

Poverty and Fruit Tree Research

FRP Issues and Options Paper – No. 6



Project No. ZF0141 – Poverty and tree fruit research

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March 2001

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This publication is an output from a research product funded by the United Kingdom Department for International Development (DFID) for the benefit of developing countries. The views expressed are not necessarily those of DFID. [ZF0141 Forestry Research Programme]

Acknowledgements

We wish to thank Andreas Schneider and Kate Murray for all their help in assembling material for the preparation of this paper. We are also extremely grateful to all the people who provided information to inform the discussion within the paper and/or gave their time to discuss the topics covered within it. In addition to those named in the Appendix, several others kindly suggested people whom we could contact (some of whom we were able to establish contact with, others not!).

Cover Photo

Market stall in Oxcutzcab, Yucatán, Mexico – Nigel Poole

Executive Summary

This paper was commissioned to assist DFID's Forestry Research Programme (FRP) with the targeting of its tree fruit research activities, so as to maximise the poverty reduction benefits for forest-dependent people. The paper sets out to assess whether FRP might achieve a greater impact on sustainable livelihoods and poverty reduction through research into:

- a) domestication of indigenous fruit trees in developing countries, or
- b) reducing the barriers which prevent poor people from participating in conventional tropical tree fruit (e.g. citrus, cocoa, mango, papaya) marketing systems.

In line with the choice of species in option b), the paper focuses primarily on the production and marketing of fresh fruit products. However, the authors also recognise that the most valuable products of many indigenous fruit trees are nuts and oils, rather than the fruits. The authors also introduce an intermediate category of "semi-domesticate" species, between "indigenous" and "conventional" tropical tree fruit. These semi-domesticate species commonly are planted, although wild populations still exist, and have received a certain amount of research attention, generally from public sector research institutes within Asia. Significant regional markets now exist for them, fuelled by economic growth in East and South East Asia in recent decades.

For the purposes of this paper, forest-dependent people are defined to include all four of FRP's main target beneficiary groups:

- small-scale poor farmers
- landless poor families
- small-scale traders and entrepreneurs
- urban and peri-urban poor families.

Poverty is now recognised as a multi-faceted phenomenon, encompassing issues of security and safety nets, self-esteem and belonging, power and control, as well as income and wealth considerations. However, much policy discussion still focuses on "income poverty", both because it is the most amenable to measurement and because it connects to all the other dimensions. The international development targets suggest that research should identify and address problems impacting on large numbers of people, rather than seeking larger gains in well-being for a few. Characterisation of poor households suggests that research should focus on generating benefits (direct or indirect) for particular types of households and possibly also for particular geographic regions. The report focuses most of its attention on Sub-Saharan Africa and South Asia - the regions with the greatest concentrations of poverty in the world, in terms both of absolute numbers (where South Asia tops the tables, followed by Sub-Saharan Africa) and the depth of the poverty problem (where Sub-Saharan Africa increasingly stands alone). Poverty remains a predominantly rural phenomenon in both regions. However, the report notes important differences between them, not least in the degree of market development and the commercialisation even of small-scale farming.

To develop a framework for comparing the potential poverty reduction impact of different strands of research, the report reviews different perspectives on poverty reduction (section 4). The sustainable livelihoods approach focuses on the assets of the poor, that determine which activities they can best engage in to generate income and to secure consumption needs in a highly uncertain world. Theories of agricultural-led growth, based on historical studies of national economic development experiences, see smallholder agricultural development as a powerful engine for rural poverty reduction and broader economic growth. Smallholder agriculture can play such a major role because, aside from the large numbers of poor households directly engaged in it, it has strong linkages to other parts of the economy (both rural and urban). These linkages include labour demand, upstream and downstream production

linkages, consumption and investment linkages. However, smallholder agricultural development requires increased commercialisation of smallholder production (i.e. a greater emphasis on production for the market), which entails both costs and risks for those involved. The sustainable livelihoods approach gives insights into which households will be able to engage successfully in this type of activity.

Markets are divided up into local, national, regional and international (section 5). Although local markets are of particular importance to the poorest producers, who need to make occasional sales of small quantities of produce, market development efforts for smallholder fruit tree growers should focus primarily on national markets. This is where the overwhelming majority of tropical fruit sales currently take place. Successful export marketing is particularly demanding in terms of infrastructural and institutional development, not least because of the perishability of fresh fruits. Important markets do exist for some processed products. However, there are doubts as to whether either Sub-Saharan Africa or South Asia has comparative advantage in commercial fruit processing. Finally, the main markets for conventional tropical tree fruits are in the US, EU and Japan, where fresh products from poor countries are vulnerable to:

- intense competition from growers in both middle income and developed economies;
- increasingly stringent phytosanitary requirements;
- consolidation within supply chains.

However, there are market opportunities for semi-domesticate fruits within expanding Asian regional markets.

In theory, tree fruit research can contribute to FRP's poverty reduction objectives by:

- improving market access, creating assets and reducing risk for poor tree growers, whilst protecting their rights over natural / genetic resources;
- enhancing the availability of fruits for poor consumers, including the range and quality of the products, the timing of their availability and their price;
- increasing employment opportunities for poor labourers and business opportunities for traders and processors.

In the light of evidence on fruit markets and tree planting (section 6), it is suggested that:

- amongst producers, the main beneficiaries of improvements in access to markets for tree fruits (both domestic and international) will not be the poorest. However, even small gains obtained by the poorest households could be significant for them.
- The employment generated by production of fruit trees as cash crops is likely to be less than that generated by intensified production of many annual crops. However, once ecological conditions are taken into account, fruit trees (e.g. certain indigenous species in the Sahel) may be amongst the most suitable candidate crops for agricultural intensification and commercialisation in locations that are increasingly important in terms of world poverty.
- The small volumes of international trade in major tropical fruits means that domestic consumers should gain from increased local production through lower real prices, as well as through enhanced availability of fruits. However, fruits are not a major component of expenditure of poor households in the way that, say, grain or other major staples are. Thus, it is not clear how important such benefits will be to the poorest.

The very nature of fruit trees as long duration investments requiring secure "private" property rights over land means that there are limitations as to how far they can assist very poor farmers to improve their livelihoods (Arnold 1995). However, there is some evidence that, even where they only have

control over a tiny area of land around their homestead, poor households will plant a few fruit trees. Fruit trees are prioritised by such people not just because of their contribution to domestic food security, but also because of their potential contribution to household cash income. Commonly, such households have planted primarily exotic species, partly because they are valued in their own right, but also partly because that is the growing stock that has been available. Where both indigenous and exotic species have been made available, households have been keen to plant both.

Where just a few fruit trees (either indigenous or exotic) are planted around a homestead, they tend to be seen as a “minor” income earning activity within the household and/or an integral part of the household’s food supply. Management and even marketing activities are thus often left in the hands of women. Such gender considerations suggest that increasing the returns achieved from these activities could be of particular benefit to women household members. However, a research strategy that aimed to promote conventional tropical fruits essentially as cash crops might run a greater risk of encouraging male entry into areas that were previously women’s domains than a strategy that promoted domestication of indigenous fruit trees to generate a range of benefits to poor farm households.

Research efforts to improve growing stock are discussed in section 7. The fundamental benefit of fruit tree domestication programmes is held to be that they enhance the options open to poor households who do want to plant trees. Even if the poorest households only plant small numbers of domesticated indigenous fruit trees, many such trees will still be planted by poor people to add to their stock of natural capital. Mitigating risk is a major objective of the livelihood strategies of such people and having a range of reliably productive fruit trees to choose from is better than only being able to access planting material for a few exotics. Diversity of species (and within species) can help spread the timing of food and income availability, reduce vulnerability to pests, diseases, drought and market fluctuations, and enhance the contribution made to other aspects of farm productivity and sustainability.

A major drawback of domestication programmes, in the light of international poverty reduction targets, is the long time it takes to achieve significant impact on livelihoods. If FRP were only interested in maximising poverty reduction impact (i.e. bringing the biggest improvement in livelihoods to the largest number of poor people) before 2015, it would not invest in domestication. However, the circumstances of poor farmers will continue to change after this date as they have before it and efforts need to continue to provide them with a range of assets with which to respond to these changes. A strategy that seeks poverty reduction by 2015 without regard for what happens after then is itself open to the charge that it is not promoting sustainable livelihoods.

Meanwhile, for South Asia, a research strategy that seeks to improve and commercialise primarily semi-domesticate fruits is seen to represent a better balance between short-term poverty reduction and longer term livelihood sustainability than either a focus entirely on conventional tropical tree fruits or a “strategic” decision to work on the next generation of (currently undomesticated) marketable fruits. Regional tissue culture capacity and the interest of NGOs in developing and promoting semi-domesticate fruit species should increase the speed with which research efforts can achieve poverty reduction impact.

Market access problems are pervasive (section 8) – for indigenous (non-domesticated) fruits as well as conventional tropical tree fruits, and in domestic markets as well as international ones (although the barriers are more daunting the more sophisticated the market). The report surveys generic market access problems that might be appropriate research issues for Forestry Research Programme (FRP). Some of the major problems, e.g. infrastructure and transportation, are beyond FRP’s remit. Others are primarily the responsibility of DFID’s Crop Post-Harvest Programme (CPHP), but FRP may wish to fund some work alongside CPHP, where there are issues of particular relevance to producers of fruit and other tree products. Priorities suggested for FRP are research into:

- the design of sustainable market information systems for tree fruits (and other tree products);

- attempting to assess the impact of the maintenance of inappropriate forestry legislation (originally designed to protect forest reserves from unlicensed extraction of forest products) on the production and marketing of indigenous fruits by small-scale farmers;
- the development and promotion of small-scale processing technology for tropical fruits. It is felt that this could both contribute to the potential of tropical fruit systems to generate employment for poor households and strengthen the position of small-scale tree growers within such systems.

In addition to generic research issues related to market access, the report recommends that most projects (or clusters of projects) focusing on plant genetic improvement also have a marketing action component.

The overall recommendations of the report are as follows:

1) In light of:

- the nature of the barriers to entry confronting poor producers in low income countries if they wish to enter international markets for tropical fruits;
- our analysis of the benefits to poor households that may be expected from the production of fruit trees as cash crops,

we do **not** recommend that FRP concentrate its fruit tree research efforts on reducing the barriers which prevent poor people from participating in conventional tropical tree fruit markets.

2) Despite the time-scale issue, we **do** recommend that FRP support work on domestication of indigenous fruit trees in Sub-Saharan Africa as a way of expanding the basket of attractive options open to poor households who wish to plant trees. In South Asia, we recommend that FRP focus on semi-domesticate species, which represent the best trade-off between poverty reduction impact and maintenance of diversity / options. The time-scale within which benefits from the improvement and commercialisation of semi-domesticate species will be felt could be considerably shorter than that for pioneering work on the domestication of new species. Important factors here are the capacity for multiplication and dissemination of improved growing material and the observed expansion of markets for semi-domesticate fruits.

3) Improving market access is important to poor producers of fruit trees, irrespective of the type of tree (indigenous, semi-domesticate, conventional tropical fruit tree). Domestic markets will remain the most important focus for most poor fruit tree growers in the foreseeable future. Researchable generic market access issues related to domestic markets include:

- the impact of forestry regulations and controls on the planting of indigenous fruit trees and marketing of their products;
- the design of sustainable market information systems for perishable tree fruits;
- the development and promotion of small-scale processing technology for tropical fruits. It is felt that this could both contribute to the potential of tropical fruit systems to generate employment for poor households and strengthen the position of small-scale tree growers within such systems.

4) In addition to generic research issues related to market access, we recommend that most projects (or project clusters) focusing on plant genetic improvement also have a marketing action component. This would tackle specific marketing problems within the relevant market system, drawing on knowledge of best practice from elsewhere, so that improvements in market access can provide the necessary incentives for adoption of improved growing stock at the same time as improved growing stock makes increased market penetration plausible.

Finally, we note that **how** domestication and improvement programmes are carried out will be as important as **whether or not** they are carried out in achieving poverty reduction impact. This ties in

closely with DFID's current focus on achieving uptake of research findings in order to achieve impact. In the specific case of domestication and improvement work, we recommend that:

- 5) Where regional species prioritisation frameworks already exist, FRP should use them and should seek to focus on research problems that are not already funded by other organisations. FRP should also pay particular attention to the processes for attribute selection being used by potential research partners to ensure that the voices of poor producers are sought and listened to within domestication and improvement activities.
- 6) Particular attention should be paid to the "downstream" stages of domestication and improvement work, such as dissemination of information about propagation techniques, the establishment of local nurseries and the training of extension staff (public sector and NGO) to assist farmers in all aspects of fruit tree growing. Active involvement of intermediate users of project outputs should be checked for both at the design / approval stage of projects and during the project's life.

We also note that the terms of reference for the current study focused on fruit trees and have required a particular focus on the production and marketing of fresh fruit. Whilst fruit trees have been the top ranked species in most regional prioritisation exercises for domestication programmes undertaken with farmers around Africa, these trees have often been valued for many reasons other than just the production of fresh fruit. Indeed, the nut and its associated products (less perishable than fresh fruit) are often valued more highly for income generation than is the fruit. Research funding, therefore, should not make an artificial distinction between fresh fruit and nuts from the same trees (let alone ignore the other values that poor households attribute to these trees). Moreover, it should not ignore other types of trees (e.g. fodder trees) where these have clear potential and are desired by farmers.

1) Introduction

This paper was commissioned to assist DFID's Forestry Research Programme (FRP) with the targeting of its tree fruit research activities, so as to maximise the poverty reduction benefits for forest-dependent people. The terms of reference required the paper to assess whether FRP might achieve a greater impact on sustainable livelihoods and poverty reduction through research into:

- a) domestication of indigenous fruit trees in developing countries, or
- b) reducing the barriers which prevent poor people from participating in conventional tropical tree fruit (e.g. citrus, cocoa, mango, papaya) marketing systems.

In 1999-2000, FRP's annual budget was in the order of £2.5M (Palmer and Macqueen 2000). As expenditure on fruit tree research will only be a fraction of the total budget in any given year, prioritisation is essential.

Implicit in the choice of species in option b) was the expectation that the paper would focus primarily on the marketing of fresh fruit products. However, the authors also recognise that the most valuable products of many indigenous fruit trees are nuts and oils, rather than the fruits.

The paper takes the form of a review of literature, supplemented by discussions with key informants (see Appendix 1). A first draft of this paper was presented to a specially convened workshop on Poverty and Fruit Tree Research held in London on 24/1/2001. This final version of the paper incorporates some of the comments (verbal and written) of the workshop participants. However, the views expressed in this version remain those of the authors. A copy of the workshop report, including the recommendations made by the participants to FRP, can be downloaded from the FRP web site at www.nrinternational.co.uk.

For the purposes of this paper, forest-dependent people are defined to include all four of FRP's main target beneficiary groups:

- small-scale poor farmers
- landless poor families
- small-scale traders and entrepreneurs
- urban and peri-urban poor families.

These people might participate in tree fruit systems as harvester-producers, labourers, processors, traders or consumers.

The paper is structured as follows. Firstly, current thinking on rural poverty and the means for its reduction is reviewed in sections 3 and 4. Then markets for tropical fruits are examined (section 5) and consideration is given to the production of fruit trees as cash crops (section 6), in order to assess the benefits that might be obtained through pursuit of option b) above. In section 7, attention is turned to the domestication of indigenous fruit trees and to the improvement of so-called "semi-domesticate" species, a term defined below. The benefits and limitations of domestication programmes are discussed. Despite the dichotomy suggested in the terms of reference above, proponents of domestication programmes also recognise the importance of market access for poor fruit tree growers. Therefore, specific measures to improve market access (for poor producers of both conventional tropical fruits and indigenous fruits) are discussed in section 8. Finally, conclusions are drawn as to where research might generate the greatest poverty reduction benefits.

2) **Definitions Adopted**

Domestication has been defined by Harlan as "human-induced change in the genetics of a plant to conform to human desires and agro-ecosystems" or, more generally, by Leakey and Simons, as "the management and adoption of genetic resources by farmers" (both quoted in Leakey, Wilson et al. 1999). Similarly, the Convention for Biological Diversity defines a "domesticated or cultivated species" as one in which the evolutionary process has been influenced by humans to meet their needs¹. From these definitions we note that:

- "Domestication" is generally associated with the planting of a particular species by farmers or others². Whilst individuals or communities typically engage in a number of management activities related to a given tree species (with implications for the genetic composition of the local population of that species) before they take to planting it, in this paper we adhere to the link between domestication and planting.
- The process of tree planting has significant consequences for the genetic composition of local tree populations, as planters have to select which planting material to use and generally aim to reproduce trees with particular, valued characteristics.

As will be noted later, domestication may occur largely through informal experimentation by planters or it may be accelerated through formal scientific research efforts. Roger Leakey has explained formal **domestication programmes** for tree species in the following way (www.agroforester.com):

"The domestication of tree species is a dynamic process which develops from deciding which species to domesticate and proceeds through background socioeconomic studies, the collection of germplasm, genetic selection and improvement to the integration of domesticated species in land-use. Domestication is an ongoing process in which genetic and cultivation improvements are continuously refined. In genetic terms, domestication is accelerated and human-induced evolution. Domestication, however, is not only about selection. It integrates the four key processes of the identification, production, management, and adoption of tree resources."

