases such as lethal yellowing and related mycoplasma diseases of unknown etiology are especially damaging in Africa and in Latin America and the Caribbean. There appears to be several virus and viroid diseases affecting coconut in the Asia/Pacific region, some of unknown etiology. The etiology of the lethal diseases needs to be established, as a first step towards their control.

In regard to pest control, priority should be given to the development of integrated pest management methods for pests important in several countries.

7.4. **Sustainability of coconut-based systems**

Coconut-based systems are amongst the oldest farming systems in the world. They contribute to the sustainability of farming systems in coastal areas and islands, where few other crops will grow. There needs to be further research into the productivity and longevity
of various intercropping systems, and to the role of coconut in coconut/pasture/animal systems.

7.5. Post-harvest handling and utilization

There are several problems of copra and coconut oil processing, especially at the village level, which are important to many countries, and which could be more efficiently investigated under international auspices. The results could be made widely available through regional networks. The results from bilaterally-funded projects may be able to be adapted to other countries, at marginal cost, through an international initiative.

7.6. Socio-economics

There is a need to address the sociological and economic issues involved in each of the above four areas. The factors affecting smallholder adoption of new technologies, such as new varieties, are especially important as a guide to the development of appropriate technologies.

8. Institutional Options

Although there are many bilaterally and multilaterally funded coconut research and development projects, all currently operate for relatively short periods (usually 3 to 5 years), and are rarely linked to one another. This system of discontinuity of funding, provided primarily on a bilateral basis, is not conducive to achieving a quantum leap in coconut productivity in many countries. If an increase in productivity in coconut is to be achieved, it requires a critical mass of funds and research capacity to be brought to bear on coconut for a sustained period of time.

There are several institutional mechanisms by which an international research programme on coconut could be established. These institutional options include ones which could be incorporated into the CGIAR System and ones which could be conducted under international auspices but outside the CGIAR System. The key elements which require international auspices are especially in regard to germplasm conservation, evaluation and improvement. There is also a need to provide a mechanism for continuity of funding.

Six institutional options by which an international initiative on coconut research could be established and conducted are outlined below. The relative features of the options are summarized in Table 3.

Option 1 Provide Additional Support to National Programmes

Advantages

Builds on existing research capacity and facilities in national programmes. Decentralized activities, in major and minor producing countries.

Disadvantages
Does not bring a critical mass of scientific expertise and resources to the international problems of the crop. No international focus. No global view of research needs. No in-house research capacity.

Option 2 Establish an International Coconut Research Network amongst national research institutes, and other interested regional and international bodies to coordinate existing activities.

Advantages
- Maximizes use of existing programmes and institutions.
- Cost-effective mechanism.
- Develops a strong sense of equal partnership.
- Provides global view of research needs.
- Decentralized activities, in major and minor producing countries.

Disadvantages
- No critical mass of expertise or resources.
- Previously attempted in the Asia/Pacific region with little success.
- Without an international coconut research centre problems of scientific backstopping are likely to arise.
- Continuity of funding would continue to be a problem since most research would be funded from national and bilateral sources, on a short-term, project basis.
- No in-house research capacity.
- No international, multisite germplasm collection.

Option 3 Establish an independent body, under the auspices of the CGIAR, called here the International Coconut Research Council to identify, support, promote and undertake research of international significance. The new body would be able to undertake research itself; contract research to national programmes and to other advanced laboratories elsewhere; establish subject-specific research networks on problems of international significance; establish regional networks; and manage a multi-site germplasm collection, held under international auspices.

Advantages
- Provides a focus for research, training, and documentation on coconut.
- Assembles a critical mass of scientists and resources under effective management.
- Provides a mechanism for continuity of funding.
- Provides global view of research needs.
- Guarantees international auspices and free availability of research results and improved germplasm for use by large and small countries.
- Builds on and strengthens existing research capacity by providing additional funds.
to enable some national programmes to undertake research of relevance to many countries.

In-house research capacity.

Limited in-house research facilities required.

Provides financial support for existing germplasm collections and breeding programmes of international significance.

Facilitates collaborative research amongst scientists in different countries.

Facilitates participation by both public and private sector organizations.

Allows participation by small countries with no national research programmes in an international coconut breeding and evaluation programme.

Decentralized approach.

Disadvantages

Higher cost, especially in establishment phase.

Research leadership and management more difficult than with a commodity centre at one location.

More difficult to avoid a 'top-down' perception with national programmes.

Obtaining international legal status may be a lengthy process.

May give too high a priority to coconut relative to other commodities within the CGIAR System.

