Outline (Draft)

Underutilised Crops for Food Security and Poverty Alleviation

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1. INTRODUCTION

It is estimated that 1.2 billion people in the world do not have enough food to meet their daily requirements and a further 2 billion people are deficient in one or more micro-nutrients (Azam-Ali and Battcock, 2001). Most of them are from developing countries. Many of the rural and urban households use traditional underutilised crops to meet their needs but these crops are being displaced because of pressure from imported species, demography and household structure changes. In addition, loss of agrobiodiversity and farmers’ dependence on a few highly selective crops resulting in narrow food baskets, have also caused food and nutrition insecurity and poverty in rural and urban communities.

There are many plant species with significant food and/or industrial potential which remain underutilised through lack of a coherent strategy for their evaluation and development. The vast numbers of those unused and underutilised species represent an enormous untapped commodity resource which can help to meet the increasing demand for food and nutrition, energy, medicines and industrial needs. Some of these untapped resources are either partly or fully domesticated but most remain wild and unevaluated. With the development of modern agriculture practices the potential of many of these commodity resources have been neglected. Some have been so neglected and the erosion of their genepools so severe that they are often regarded as “lost crops”. Nevertheless, in much of the world underutilised crops and commodities play a vital role in the lives of the rural and urban poor, because they contribute to livelihoods, poverty alleviation and sustaining the environment. Many of these species are included in traditional subsistence farming systems particularly in marginal areas and, in many cases, these crops and commodities are life-savers for millions of resource poor people in regions where food and nutritional security are significant problems.

The rural community know how to cultivate underutilised crops and prepare food from them; use them for health care, shelter, forage and fuel. Many products are produced at the household and small-scale level offering opportunities for income generation and employment. These crops include cereals, pseudo cereals, fruits and nuts, pulses, vegetables, root and tubers, oilseeds and other industrial, forage and fodder species. Traditionally, underutilised crops make a significant contribution to the diet of rural households, particularly during drought, famine and the dry season (Campbell, 1987).

Hence, the production of underutilised crops plays a central role in ensuring the food security for millions of people worldwide. The benefits of these species are many fold:

- They have potential to contribute to poverty elimination through employment opportunities and income generation and also through improved efficiency and profitability of farm household labour use in both rural and urban environments.
- They can contribute to sustainable livelihoods through household food security as they can widen the food basket.
- They add nutrients to the diet and are sometimes convenience food for low income urban people (Examples are drawn from ICUC’s project experience in Africa).
- They are adapted to fragile environments and can contribute to the stability of agroecosystems, particularly in the arid, semi-arid lands, mountains, steppes and tropical forests.
- They provide a broad portfolio of crops to improve productivity and global food security and to meet new market demands.
- They assist development through small-scale investment.
- They have a strong cultural identify and are associated with traditional customs and beliefs.

However, the role of underutilised crops is often ignored or underestimated by crops researchers, planners and policy makers, donor agencies, public and private investors, extension services and economists. Whatever research and field projects have been carried out these are mostly fragmented and information on them is difficult to compile. However, this paper will attempt to provide the background; current research; constraints for sustainable production; approaches to research and potential strategies and action plans which we hope would be helpful to lead the strategic development of underutilised crops for sustainable food and nutrition security and poverty alleviation.

2. BACKGROUND

The past three decades have seen a wide and varied range of research interests on underutilised crops. Whereas most of these interests were focussed on particular projects of individual researchers, there have been a number of significant programmes to promote underutilised species for agricultural systems, as alternative crops or as sources of new products; and these programmes have been undertaken in both developing and developed countries. Additionally, there has been a broader recognition that underutilised crops should be promoted. Starting in the 1970’s the NAS, documented a number of species meriting further research and in the 1980’s the Food Policy and Nutrition Division of FAO started a programme on Underexploited Traditional Food Plants.

In 1987, an international symposium led to the creation of the International Centre for Underutilised Crops (ICUC), which has continued to initiate research and development activities and to act as catalyst in promoting these activities worldwide. Subsequently, two other international conferences were organised by ICUC to strengthen the domestication and utilization of underutilised crops through community participatory research for poverty alleviation. In 1996, the FAO Global Plan of Action for the conservation and use of plant genetic resources for food and agriculture led to the greater commitment to promote and commercialise underutilised species. Later, IPGRI strengthened its activities on conservation and use of neglected and underutilised plant species in the 1990s. Other international centres (CIAT, CIP, ICRAF, IITA, ICRISAT, AVRDC and others) also initiated significant projects in the 1990s. Funding has been mobilised from a range of bilateral donors especially by Australia, Canada, Denmark, EC, France, Germany, Italy, the Netherlands, Switzerland, UK and USA.
Other associated interests stemmed from the upsurge of interest in biodiversity conservation and its use; and the Convention on Biological Diversity (CBD) became a rallying point and promoted the concept of maintaining local agro-biodiversity. This drew into the broader framework the biological and taxonomic work such as the efforts of PROSEA (Plant Resources of South East Asia).