In this paper, we effectively equate the term **indigenous** with "not domesticated". Thus, indigenous species:

- are native to a particular district, country or region, in the sense that wild populations are (still) found growing there;
- are rarely planted by farmers – or have only recently begun to be planted;
- have received little attention from formal scientific research activities³.

Following the terms of reference, our intention is to distinguish such species from **conventional** tropical tree fruit species (e.g. citrus, cocoa, mango, papaya). We recognise that this distinction is not always hard and fast⁴. However, important differences that our distinctions are meant to highlight are that:

¹ Some people would argue that the evolutionary processes of most species have been influenced by humans (anthropogenic disturbance), as even forays into forests to gather forest products can affect the numeric and spatial distribution of species. Some, therefore, question whether any tree population can truly be called "wild". We, however, will use this term to connote any unplanted tree resource, generally off-farm.

² A given species may, therefore, be domesticated in one area whilst still remaining basically wild in another area.

³ Leakey and Newton (1994) use the term "Cinderella species" to describe such species.

⁴ For example, Scherr (1995) notes that mango and guava were introduced into Siaya and South Nyanza districts of western Kenya prior to 1900 – and could qualify as indigenous under our loose definition.

- Unlike indigenous species, conventional tropical tree fruit species have benefited from significant international (often commercial) research attention;
- They are now widely planted by farmers in many countries;
- As a result, well developed markets exist for conventional tropical tree fruit species at almost all levels (local, national, international). By contrast, whilst local and national markets are fairly well established for some indigenous fruits (and, in a few cases, informal cross-border trade takes place), there is little in the way of organised international trade.

In addition, with particular reference to Asia, we also wish to define a third category of fruit trees: **semi-domesticates**. These are species such as jackfruit, ber (*Zizyphus*), emblic, soursop and rambutan. Their defining characteristics are that:

- They are basically planted, although wild populations still exist;
- They have received a certain amount of research attention, generally from public sector research institutes within Asia, although the amount of attention that they have received is nothing like that received by conventional tropical tree fruits;
- Significant regional markets now exist for them, fuelled by economic growth in East and South East Asia in recent decades. In addition, some opportunities for export to western markets are developing, although they remain “niche” products in these markets.

They are thus an intermediate category between conventional tropical tree fruits on the one hand and what we are calling indigenous species on the other⁵.

3) *The Nature and Incidence of Poverty*

Poverty is now recognised as a multi-faceted phenomenon, encompassing issues of security and safety nets, self-esteem and belonging, power and control, as well as income and wealth considerations. However, much policy discussion still focuses on “income poverty”, both because it is the most amenable to measurement and because it connects to all the other dimensions. The central poverty reduction target to which DFID, along with most other donors, has committed itself is the halving of the number of people living on less than US\$1 per day by the year 2015.

In terms of this poverty line, a greater number of poor people are found in South Asia than in any other sub-continent or region. However, as a proportion of total population, the number of poor people is higher in Sub-Saharan Africa than elsewhere. The proportion of people falling under this poverty line has been falling in recent decades in South Asia, but has risen in Sub-Saharan Africa. This paper will focus primarily on Sub-Saharan Africa and South Asia, with some reference to Latin America.

Despite growing urbanisation, the majority of poor households in both Sub-Saharan Africa and South Asia are still found in rural areas. Landless households feature prominently amongst the poorest in South Asia, whereas landlessness is less common in Sub-Saharan Africa. Nevertheless, restricted access to land is a feature of many of the poorest rural households. Access to water is an increasingly important determinant of well-being in both continents, whilst education levels are an important determinant of the ability of household members to obtain work outside the immediate rural environment. The major countries in Latin America are characterised by a higher degree of urbanisation than is found in most of Asia or Africa. Meanwhile, the rural areas are characterised by

⁵ In fact, even a three-way distinction is imperfect and somewhat arbitrary. As well as varying from place to place, the status of a given species can alter over time. For example, mangosteen might be classed as a semi-domesticated in Sri Lanka, but Vinning and Moody (1997) class it as a “crossover” crop in the Australian context, i.e. on the verge of being seen as a conventional tropical tree fruit.

extreme inequality between wealthy landlords and poor peasants (and also inequality within poor communities). According to de Janvry and Sadoulet (2000), the number of poor rural households has been rising in Latin America (excluding Brazil) in recent decades, in both absolute terms and as a proportion of all rural households. In Central America, the majority of all poor households still live in rural areas, although this is not the case for the rest of Latin America.

There is some debate as to whether the occurrence of rural poverty is greater in more remote or in relatively more accessible areas. Higher potential and more accessible agricultural areas tend to be home to higher densities of people, including very poor households. However, the challenges of poverty reduction are arguably more acute in more remote areas and areas of lower agro-ecological potential, particularly with the increased reliance on market mechanisms and a reduced role for the state in rural development activity in recent years. de Janvry and Sadoulet (2000) for Latin America and Dercon and Krishnan (1998) for Ethiopia report that remoteness from major markets contributes to poverty by reducing the returns that households can obtain on their other assets (e.g. land, capital). Fan, Hazell et al. (2000) suggest that higher returns (in terms of poverty reduction) could now be achieved on various forms of public investment in remoter parts of India than in more accessible parts, given the quantity of investment already undertaken in more accessible parts and the increasing gap between development here and in less favoured areas.

What implications do these broad facts have for the current paper? The international development targets suggest that research should identify and address problems impacting on large numbers of people, rather than seeking larger gains in well-being for a few⁶. The characterisation of poor households suggests that research should focus on generating benefits (direct or indirect) for particular types of households and possibly also for particular geographic regions, although the question of the cost of generating benefits for different household types and/or in different areas has also to be taken into account. The difficulties of proving and quantifying the links between research and poverty reduction are widely recognised (Kerr and Kolavalli 1999), as is the uncertainty inherent in the research process. Not all efforts to overcome researchable constraints will be successful. However, setting out in the right direction is important if one is to reach a desired goal.

4) *Approaches to Poverty Alleviation*

World Development Report 2000

World Bank (2000) suggests a three-pronged strategy for tackling poverty in its various manifestations. The latest terminology concerns promoting opportunity, facilitating empowerment and enhancing security. Economic growth is still seen as essential to poverty reduction. However, there remains some debate (including within the Bank) as to how important the “quality” of growth is to poverty reduction. World Bank (2000) summarises evidence showing that high starting inequality is bad both for the rate of growth and for the poverty reduction impact of any growth that does occur. At the same time, growth itself may exacerbate inequality. Beyond the short term, growth is inevitably bound up with processes of structural change, which – again almost inevitably – create losers as well as winners. It may be little comfort to those immediately disadvantaged that, in the proverbial long term, they (or their children) will be better off. The faster the growth, however, the shorter that “long term” is likely to be.

⁶ There are, of course, dangers in only looking at headcounts. For example, poverty reduction could be considered to have happened if a small improvement in livelihood lifts an individual or household above the accepted poverty line, whereas a greater improvement in livelihood might leave an even poorer individual or household below the line (Reddy and Chakravarty 1999).

Two concerns of World Bank (2000) that are directly relevant to the current paper are the concern to make markets work better for the poor⁷ and to expand the assets of the poor. According to the Bank, making markets work better for the poor, involves making markets more competitive – to reduce the exercise of monopoly power by sellers and/or middlemen at their expense⁸ - and reducing barriers that specifically hinder poorer producers and traders from competing successfully in them. Such barriers include, for example, poor access to capital and information or regulations that discriminate against small players (for example, by imposing fixed costs on all players regardless of their size).

Sustainable Livelihoods

Particularly in the rural arena, DFID's approach to poverty reduction has centred on the promotion of "sustainable livelihoods"⁹. Farrington, Carney et al. (1999) state that a livelihood:

“... comprises the capabilities, assets (including both material and social resources) and activities required for a means of living.” (p1)

The sustainable livelihoods framework conceives of individuals and households as having five types of asset – human, financial, physical, natural and social – which they can use to generate income or consumption goods, both in normal times and in periods of hardship. Risk and uncertainty are taken as everyday facts of life for poor households. The livelihoods framework also accepts that poor households often have to take as given a whole set of market and political processes, which determine the terms on which they access and sell goods and services. However, they can also work collectively to influence these terms.

Assets

Different schools of thought place greater emphasis on different parts of this “livelihoods framework”. One school, which we may call the human development school, believes that investment in human capital – giving people internal resources with which to chart their way through life's uncertain waters - is the safest developmental bet, given the uncertainty surrounding everything else. This translates into heavy investment in education and health programmes.

Others emphasise asset creation more broadly. In the context of the current paper, we note the significance of **trees as (natural) assets**. Different trees perform different and multiple livelihood functions, which include:

- Generation of consumption goods (e.g. fruit, firewood)
- Generation of production inputs (e.g. construction materials, fodder, soil nutrients)
- Generation of income, through sale of most of the above

⁷ DFID's 1997 White Paper (DFID 1997) similarly highlights the importance of developing “well-regulated” markets.

⁸ Poor producers may, of course, lose out to competition from better-resourced or better-positioned rivals in markets in which they try to sell.

⁹ A related approach to poverty reduction that has a strong following within DFID is the “rights based” approach to development, which starts from the basis that all people – including the poor – have various human, economic and political rights. Recognising the rights of the poor gives a distinctive perspective on development problems, as economic concerns about returns from scarce resources are not given supremacy. Rather the emphasis is on finding the most effective ways of realising people's rights. Concerns about property rights expressed in this paper would chime in with a “rights based” approach to development issues.

- Savings / investment function, whereby the tree or wood can be sold to meet an immediate cash need. Chambers and Leach (1989) argue that trees can be as effective a savings mechanism for the rural poor as many other more familiar ones, e.g. livestock, financial services.
- Security function, whereby the tree's produce is relied on particularly at times of the year or in years when other sources of food or income are in short supply.

A theme that we shall refer to later in the paper is the **multi-functionality** of many tree species. Whilst some species might generate particularly attractive income streams (albeit for a short period of the year), others might be valued for the other livelihood functions that they perform, maybe over the long-term, whilst at the same time having the potential to generate a more modest stream of income.

Agricultural-Led Growth

Another school of thought stresses the importance of smallholder agricultural growth in rural poverty alleviation and, indeed, in economic growth more broadly. Recent literature on the importance of non-farm income sources notwithstanding, agriculture¹⁰ is held to be important because:

- At least since the days of Adam Smith, economists have recognised that the driving force of economic growth is the production of goods tradable outside the immediate area of production. In many rural areas in developing countries, agricultural products are the major locally produced tradable goods. (In areas of low agricultural potential, migrant labour may be even more important, however).
- The majority of rural households are still engaged, to a greater or lesser degree, in agricultural production. In many areas, the poorest households are the ones most dependent on agricultural production for their livelihoods.
- There are a number of important “multiplier” linkages between smallholder agricultural production and other rural activities.

Hazell and Hojjati (1995) identify four main types of linkage:

- Increases in agricultural production generate increased demand for labour. This again is particularly important for poverty reduction, as the poorest households are often highly dependent on income from un/semi-skilled employment, being either landless or owners of plots that are too small to absorb all their available household labour.
- A wide range of non-farm activities in rural (and urban) areas either supply production inputs to agriculture, use agricultural products as raw materials or involve the trading of agricultural products.
- Smallholder households tend to spend a significant proportion of any incremental income from crop sales on goods and services produced in the local area¹¹. It is sometimes maintained that poor households are important suppliers of such local goods and services. However, Reardon, Taylor et al. (1998) find that, particularly in Africa, it is primarily the better-off rural households that have both the capital and the skills to provide most of these services. Thus, for the poor to benefit from

¹⁰ ‘Agriculture’ here need not be limited to annual, arable agriculture, although it is sometimes couched in such terms. For example, the arguments advanced in favour of an agriculture-led approach to rural poverty reduction apply equally well to fruit (and nut) tree production.

¹¹ This does not include school fees or (formal sector) medical expenses, where payment tends to go straight to central government. Few of the major “linkage” studies are based on data collected after the introduction of such user charges and it is possible that the proportion of incremental income spent on local products has fallen as a result. If so, the local multiplier effect from increased agricultural production will be lower. It should be noted that the definition of local varies from study to study. It can be anything from the village in which production occurs to the country in which it occurs. Thus, the results of such studies, and their implications for rural poverty reduction, are not always directly comparable.

consumption demand generated by increased agricultural incomes, training and microcredit provision may be necessary.

- Agricultural profits can be an important source of investment capital for non-agricultural activities. However, increasingly another dynamic is also observed: those households with access to remittance income from relatives living in urban areas are the ones most able and willing to invest in agricultural improvement (Savadogo, Reardon et al. 1998; Jayne 1994). This is highly relevant to tree planting activities (Noordin, Amadalo et al. 1999).

Studies of the indirect consequences of the Green Revolution in Asia estimate regional agricultural multipliers between 1.3 and 4.3, i.e. a one dollar increase in technologically induced agricultural income generated an additional \$0.30 to \$3.30 income in other sectors of the rural region in question (Haggblade, Hammer et al. 1991). Conventional wisdom is that multiplier effects are weaker in Africa. Hazell and Hojjati (1995) attribute this to:

- lower levels of per capita income that restrain consumption expenditure on non-foods;
- more traditional agricultural practices that use fewer purchased inputs;
- poor infrastructure development that weakens links between villages and rural town;
- low population densities that lead both to seasonal bottlenecks that choke off the supply of local products in response to extra demand;
- inadequate market concentration which hinders the growth of small, labour intensive firms.

Delgado, Hopkins et al. (1998) have estimated multipliers of 2.0 or more for a number of African situations. However, these estimates are critically dependent on the classification of particular products as tradable or non-tradable and, to a lesser extent, on assumptions made about labour availability.

Bautista and Thomas (1999) estimate a GDP multiplier of 1.92 for smallholder agricultural growth in Zimbabwe and lower multipliers (1.5 – 1.6) for traditional and non-traditional agricultural export growth. (Even these figures compare favourably with the best non-agricultural growth multiplier – that from labour-intensive light manufacturing). An important general comment offered by Bautista and Thomas (1999), and one that is supported by Delgado, Hopkins et al. (1998), is that:

"... the 'consumption linkage' effect of the induced increases in rural income represent the more potent intersectoral influence than the 'production linkages' of agricultural growth."
(p.66)

The lower multiplier from export agriculture occurs because this is predominantly a commercial farm activity and commercial farmers are more likely to spend their incremental income on capital-intensive and/or imported goods than on labour-intensive, local goods and services. On the other hand, whilst households in communal areas benefit most from smallholder agricultural growth, the other two poor groups in Bautista and Thomas's (1999) model - workers on large-scale commercial farms and urban low income groups - benefit less from smallholder agricultural growth than they do from any of the other posited growth paths. We thus note that there may be trade-offs between the benefits received by FRP's four target groups of poor, forest-dependent households from different research and development interventions. In particular, focusing on the livelihoods of small-scale farmers (as we do later in this report) may generate fewer benefits for urban and peri-urban poor families than a growth strategy built on commercial crop production. To the extent that this is the case, we would justify our focus in terms of the current distribution of poor households in our target regions (section 2). A focus on small-scale farmers is also likely to generate greater benefits for small-scale traders and entrepreneurs than an emphasis on commercial crop production. The impact on landless households of the different strategies is less clear, given the low labour requirements of much fruit tree production (section 6).

The Poor as Consumers

Historical evidence suggests that agricultural growth does indeed play a critical role in the early stages of economic development (Timmer 1988) and hence poverty reduction. In addition to the linkages noted above, agricultural growth keeps food prices down. This:

- benefits the majority of rural households who are net consumers of staple and other food products (see, for example, Barrett (1998));
- assists the shift of population to urban areas as industrial and service sectors begin to grow.

Winters, de Janvry et al. (1998) highlight the importance of the “invisible transfers” from rural to urban areas implied by falling real food prices. Of course, lower food prices may enable employers to offer lower wages – indeed, this is one of the ways in which agricultural growth assists industrial development. However, it still remains true that the urban poor can be major beneficiaries of agricultural growth. A broad conclusion from the Green Revolution experience is that the major group of poor beneficiaries was poor consumers, as production increases of rice and wheat lowered the real price of staple foods over time (Lipton and Longhurst 1989). However, it is also worth noting that this occurred because these items were not freely imported and exported at the time that domestic production was expanding rapidly. Where key agricultural products are freely traded internationally, domestic price levels are determined largely by prices prevailing on international markets¹² rather than by domestic supply and demand. Therefore, domestic production increases do not translate into lower consumer prices. Rather, a larger proportion of the gains from expanded production will accrue to producers and those who supply them with goods and services (Winters, de Janvry et al. 1998).

Cash Cropping

Poulton, Al-Hassan et al. (2000) have recently reviewed literature on cash cropping in the light of these wider literatures on livelihoods and the role of agriculture in economic development. They define cash crops as “crops that are intended entirely or primarily for market”, in contrast to food crops which are “intended entirely or primarily for home consumption”. Greater emphasis on cash crops is seen as both an inevitable feature of rural development and essential if the agricultural sector is to support economic development more generally. Cash crops typically have a higher value than those consumed within the household, whilst the higher input usage associated with such crops (and at some stage also the increasing specialisation in production associated with them) raise the efficiency of resource use in production. Cash crops thus typically generate higher returns to both land and labour than food crops¹³.