Option 4 International Council on Agroforestry (ICRAF): Coconut Research Programme

Incorporate an Asian-based coconut research unit within the International Council of Agroforestry (ICRAF).

Advantages

Flexibility in modes of operation, with in-house research capacity, contract research responsibilities, and regional and subject-specific research networks.

Provides in-house research capacity.

Enables research to be contracted to NARS and other advanced laboratories.

Established linkages with research on other tree species.

Some common services possible, thereby reducing costs.

Ensures the research related to the sustainability of coconut-based systems will be given priority.

Disadvantages

May not bring a critical mass of expertise and resources focussed on coconut.

Less emphasis on germplasm improvement aspects.

May not provide early international auspices for a multi-site germplasm collection and an inter-country coconut improvement programme.

May not provide continuity in funding.

ICRAF is itself considering its own future, in relation to the CGIAR forestry initiative. Coconut may not receive high priority from ICRAF, at least not initially.

ICRAF is primarily focussed on Africa, whereas the proposed coconut research initiative would have a substantial programme in Asia/Pacific as well as regional activities in Africa, Latin America and the Caribbean.

May not give global coverage of activities.

Implementation may be slow.
Option 5 IBPGR Crop Genetic Resources Network on Coconut

Establish an IBPGR-sponsored Crop Genetic Resources Network on Coconut, with a steering committee to guide its research strategy. The international R and D programme outlined in Section 7 contains a large element of work concerned with the long-term support of coconut germplasm collections to be held under international auspices; breeding and inter-country evaluation of germplasm; and related research on tissue culture and disease control. These activities could be conducted within a crop genetic resources network on coconut, sponsored by IBPGR and supported by additional funds provided to IBPGR by interested development agencies, and possibly industry sources and commodity funds.

Advantages

Establishes a critical mass of expertise and resources focussed on coconut research needs.
Flexibility in modes of operation, with in-house research capacity, contract research responsibilities, and regional and subject-specific research networks.
Provides in-house research capacity, especially in relation to germplasm conservation.
Provides international auspices for a multi-site germplasm collection, and an inter-country coconut improvement programme.
Provides a mechanism for continuity of funding.
Enables research to be contracted to NARS and other advanced laboratories on specific problems of international significance.
Global coverage of activities via regional and subject-specific research networks.
Reduced overhead costs, due to sharing of common services such as administration, information, training and governance.

Disadvantages

Requires IBPGR to expand its usual mode of operation to manage research on germplasm utilization, as well as provide additional support for coconut collection and conservation.
Greater emphasis on the germplasm improvement aspects of the programme (including disease and pest control) and less on sustainability of coconut-based farming systems and post-harvest handling and processing.
International status and speed of implementation of the programme may be affected by IBPGR’s own negotiations on its future.

Option 6 International Rice Research Institute: Coconut Research Unit

The major coconut producing and exporting country is the Philippines. The International Rice Research Institute (IRRI) in the Philippines could host an international coconut research network, and provide logistical support of its activities in Asia/Pacific, Africa, Latin America and the Caribbean.

Advantages

Establish a critical mass of expertise and resources focussed on coconut research needs.
Flexibility in modes of operation with in-house research capacity, contract research responsibilities, and regional and subject-specific networks.
Provides in-house research capacity, especially in relation to germplasm conservation, evaluation and utilization.

Enables research to be contracted to NARS and other advanced laboratories.

Global coverage of activities.

Provides international auspices for a multi-site germplasm collection and an inter-country coconut improvement programme.

Provides a mechanism for continuity of funding.

Reduced overhead costs, due to sharing of common services and governance.

Access to other research expertise at IRRI (e.g. biotechnology, plant nutrition, pest control and farming systems).

Disadvantages

Requires IRRI to provide an international umbrella for a new commodity. IRRI's mandate would require modifications.

The Philippines is the typhoon zone, and has one lethal disease of coconut (cadang-cadang). It is therefore not the ideal location for the primary site of an international germplasm collection. The primary site of the germplasm and the germplasm research unit would have to be located elsewhere in Asia, preferably in Indonesia, to facilitate germplasm exchange.

9. An International Coconut Research Council

9.1. Institutional arrangements

The preferred option is Option 3, to establish a new body whose purpose would be to identify, support, promote and undertake priority research on coconut of international significance. It is called here the "International Coconut Research Council".

The new body would be able to:

(1) Undertake research itself on a limited number of topics of international significance, with some emphasis on those related to germplasm conservation, evaluation and improvement. These may extend to other palm species in the future.