All these various international promotions of underutilised species have led to a better liaison between relatively isolated groups of workers but there were still major gaps. Following the FAO Global Plan of Action, the Consultative Group on International Agricultural Research (CGIAR) organised a workshop in Chennai, India in 1999. One of the outcomes was a recommendation to survey all ongoing activities on underutilised species worldwide.

3. CURRENT STATUS OF RESEARCH

A report on current activities and proposals for enhanced cooperation was completed in 2000; issued in 2002 (Williams and Haq, 2002). It showed that the number of countries with dedicated research programmes on underutilised crops is very small and also that sustained funding for these programmes is not severe. The report identified existing priorities and noted that priority-setting needed greater attention. A list of priority species was provided as a guideline and where the authors were confident that the species merited greater attention.

For any given species the people in the production to consumption chain vary from those dealing with other species, and a structured approach is needed at the local, regional, national and international level. One problem is identifying significant needs at the community level and having these taken into account at national policy level. And an even bigger problem to be tackled is how to maintain materials on-farm without farmers discarding them when local and regional markets face change.

To our knowledge, there are two systematic global programmes for the improvement of underutilised crops to contribute to food security and poverty alleviation. These are: Global Programme on Underutilised Fruit Trees of ICUC, funded by DFID-FRP and Global Initiative on Neglected Crops of IPGRI, funded by IFAD. In addition to these there are several smaller farmers’ participatory research projects which are being carried out by several NGOs, IARCs (e.g. ICRAF, IPGRI, CIP, CIAT, AVRDC), FAO and ICUC. There are also several bilateral projects underway on various underutilised crops. In the NWFP (Non Wood Forest Products) projects of FAO, the organic farming and certification programmes are mostly dealing with underutilised crops. However, most of these projects are imbedded in crop diversification programmes of households and small farms (Table…to be included), as the small farmers noted the great value of underutilised crops (especially in multicropping agricultural systems) and also that women are often the ones with prime responsibility for the production of subsistence crops that are essential to household food security.

Interest in diversifying crops around the world has derived from a long history of plant introduction, in which crops have been tested out far from their original areas of diversity. Many species diversified further in new areas and formed the basis of much of the staple food production as well as new agricultural production systems (such as oil palm in SE Asia, cocoa...
in West Africa, kiwi fruit, pineapple and other major fruits in many parts of the world). However, agriculture in the tropical world, with few exceptions, suffered from lack of mechanisms to introduce, test and understand less important species; and where a number of such less important species were tested the germplasm base was often so limited and narrow that they were not successful. At the same time, the institutional framework in less developed countries was such that the research and experimentation did not have the capacity to extend to such crops.

4. CONSTRAINTS FOR SUSTAINABLE PRODUCTION

Gundel (2002) indicated a few points why various sectors have neglected underutilised crops. She highlighted that some might be for global reasons and others were regional in nature. However, it is the NARS (National Agricultural Research Systems) which influence the crop production in each country. If the NARS includes a species in its national programme then the funds will be allocated for research and development. We were delighted to see the impact of our Global Programme on Fruits for the Future when it influenced the Nepal Agricultural Research Council (NARC) to include Jackfruit in their national programme and ICAR (Indian Council for Agricultural Research), has created a new Cell “All India Co-ordinated Network on Underutilised Fruits” which includes 8 underutilised fruit species (from ICUC priority setting) for research and development. However, the scenario with other NARS is quite different as most have invested resources to improve their staple foods but ignored research on underutilised crops to improve the household farming and to generate extra income for the last 30 years. Any examination of data available over this time, from FAO or ISNAR, shows that human capacity building in developing countries was largely a phenomenon of the 1970s and 1980s onwards, that in terms of finance many NARS were poorly funded, and that many NARS were relatively weak. It is not surprising therefore that when the scientific community started to promote the need to apply knowledge on underutilised crops (from the mid 1970s) that the very research systems suited to do the applied research were unable to consider such things: rather they were faced with providing adequate research and extension related to domestic food production and tropical plantation crops, although even the latter suffered during decolonialisation.