¹² Domestic prices can fluctuate within a range, the lower bound of which is set by the export parity price and the upper bound of which is set by the import parity price. In landlocked countries and countries where infrastructure is particularly poor, i.e. quite a bit of Africa, the costs of transporting products between the point of production / consumption and a port can be extremely large. In these cases, the range within which prices can fluctuate is this also wide, so domestic supply and demand remain important determinants of prices.

¹³ An important recent paper by Cavendish (2000) sets out to show that the significance of common property “environmental resources”, including many tree products, has been systematically underestimated in much development discourse, not least in relation to “cash crop production, unskilled labor income and small-scale enterprises and crafts”. The paper presents detailed data from Shindi Ward in southern Zimbabwe, an area of low agricultural potential. However, even this paper acknowledges that, “... it is clear that the process of enrichment in Shindi involves shifting into much more lucrative economic activities. The counterpart to the declining environmental cash income share is the rising share of cash derived from remittances and, less significantly, high value crops and large livestock.”

At the same, greater exposure to markets for both own output and food supplies (often the corollary of shifting more resources into cash crop production) entails risks (Fafchamps 1992). Combined with the higher input costs associated with much cash crop production, these often serve to discourage poorer households from engaging in significant cash cropping activity. In Africa, it is commonly the households that are able to produce enough staple foods to meet their own basic needs that invest in cash crop production (Jayne 1994; Govereh, Nyoro et al. 1999). This is often only the top quartile or fewer. Cash crop production may thus contribute to rural inequality (Savadogo, Reardon et al. 1998), even though it can also generate significant multiplier benefits for poorer households.

In addition, women rarely share equally in the benefits of cash cropping. Rather, gains in cash crop income that flow their way are liable to be offset by increased demands on their labour time. Where crops start out as “women’s crops”, control of production and marketing decisions is often assumed by men when the income-earning opportunities exceed those derived from more traditional men’s cash crops. Poulton, Al-Hassan et al. (2000) note that these effects are related to local cultures and “are not immediately amenable to change through policy legislation”. They tentatively suggest approaches to enhance the benefits that women derive from cash crop-led growth:

- Legislation that seeks to strengthen women’s right to land;
- Support to women-only marketing associations;
- Strengthening the capacity of women producers to supply the goods and services demanded as rural incomes rise through cash crop production. This should not only enhance women’s livelihoods directly, but should also strengthen their bargaining position within the household over labour input into cash crop production.

Overall, Poulton, Al-Hassan et al. (2000) recommend that public policy should not seek to restrict cash crop production, but should rather find ways of broadening participation in cash crop production and marketing and also of enabling poor households to benefit from the “linkage” effects into the remainder of the rural economy. They suggest:

- Continued efforts to improve the performance of food marketing systems, not just for its own sake, but also to reduce the costs and risks for poor, food deficit households of relying on food purchased from the market;
- Measures to widen access to land and capital and to increase information flows about markets and prices (although none of these are without their difficulties);
- Continued research into contract farming schemes and other forms of interlocked transactions¹⁴, as a means both to broaden participation in cash crop production and to provide access to inputs for enhanced food crop production;
- Research into market opportunities and appropriate technology for local crop processing, as a means of increasing rural employment, particularly for women.

Sustainability

An aspect of poverty reduction that we have not touched upon so far is the sustainability of livelihoods. Farrington, Carney et al. (1999) state that:

“A livelihood is sustainable when it can cope with and recover from stresses and shocks, and maintain or enhance its capabilities and assets both now and in the future, while not undermining the natural resource base.” (p1)

¹⁴ Interlocked transactions have been defined as “Provision of seasonal inputs on credit using the borrower’s expected harvest of the crop in question as a collateral substitute to guarantee loan repayment.” (Poulton, Dorward et al. 1998: 88).

Increases in income and consumption will not be sustained if they are achieved at the expense of running down the asset (including natural resource) base upon which the poor ultimately depend. However, this unobjectionable statement masks the fact that important trade-offs may still be made. For example, the sustainable livelihoods approach does allow for some trade-offs between asset classes. Thus, typically, economic development is accompanied by some running down of the natural resource base, but at the same time other assets (especially human, physical and financial) increase tremendously. In some cases these may act as substitutes for reduced natural assets. Alternatively, when disaster strikes because of neglect of the natural environment, they provide the resources with which to cope.

Here we consider briefly two issues of direct relevance to the current paper¹⁵: maintenance of soil fertility and of biodiversity.

Soil Fertility

Maintenance of soil fertility is critical to the prospects for agricultural development, particularly in Sub-Saharan Africa (Larson and Frisvold 1996). Poulton, Al-Hassan et al. (2000) observe that unresolved difficulties with provision of credit for seasonal agricultural production are making cash crop production an increasingly important channel through which inorganic fertilisers can be purchased and applied to farms. Cash crop production may thus benefit food crop production within mixed systems either through generating income for purchase of fertiliser or through residual effects on soil fertility. From the foregoing discussion of cash cropping, however, it is clear that only a minority of households can obtain benefits through this route. The remainder have to rely instead on other non-farm income sources for fertiliser purchase or on entirely organic approaches to soil fertility maintenance¹⁶.

Tree crops, even when grown primarily as cash crops, rarely receive significant inputs of inorganic fertiliser, although they may generate revenue that can be used for fertiliser purchase for food crops. On the other hand, they may contribute to soil fertility through leaf litter deposition, as well as protecting soil from erosion by water and wind. Particular tree species may be planted (or retained) by farmers in their fields for their contribution to soil fertility through generation of green manures. Others have root systems that make them particularly effective at soil stabilisation. This makes them excellent choices as cash crops in hilly areas (Shively 1999).

Warner (1995) extols the virtues of the tree-banana-coffee gardens around Mount Kilimanjaro in northern Tanzania as both sustainable and highly productive land use systems in an area of high population pressure. Banana does well under shade and, in turn, provides mulch for the coffee bushes. However, these gardens are only part of the overall farming system in the area. High population density means that the gardens are too small for households to survive on them alone. They have, therefore, expanded their maize cropping into the plains below.

Warner observes that:

¹⁵ We have decided not to look at other environmental issues such as carbon sequestration and impact on microclimates, as the links between these and fruit trees, which are often planted in small numbers by particular individuals at any given time, are somewhat less direct.

¹⁶ In Shindi Cavendish (2000) highlights the importance of termitaria and leaf litter, which were found to be more important (in value terms) than either livestock manures or, in one survey year, inorganic fertilisers. It should be pointed out that the “ideal”, from the perspective of the current authors, is not an inorganic-only approach, which would be disastrous for soil structure (amongst other things), but organic practices supplemented where necessary by additional, purchased inorganic nutrients.

"The pressures of rapidly growing populations for the intensification or expansion of existing LUSs [land use systems] are likely to impose growing threats to some monocropping systems. Trees should play an increasing role in maintaining soil fertility and in reducing levels of risk for households and their crops in the region and in diversifying the range of farm household products and income. This is likely to need, in addition to the present patterns of integration of trees, new niche and micro-level ways of incorporating trees." (p106)

Biodiversity

The maintenance of biodiversity may traditionally have been seen as a luxury in the face of urgent development necessities. However, there is now a widespread recognition both that:

- the solution to some of man's most intractable problems (e.g. health issues) may be dependent on genetic resources the value of which is currently scarcely appreciated, and that
- the poor are particularly dependent on the maintenance of biodiversity for their livelihoods. In the area of forest resources, studies (e.g. (Cavendish 2000), Reddy and Chakravarty (1999)) have shown that it is generally poor groups that derive the greatest proportion of their total household income from forest products and sometimes also that these groups derive the greatest absolute income from forest products. In India, 50 million people are assumed to rely on forest products. A study by Hegde, Suryaprakash et al. (1996) of interior and forest margin communities of Soliga people in Karnataka State showed that marginalisation in terms of physical distance from markets, lower levels of education and restricted employment opportunities increased dependence on household harvesting and marketing of NTFPs in the Soliga communities. Forest resources may also be a particularly important source of food and other essentials during times of climatic stress Palmer and Macqueen (2000). More generally, poor agricultural producers rely on maintaining diversity of income sources – and therefore of biodiversity also - to protect them from a range of possible shocks. Planting a range of crops offers a given household some protection against climatic, market and disease risk. The poor have the fewest assets to draw upon when harvests fail. On a slightly wider scale, maintaining genetic diversity even within a given species offers protection against pest and disease infestation. The poor are the least able to afford the crop protection chemicals if pests and diseases are rampant.

Conservation of biodiversity, however, is not free. Therefore, even if the poor are the prime targets, there is a trade-off to be made between investment in biodiversity and in building other components of the asset portfolio of poor households.

Integrating Theoretical Frameworks

The sustainable livelihoods and agricultural-led growth perspectives on poverty reduction have different origins (anthropology / grassroots participatory studies vs economic history) and so contain different emphases. Whilst the latter is more prescriptive in terms of its sectoral priorities for poverty reduction, it should be remembered that the micro-level changes in livelihood portfolio that it views as desirable occur over generations. By contrast, although the sustainable livelihoods framework recognises risk as an unavoidable part of life for poor people, it remains essentially a snapshot into the circumstances of poor households at a given point in time, with a whole set of external circumstances taken as given. It thus provides little strategic direction for poverty reduction, other than to build on what poor households already have and do. This absence of strategising is seen as desirable by some proponents (e.g. Ellis (2000)) and is indeed a useful caution against trying to push poor households too fast along a particular development path or along a development path that is not of their choosing¹⁷. In

¹⁷ It also has its drawbacks, however. For example, where poor households produce goods and services for local markets, expanded production of these will soon depress their prices if, at the same time, nothing is occurring to

the debate on cash cropping, one might see the sustainable livelihoods framework as providing insights into the ability of different households to engage in significant cash crop production. This ability depends both on:

- their own asset position, which – in addition to basic requirements such as land and labour - affects their ability to finance cash crop production and, perhaps even more importantly, their ability to bear the various risks that this entails;
- the external environment, most notably the level of market development and the efficiency with which marketing services are provided.

Where poor households generate good returns from cash crop production, they can invest these in various ways (education, soil and water conservation, production inputs, non-farm enterprises) and enhance their asset position, thereby enhancing their capacity to expand their production activities in future. Similarly, as more producers sell crop surpluses, competitive marketing services are more likely to develop – and infrastructure investment can be more easily justified. In turn, this will encourage greater production. On the other hand, where few households have the asset base and capacity to bear the risks associated with significant cash crop production, the priority of a programme such as FRP might be to enhance the general asset base of poor households. Expanding opportunities for cash sales could well be a part of this, but not the only (or even necessarily the dominant) objective.

In other words, it is important to note that the potential for widespread participation in cash cropping activity – and the importance of such activity within the economy as a whole – evolves over time. With specific reference to smallholder tree crop agriculture, Barlow and Jayasuriya (1986) set out three stages of development. The first they call the emergence from subsistence, which may be triggered by the building of the first major road into an area, the arrival of traders or the spillover effect of the establishment of large-scale plantation production. Gradually, infrastructure and services (e.g. credit provision, input supplies, extension) improve, such that producers can respond much more readily to changing market opportunities. Planting material is also improved either by formal research or farmer adaptation. Thus, a phase of agricultural transformation takes place, albeit still within a framework of large numbers of tiny, semi-subsistence producers using highly labour intensive production methods. Eventually, this agricultural transformation stimulates broader economic growth and industrial and service sectors become the driving forces within the economy. As these other sectors compete with agriculture for available labour, real wages are at last driven up significantly. Tiny farm plots can no longer generate competitive incomes. As less successful households sell up and move out of rural areas altogether, the more successful expand, adopting mechanised production practices to economise on rising labour costs. In this third stage of extensive structural change, agricultural (including tree crop) production becomes oriented almost entirely to the needs of expanding urban and export markets.

In general, the commercialisation of smallholder agriculture (i.e. its progression through the stages set out by Barlow and Jayasuriya (1986)) has proceeded much further in Asia than in Africa. The greater population density in much of Asia than in most of Africa, and the interactions of population density with asset ownership, are undoubtedly important contributory factors. However, even more important have been the rapid advances achieved in agricultural production technology (the Green Revolution) and the high rates of broader economic growth achieved most notably in East and South East Asia¹⁸,

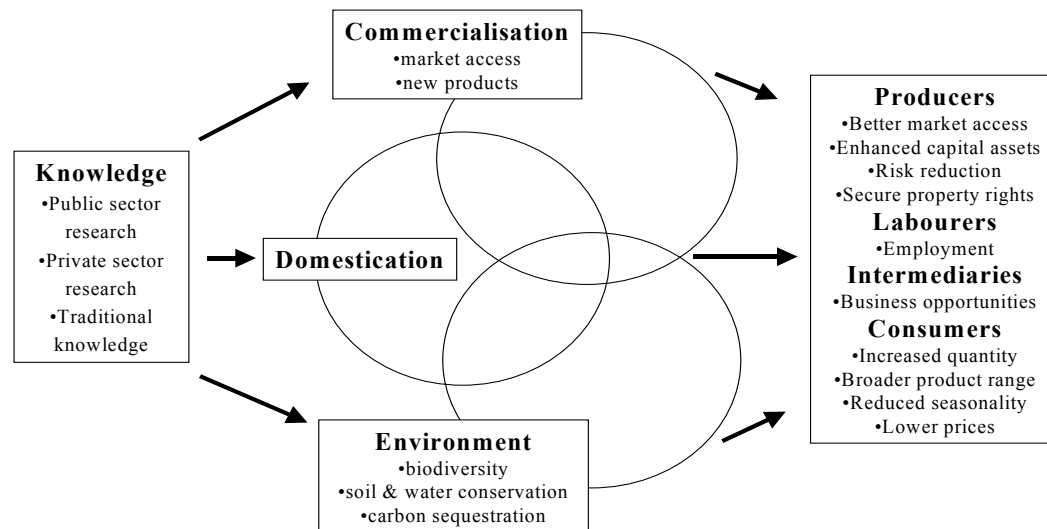
raise the level of local demand for such products (e.g. increasing incomes through expanded production of goods traded in wider markets).

¹⁸ Pingali (1997) describes the structural changes now taking place in East Asian agriculture, that correspond to Barlow and Jayasuriya (1986)'s third stage of development. Except in the highest potential rice areas, agricultural producers are searching for high value alternatives to rice production. Multi-purpose production systems are being replaced with specialised, higher productivity ones. Thus, not only are tractors replacing livestock as the main source of draft power, but fodder markets are developing to meet the needs of dairy and other (zero grazing) livestock producers.

but also in some areas of South Asia in recent years. Arguably, small-scale producers in South Asia are not only better equipped to produce agricultural surpluses for market than their counterparts in Sub-Saharan Africa, but also face greater pressures to do so (e.g. need to pay rents, water charges etc). Later in this paper, we will suggest that research priorities for Sub-Saharan Africa and South Asia might be somewhat different.

Diagram 1 summarises the contributions that fruit tree research can make to poverty reduction for FRP's four target groups, and also illustrates the overlaps between aspects of a possible research portfolio.

Figure 1: Fruit Tree Research Inputs and Livelihood Outputs for FRP Target Groups



In sections 5 and 6, we explore the second option set out in the terms of reference for this paper: reducing poverty through reducing the barriers which prevent poor people from participating in conventional tropical tree fruit (e.g. citrus, cocoa, mango, papaya) marketing systems. Two issues are investigated:

- the nature of markets for such fruits (in contrast to markets for indigenous and semi-domesticate fruits)
- particular characteristics of fruit trees that influence the magnitude and distribution of benefits that might arise from the cultivation of such fruits primarily for market. This builds on the discussions of agricultural-led growth and cash cropping (above), and links fruit tree production for market to FRP's four groups of poor, forest-dependent people.

It is argued that:

- international markets for conventional tropical tree fruits offer few opportunities for poor producers in poor countries (even with additional research by a programme such as FRP);
- in poor countries, domestic markets for conventional and indigenous fruits are similar in nature, so there is little justification in focusing narrowly on conventional fruits;
- the linkage effects of fruit tree cultivation on the livelihoods of poor people are likely to be modest;
- where poor households themselves grow fruit trees, they do so for a variety of reasons – including, but certainly not restricted to, their cash earning potential.

5) **Markets for Tropical Tree Fruits**

In thinking about markets for tree fruits, we may usefully distinguish between:

- local (rural) markets
- national markets (and cross-border markets in Africa)
- regional markets in Asia
- international markets.

Local Markets

In line with local markets for other products, we characterise these as:

- informal
- most players operating on a small scale
- short marketing chains (sometimes just direct producer – consumer interaction)
- generally low margins
- little emphasis on quality
- high seasonality
- reasonable information flows
- significant other inefficiencies (e.g. peri-harvest losses, glutting).