(2) Contract research to national programmes and to other existing research institutions on the priority research topics of international significance.

(3) Establish subject-specific research networks amongst active research workers, on problems of international significance and contract additional research on these subjects; and

(4) Establish regional networks, to identify the priority problems requiring additional research efforts, and to facilitate the distribution of research results to all coconut producing countries.

The advantages of establishing such an international initiative are that it could:

(1) Identify important research priorities relevant to several producing countries which
cannot be addressed adequately by any one country.

(2) Build on existing research capacity by providing additional funds to enable national programmes to undertake research of relevance to many countries.

(3) Provide additional support for germplasm collections held under international auspices and breeding programmes of international significance.

(4) Allow small countries with no national coconut research programme to participate in the evaluation of new technologies, including new coconut varieties, and improved processing technologies.

(5) Provide continuity of funding, especially for a coconut germplasm collection held at several sites under international auspices, and related research on coconut improvement of importance to many countries.

(6) Facilitate participation in an international coconut research effort by both public and private sector organizations. The buyers of coconut oil in industrialized countries would benefit from continuity of supply from producing countries. These private sector interests could be invited to participate in, and contribute to, an international research effort.

9.2. Organization and functions

The components of the proposed International Coconut Research Council are illustrated in Figure 1. The international elements of the Council would comprise:

- Board of Directors
- Headquarters Unit
  - Administration
  - Information Services
  - Training Programme
  - Socio-economic Programme
- Germplasm Research Unit
- Regional Networks
  - Asia/Pacific
  - Africa
  - Latin America and the Caribbean
- Subject Specific Research Networks
  - Tissue Culture
  - Lethal Diseases
  - et al.

The proposed initial complement of senior staff would be 14. In addition, the Council would require some support staff. It would also require a significant contractual research budget. The Council would then have the responsibility to commission research of international significance with national programmes and other interested research
organizations within its identified high priority research areas.

The indicative staffing of the Council is as follows:

**Headquarters Unit**
- Director
- Administrative Officer
- Information Officer
- Training Officer
- Socio-economist

**Germplasm Research Unit**
- Germplasm conservator - germplasm collection and conservation
- Plant breeder - hybrid production
- Plant breeder - international testing network
- Plant pathologist
- Research station manager

**Regional Networks**
- Four regional coordinator for (1) Asia, (2) Papua New Guinea and the Pacific Islands, (3) Africa, and (4) Latin America and the Caribbean.
<table>
<thead>
<tr>
<th>Region</th>
<th>Area (1000 ha)</th>
<th>Average Holding (ha)</th>
<th>No. Farm Families (1000)</th>
<th>Estimated No. Producers</th>
<th>Total Coconut Production (Thousand metric tons)</th>
<th>Estimated Domestic Consumption (Thousand metric tons)</th>
<th>Estimated Coconut Consumed (Thousand metric tons)</th>
<th>Coconut Oil 1000 mt</th>
<th>Copra 1000 mt</th>
<th>Copra 1000 mt</th>
<th>Coconut Shell 1000 mt</th>
<th>Shell Fibre 1000 mt</th>
<th>Other 1000 mt</th>
<th>Total Export Earnings (US$ Millions)</th>
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</thead>
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<td>PEC</td>
<td>1,700</td>
<td>1</td>
<td>1,100</td>
<td>165</td>
<td>1,500</td>
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<td>250</td>
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<tr>
<td>SIA</td>
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<td>1,000</td>
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<td>500</td>
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<td>250</td>
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<tr>
<td>EA</td>
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<tr>
<td>NCA</td>
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<td>165</td>
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<tr>
<td>MB</td>
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<td>250</td>
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<tr>
<td>APEC ASIA</td>
<td>8,852</td>
<td>1.5 - 3.5 ha</td>
<td>9,800</td>
<td>900</td>
<td>11,500</td>
<td>7,674</td>
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<td>2,500</td>
<td>630</td>
<td>630</td>
<td>800</td>
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<td>150</td>
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<tr>
<td>- APEC PACIFIC</td>
<td>461</td>
<td>1.5 - 4.0 ha</td>
<td>210</td>
<td>620</td>
<td>2,900</td>
<td>1,580</td>
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<td>20</td>
<td>20</td>
<td>300</td>
<td>50</td>
<td>50</td>
<td>20</td>
</tr>
<tr>
<td>- APEC ALPINE</td>
<td>9,823</td>
<td>1.5 - 4.0 ha</td>
<td>210</td>
<td>620</td>
<td>2,900</td>
<td>1,580</td>
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<td>20</td>
<td>300</td>
<td>50</td>
<td>50</td>
<td>20</td>
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</table>