Experience has shown that investments in public institutions (and reform of these when necessary) has increased the capacity of the agricultural sector to respond to economic forces. NARS still have many problems to cope with - population, underdeveloped market systems, distorted incentives and pricing (indicating what is recognised as “perverse subsidies”), and others - but there are marked signs of technical and institutional changes. The question that has to be asked is, "Can the NARS cope adequately with underutilised crops?" In the majority of cases the answer is "No." The second question to ask then is "When will they be ready to do so?", and this is not so readily answerable.

Having pointed this out, it will not be surprising that the number of national programmes involved with underutilized crops is small. Added to the weakness factor of the NARS are constraints in expanding R & D on underutilized crops
Table…. Developing countries with some research interest on expanding use of underutilised crops (other than those with active national programmes listed in Table)....to be included.

Other than countries listed in Table ?, only 8 others have a stated aim to develop a national programme on underutilised crops: Angola, Costa Rica, Cuba, Ghana, Guatemala, Pakistan, Turkey and Vietnam. From the above few examples we can see that only a few NARS are serious about underutilised crops so far and we need to influence the NARS to include these species in their policy framework.

The other constraints which are delaying the improvement of underutilised crops are:

(i) Access to good quality planting materials is a major constraint to rural and urban farmers. In addition, the multiplication methods and production technologies have not yet been fully developed. The quality of products depends on good quality produce and there is a strong need to carry on production and processing activities in parallel so that good quality raw materials are available for processing and marketing to generate income for household farms.

Different crops have different characteristics and different uses, even in the same country. Therefore the utilization including the value addition, processing and marketing strategies and consumer requirements are different, and for many small-scale producers, these remain unknown. Farmers will often sell the excess produce from underutilized crops for extra income but they have to depend on the market chains because of their present limited uses in the industries. By combining well established principles and appropriate equipment with good standards of quality and hygiene, small scale food processing enterprises can produce quality, marketable products.

(ii) Access to information on technologies is a major constraint to small scale production. Farmers and potential users of underutilised crops are unaware of the benefits of the crop and the technologies that may be appropriate to their needs. The lack of information precludes spontaneous dissemination. The particular challenge here is to develop information that can be effective in a country with high levels of illiteracy. In terms of extra income, improved family diets and opportunities for trading and processing, better utilisation of the underutilised crops will provide a number of opportunities to raise the household income.

(iii) Lack of access to credit is also commonly cited as a constraint to small scale production. The majority of small scale farmers and processors, especially women, face a variety of problems when seeking credit, including lack of information, high interest rates, lack of collateral, bureaucratic difficulties and misunderstandings, prejudice against women and small scale farmers and processors, and lack of government support in accessing credit (Azami 2002).

Overall, the slow progress in the effective development and utilisation of underutilised crops results from a number of constraints which are summarised below:

- Lack of information on production, nutritional quality, consumption and utilisation
- Lack of information on economic benefits and market opportunities
• Lack of technology for adding value – village level food processing
• Lack of (improved) quality planting materials
• Lack of interest by researchers, agriculturists and extension workers
• Lack of producer interest
• Low yield
• Post-harvest and transport losses
• Local market structures poor and lacking
• Lack of national policy
• Lack of credit and investment.

4.1. Approach to Research

The global report by Williams and Haq (2002) highlighted the role of networking to carry out research for the domestication and improvement of underutilised crops. They have also categorised the existing networks, their coordination and the constraints faced by the network to implement research.

4.1.1. Networking

Many development projects and network efforts on particular crops have attempted to promote underutilised species because markets are foreseen for the produce. If marketing is important it cannot succeed in a developing country without a well-articulated market system. This must be able to reflect accurately the changes in supply, demand and production; and frequently such marketing intelligence is not in place.

In recent decades much has been written about the value of networks, particularly when related to a specific crop commodity. In fact, many of the successes of international agricultural research through the CGIAR have been developed and promoted through networks. Essentially networks comprise a group of partners which set a research agenda, mobilize support, and build a cooperative inter-disciplinary, critical mass of researchers, thus filling gaps where individual partners may not have adequate strength. Networks also pool limited resources and share the workload amongst members, and network members share the outputs and benefits.

Networking for underutilised crops needs a great deal of clarification since a major current international goal is widely recognised as using such crops to broaden the base of agriculture and incorporating them into sustainable utilisation to meet the nutritional and income needs of local people or even needs at the national level. Nonetheless many nations would like to see as a goal the enhancement of a particular underutilised commodity in order to produce export earnings from particular products, such as a specific vegetable oil, or a focused market-niche product.