Clearly, such markets are important outlets for some producers (Gumbo, Mukamuri et al. 1990). In particular, poor producers who wish to make small, irregular sales and cannot afford high costs of accessing remoter markets, may depend largely on local markets. Nevertheless, such markets have only a limited capacity to absorb surplus produce and marketing interventions to assist producers should soon seek to improve their links with wider market systems.

National Markets

These will be the most important markets for the majority of smallholder producers over the medium term (say, up to the 2015 deadline for the international poverty reduction targets). FAO (2000) note that:

"The volume of [international] trade in fresh tropical fruits is very low, averaging slightly over three percent of production for the past five years, as output is mainly consumed in domestic markets." (p40)

The dominance of the domestic market is particularly the case in low income countries. India produces almost 50% of the world's mangoes, although it is only the world's fourth largest exporter (FAO 2000)¹⁹. Similarly, China is the world's largest producer of mandarins, but exports are negligible (Poole 1999). This means that, in relation to our earlier discussion of linkages and multipliers, increased domestic production is likely to translate into lower real prices for consumers over time.

¹⁹ Although this is not captured in Table 1b, Brazil overtook India to become the world' third largest exporter of mangoes in 1998.

We characterise national fruit marketing systems in most poor countries²⁰ as:

- still largely informal
- most players operating on a modest scale
- longer marketing chains than in local markets, but little (if any) development of cool chains
- significant price volatility due to limited information flows and high perishability
- high seasonality
- limited added value through small-scale processing
- profit margins generally low (particularly once risk factors are taken into account), but marketing costs often high due to poor transport, roads and communications infrastructure
- price premia for good quality and supplies out of main season, but still relatively little emphasis on quality overall (many consumers are poor).

Mango markets in India illustrate this last point. Lespinasse and Bakry (1998) note that intensive breeding activity over several decades has produced hybrids that are regular bearing, with good quality fruits, attractive skin colour and higher pulp yield than traditional varieties. “Nevertheless, owing [to] problems of commercialisation and promotion in markets, the adoption of these new varieties is still fairly low.”

The demand-side characteristics of these markets do not impose any major constraints on successful participation by poor producers. Whilst this remains the case, the most critical aspect of the market system affecting participation by poor producers is likely to be the existence (or otherwise) of a well-developed system of market intermediaries to assemble their small and irregular surpluses at reasonable cost.

In Africa, national and even cross-border markets in some indigenous tree fruits are fairly well developed. For example, Schreckenber, Degrande et al. (2000) quote findings from Ndoye et al. (1998) that trade in four species (*Dacryodes edulis*, *Irvingia gabonensis*, *Cola acuminata* and *Ricinodendron heudeloti*²¹) within Cameroon and to neighbouring countries was worth US\$1.75 million in the first half of 1995. An estimated 1,100 traders, mainly women, were engaged in this trade.

In general, cross-border trade in Africa shares many of the characteristics of national market systems outlined above. However, for traders, problems of obtaining timely and reliable marketing information and enforcing contractual agreements are more difficult.

Asian Regional Markets

These have grown rapidly with the economic growth of East and South East Asian economies in recent decades. Significant levels of regional trade occur in many semi-domesticates, capitalising on rising urbanisation and urban incomes on the one hand and the existence of sizeable communities of migrants on the other. Vinning and Moody (1997) highlight durian, longan, lychee, pitahaya, pomelo, rambutan, carambola, coconut, custard apple and jackfruit as offering medium-good market prospects. Some traders in South Asia are already responding to opportunities to supply markets in East and South East Asia. For example, jackfruit is exported from Bangladesh and India to Malaysia, Thailand,

²⁰ Exceptions will be found where supermarkets are developing linkages with major wholesalers and/or commercial suppliers, as in much of Latin America and Zimbabwe. This may only affect a segment of the national market system, however.

²¹ These are known in English, respectively, as: African plum, bush mango / dika nut, cola and njangsang.

Singapore and Hong Kong (where, amongst other uses, it is used to flavour ice cream). Ber is exported to Thailand, Malaysia and Singapore (where, amongst other uses, it is used in jams and pickles). Obviously, demand in these markets was then hit by the 1997-98 East and South East Asian crisis. However, insofar as trade was affected by the downturn in incomes and the return home of migrant workers, we may expect these markets to continue to grow as general economic growth resumes its upward path.

From the limited information on the organisation of these regional markets collected by the authors, it appears that they have not yet succumbed to the quality- and safety-driven pressures for closer vertical integration within supply chains that are now such a major feature of western-type markets²². This means that there may still be opportunity for relatively poor producers in South Asia to participate in the relevant supply chains.

At the same time, major markets in South Asian metropolises (such as Azadpur in Delhi) source a wide range of produce from across the sub-continent.

International Markets

Tables 1a-c and 2a-c (all reproduced from FAO (2000), show trends in the production and international trade of major conventional tropical tree fruits since the mid-1990s.

Table 1a: Major Global Producers of Selected Tropical Tree Fruits ('000 tonnes)

	1994-6 (average)	1997	1998	1999
<i>Mangoes</i>	22388	23138	21000	22853
India	11497	12000	9000	11000
China	1844	2140	2100	2150
Mexico	1216	1510	1461	1538
<i>Avocados</i>	2199	2146	2184	2259
Mexico	809	762	896	907
US	168	166	156	131
Dominican Republic	158	155	155	155
<i>Papaya</i>	5005	4830	4825	5082
Brazil	1752	1763	1763	1763
Indonesia	446	283	283	336
Nigeria	500	500	500	500
<i>Other Fruits</i>	12839	14018	14021	14172
Philippines	3590	3695	3695	3700
India	3290	3500	3500	3700
Indonesia	1630	2000	2000	2000
Total	42431	44132	42030	44366

Source: FAO, 2000

²² Latin American markets vary in the degree of sophistication but broadly can be categorised as intermediate between the mode in Asian regional markets described above and the following account of advanced western-type markets. See, for example, Reardon, Codron et al. (forthcoming).

Table 1b: Major Exporters of Selected Tropical Tree Fruits ('000 tonnes)

	1994-6 (average)	1997	1998
<i>Mangoes</i>	357	466	510
Mexico	141	187	209
Philippines	38	45	53
India	17	23	39
<i>Avocados</i>	241	240	322
Mexico	56	50	71
Israel	37	40	29
South Africa	27	23	47
<i>Papaya</i>	104	115	128
Mexico	36	48	60
Malaysia	35	33	34
US	9	7	6
<i>Other Fruits</i>	120	110	113
Malaysia	56	43	43
US	21	24	23
Kenya	9	13	8
Total	822	931	1073

Source: FAO, 2000

Table 1c: Major Importers of Selected Tropical Tree Fruits ('000 tonnes)

	1994-6 (average)	1997	1998
<i>Mangoes</i>	348	433	471
US	145	187	197
EC	82	117	131
Hong Kong	33	39	47
<i>Avocados</i>	220	254	308
EC	154	175	194
US	23	27	61
Canada	9	10	11
<i>Papaya</i>	95	110	114
US	36	48	48
Singapore	21	22	21
Hong Kong	13	12	13
<i>Other Fruits</i>	129	167	143
Singapore	50	58	56
Malaysia	22	37	15
Canada	19	22	27
Total	792	964	1036

Source: FAO, 2000

North American and Western European markets are the main destinations for internationally traded mangoes, papaya and avocado. Traded volumes of these products expanded fairly rapidly in the second half of the 1990s, despite stable global production. The main driving forces in this export expansion were middle income countries, such as Mexico, Philippines and Brazil.

The “other fruits” in Tables 1a-1c are primarily the more commercialised semi-domesticated / “crossover” species, such as durian, guava, lychee, mangosteen and rambutan. As can be seen from

Table 1a, in production terms they are collectively about half as important as mango. In international trade terms, they are about one third as important (if 1997 and 1998 are accepted as bad years due to the Asian crisis). International export arrangements for indigenous fruit products are still rare and rarely large scale.

Table 2a: Major Global Producers of Citrus Products ('000 tonnes)

	1994/5 – 1996/7 (average)	1997/8	1998/9 (estimate)	1999/2000 (forecast)
<i>World Total</i>	83018	92900	81462	88875
Brazil	16859	20626	17659	19637
US	14683	16090	12396	15003
China	7302	9522	8101	9069
Mexico	5152	4965	4475	4530
Spain	4755	5885	5261	5647
Italy	3199	3205	2373	3012
Egypt	2586	2692	2470	2471
Argentina	2150	2521	2285	-
Turkey	1825	1287	1597	1770
Japan	1668	1906	1597	1746
Others	22841	24202	23248	25991

Source: FAO, 2000

Table 2b: Major Exporters of Citrus Products ('000 tonnes)

	1994/5 – 1996/7 (average)	1997/8	1998/9 (estimate)	1999/2000 (forecast)
<i>World Total</i>	9218	9787	8987	9721
Spain	2676	3170	2789	3084
US	1200	1180	805	1171
South Africa	636	625	665	-
Morocco	512	610	583	580
Greece	427	385	309	360
Argentina	305	323	319	-
Israel	332	326	255	317
Egypt	267	275	227	228
Turkey	364	225	456	420
Italy	192	193	112	176
Others	2307	2475	3385	3385

Source: FAO, 2000

Table 2c: Major Importers of Citrus Products ('000 tonnes)

	1994/5 – 1996/7 (average)	1997/8	1998/9 (estimate)
<i>World Total</i>	8872	9168	8410
Germany	1067	1213	1002
France	1047	1037	864
Netherlands	690	762	554
Former USSR	662	790	468
UK	610	678	458
Japan	525	469	437
Canada	400	410	322
Belgium + Luxembourg	457	449	441
Saudi Arabia	308	287	-
Poland	296	358	-
Others	2307	2475	3385

Source: FAO, 2000

International demand for fresh citrus products geographically is somewhat more diversified than that for mangoes, avocados and papaya. No clear trends in demand emerge from Table 2c. Rather, imports appear to be sensitive to international prices, which were high in 1998/9 following a bad production year. On the supply side, Mediterranean countries account for a significant proportion of world exports.

Indeed, aside from India in mangoes and Egypt in citrus, low income countries do not feature significantly in FAO's international trade statistics for tropical tree fruits²³. This is because:

- Exports require a high degree of infrastructural and institutional²⁴ development – not least so that perishable products can get to their destination fast and in good condition. (Thus, even where some smallholders in low income countries are able to link up with export markets, it is only likely to be those in the most accessible, best serviced areas, i.e. rarely the poorest).
- Quality requirements are getting ever stricter. Western states are continually tightening their sanitary and phytosanitary requirements. FAO (2000) highlights the implementation of phytosanitary measures banning methyl bromide – an infestation treatment widely used in international tropical fruit trade - as a looming problem for all tropical fruit exports, especially if no alternative treatment is found.

Simultaneously, pressures from the major retailers that dominate many supply chains are forcing importers to rationalise the number of suppliers with whom they do business, in the process focusing on larger companies that can not only meet quality requirements, but can also enact quality assurance

²³ Côte D'Ivoire (where production is concentrated in the hands of agribusinesses) is also a major international exporter of pineapples.

²⁴ Institutions are defined by North (1990) as “the rules of the game” that guide and reduce uncertainty in human interaction. In the area of agricultural trade, they include: laws and norms governing contracts and their enforcement, mechanisms for providing information to potential and actual trading partners, insurance mechanisms, mechanisms for financing trade transactions. The concept of institutional development also applies to the workings of public and other organisations – whether they function transparently and with the necessary incentives for efficient performance. For example, can an exporter clear a shipment of fruit through a port or airport in a predictable and reasonable time without recourse to bribery? North argues that institutional development is the key to overall economic development. It has been sadly neglected in much of Africa, with the result (amongst other things) that private sector investment and trade in non-traditional goods and services has been severely restricted.

programmes that show that they are doing this (see, for example, Dolan, Humphrey et al. (1999) for the case of fresh vegetables).

As well as fresh produce markets, there are significant markets for processed products, especially citrus (and pineapple) juice. Commercial processing is, however, an intensive user of both capital and skilled labour and there are doubts as to whether either Sub-Saharan African or South Asian economies enjoy much comparative advantage here.

Cocoa remains the one tropical fruit tree product where smallholder producers within low income countries (especially Côte D'Ivoire and Ghana) retain a major market share. The less acute perishability of cocoa, compared with the fresh fruit products that we have been discussing above, is an important factor in this differential performance.

The view of the current authors is that the barriers to successful participation by poor producers from poor countries in international markets for fresh tropical fruit are not likely to be reduced significantly by research in the short-medium term. Possible research avenues are discussed in more detail in section 8, but our general view is that FRP should concentrate on equipping poor producers to exploit opportunities available within domestic markets and, in the case of South Asian countries, exploring opportunities for sale of semi-domesticates within regional markets²⁵.

6) Fruit Tree Production and Marketing

Earlier we noted that (fruit) trees are natural assets that can generate a number of benefits to their owners, including (and in some cases particularly) the poor. Here we approach the issue from a rather different angle: how the characteristics of fruit trees (many of which are common to trees in general) affect who is most likely to:

- Plant fruit trees
- Market fruit from trees that they have planted.

Our conclusion from theory is that several important characteristics of fruit trees mitigate against intensive planting and marketing by the poor (although production for own consumption of fruit and other products is likely). We then look at evidence as to why people plant fruit trees and who actually does plant them and market their fruit.

Characteristics of (Fruit) Trees

Initial capital requirement

This is generally modest, such that even poor households could afford to plant one or two trees per year. Warner (1995) notes that "... lack of capital is unlikely to prevent a farmer from planting trees, although it may hinder him or her from obtaining a preferred species or a large number of seedlings" (p104). On the other hand, the cost of establishing an orchard might be quite considerable, particularly where land has to be prepared specially and hired labour relied upon (Matin, Huq et al. 1999).

²⁵ In India, the national strategy with respect to fruit trees is now to encourage diversification out of mango – where international markets are perceived as over-supplied with products from more developed economies – into various semi-domesticate and other species (N.Haq, *pers.comm.*, 15/2/2001).

Gestation period

Notwithstanding wide species differences, it commonly takes 3-5 years from the time of planting to the time when a fruit tree first yields fruit. It may then take several more years before the tree reaches its full productivity. For a poor individual or household, investing even fairly modest capital and time in assets that will not deliver any return for 3-5 years can thus be hard to justify. More specifically, poor households can rarely afford to give over land that would otherwise be planted to food crops for the planting of trees, as fruit in the future cannot compensate for lost food intake now.

At a more macro level, another consequence of the long gestation period is the inelastic supply response: the supply of tree fruits only responds to price signals with a lag. Thus, prices can move in quite pronounced cycles, with large production increases in response to a period of high prices, followed by long periods of depressed prices until enough producers decide to uproot old stock. Overlaid on these longer-term cycles, however, are year-to-year fluctuations resulting primarily from the impacts of weather in major production areas.

Labour requirements

Fruit trees may require considerable care and attention when first planted and some skill in management generally (Neunhauser, Hauser et al. 1986). Pruning, harvesting and phytosanitary treatments are labour-intensive for plantation-scale production. However, the labour requirements for most fruit trees are likely to be relatively unimportant for smallholders and are lower than for high value annual crops (especially vegetables). Moreover, the use of this labour and other inputs is relatively flexible. Yields do suffer if husbandry is neglected, but again not by as much as in many annuals. Labour input can thus be varied in response to market conditions and the relative attraction of alternative economic enterprises. Fruit trees are also useful crops for poor farm households vulnerable to embedded labour risk²⁶. The implications of low labour requirements for poor households are mixed, however. From the point of view of producers, fruit trees are good for labour-constrained households. These might include AIDS-affected households and many female-headed households, who may or may not be poor. Where the poor rely on agricultural employment for an important part of their livelihood, the growing of fruit trees (by less poor households) may restrict their opportunities for employment. Indeed, it may be part of a conscious strategy on the part of the less poor households to cut down on labour costs (Deweese and Saxena 1995).

Working capital requirements

Once fruit trees are established, working capital requirements may be quite low, as labour requirements are low and fertiliser is often not applied. Exceptions will occur where pests or diseases (or market expectations as to the appearance of the fruit) necessitate significant application of chemicals, or where intensive labour input is required to harvest the fruit quickly (Deweese and Scherr 1996).

²⁶ At the start of an agricultural season, smallholder households can rarely be sure of the total quantity of labour that they will be able to draw upon for their own agricultural production activities during the course of the season. Family members may fall ill (and cash may not be available to hire in substitute labour) or they may have to hire out their labour to meet unexpected cash demands. When labour availability does fall below what was anticipated or hoped, it is generally thought that households endeavour to maintain labour input into their priority crops (e.g. the staple foods) and let most of the burden of labour reduction fall on other crops.

Fruit is perishable

The perishability of fresh tropical fruits is at the heart of the problem facing poor producers and poor countries looking to participate in international markets (see section 5). Perishability makes marketing inherently more uncertain and the poor are generally least well equipped to cope with uncertainty. It also places a premium on good infrastructure (including cold chains for high value markets), market information and good links with buyers (social capital), areas where poor households (and/or poor countries) rarely score highly. The problem of perishability is somewhat reduced – though far from eliminated – in informal markets where there is not a high premium on reliable, high quality produce. However, in high value markets, inability to deliver reliably high quality (i.e. to get the produce to the buyer in good condition and before it has started to deteriorate) can result in exclusion from the market or, at the least, very severe price discounts.