Table 1: Coconut Production Data for Asian-Pacific Coconut Community, 1984

Note: Data includes estimates for coconut production, consumption, and export earnings for various regions within the Asian-Pacific region.
<table>
<thead>
<tr>
<th>Region</th>
<th>Country</th>
<th>Research Institutes</th>
<th>Programs</th>
<th>External Collaboration</th>
</tr>
</thead>
<tbody>
<tr>
<td>Asia</td>
<td>China</td>
<td>Chinese Academy of Agricultural Sciences Hainan Island</td>
<td>Hybrid production</td>
<td></td>
</tr>
<tr>
<td></td>
<td>India</td>
<td>All-India Coordinated Coconut and Areca nut Improvement Project</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Central Plantation Crops Research Institute, Kasaragod (plus 11 other research centres)</td>
<td>Past and disease control, Tissue culture, Germplasm collection, conservation, and evaluation Hybrid breeding</td>
<td></td>
</tr>
<tr>
<td>Indonesia</td>
<td>Agency for Agricultural Research and Development (AARD)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Coordinating Research Institute for Industrial Crops, Research Institute for Coconuts, Main stations at Medan, Pahang, Penang, Borneo</td>
<td>Germplasm collection, Hybrid breeding</td>
<td>IBPGR, FAO, World Bank</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Industrial Plantations (PTP/PNS) Coconut Research Program, Medan, North Sumatra</td>
<td>Hybrid breeding</td>
<td>France (IRBO)*</td>
</tr>
<tr>
<td>Malaysia</td>
<td></td>
<td>Malaysian Agricultural Research and Development Institute (MARDI)</td>
<td>Smallholder planting and rehabilitation</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Private Sector Research Programs</td>
<td>Hybrid seed production, Intercropping</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Universities</td>
<td>Processing, Food technology</td>
<td></td>
</tr>
<tr>
<td>The Philippines</td>
<td>Philippines Coconut Authority</td>
<td></td>
<td></td>
<td></td>
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<tr>
<td></td>
<td></td>
<td>Albay Research Centre</td>
<td>Cadang-cadang disease, Tissue culture, Entomology (disease transmission)</td>
<td>FAO/UNDP, Australia (ACIAR)*, Germany (GTZ)</td>
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<tr>
<td></td>
<td></td>
<td>Davao Research Centre</td>
<td>Agronomy, nutrition, entomology, Post-harvest</td>
<td>FAO/UNDP, Potash Institute, France (IRBO), ODA* (GTZ)*</td>
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<tr>
<td></td>
<td></td>
<td>Zamboanga Research Centre</td>
<td>Germplasm conservation, Hybrid breeding, Coconut wood utilization</td>
<td>FAO/UNDP, New Zealand</td>
</tr>
<tr>
<td>Region</td>
<td>Country</td>
<td>Research Institutes</td>
<td>Programs</td>
<td>External Collaboration Past/ Present*</td>
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<tr>
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<td>--------------------------------------</td>
<td>--------------------------------------------------------</td>
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<tr>
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<td>University of the Philippines, Los Banos (UPLB)</td>
<td>Embryo culture</td>
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<tr>
<td>Sri Lanka</td>
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<td>Visayas State College of Agriculture (VISCA)</td>
<td>Hybrid breeding</td>
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<td></td>
<td></td>
<td></td>
<td>Intercropping</td>
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<td></td>
<td>Village level processing</td>
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<td></td>
<td></td>
<td></td>
<td>Product development</td>
<td></td>
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<td>Sri Lanka</td>
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<td>Coconut Research Institute</td>
<td>Breeding and selection</td>
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<td>Soils and plant nutrition</td>
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<td></td>
<td></td>
<td>Agronomy</td>
<td></td>
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<td></td>
<td></td>
<td>Pest and disease control</td>
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<td></td>
<td></td>
<td>Coconut information service</td>
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<td>South</td>
<td></td>
<td>Coconut Board</td>
<td>Post-harvest processing</td>
<td>U.K.*</td>
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<td>Pacific</td>
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<tr>
<td>Thailand</td>
<td>Department of Agriculture, Horticultural Research Institute, Sawi Research Centre</td>
<td></td>
<td>Hybrid breeding</td>
<td>ODA</td>
</tr>
<tr>
<td>Vietnam</td>
<td>Oil Crops Research Institute</td>
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<td>Hybrid production</td>
<td>FAO</td>
</tr>
<tr>
<td>Fiji</td>
<td>Ministry of Forestry</td>
<td></td>
<td>Hybrid breeding</td>
<td>France (IRBO)*</td>
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<td>Past control</td>
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<td></td>
<td></td>
<td></td>
<td>(biological control of rhinoceros beetle)</td>
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</tr>
<tr>
<td>French</td>
<td>Coconut Research Institute</td>
<td></td>
<td>Hybrid breeding</td>
<td>France (IRBO)*</td>
</tr>
<tr>
<td>Polynesia</td>
<td></td>
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</tr>
<tr>
<td>Papua New</td>
<td>Cocos and Coconut Research Institute</td>
<td></td>
<td>Germplasm collection and conservation</td>
<td>Australia (ACLAR)*</td>
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<tr>
<td>Guinea</td>
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<td></td>
<td>Hybrid breeding</td>
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<tr>
<td></td>
<td></td>
<td></td>
<td>Past control</td>
<td></td>
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<td></td>
<td>Hybrid breeding</td>
<td>Unilever*</td>
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<td></td>
<td>Intercropping (cocoa/coconut)</td>
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<td></td>
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<td>Tissue culture</td>
<td></td>
</tr>
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<td></td>
<td>Department of Agriculture</td>
<td></td>
<td>Disease surveys (viral diseases)</td>
<td>Australia (ACLAR)*</td>
</tr>
<tr>
<td>Vanuatu</td>
<td>Oil Crops Research</td>
<td></td>
<td>Hybrid breeding</td>
<td>Frane (IRBO)*</td>
</tr>
<tr>
<td></td>
<td>Sararaccoa</td>
<td></td>
<td>Disease control</td>
<td>Australia (ACLAR)*</td>
</tr>
<tr>
<td>Region</td>
<td>Country</td>
<td>Research Institutes</td>
<td>Programs</td>
<td>External Collaboration</td>
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<td></td>
<td></td>
<td></td>
<td>Hybrid breeding</td>
<td>FAO*</td>
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<td></td>
<td></td>
<td>Fast control</td>
<td>World Bank</td>
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<td>(biological control of rhinoceros beetle)</td>
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<td>America</td>
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<td>Germplasm</td>
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<td>Jamaica</td>
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<td>collection and evaluation</td>
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<td>Lethal yellowing disease</td>
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<td>Red ring disease</td>
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<td>Africa</td>
<td>Marc Delorme Coconut Development Centre</td>
<td>Germplasm</td>
<td>World Bank*</td>
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<td>collection</td>
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<td>Tanzania</td>
<td>National Coconut Development Program</td>
<td>Hybrid breeding</td>
<td></td>
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<td></td>
<td></td>
<td>Agronomy</td>
<td>World Bank*</td>
</tr>
<tr>
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<td></td>
<td></td>
<td>Disease control</td>
<td>German (GTZ)*</td>
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<td>(mycoplasmas)</td>
<td>France (IRD)*</td>
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<td>Biological control of insect pests</td>
<td>U.E. (Imperial College)*</td>
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<td></td>
<td></td>
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<td>Socioeconomic</td>
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</table>