Any historical survey of diverse networking mechanisms for individual underutilised crops shows that it takes a minimum of 20 years to lead to really productive results, and this includes the internationalisation of the research. Williams (1995) cited the cases of triticale and grain amaranth but these two examples also had major infusion of funding, particularly for the testing network and the germplasm enhancement. It remains to be seen if crop networks of
more recent origin will generate the same external inputs, and lead to similar major impacts in similar time frames.

The diversity of the 30 or so networks is a reflection of how they have come into being. Others have been created in the recent past and become inactive. Key institutional leaders have been IPGRI, especially for the multicrop genetic resources networks; ICUC and FAO especially for multicrop networks in specific geographic regions, but also CIP for the Andean roots and tubers and AVRDC for some Asian vegetables; and inter-country organisations, such as IICA in Latin America, the Pacific Community or the Commonwealth Science Council. In total, these promoters cover about half of the non-genetic resources based networks.

4.1.1. ICUC’s current role in food security for poverty alleviation through networks

ICUC has been instrumental in establishing and promoting networks of researchers and farmers to address these issues. Additionally there is focused work, as for example a specific DFID-funded global project on Fruits for the Future which aims to package information and know-how for policy makers, researchers, farmers, NGOs and CBOs.

ICUC has always attempted to maintain a broad overview of activities around the world. Relevant ones may be dealt with in many diverse ways:

1. Agroforestry and social forestry, especially those involved with NWFP.
2. Crop diversification and diversified products
3. Traditional farming systems
4. Rural development projects
5. Improving nutrition at the local level through better diets
6. NGO and community projects involved with underutilised crops.

4.1.2 Practical Approach

4.1.2.1. Issues Still to be Addressed

There are a number of major species which need more attention by those promoting underutilised crops and particularly by those designing and implementing appropriate research - whether crop diversification, maintenance of agrobiodiversity, or meeting the needs of industries and/or communities. We focus below on some concerted areas, which we hope can help guide facilitatory mechanisms.

- Multidisciplinary Research

Whereas research and development of any crop requires a degree of multidisciplinary research, it is pertinent to investigate both the range of species dealt with and to focus on any special needs in the areas where underutilised crops are to be grown.

First of all, there is interest in a very wide range of species which show different degrees of domestication and/or genetic changes from the original wild species or progenitors. Since domestication pathways vary tremendously and proceed along different lines, there is much to be gained in developing research planning by those working on underutilised crops being
aware of current advances in many associates plant sciences research and even human cultural research. To illustrate this it is helpful to consider the species in varying stages of domestication (Sensu Davies and By, 1982 and Rindos, 1984).

(i) “Incidental domesticates” so clearly seen through the historical distributions of target species and village settlements and epitomized by distribution and use of baobab, shea butter tree, *Moringa* sp. in Africa (Harlan et al. 1976; Sidibe & Williams, 2002) or Oak in Europe remaining from times when acorns were human food (Schwanitz, 1966). Because all such incidental domesticates are limited in terms of their ecological niches usually being non-agricultural land and related to human demography, each has to be looked at on a case by case basis.

(ii) “Specialised domesticates” which rely for dispersal and are co-evolved in frequently disturbed local environments. Here are species considered to be protected and used in replacement plantings. There are many local varieties available which need systematic characterisation and evaluation. Diverse examples include *Tamarindus, Ziziphus, Dacryodes* (David, 1976, Gunesena & Hughes, 2000, Kengue, 2002, Pareek, 2002), *Parkia* sp. *Acacia albida* and species of Amaranths, *Chenopodium* used as vegetables (Schippers, 2000, ICUC Report, 2002).

Research on these species requires understanding of the local agroecologies and patterns of genetic changes which have occurred and can be used further.

Much has been written about specialised domesticates, in particular by Harris (1977). Many such species are of great interest for wasteland development (Singh, 1992), agroforestry systems and multiple and diversified cropping.

(i) “Agricultural domesticates” – There are the obligate cuttings in which change (frequently for production characteristics) is always within agroforestry and for which further change relates more to plant breeding than is the case for other categories.