A potential benefit of perishability within domestic markets is that it should favour processing close to the place of harvest – a competitive advantage for small-scale, local activity?

We note that nuts are less perishable than fruits, which might indicate that:

- They are more suitable smallholder cash crops. In addition to their lower perishability, we note that medium-term market prospects for many “conventional” nuts are thought to be good, as they are associated with a health conscious lifestyle. (This, however, may be offset by allergy worries). On the other hand, nut production may require more protection against pests and diseases, whilst access to European markets is threatened by increasingly strict phytosanitary measures designed to protect against aflatoxins (NRET 2000).
- Support for domestication of indigenous fruit trees should not concentrate solely on trees that are valued for their fresh fruits. Indeed, many of the species prioritised by farmers around Africa (see section 8) are valued primarily for their nuts or associated oils.

However, a full evaluation of the relative benefits of growing trees for nut markets, rather than fresh or processed fruit markets, was outside the scope of the current study.

Ownership Complications

Tree planting is often associated with a claim to land. Thus, according to the local culture, there may be restrictions on planting of trees by women. They may not be allowed to plant trees in fields, although planting around homestead is accepted or even encouraged (Cavendish 2000). Warner (1995) notes that, in Eastern Africa, women are generally seen as the users, not owners, of resources. (Even in matrilineal societies, men are given control over resources). Thus men make decisions over tree planting. Even in female-headed households, permission may have to be sought to plant trees, from either the (absent) husband or father. The one exception to this is fruit trees for food planted around the homestead, as it is part of a woman's duty to provide food for her household. Gumbo, Mukamuri et al. (1990), however, report that, even when planted in the homestead, trees are seen to belong to men.

Another group generally not allowed to plant trees are short-term tenants, as tree planting might be construed as giving them a more permanent claim to the land. This suggests an interesting case where sharecropping (particularly if it is a medium term arrangement) may be superior to fixed rate tenancy. For example, the land owner may buy the seedlings for fruit tree planting (and retain ownership rights over the trees), the sharecropper supply the labour input and the fruit be shared at harvest time (N.Haq, *pers.comm.*). Ghanaian cocoa farms are often managed by sharecroppers (Robertson 1987), with the sharecropping contract evolving over time as trust builds between the ageing owner and his tenant.

Arnold (1995) uses a livelihood perspective to caution *against* seeing tree planting as a solution to all poverty problems in rural areas. He notes that:

"... much poverty is associated with landlessness. Where the household does not have access to land, private tree growing evidently cannot have a significant role in alleviating poverty. The range of situations in which tree growing is a viable option for a poor farmer with access to a small amount of land is also limited by their need for annual rather than periodic income, and by the priority they attach to ensuring household food security." (p11)

Interactions with Other Crops

Trees can interact both positively and negatively with other crops grown in close proximity to them. Positively, they can provide shade to those crops (e.g. coffee, cocoa) that require it and can enhance soil fertility through deposition of leaf litter. Negatively, they can compete for land, water and light with other crops.

Competition for land and light explains why no trees are found in fields in the Shire Highlands agro-ecosystem in Malawi, where holdings are both small overall and subdivided into tiny plots (Warner 1995). In areas with high population densities (such as this) and on small individual holdings, trees may only be grown in small niches within farms that are not readily usable for other crops. As already noted, this can act as a constraint on the extent of fruit tree cultivation by poor households.

In respect of competition for water, citrus and other commercial crops are often far more demanding than indigenous species that have occurred naturally in a (semi-)arid environment. In the Sahel, it is believed that citrus cultivation cannot be sustained on any significant scale. However, indigenous trees rely both on deep tap roots and spreading surface roots. The Sahel "parklands" (mixed cropping systems featuring widely spaced, generally retained, indigenous trees) thus suggest a model for sustainable agro-forestry in the region. The species in question (e.g. shea, baobab, tamarind, nere) also produce a range of high value tree products offering real potential for market development (Leakey, Wilson et al. 1999). This is an exciting prospect in countries that are often landlocked (hence putting a premium on high value:weight ratios for trade) and which are currently very dependent on cotton for their government revenues and foreign exchange earnings.

More generally, Sinclair (1996) argues that farmers – particularly in drier areas – deliberately retain slower-growing, indigenous fruit- and gum-producing species (as opposed to planting faster-growing exotics?), as these do not adversely impact their other crop production activities. In other words, trade-offs are made that might not be appreciated by a programme promoting fruit trees primarily as a commercial activity. de Foresta and Michon (1996) make a similar point with reference to multi-strata agroforestry systems. Here, farmers may select tall trees, that can form the canopy layer of a multi-strata system and have high(er) timber value, over shorter genotypes – even though the latter might be easier to harvest and might start bearing fruit sooner, and so would be more likely to be selected by a programme promoting fruit trees primarily as a commercial activity²⁷.

Why People Grow (Fruit) Trees

If we are to decide where the priorities for research into fruit trees and poverty reduction lie, we must understand what motivates different groups (particularly poor ones) to plant them.

Arnold (1995) notes that programmes to encourage farmers to produce trees either as a response to deforestation or to meet basic household needs have rarely been successful, as their understanding of why farmers plant trees have been too crude. He argues that the circumstances in which farmers find

²⁷ Note, however, that farmers contacted by ICRAF in a variety of regions of Africa and Amazonia specifically expressed the desire to see their prioritised indigenous tree species "coming into production at an earlier age" and "the tree height reduced" (Leakey 1999), p12.

themselves are constantly changing. There are new or growing pressures (most notably from expanding populations), but there are also new opportunities (for example, developing markets for fruit, poles and other tree products, and growing availability of substitutes for some tree products, e.g. kerosene). Thus, farmers will not simply plant trees to replace forest products that are disappearing:

"The creation of new tree stocks on farm land in order to reproduce flora of forest products that were earlier drawn on to meet particular needs of poor households may, therefore, be neither efficient nor appropriate." (p11)

Instead:

"... tree planting can be explained as being one or more of four categories of response to dynamic change:

- To maintain supplies of tree products as production from off-farm tree stocks decline due to deforestation or loss of access;
- To meet growing demands for tree products as populations grow, new uses for tree outputs emerge, or external markets develop;
- To help maintain agricultural productivity in face of declining soil quality or increasing damage from exposure to sun, wind or water run-off;
- To contribute to risk reduction and risk management in face of needs to secure rights of tenure and use, to even out peaks and troughs in seasonal flow of produce and income, and in seasonal demands on labour, or to provide a reserve of biomass products and capital available for use as a buffer in times of stress or emergency.

The attractiveness of tree-based options in addressing these changes is likely to alter over time, as the relative prices and availability of the farmer's resources of land, labour, capital and of other inputs and outputs, change. In most farming systems trees are present for a combination of more than one of the above reasons. Tree components of home gardens and compound farms, for example, typically contribute to all of the above." (p12)

With some notable exceptions (e.g. Scherr (1995)), it seems that a high priority is generally given to fruit species when households start planting trees. Both food supply and income considerations are undoubtedly important. However, the relative importance attached to these varies from situation to situation. Likewise, the relative importance attached to planting indigenous and exotic species varies. As wild indigenous resources decline in a given area, however, one would expect more poor households to elect to plant indigenous species *in addition to* exotics, even where reliable supplies of planting material for conventional tropical fruit trees are available.

The following studies from different parts of Africa illustrate these points. They suggest that research work on fruit trees should seek to expand, not limit, the range of attractive planting choices open to poor farmers, so that households with different existing asset portfolios and in different circumstances can tailor tree planting activities to suit their own particular requirements.

Warner (1995) surveys tree planting experience in eight countries of Eastern Africa, which she divides into a Bimodal Highlands Zone and a Unimodal Plateau Zone. Fruit trees are the first priority for planting in both zones, although an abundance of wild fruits are found in the miombo woodland areas of the unimodal zone. The main species planted are exotics: mango, papaya and guava in the unimodal zone and avocado in the bimodal. Even where these species were originally planted as substitutes for dwindling indigenous fruits, they are now highly valued in their own right. Indigenous fruit trees are retained in both homesteads and fields in the unimodal zone, but the abundance of wild resources means that there is little planting of indigenous species. Retained fruit trees are used primarily for food, a resource that is especially valuable in the dry season. Some species are preferred to others,

which may not be kept. Trees that produce leaves and fruit for animal fodder are sometimes also retained. Some trees can supply fruit, fuel, timber and fodder. By contrast, the main use of retained trees in the bimodal zone is for fuelwood.

Up to now, "The primary motive for the planting of trees in the study area has been to achieve household self-sufficiency." (p104). However, this is changing as markets for tree products (both fruit and poles – with others likely to follow) expand with road development and population increases. In addition, seasonal labour shortages - resulting from labour outmigration and increasingly also from the AIDS epidemic – will tend to encourage planting of trees yielding high value products for sale, as such trees give high returns to labour input.

Gumbo, Mukamuri et al. (1990) specifically address the question of the relative values attached to indigenous and exotic species within one community-based tree planting programme in Zimbabwe. When asked to rank crops on a pairwise basis, community members often listed exotics (e.g. mango, guava, lemon, peach, banana, naartjie and pawpaw) as their top preferences, due to their greater cash generation potential. On the downside, exotics were subject to glutting (and thus spoilage) on the local markets on which producers primarily depended. Moreover, they generally required better rainfall than indigenous species, so could not be grown in all parts of the survey area.

Two factors restricted the local market for indigenous fruits, forcing those who wished to sell them to travel further afield:

- Indigenous fruit trees are held to belong to God (Mwari), so the ancestors can get offended if their fruits or derivative products are sold. The custodians of religious-political control, therefore, enforce restrictions on marketing of indigenous fruits. These are particularly effective after a drought or other disaster (thought to indicate that the ancestors are angry with the people).
- Where indigenous fruit trees are still relatively plentiful, there is effectively no local market for their products.

However, some indigenous fruits were found to have a reasonable market in urban centres outside the project area (e.g. Zvishavane), where they were regarded as "exotic", in the sense of being "special" or unusual.

Meanwhile, indigenous trees were valued (and planted) for their wide range of uses. Depending on the species, these included beer making, nuts for snacks and cooking ingredients, medicines, artefact manufacture and green manure. Whereas exotics were basically consumed as fresh fruit, the food uses of some indigenous species extended into being porridge ingredients and being cooked, dried or salted to preserve them for the dry season months when no fresh products were available²⁸. This seasonal dimension to consumption patterns indicates that indigenous and exotic species are not complete substitutes. Rather, poor households like to have access to both as a means of meeting the full range of livelihood needs and spreading risks. This is a safer and probably more satisfying option to them than relying on exotics alone to generate income (with all the vagaries of markets from year to year), then saving the cash so obtained in order to buy food during the lean season.

Schreckenberg, Degrande et al. (2000) look specifically at *Dacryodes edulis* (African plum – an indigenous species, albeit one that is now found largely on farms) within cocoa, coffee and oil palm systems in four villages of southern Cameroon. Their findings reinforce those of Gumbo, Mukamuri et al. (1990) on multi-functionality and seasonality. *Dacryodes* trees are valued primarily as shade trees for cocoa and coffee plantations and thus over 90% are found within cocoa or coffee fields. However,

²⁸ From a food point of view, Gumbo, Mukamuri et al. (1990) do also note some disadvantages with some of the indigenous species. Some could cause digestion and other problems if eaten the wrong way. However, it is worth noting that this assessment was undertaken on species that had undergone little or no genetic improvement and for which no work had been undertaken to develop markets.

they are also valued highly for their food value and, in two of the villages in particular, bring in significant cash income. Moreover, the timing of both the food availability and the cash income stream was considered important. The roasted or boiled fruit can be eaten with cassava as a quick and easy meal at a time when labour is in high demand for agricultural activities. The peak of the harvest in August-September coincides with when school fees need paying. Income availability at this time is particularly important for men, as their main source of income (cocoa) only comes on stream in November. By contrast, women grow bananas and tubers that can give year-round income.

Who Grows Fruit Trees?

The previous section accepted implicitly that rural households are heterogeneous and so will have differing priorities and capabilities when it comes to tree planting. In this section we examine evidence on the fruit tree planting practices of different groups within given communities. A broad generalisation is that most households with control over a minimal area of land will try to plant fruit trees, probably in conjunction with other highly valued tree types. In the case of poorer households, these trees are intended to serve a multiplicity of functions (including income generation). The planting of fruit trees as dedicated cash crops is the preserve of better off households.

Fruit Tree Planting by Wealth Group

Cocoa dominates the farming systems in three of the four villages surveyed by Schreckenberg, Degrande et al. (2000) and accounted for 80% of the whole area surveyed. This suggests a fair degree of commercialisation amongst the households concerned, although the extent to which they depend on cocoa income to purchase basic foodstuffs is unclear. Out of 73 households surveyed, only one did not have *Dacryodes* trees on their farm. The mean number of *Dacryodes* trees per farm ranged from 17 in one village to 101 in another that is renowned for growing this species. These include both trees retained when the land was cleared for cultivation and others planted from seed. Intriguingly, initial analysis does not show any clear pattern in the number of *Dacryodes* trees across five defined well-being groups, although female-headed households were found to have fewer *Dacryodes* trees on their farms than their male-headed counterparts²⁹. Tenants in the surveyed villages are in general not allowed to plant perennial crops, except in agreement with the landlord. However, sharecroppers are expected to replant old cocoa and coffee bushes and, similarly, to replace ageing fruit trees. This does not give them any rights over these trees.

Taking fruit trees as a whole (*Dacryodes* accounted for 42% of all fruit trees in the sample), the survey data shows that smaller farms have a higher density of trees, if fewer in absolute numbers. (Schreckenberg, Degrande et al. 2000) suggest that households in these villages may aspire to have a certain "minimum" number of fruit trees, although what would determine this number is not clear. Farmers generally plant 2-3 trees per year, more or less systematically. "Planting good quality trees, in the form of an orchard of selected trees ... was considered to be a luxury reserved for the very rich."

Scherr (1995) examines detailed data on tree planting behaviour by around 400 households who were beneficiaries of a CARE International project in Siaya and South Nyanza Districts of western Kenya from 1985-1989. The project assisted the establishment of nurseries that produced seedlings of a wide range of trees, including indigenous species that had not traditionally been planted. During the study period, a large increase was observed in the number of trees on respondents' land holdings, with the most dramatic increases recorded for agroforestry species such as *Leucaena* and *Markhamia*, which

²⁹ The reasons for this are not yet apparent, as female-headed households had similar sized farms and similar areas under cocoa as male-headed households. Moreover, their tenure of their land did not seem any less secure and female household heads are able to bequeath their farms to their children just as males are. However, at the time this paper was presented, the analysis was still at a preliminary stage. Work is continuing to answer some of the more detailed and intriguing questions arising from these initial results.

contributed to soil fertility through the provision of green manure. This preference – and the relatively low proportion of fruit trees observed (7% before the project rising to 8% at the end of the study period) – is partly explained by the poor infrastructure in the area. Ensuring self-sufficiency in maize (the staple food) was thus a major priority, to avoid the cost of obtaining purchased supplies, whilst marketing fruits beyond the immediate environs was not easy. Nevertheless, farmers were keen to obtain income through product sales and soon requested marketing assistance from the project. Citrus and papaya were sold on both local and regional markets. In one year, 47% of survey respondents reported obtaining some income from the sale of fruit³⁰.

A total of 27 fruit tree species, both planted and retained, were identified during the survey. The majority of these were valued primarily for their food (home consumption) value, especially for children and for the lean period prior to the main harvest. Households classified as poor in a participatory ranking exercise had proportionately fewer fruit trees than average or wealthier households. By contrast, they had proportionately more trees valued primarily for fuelwood³¹.

Scherr (1995) comments that, "General programmes to encourage cash tree crops could easily bypass the poor, if poorly designed." However, she notes that the poor do have cash needs, so will grow trees for cash if key conditions met. These include:

- low costs of entry
- a short waiting period before the first cash returns are realised
- accessible marketing channels.

If possible, production should be established incrementally. Intercropping is also seen as a poor-friendly strategy as it allows tree establishment without significantly reducing food production.

A study by Neunhauser, Hauser et al. (1986) of four villages of Tanga Region in Tanzania (a high potential fruit growing area) found that 90% of households grew some fruit trees (including coconut and bananas). Where a household cultivated less than 0.8 ha of land, it generally planted few trees, concentrating instead on staple food production. On land holdings of 0.8 - 2.0 ha (the majority), some trees were usually grown, at times in pure stand. Finally, on landholdings of over 2.0 ha, more than three quarters of the cultivated area was planted with fruit trees, either mixed with food crops or in pure stand. Amongst the fruit crops, bananas and coconuts were important food items for household consumption. However, perennial crops also generated two thirds of on-farm cash income (with coconut generating an average of 33%; citrus and banana 19% each, and the rest accounted for by sugar cane, jackfruit, mangoes and cashew). 80% of oranges and two thirds of coconuts were marketed, compared with 20% of bananas.

One important constraint on tree planting in the area related to borrowed land, which accounted for 40% of all land cultivated (and 70-100% of land cultivated by migrants). Those borrowing land were not allowed to plant perennial crops on it.