* Existing research project supported by technical assistance, or collaborative research grants.
TABLE 3. SUMMARY OF INSTITUTIONAL OPTIONS FOR AN INTERNATIONAL COCONUT RESEARCH INITIATIVE

<table>
<thead>
<tr>
<th>Institutional Options</th>
<th>Critical mass capability</th>
<th>In-House research capacity</th>
<th>Contract/Global coverage</th>
<th>Likely continuity of funding</th>
<th>International auspices for germplasm</th>
<th>Admin. costs</th>
<th>Other factors</th>
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</thead>
<tbody>
<tr>
<td>1. National programme support</td>
<td>-</td>
<td>-</td>
<td>+</td>
<td>+</td>
<td>-</td>
<td>-</td>
<td>Low Collocation with an existing institution would reduce these costs</td>
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<td>2. Network</td>
<td>-</td>
<td>-</td>
<td>+</td>
<td>+</td>
<td>-</td>
<td>-</td>
<td>Low IBPGR mode of operation would require modification</td>
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<tr>
<td>3. Coconut Council</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>High Establishment and governance costs may be high. Costs could be reduced by sharing common services</td>
</tr>
<tr>
<td>5. IBPGR Network</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>Low IBPGR would have to change strategy. Possibly slow implementation. Programme restricted to germplasm</td>
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<tr>
<td>6. IRRI-based unit</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>?</td>
<td>+</td>
<td>+</td>
<td>Low IRRI mandate may require modification</td>
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Figure 1. Proposed International Coconut Research Initiative