It is important to note that the origin of domesticated forms is by no means synonymous with the origin of agroecology. Multidisciplinary research may require a very strong ecological input because data on limitations on the site adaptability are essential when recognising that some underutilised species will grow well in entirely new environments while others often need to be adapted by specific management or by specific genetic selection. Hence, whereas Botanic Gardens and agriculturists have played major roles in the past in devising simple cultural methods, good ecological research is now probably better to speed the desired use of underutilised species.

Ecological research takes into account population studies and selection processes, and appreciates the role of locally agriculturally induced instabilities in the development of agricultural systems. The well-known R and K selection mechanisms (Sensu Harper, 1967; Pianka, 1970; King & Anderson, 1971) link the potential reproductive rates to the carrying capacity of the environment and the changes to a more K-selected ecology.
We have stressed this point because research on underutilised crops can well follow a commodity chain approach based on inputs of agronomists, breeders, processors and socio-economists but in many cases will require agronomists and ecologists, a partnership which is not often available in existing underutilised crops research teams and networks.

Frequently, success stories have followed the first approach and there are legion e.g. the *Amaranthus* and *Fagopyrum* research of the All India Coordinated Research Project on underutilised crops (Gautam et al. 1999; Williams, 1995), or a number of pulses (Williams, 1993); but there are many others in the literature.

Thus, well-planned multidisciplinary research might well focus on agroecosystem technology packages where the focus is on, for instance, a village as a target; or it might focus on wider productivity of a single underutilised crop. As at result, the mix of disciplines in terms of researchers will vary according to the goals of the research. This might be seen as self-evident but all too often discussions become dominated by major goals such as industrial applications or traditional farming, or politically correct approaches, and as a result the sight is lost in project implementation. Some elementary research considerations, as well as considerations of cost-benefit, are often forgotten.

Expanding the research team is difficult in situations where critical mass is merely available and this is a clear reason for emphasising the value of networking in carrying out the research.

- **Sustainable sources of planting material supplies**

As discussed earlier, it is a widespread constraint that underutilised species are frequently difficult to obtain in the quantities required. This can be a daunting problem with cross-pollinated underutilised species especially when segregates need regenerating for further exploitation (e.g. lupins, many trees) and bulking up planting material supply is costly and time consuming.

Commercial organisations are unlikely to be involved with such materials and again it becomes a problem of the public sector. Nonetheless, experience in the past couple of decades has shown the value of village nurseries and local seed banks, especially more recently related to maintenance of local agrobiodiversity. However, these are mostly not related to secure national supply systems. Such pragmatic solutions to the problems of sustainability are far more viable when due considerations are given to pricing of products and provision of credit.

It has to be recognised that all such solutions are likely to see changes; for instance market forces will provide rapid incentives for higher production and the need for new cultivars and maintenance of traditional agriculture incorporating underutilised crops can rapidly suffer.

In the more developed areas of the world solutions may be very different. There is great interest in heritage; collections, especially of fruits and vegetables in Europe and some can include underutilised species which are hence maintained and available for use (i.e., Henry Doubleday Foundation, UK and Les Semences de Kokopelli, France).
5. POTENTIAL STRATEGIES AND ACTION PLANS

Underutilised crops research will only be successful when national priorities are sensitised to the need of local communities, industries and consumers. Additionally, countries are party to a number of international corrections and agreements which are often dealt with outside the agricultural sector. It is widely recognised that facilitating mechanisms for underutilised crops have a major role to play in developing national strategies.

Favourable policy designs are central to sustainable agricultural production, land tenure patterns, managing natural resources and alleviating poverty. Short-term project support to underutilised crops research is unlikely to lead to clearer policy definition, especially when experience shows relatively long time – frames are needed to develop and commercialise underutilised crops. Also, the research requires many inter-sectoral linkages since research may relate to wider maintenance of agrobiodiversity at the local level, or to appropriate production in marginal areas, but other research may relate to supplying market needs for specific products.

There is a whole spectrum of scenarios to be considered by each national programme.

5.1. Sustainability and equity

In addition to the goals of promoting underutilised crops for food and nutrition security as well as measured means for the rural poor, there are major issues concerning sustainability and equity. Much has been written on this and we only need to mention the topic in this paper. Suffice to say here that it includes non-agricultural production for processing, handicrafts and other uses. This whole area is often limited to maintaining diversified field systems. In this regard, much more research is needed to dispel myths that complex communities are more stable than simpler communities-when there are higher population levels there is likely to be greater instability in production.

6. CONCLUSION

As we move into an era of support for underutilised crops research being more widely recognised, comments have been made in order to open up new possibilities for targeted research especially if priority-setting is properly reviewed and new possibilities for cost benefits.