In relation to the question of tree improvement, Neunhauser, Hauser et al. (1986) observed that:

“Farmers have traditional knowledge of various methods of mixed cultivation and husbandry practices like mulching and pest control. They are aware of different varieties of fruits and coconuts. Many raise their own coconut seedlings, some have started small nurseries and bud

³⁰ The main cash cropping opportunity from trees in this area was from poles (less perishable?) rather than fruit. Wealthier farmers grew *Eucalyptus* and sold the poles to urban areas, whilst poles from other species were sold locally. In the same survey, 60% of respondents reported obtaining some income from the sale of poles.

³¹ Scherr does not say this, but the current authors understand that the land in this part of Kenya has been titled. According to Warner (1995), we might thus expect communal wood resources to be scarce.

oranges. But farmers do not graft mangoes and avocados, which would reduce the pre-bearing age and, therefore, increase the interest in these fruits.” (p. xx)

Shively (1999) uses regression analysis to investigate planting decisions for mango in a remote, low income³² area of Philippines during 1981-94. He shows that market conditions were an important consideration even for poor smallholders. Thus the price of mangoes relative to prices of rice (the staple) and corn (a competing cash crop), plus the relative volatility of these prices, were all significant determinants of planting behaviour. Mangoes accounted for 60% of all trees planted 1981-94. The number of mango trees planted by a household was positively and significantly correlated with the size of farm at the time of planting. However, similar to the findings of Schreckenberg, Degrande et al. (2000), there was an inverse relationship between farm size and the share of the farm planted to mangoes.

Some studies in Asia highlight the importance of larger farmers in providing marketed surpluses of conventional tropical fruit species, often from dedicated gardens or orchards. For example, in Sindh Province, Pakistan, an area of considerable inequality, mangoes are grown for sale primarily by larger landowners (Khushk 1997). Smaller landowners grow them primarily for their own consumption, whilst sharecroppers are rarely involved in planting fruit trees on their sharecropped holdings.

In Malaysia, Jaafar (1997) notes that the fruit industry is dominated by 200,000 smallholders with a mean farm size of 1-2ha. This is seen as a constraint, as production is deemed unorganised and unproductive, with unselected seedling materials, many old trees and poor cultural and management practices. Nevertheless, other details about these smallholders indicate the much higher level of commercialisation of the Malaysian economy compared with those in Sub-Saharan Africa and even South Asia. For example, Jaafar (1997) considers the proportion of the average farm planted with fruit to be low at less than 50%. Malaysian national policy is to improve the productivity of selected local fruits through more commercial cultivation in order to raise incomes of both smallholders and entrepreneurs.

Marketing by Wealth Group

Earlier we noted that poorer households are constrained in the extent to which they can grow fruit trees by the priority they attach to ensuring basic food self-sufficiency in their allocations of land and labour. Leakey, Wilson et al. (1999) comment that:

“... taking advantage of [market opportunities] may depend on prior satisfaction of the need to produce staple foods, and also on the identification and creation of niches on-farm for trees that will form an upper strata above the food crops.” (p3)

However, the limited extent to which poor households can commit themselves to fruit tree production also interacts with difficulties on the marketing side, creating a mild form of vicious circle discouraging expansion of fruit tree activities by the poor. The basic argument is that many marketing costs, e.g. acquiring information, making contacts and even participating in producer groups, are essentially “fixed”. They do not vary significantly with the eventual volume of output to be sold. In other words, there are economies of scale in marketing. This is particularly important for fresh fruits because their perishability makes good coordination along the marketing chain vital. Meanwhile, from the buyer’s side, small, occasional purchases are less attractive than larger, more regular supplies, again particularly where perishability means that the quality of produce to be bought has to be carefully checked out each time a deal is agreed.

³² In 1994 the average farm size in the sample of 121 households was 2.9ha, whilst the average household (!?) income was US\$400.

Unfortunately, neither of the examples cited below relates to planted, tropical fruits. However, we believe that the issues raised are applicable to such fruits, too.

Initial research results from an FRP-funded project in México (R7349) show that forest resources are important to all households in the forest margin communities as a source of both timber and non-timber products (NTFPs). For example, in the community of Majas (sample: 25 households), forest products are one of the major sources of household income, along with agriculture, paid labour and government support (Poole, Gauthier, et al. 2000). However, apart from honey, NTFPs are not widely marketed by the people of Majas. Forest fruits such as *sakpaj* and *zapote* (*Manilkara sapota*) are collected every year by over 70% of households, but mostly for home consumption. It is only the better-off families who collect forest fruits for commercial purposes. Quantities of forest fruits sold are usually in the range of 10-60 kg per year and account for only a small proportion of the income from forest products, and an even smaller proportion of total household income. In the community of Majas there is one family who stand out as significant traders, not just of forest fruits, but of NTFPs in general. They buy forest fruits from other households in the community and sell to traders mainly from nearby towns. They have a shop and a vehicle. They also engage in forward selling of forest products from time to time, suggesting that social networks may be important in providing them with the access to markets that other members of their community lack.

The second example is drawn from the boom in deciduous fruit production in Chile's Central Valley, starting in the early 1970s, the economic and social impacts of which have been much debated. A careful study of the distributional impacts of the boom was undertaken by the Land Tenure Centre in Wisconsin (e.g. Barham, Carter et al. 1995; Carter and Barham 1996). The fruit boom, encouraged by policies of market liberalisation, followed soon after a 1968 land reform in the area and partially reversed the impacts on land structure of this reform. Smallholders, especially the recent beneficiaries of the land reform, could not make the large initial investments in fruit trees with no returns over an extended gestation period, nor the investments in standardised production and packaging required for fruit production for export markets, and were rarely able to obtain credit. They also lacked the necessary technical expertise in fruit production or familiarity with export business dealings and organisations. Export firms, in turn, preferred to avoid the high transaction costs of dealing with numerous smallholder producers³³. Thus, as land prices rose in response to the opportunities provided by the fruit export business, many land reform beneficiaries sold their parcels back to larger growers. At the same time, however, local demand for labour rose significantly as a result of the boom, thus providing employment for many of these, and other, poor households.

Drawing together insights from this study and two others on recent Latin American export booms, Carter, Barham et al. (1995) list the following crop characteristics that may influence which types of farms (large or small) will adopt and produce new crops most successfully:

- "interactive labour intensity", i.e. the need for labourers to make constant, plant-specific choices in order to achieve good quality or high quantity output. For example, in the case of snow peas, producers have constantly to decide "whether to harvest a particular plant, and particular pods on a plant, now or later". By contrast, manually harvested sugar cane "while labor-intensive in the usual sense, does not require labor to make interactive choices" (p9);
- working capital intensity;
- human capital (especially managerial) intensity. Where high levels of managerial expertise are required either in production or in marketing, smallholders tend to be disadvantaged, as skilled managers are not only scarce, but also indivisible;
- how sensitive price is to quality, as measurement (e.g. of pesticide residues) is expensive and may cost the same for large and small lots;

³³ Very similar findings are reported for irrigated grape production by small and large farms in the Sao Francisco Valley of northeastern Brazil (Collins 1995).

- perishability, as the need to ensure high capacity utilisation at processing plants may encourage reliance on larger producers, so as to gain from improved vertical coordination;
- the investment gestation period;
- output and price risks.

Of these, they suggest that it is only the first that is likely to work to the benefit of smallholder producers. As already noted in this report, several of the latter factors are highly relevant to fruit trees and mitigate against smallholder success in highly competitive markets. Thus, even with constant returns to scale in production technology, large farms will often enjoy a competitive advantage over small farms because of imperfect information and imperfections in the markets for capital and insurance.

In section 7 we consider interventions that could reduce some of the barriers to poor households' participation in fruit tree markets. However, as noted in section 5, we accept that, in markets where quality requirements are high and quality assurance mechanisms are increasingly important, the barriers to successful participation by smallholder households (and particularly poorer households) could sometimes be insurmountable.

Gender Dimensions to Fruit Tree Planting and Marketing

Our earlier reviews of the wider cash crop literature and the characteristics of fruit trees suggested that women's participation in, and/or benefits from, fruit tree production and marketing might be restricted by male control over:

- land
- cash income into the household.

Scherr (1995) cautions against an overly-simplistic view of male control over land restricting women's participation in tree planting, pointing out that not all women are subject to the same degree of control. Within the sample of Kenyan households that she surveyed, male-headed households did plant significantly more trees than women-headed. However, amongst female-headed households, women with absent husbands planted more trees than women without husbands. Indeed, women with absent husbands showed the greatest response of all socio-economic groups to the CARE project's activities, in terms of the proportional increase in trees on their farms during the survey period. This group tended to benefit from remittance income (making them amongst the better off rural households (Noordin, Amadalo et al. 1999)) and often enjoyed reasonable managerial autonomy on the farm. However, they also tended to suffer from low labour availability, making tree planting a particularly attractive option for them. Ironically, women without husbands might be subject to more restrictive male control than women with absent husbands – and did not benefit from the remittance income that could facilitate tree planting. Based on these observations, Bonnard and Scherr (1994) argue that simple gender distinctions are of limited value. Furthermore, they argue that promoting particular tree species, product marketing channels or growing techniques to benefit women is not really a viable approach. Rather, attention should be paid to the marital status of women, with any targeting focusing on those who have the freedom to plant trees.

These arguments extend beyond the question of male control over land to male control over cash income into the household. Here, the issue is that the marketing of “minor” products (particularly those that serve both as food and cash sources) is generally the preserve of women and makes a valuable contribution to the income that they control. However, if the income from marketing a particular crop approaches the level of income from more traditional cash enterprises, this can lead to male take-over. The following examples suggest that fruit trees are no different to other minor products in these respects. Moreover, indigenous and semi-domesticated species are not fundamentally

different from conventional tropical fruits. However, a research strategy that aimed to promote conventional tropical fruits essentially as cash crops might run a greater risk of encouraging male entry into areas that were previously women's domains than a strategy that promoted domestication of indigenous fruit trees to generate a range of benefits to poor farm households. The more general conclusion drawn is that there is probably a "window of opportunity" to improve the productivity of, and returns from, fruit trees that bring particular benefits to (certain groups of) women. However, such improvement is likely, eventually, to be a victim of its own success and to provoke a take-over of the activities concerned by more powerful groups (in this case men).

Although Gumbo, Mukamuri et al. (1990) report that exotic fruit species planted around homesteads are owned by men, any marketing of fruit (still a "minor" product) is generally carried out by women and/or children. Tree care is the job of children. Indigenous fruit collection (from land under communal tenure) and marketing is a women's domain, though children may also be involved in both gathering and selling.

Schreckenber, Degrande et al. (2000) report evolving divisions of labour and returns in relation to *Dacryodes* in their four sample villages in southern Cameroon. Most commonly, men are responsible for knocking the fruit from the tree, at which point the women gather it and market it, retaining some control over the proceeds. However, in the village specialising in *Dacryodes*, the men sell the fruit to their wives, who then keep all the profit from the marketing activity. In another of the survey villages, since 1996 traders from Douala and also from across the border in Gabon have been coming to the village to buy *Dacryodes* fruit direct. They come with their own labour force to harvest the fruit, so the tree owners (the men) simply sell them the right to that season's harvest. This means that their wives lose the chance to make a little income from marketing activity.

In Bangladesh, there is a contrast in gender control of fruit tree marketing and income across production areas. In the majority of areas – where rice is seen as the main source of household income - women keep control of the income from fruit trees (often semi-domesticates). However, in more marginal rice growing areas, where fruit trees are now a major source of household cash income, men have assumed control (N.Haq, *pers.comm.*).

Finally, in Ivory Coast, women traditionally gather shea nuts and process them to make butter. However, since commercial interest in the crop started developing, more men have become involved in gathering. They tend not to get involved in processing, but rather sell direct to commercial buyers and are not always so careful about maintaining product quality as the women (K.Schreckenburg, *pers.comm.*).

Consumption Issues

The high nutritional value of many indigenous fruits is well documented (e.g. Leakey (1999), Becker (1983)). They may be important sources of micronutrients that are otherwise undersupplied by poor people's diets. In addition to the innate characteristics of the fruits themselves, their current importance and potential contribution to the nutritional status of poor households is enhanced by the timing of their fruit availability – often when relatively few substitute products are readily available.

The particular value of indigenous fruits to the nutritional status of children – in urban as well as rural areas (Wiggins and Holt 2000) - is also sometimes emphasised. This is linked to the common property characteristics of the trees in question, such that children can simply pick up and eat fallen fruit. Whether this would remain the case after domestication depends on what alternative uses, if any, were found for the fruit. If a higher proportion of fruit were sold, the direct nutritional benefit to children could diminish. On the other hand, if the fruits were not the primary objective of planting the trees, traditional access for children may be retained, as is the case with cashew apples in southern Tanzania.

This latter example again cautions us against making sweeping statements about indigenous and conventional tropical fruits.

When considering the possible nutritional impacts of the two research strategies outlined at the start of this paper, we note that there may be some element of nutritional trade-off between higher incomes, where these allow greater volumes of consumption, and the particular composition of what is consumed. This assertion may not hold, however, if the focus is particular micronutrients. The studies assembled by von Braun and Kennedy (1994) show that incremental income from cash cropping generally translates into higher calorific intake for household members, but that diversifying diets (specifically to include more meat and fruit consumption) is often as important an objective as simply increasing calorific intake. On the other hand, there are greater nutritional benefits for household members from incremental income retained by women than from incremental income retained by men. If women were indeed the principal beneficiaries of a focus on domesticating indigenous fruit trees (see discussion above), this might bring double nutritional benefits to the households concerned.

We have not managed to collect much information on the importance of tree fruits (conventional or indigenous) to the diets and nutrition of different groups of urban dwellers. The general food consumption literature indicates that – in both rural and urban areas - the proportion of food expenditure allocated to fruits and vegetables rises with income. However, we have not established how sensitive the purchases of poor groups are to real fruit prices. That many indigenous fruits are sold in urban markets is also well established. However, who the main consumers of these products are in urban areas we are not certain. The observation by Gumbo, Mukamuri et al. (1990) about indigenous fruits being perceived as “exotic” suggest that better off urban residents might be as important consumers as poor groups in some markets.

Based on six country case studies (two each in Africa, Asia and Latin America), Wiggins and Holt (2000) note that:

"A wide range of foods and drinks consumed in urban areas come from forests and trees, although the products tend to be flavourings and relishes rather than staple foods and rarely take up more than small fraction of urban budgets." (p8)

They note that many of the peri-urban poor still have access to forest resources where they can go to gather forest products. In contrast, the urban poor are more dependent on cash purchases, although the nutritional importance to the urban poor of trees in urban areas (in yards and public spaces) is not known.

Benefits to Poor Households from the Growing of Fruit Trees as Cash Crops

We can now draw together various pieces of evidence from previous sections to assess the extent to which FRP's four target groups of poor forest-dependent people are likely to benefit from increased production of fruit trees as cash crops. As noted in our review of the theoretical literature, cash cropping can generate a number of indirect benefits, as well as the direct benefits to the producers concerned. However, our conclusion here is that:

- the indirect benefits from increased production of fruit trees as cash crops are likely to be limited (at least, compared to increased production of staples or many vegetables);
- poor households are unlikely to be major participants in the expansion of marketed output of fruit trees.

Small-scale Poor Farmers

Poor households do plant fruit trees and potential cash income from marketing occasional “surpluses” is clearly an important factor in their decisions. However, they are seriously constrained in the extent to which they can participate in high value markets. Interventions designed to improve the access of poor households to domestic markets (see next section) may bring them benefits that are important in terms of their current cash income flows. However, these benefits will not be large in absolute terms, given the small number of trees that they have room for. Rather, even amongst smallholder households, the majority of benefits from improved market access will accrue to the less poor. Moreover, the total level of benefits will depend on the extent to which increased supply drives down market prices over time (particularly if larger producers are also expanding supply at the same time).

Landless Poor Families

These households could benefit from increased fruit tree production – by larger smallholders or even possibly by commercial producers³⁴ - in one of three ways:

- from extra employment as agricultural labourers
- from extra demand for local goods and services that they supply to fruit tree producers
- from lower prices for tree fruits as a result of increased market supply.

The relatively low labour requirements of fruit trees (compared with many annual crops) have already been noted. This suggests that employment multipliers may be limited. However, the literature does contain claimed counter examples - for example the Chilean fruit boom (above) - which means that the general assessment requires qualification. Firstly, we note that there are areas – e.g. hilly regions, the Sahel – where fruit trees of one kind or another might offer better hope of achieving sustainable increases in high value agricultural production than any new annual crop production. Secondly, we note that labour inputs may be higher where significant spraying, pruning or irrigation is required.

A suggestion explored in the next section is to assist in the development of small-scale processing of tree fruits. The poorest households may still not be the owners of such enterprises, but there could be worthwhile employment opportunities created by them. (This is also of relevance to **Small-scale traders and entrepreneurs**).

Similarly, the extent to which the poorest households can supply non-agricultural goods and services to fruit tree producing households is an empirical question. We have already suggested that targeted support (e.g. microcredit, some training or technical advice) may be necessary to equip poor households to respond to these opportunities.

Urban and Peri-Urban Poor Families

The fact that tropical tree fruits are largely traded within their country of origin (particularly in the poorest countries) indicates that urban and peri-urban poor families should benefit from increased marketed production both in terms of lower prices and greater range of available produce. For this group, it does not really matter who the producers are. Indeed, a strategy that targeted relatively large-scale producers might generate the fastest results and thus bring them the most benefits!

³⁴ Following Hayami, Quisumbing et al. (1990), we note that fairly large scale production may be necessary if new fruit trees are to be introduced to remoter areas, with a consequent need to invest in supporting infrastructure. However, as already noted, the literature suggests that both employment and demand multipliers will be higher when smallholders (even relatively more wealthy ones) account for the bulk of additional fruit tree output

The main qualification, from a poverty reduction perspective, is that fruits are nowhere near as significant in the purchasing decisions of the urban and peri-urban poor as, say, grain staples. Indeed, better-off urban households might be expected to reap even greater benefits (in consumption and/or financial terms) than poor households. Nevertheless, we would expect even marginal increases in fruit consumption to have quite significant nutritional benefits for poor households, given a low consumption base.

Conclusion Regarding Option 2

In light of:

- the nature of the barriers to entry confronting poor producers in low income countries if they wish to enter international markets for tropical fruits
- our analysis of the benefits to poor households that may be expected from the production of fruit trees as cash crops,

we do **not** recommend that FRP concentrate its fruit tree research efforts on reducing the barriers which prevent poor people from participating in conventional tropical tree fruit markets.

We do recognise that market access is an important concern for poor households. However, at least where domestic markets are concerned, many of the issues are similar regardless of the type of fruit in question. Perhaps more importantly, we note that fruit trees generate a range of benefits for poor producers and that a research strategy targeting the poor should take this into account. It is in this light that we now consider the first option specified in our terms of reference: domestication of indigenous fruit trees in developing countries.

7) *Domestication Programmes*

In section 2 we set out our definition of domestication. Domestication activity involves all of the following components to some degree:

- **Identification** of attributes that people value in their trees and tree products;
- **Capturing** and **selecting** genetic variation;
- **Planting** and cultivating trees possessing the desired attributes, initially on an experimental basis, but then more widely.

A common component of domestication programmes is the development of asexual techniques for plant propagation. Techniques for vegetative propagation (e.g. grafting, air layering) enable tree growers to produce trees (and fruit) with the same characteristics as the stockplant. This is particularly important in the case of fruit trees, where markets can express clear preferences for fruit with specific characteristics. The greater certainty as to the characteristics of the tree and fruit that is being planted significantly strengthens the incentives to invest in tree planting.

Vegetative propagation can also significantly reduce the time that elapses between tree planting and first fruiting. This is felt to be particularly beneficial to poorer households, who cannot afford to undertake activities that do not generate fairly quick returns, especially where the decision to plant a tree means that an alternative productive use of the same piece of land has to be foregone. In addition, where the laboratory and organisational capacity exists, tissue culture may be used to further speed up tree multiplication and also to ensure that viruses are eliminated from growing stock³⁵.

We can distinguish three types of domestication activity:

- **Bottom-up**, whereby farmers experimentally select and plant trees on their farms. For example, the Mayans in Mexico have been domesticating trees from their local forests for centuries (Poole, Gauthier et al. 2000). However, although bottom-up domestication involves selecting trees for desirable attributes such as larger or sweeter fruit, achieving significant, widespread productivity improvements may take generations.
- **Commercial or market-driven**, where companies invest in research and development of propagation techniques to enable producers to grow particular forest products, rather than relying on harvesting of wild resources. A company may begin by contracting people to supply it with products harvested from common property resources, but may then find that this supply can no longer satisfy its demand or may wish to improve the quality of the products that it sources.
- **Institutional**, where impetus for domestication activity is provided by a publicly-funded research programme. The most notable example of this type is the programme coordinated by ICRAF, involving numerous partner organisations in different continents and regions.

Leakey and Simons (1998) see the first two types as the two ends of a continuum. Institutional domestication activity may engage with farmers and commercial interests at almost any point along this continuum.

The Need for Institutional Domestication Programmes

The terms of reference for this paper require us to consider the potential of institutional domestication programmes to enhance the livelihoods of FRP's target groups of forest-dependent poor people. It is, therefore, useful to pose the question as to why publicly-funded, institutional domestication programmes are either necessary or desirable when both bottom-up and commercial domestication processes also operate. Will publicly-funded programmes not just duplicate (or possibly "crowd out") private activity of one form or another? One way of answering this is to suggest what publicly-funded programmes can add to either bottom-up or commercial processes:

- As already noted, bottom-up processes tend to be slow. They occur in response to changing ecological and economic circumstances – most notably rising populations putting pressure on common property tree resources, combined with growing market opportunities for the products in question³⁶. However, they cope best when such changes are gradual. When the pace of change accelerates, bottom-up domestication processes may be unable to respond swiftly enough. This is both because of the inherently long lags in experimental selection of trees and because property

³⁵ Where tissue culture laboratories are involved, however, care has to be taken to ensure that control of the domestication process is not taken entirely out of the hands of the rural communities whom it is supposed to be benefiting. Those who argue that tissue culture does have a valuable role to play suggest that conscious efforts to ensure beneficiary participation at other stages of the domestication process (e.g. identification of desirable traits and of "plus trees" for multiplication) can compensate for the inevitable "centralisation" of the laboratory stages.

³⁶ These changing circumstances also have important impacts on local cultures and social relationships. However, whilst recognising that cultures and social relationships are themselves dynamic, some also claim that bottom-up domestication processes are compatible with them in a way that commercially-driven domestication might not be (Leakey and Tomich 1999).

rights (to land and trees) may also only evolve with a lag, thus diminishing the incentives for farmers to engage in such experimental activity. By contrast, the greater resources and level of expertise (including multiplication techniques) available to institutional programmes mean that they can respond much more rapidly when circumstances change. In Sub-Saharan Africa, the most important change bearing on (fruit) tree resources in recent decades has been the historically unprecedented rate of population growth. New market opportunities are also constantly emerging, though market growth has not been anywhere near as dramatic as in Asia. Meanwhile, there is a debate as to whether the nature of land rights acts as a constraint on agricultural innovation (Platteau 1996; Sjaastad and Bromley 1997). In South Asia, market opportunities have expanded rapidly with regional economic growth, but this has not yet attracted the attention of large commercial players able and willing to invest in genetic improvement of semi-domesticated species of major interest to poor households³⁷.

- In contrast to bottom-up activity, commercial programmes can (theoretically) respond quite quickly to changing circumstances and can mobilise plentiful resources in support of domestication activities. However, their limitation is in their scope and the distribution of benefits. Commercial research resources are only likely to be applied to a narrow range of trees, selected purely according to their commercial or industrial potential. For example, *Dacryodes edulis* is valued by smallholders primarily for its shade and its fruit. Given the choice, farmers are most likely to select “plus trees” that score highly in these areas. By contrast, potential future commercial interest could focus on the oil that can be obtained from the kernel³⁸. Meanwhile, trees that are valued by poor communities as sources of food or other goods, but which have no obvious industrial potential, are unlikely to benefit from commercially-funded domestication research (Leakey and Tomich 1999). Moreover, whilst some large firms are willing to work with poor communities to enable them to function as suppliers of raw materials, there is a fear that most large firms would really prefer larger-scale, more commercial suppliers - if only sufficient progress could be made with tree domestication to attract such players into the market. There are also potential intellectual property right (IPR) complications when the domestication of trees previously managed by poor communities is funded by a large commercial organisation³⁹. In theory, institutional domestication programmes can attach greater priority to the needs of poor communities or groups and can be structured in such a way that the property rights over the basic genetic resources, whilst perhaps not very well defined or protected, nevertheless remain with those communities.

Reservations about the interactions between commercial domestication programmes and poor communities notwithstanding, growing market opportunities for tree products provide one of the most powerful incentives for tree planting and hence also domestication. Pro-active efforts at commercialisation may, therefore, be pursued alongside a domestication programme, in order to increase the incentives for farmers to plant the target tree species. These efforts could include:

³⁷ By contrast, there has been investment in some South-East and East Asian semi-domesticated species, as the earlier reference to mangosteen indicated.

³⁸ This does raise the question as to whether parallel bottom-up / institutional domestication efforts could select for different attributes, with market segmentation meaning that commercial exploitation did not undermine smallholder markets.

³⁹ Leakey and Tomich (1999) point out that vegetatively propagated trees are common pool goods, so enforcement of property rights is inherently difficult. However, any attempt to restrict propagation by communities for purposes other than supplying the company in question would certainly create conflict. The recently released White Paper on globalisation (DFID 2000) makes DFID’s interest in this issue quite clear: “We support the development of internationally recognised standards, consistent with the objectives of intellectual property agreements, for the protection of traditional knowledge and access to genetic resources, which will help ensure fair and equitable benefit sharing. ... Another concern in this area has been that transnational companies may be able to patent the results of research which should be made freely available as an [sic] ‘global public good’, for instance the human genome or plant and animal genomes. We are committed to working for international agreement on the need to release fundamental information on the human genome and the DNA sequences of the world’s major naturally occurring food crop and livestock species into the public domain.” (paras 147 and 148).

- the development of processed products derived from these species
- industrial applications of tree products
- strategies to enhance the ability of target communities to participate in product markets (improving market access), including establishing links with commercial buyers of particular products.

Arguably, the optimal approach to domestication combines all three types of activity listed above: an institutional programme that allows farmers to set priorities (species, valued attributes etc), but also forges links with the private sector to promote market development (R.Leahey, *pers.comm.*). In this vision, the role of publicly-funded research is to:

- enhance the capability of local communities to undertake domestication activity, thereby enabling more rapid progress to be achieved than would otherwise be the case;
- establish links between poor producers and commercial interests;
- in doing so, protect the competitive position of poor producers relative to potential, larger-scale suppliers.

However, exactly how this third role is to be achieved – and, indeed, what the precise nature of the challenges is – is still not fully understood (Leahey and Izac 1996). We return to this issue shortly.

The Case for Investing in Domestication

At the end of section 6, we advised FRP against focusing their efforts on improving market access for poor households to markets for conventional tropical fruits. We suggested that trends in international markets for conventional tropical fruits are making it increasingly difficult for poor producers from poor countries to compete successfully; that the multiplier benefits for poor people from production of such fruits by less poor producers would be modest, and that, whilst poor households are clearly interested in cash earning opportunities, these are not their only interest when planting trees. In the light of this earlier conclusion, the case for focusing on domestication of indigenous fruit trees might be set out as follows:

- Domestication programmes expand the basket of attractive options open to poor households who wish to plant trees. This diversity makes it more likely that households in a range of environments and with a range of socio-economic characteristics will find it worthwhile to plant trees. Within and across poor households, diversity of (fruit) trees planted has advantages both from an economic point of view (spreading production and market risks) and from an environmental point of view.
- As noted above, institutional domestication programmes can ensure that domestication activity takes into account the needs of poorer households, for whom fruit trees are multi-purpose assets, and is not driven entirely by the requirements of a particular market or markets (in which case better resourced households are likely to capture most of the benefits)⁴⁰.
- The markets for a number of indigenous fruits and fruit products are growing. These include domestic, regional and, less commonly, international markets. We have already noted the growth of Asian regional markets for semi-domesticate fruits and West African cross-border trade in

⁴⁰ However, although ICRAF have developed clear methodologies to ensure that the voices of different groups of farmers are heard in priority setting for their domestication work (Franzel, Jaenicke et al. 1996), it cannot automatically be assumed that all institutional domestication will do this. If considering support for domestication activity, FRP should pay particular attention to the processes for attribute (as well as species) selection being used.

certain indigenous fruit species. In addition to these, Leakey and Tomich (1999) note the local importance of markets for peach palm fruits and heart of palm (Amazonia), *Sclerocarya birrea* (“marula”) and other indigenous fruits in southern Africa, and *Vitellaria paradoxa* (shea) and *Parkia biglobosa* (nere) in the Sahel. Although these markets are much smaller than the markets for major conventional tropical tree fruits, they are not subject to the intense competition nor to the processes of vertical integration, driven by consumer requirements for quality, that are now the norm in the major western markets for citrus, mango, papaya etc.

Considering FRP’s four main target groups of poor, forest-dependent people, we note the following:

- The case for focusing research support on domestication (as opposed to markets for conventional tropical fruits) is based primarily on which groups of *producers* are envisaged as being major beneficiaries. Proponents of domestication programmes argue that poor households who plant indigenous fruit trees will be major beneficiaries, gaining important benefits
 - as consumers of the fruit, especially where such trees fruit when other sources of food or income are scarce
 - as users of the trees’ other products (e.g. the wood, for energy or construction needs)
 - as (occasional?) sellers of these various products
 - from the contribution that such trees can make to the general productivity of farming systems (e.g. contributing to soil fertility).
- However, domestication may also be essential if various indigenous fruits (and their associated products) are to continue to feature in local markets, let alone to grow in their importance to consumers.
- Market systems for most indigenous fruits are (currently) dominated by informal intermediaries, many of whom fall within FRP’s category of small-scale traders and entrepreneurs. Greater volumes of better quality produce and greater development of final markets will stimulate these people’s business – providing it doesn’t lead to their roles being taken over by larger, better resourced players.
- Benefits to the landless are likely to be few. Domestication is often associated with the demise of gathering activities from wild resources (an important activity for some rural households with little or no land), although it is not the cause of this demise. Encouraging small-scale processing of indigenous fruits may, *inter alia*, create some local employment for landless households. Moreover, if smallholders are the main beneficiaries of increased fruit production through domestication, there may be some consumption linkage benefits that landless households can appropriate. However, whilst landless households may be better off with domestication than without, one should not overplay the potential scale of these benefits.

In what follows we critically appraise the case for poverty reduction benefits from a research focus on domestication.

Critiques of Domestication

Will Poor Households Really be the Main Beneficiaries of Domestication?

We suggested above that institutional domestication programmes can take account of the particular needs of poor households. However, there are two counter-arguments that need to be considered in more detail:

- That poor households who lose out from the decline of wild tree resources may not benefit from domestication;

- That domestication may encourage the entry of more commercial players into the production and marketing of indigenous fruit products, thereby undermining the benefits to poor producers.

As noted earlier, where indigenous species exist as a common property resource, there is evidence that it is the poorest households who are the most dependent on them as a source of household income, certainly in proportionate terms and often in absolute terms, too. Common property resources side-step the land constraint that otherwise impinges particularly on the poor. However, as soon as one enters the arena of cultivation, secure “private” rights to land become critical. A key distinguishing feature of many poor groups in rural areas is that they only have control over very small plots of land, if any at all. Many poor households will plant some fruit trees around their homestead, assuming they have one, but staple food production is generally their top priority on any fields that they own - and fruit tree cultivation is not always compatible with this.

The question of land access is a rather intractable one. It is certainly beyond the remit of FRP. However, we have to remember that, with growing population pressure in most areas, the “without domestication” scenario for poor households is not one of continued benefits at current levels from common property resources. Rather, it is one of declining common property resources – with the poor the most seriously affected because they were previously the most heavily dependent on these resources. Clearly, the decline in common property resources is more advanced in some areas than others and strengthening local management of these resources will slow the rate of decline. This, therefore, remains an important area for supporting the livelihoods of many poor people in rural areas. Nevertheless, the long term options for many species may still be domestication or disappearance.

The question of entry by commercial players hinges on the issue of tree productivity. By yielding more fruit for home consumption (or fruit over a longer period), higher productivity trees may benefit poorer households even when their access to markets is poor⁴¹. However, low productivity (as a result of lack of species improvement) can act as a protection as well as a constraint. Where a species exhibits low productivity, only the least well off (i.e. those with the fewest alternatives) will engage in its exploitation. As productivity is raised, the potential gains from its exploitation rise and this is likely to attract others in to exploit it. Thus, those who previously exploited it do not necessarily end up better off. In the worst case scenario, they could end up being competed out of the market altogether. This trade-off between greater total gains and danger of existing producers losing their market share (assuming that the existing producers are somehow more deserving of support than the new entrants) is present all along the domestication – improvement continuum. Where semi-domesticates have been the preserve of smallholders, genetic improvement may take them over the threshold at which commercial enterprises decide to establish their own plantations. Whilst it seems reasonable that the initial stages of domestication are less likely to cross some critical threshold in triggering commercial entry than is subsequent improvement work, domestication does produce the discrete change that a species can now be transported and grown away from its wild populations. Thus, even if commercial enterprises do not rush to plant it, other “outsiders” (e.g. smallholders from other areas) may do so.

The case of *Sclerocarya birrea* (“marula”) in South Africa may prove instructive here. Despite efforts over some years, domestication efforts have yet to overcome the problem of highly variable fruit yield from year to year. This makes planting of marula orchards a highly risky business proposition, despite growing markets both for the fruit (for liqueur production) and kernels (for oil extraction). On the other hand, poor smallholders deriving multiple goods and services from the trees might still consider it worthwhile planting them, recognising that in good years (though not in all years), their trees will generate significant cash benefits for them. At present, the liqueur and oil industries source largely

⁴¹ However, whilst the strong subsistence element in the livelihood strategies of many poor households is not imminently going to disappear, markets are becoming increasingly pervasive even in African rural life. Even where trees are multipurpose (i.e. very commonly), market options may still be an important determinant of whether households grow trees that also generate subsistence benefits. This is probably clearest in the case of fruit trees, which are increasingly prioritised for planting by farmers because they have recognised income-generating potential.

from households gathering wild resources. However, some orchards are also being planted on an experimental basis. It is surely only a matter of time before cultivated production takes over from supplies from common property resources. The question is: who will undertake the cultivation?

Michon and de Foresta (1996) argue that the nature of the domestication process itself can also have a major influence on whether or not commercial producers take over from smallholders. They are concerned that attribute selection by research institutes often favours cultivation of trees in a monocropping environment where a particular tree is only valued for its production of one commercial product. By contrast, they argue that domestication efforts aiming to benefit smallholders in large parts of Asia should seek to increase the productivity of trees as they are grown within complex, multi-strata agroforestry systems.

As noted earlier, processes of commercialisation are an inevitable, indeed integral, part of economic development (including in the area of fruit trees). Where commercialisation is an evolutionary process, in which most of the components of a coherent system move forward together, the problems are minimised. There will still inevitably be some losers, but, for example, those who have to sell up their land and exit agricultural production in a growing economy stand some chance of finding alternative employment elsewhere. By contrast, major tensions are much more likely to arise in situations where highly commercial activities are juxtaposed with less developed, more subsistence oriented activities and players. Ongoing processes of globalisation, trade and investment liberalisation mean that powerful commercial forces may come into more or less direct contact with semi-subsistence livelihoods and production systems. These dynamics remain a valuable area for further socio-economics research (Leakey and Tomich 1999).

Domestication and Forest Conservation

There have been hopes, in some quarters, that domestication of indigenous species previously harvested from heavily exploited forest or woodland areas could reduce the pressure on those resources and aid their conservation. These hopes rested on the expectations that:

- the same people who were most heavily engaged in harvesting prior to domestication would be the ones who would plant the species afterwards;
- they would be able to earn a sufficient income from the sale of their products that they would not need (or not have time) to exploit the resources within the forest so intensively.

However, (Fereday, Gordon et al. 1997) note that remaining forest resources are normally quite remote from major market centres. They argue that, where markets for the products in question are genuinely strong, smallholders living in more accessible areas will probably come to dominate production of domesticated fruit trees. Thus, neither of the conditions above is likely to be fulfilled.

Forest-fringe dwellers are probably the most heavily forest-dependent poor groups of all. However, in terms of global poverty, they are also not that numerous (Palmer and Macqueen 2000). An alternative way of assisting them to reduce their pressure on forest resources might be to develop processing technology that would raise the returns that they receive from each unit of fruit harvested, thus raising the value of the resource and increasing the incentives to its conservation. Raising the value:weight ratio of the products produced by (assumed) remote communities is a good strategy for assisting them to find markets. Moreover, whilst their raw material was still restricted to particular forest locations, it would be less easy for more accessible communities to take over production of the resulting products. However, higher returns to the exploitation of forest products could increase, rather than decrease, exploitation of the forest itself. Thus, secure long term property rights over the forest resource for the harvesters / processors would probably be a necessary (though not sufficient?) condition for ensuring that higher returns led to enhanced conservation, rather than increased exploitation.

If the species in question were valuable, would they not already be domesticated by now?

This question relates to the size of the markets for indigenous fruits, which, as already noted, are still much smaller than those for the main conventional tropical fruit species. Underlying the question, however, there is also the assumption that product research and development responds fairly smoothly and reliably to market opportunities. By contrast, our view is that research – requiring significant investments with often quite uncertain returns – is subject to significant “market failure”. Thus, there may be long lags between market opportunities arising and research efforts responding to meet them. There may also be a strong degree of “path dependence”, whereby initial research into a tree or product tends to encourage further research along the same line. We incline to the view that the extent of improvement work undertaken on the main conventional tropical fruit species has as much to do with the degree of involvement of producers in developed economies and to the decisions of colonial administrators, often taken with plantation exporters in mind (Leakey and Tomich 1999), as to the innate value or potential of the species concerned.

Circumstances that determine “value” are changing all the time. Technological and knowledge advances might suddenly create demand for a species that had little value previously (although this is more likely in the case of a medicinal or industrial application of a tree product than where a tree’s primary value is for food use). Market tastes and preferences also change over time, as does the intensity with which market demands are felt in particular rural areas. As noted earlier, where market conditions change rapidly, informal domestication processes may not be able to respond quickly enough.

That said, it is certainly true that some indigenous trees have greater market and other values than others. Even where indigenous trees are retained, rather than planted, farmers may choose only to retain certain species. On the one hand, that some fruits taste foul, or that some species are only marketed or consumed by restricted numbers or people, does not discredit all institutional domestication activity. On the other hand, one cannot discount the possibility that species with considerable subsistence and market potential remain under-researched and under-exploited. For example, some *Annona spp.* in the Yucatán peninsula of Mexico are highly appetising, yet their existence is imperilled by lack of scientific attention. Comprehensive regional domestication programmes that start with species prioritisation by farmers or other stakeholders over an entire agro-ecological zone adequately should respond to objections of this nature. (Where such prioritisation work has already been conducted – as it has for most of the sub-regions on which we are focusing in this paper - it is also wise for FRP to work within the framework that this provides).

At the other extreme, one should probably treat with some caution claims that domestication programmes for indigenous tree species will unlock enormous, previously untapped economic potential. For example, in relation to the Brazilian Amazon, Moraes, Muller et al. (1994) conclude that:

"The greatest world reservoir of unexploited fruit species ... is in fact not so great if economic connotations are considered." (p51)

However, the tenor of this report has been to highlight the importance of incremental improvement to poor people’s livelihoods, rather than revolutionary advances.

What incremental productivity improvements might be expected from domestication?

The basis for productivity improvements through domestication is the often dramatic genetic variability found within populations of indigenous tree species. For example, Leakey and Ladipo (1996) report a 5-fold variation in key characteristics (e.g. fruit size, pulp:seed ratio) within *Dacryodes edulis* from a small study of Yaounde markets in Cameroon. Multiplication of “plus trees” which score highly on one, two or more desired attributes can raise the average score across tree populations on

these indicators. Comparison of key tree and fruit characteristics across retained and planted *Dacryodes edulis* and *Irvingia gabonensis* trees in southern Cameroon indicates that farmers' selection has already led to major improvement in productivity / quality indicators (67% genetic gain in *Dacryodes edulis* and 44% in *Irvingia gabonensis* – R.Leakey, *pers.comm.*), even though farmers have so far relied on planting from seed. Using vegetative propagation methods would enable them to increase levels still further and would strengthen the incentives to plant new trees.

Can domestication programmes deliver poverty reduction benefits within a reasonable timeframe?

The following quote indicates that the time frame over which domestication programmes can deliver results is an important issue for agencies such as DFID that are committed to international poverty reduction targets:

“DFID/NRRD stress on achievability of developmental impact by the year 2005 means that FRP will have to focus on problems of the enabling environment and on improving the benefits which flow from trees already growing, rather than research for the creation of improved growing stock or new planting patterns.” (Palmer and Macqueen 2000: 33, para 5.3)

In this context, we understand “the creation of improved growing stock” to include domestication programmes that aim to enhance the choice of growing stock *available to tree planters* through selection and multiplication, even where no new germplasm is created. A domestication programme may contribute to improved growing stock through:

- broadening the number of species for which growing stock is available. Instead of only having the option of planting conventional tropical fruit trees – whilst retaining, but not planting, preferred indigenous species – domestication programmes facilitate farmers' planting of indigenous species, too.
- improving the quality of the growing stock that is available for particular species.

Once the priority species for domestication have been identified, there are various steps that have to be completed in order to produce growing stock for a target species:

- The genetic diversity within wild populations has to be assessed and collection of representative germplasm undertaken. The time needed for initial germplasm collection cannot be predicted in advance, but – even in a well-resourced programme – it may take two years. However, some selection work can be conducted during this period and further studies on the genetic variation within a species can also continue in parallel with other activities.
- Appropriate vegetative propagation techniques for the species in question need to be developed. (This is basically a question of “tweaking” techniques developed for other species). Assuming, in an African context, that farmers are going to do almost all the propagation themselves, the techniques need to be simple and reliable enough for poor farmers to undertake. Critical considerations are the equipment required by a propagator and the success rate under on-farm circumstances. For example, the success rate with *I.gabonensis* marcotts so far is only 10% whereas that achieved with *D.edulis* is 50-70% (R.Leakey, *pers.comm.*). Whilst the development of these techniques can, in theory, proceed in parallel with other activities, it may also be a source of delay in progress with the programme as a whole.
- Once promising techniques have been developed, the first vegetatively propagated plants need to grow sufficiently to start being used as stockplants for further multiplication. Tree biology matters a lot here, although research can be used to reduce the time lag. There is also a trade-off between the number of stockplants that a programme (or nursery) wishes to produce and how soon one can

start trialing trees on farm. Experience at this stage might necessitate that the propagation techniques be further developed / modified.

- The results of on-farm trials are seen once fruiting has taken place (eighteen months or more, again according to tree biology).
- Finally, good performing trees are further multiplied and sold to farmers for their own use.

Progress with these steps determines the minimum time required before domestication activity for a particular species *can* bring benefits to the lives of poor rural households. However, in order for this work to achieve widespread poverty reduction impact, a sufficient number of nurserymen and farmers have to be trained in the multiplication techniques. Lack of trainers and resources for training may be a more important source of delay in achieving poverty reduction impact than the inherent delays in the scientific process outlined above⁴².

In Africa, domestication activity is reasonably well advanced for *I.gabonensis*. The collection of germplasm began in 1994-5, following its identification as a priority species for domestication in a participatory process organised by staff of ICRAF in conjunction with partner organisations. Progress with the development of vegetative propagation techniques was noted above. Meanwhile, researchers are working in 10 villages in West / Central Africa where they hope that farmers will eventually establish village nurseries to multiply cultivars of this and other domesticated species. However, it could still take 5-10 years before such nurseries are selling growing material to farmers in their respective areas (R.Leakey, *pers.comm.*). Assuming that these cultivars are sought after by farmers and that the nurseries prove to be viable local enterprises, there will then be a further lag before the technology is adopted in other areas.

Put in apocalyptic language, if the world is assumed to end in 2015 and the sheep will be separated from the goats solely on the basis of their contribution to poverty reduction by that point, FRP may not want to support domestication efforts. The case for domestication thus depends on FRP taking a balanced, long term strategy that recognises the importance of investing in the expansion of choices even after 2015. The circumstances of poor farmers will continue to change after this date as they have before it (assuming that the world doesn't end!) and efforts need to continue to provide them with a range of assets with which to respond to these changes. A strategy that seeks poverty reduction by 2015 without regard for what happens after then is wide open to the charge that it is not promoting sustainable livelihoods.

Commercialisation and Improvement of Semi-Domesticates in South Asia

The earlier parts of the report sought to emphasise differences in the general economic circumstances of farmers in Sub-Saharan Africa and South Asia (not to mention other parts of Asia that are more developed still). Differences that we noted that are relevant to the discussion in this section include:

- The greater degree of market development, due to:
 - denser populations
 - historically greater investment in infrastructure

⁴² More optimistically, where farmers learn new propagation techniques for fruit trees, they can experiment with a range of cultivars with different attributes – good for tailoring trees to the varying needs of different categories of farmers and also for maintaining biodiversity. (Indeed, the importance of continually introducing new cultivars must be stressed to those being trained or otherwise assisted to establish local nurseries). They may also experiment with new species once they are familiar with the few that have received institutional research support. In the best case scenario, a long initial lag before domestication efforts yield significant poverty reduction benefits could be followed by an exponential expansion in those benefits as bottom-up domestication receives a new impetus.

- strong economic growth in recent decades, both within South Asia (to a greater or lesser degree) and in other parts of the continent, leading to the growth of regional markets;
- A greater degree of dependence on, and engagement in, markets (land, labour, water, product) amongst poor households than is the case in Africa. Ignoring markets is not really an option when your landlord requires rent every year and you have to pay for water from a tubewell owner!
- A wider range of tropical fruits with established domestic or regional markets;
- Stronger (albeit still uneven?) public sector research capacity, which has devoted some resources to the fruits that we have termed semi-domesticates.

Undoubtedly, Asia still has many undomesticated fruit trees, some of which are highly valued by farmers (see, for example, Paudel, Pieber et al. (2000) for the case of *Lapsi* in Nepal). However, research into these species is probably less far advanced than for indigenous fruit trees in many parts of Africa. At the same time, there is still plenty that can be done to improve the utility of semi-domesticate species for poor farmers. According to the summary recommendations of a regional workshop reported by de Groot (1992), research and action priorities are:

- Documenting available germplasm for priority fruits and nuts, and collecting and evaluating more;
- Dissemination of information on improved propagation techniques;
- Identifying opportunities for profitable new processing activities;
- Studies of local, regional and international markets for priority fruits and nuts, including detailed information on market requirements;
- Identifying opportunities for utilisation of by-products from fruit trees;
- Documenting the main pests and diseases affecting the priority species and dissemination of information on control practices;
- Further improving productivity and fruit quality (through agronomic work, investigation of problems with fruit setting in some species, reduction of the juvenile period, reduction of irregular flowering, improving nutritional value);
- Breeding of superior varieties (through clonal selection of existing promising varieties, hybridisation, improvement of rootstock);
- Improving packaging and transport;
- Improving consumer awareness of new fruits and their products.

It would appear that these needs have arisen because:

- Asian markets have developed far faster in recent decades than either farmer innovation or national public sector research has been able to keep up with;
- National research efforts have not been well coordinated, so that the benefits of learning from neighbouring countries' research efforts have not been realised.

In our discussion of domestication so far (relevant particularly to Africa), we have acknowledged that there may be a tension between, on the one hand, the speed with which research can achieve poverty reduction impact and, on the other, the need to equip poor farmers to handle changing circumstances (e.g. relative resource endowments, market demands) over time. A research strategy that seeks to improve and commercialise primarily semi-domesticate⁴³ fruits in South Asia seems to strike a fair balance between these two objectives:

⁴³ In fact, proponents of this view tend to talk in terms of “underutilised” crops, rather than categories such as indigenous, semi-domesticate and exotic (which, as we have acknowledged, are somewhat artificial). In the Asian context, underutilisation appears to be measured almost exclusively in terms of market potential – not an unreasonable yardstick given ongoing changes in Asian economies. However, the priority crops reported by de

- Such a strategy should give quicker returns in terms of poverty reduction than a strategy based on Cinderella crops. In Asia, unlike in most of Africa, there is some public capacity for tissue culture, which can dramatically increase the speed of multiplication of growing material. This may exist in the public sector or – more promisingly? – in the commercial or NGO sector. In Bangladesh, several of the powerful NGOs (BRAC, Proshika, CMES) are investing in tissue culture capacity and have plans to integrate the distribution of growing material with their successful and wide-reaching microcredit programmes (N.Haq, *pers.comm.*). These reach large numbers of very poor people, if not necessarily the poorest of the poor. Relying on tissue culture laboratories to produce many of the stockplants for local nurseries removes an element of control over the domestication process from farmers' hands. For this reason, and in order to ensure that domestication does generate significant productivity improvements for farmers, any strategy that involves tissue culture laboratories must also have a strong element of farmer participation in the process of selecting material for multiplication. However, assuming that due emphasis is placed on getting the selection process right, the impact of organisations such as the Bangladesh NGOs taking on fruit tree improvement could be considerable. In particular, a highly commercially minded organisation such as BRAC is likely to take marketing challenges for the resulting fruit products very seriously;
- Nevertheless, it does broaden the choice of fruit tree growing stock available to farmers.

A counter-argument is that, if an agency such as DFID does not undertake strategic research to start to identify the next generation of marketable fruits, who will? However, the priority that DFID currently attaches to progress with poverty reduction seems to count against this argument.

Will Commercial Producers Take Over Production of Semi-Domesticates as Improvement Proceeds?

Although many Asian governments aim to increase the commercialisation of their nation's smallholder farmers and although the agricultural sectors in East and South East Asia are already undergoing rapid structural change, the replacement of family farms by commercial estates is not generally a desired outcome. Some features of semi-domesticates (at current levels of improvement) do encourage smallholder production even when commercial competition is a possibility:

- Many semi-domesticates are still highly valued by smallholder households for their multi-functionality. These multiple values mean that the trees might still be worth growing even if the price of fruit was competed downwards by large-scale competition;
- The likely pest and disease problems of large pure stands of many semi-domesticates are still unknown, making such production extremely risky. These species are, however, appropriate for species-rich, multi-strata agroforestry.

On the other hand, to enhance the value of semi-domesticates to smallholder producers and to protect their competitive position against estate production, tree improvement should recognise the multiple values that trees have for poor households and should seek to enhance their productivity as parts of complex smallholder farming systems. For example, jackfruit trees produce marketable fruits, but are also an extremely valuable timber tree (an example of the savings function of fruit trees) and can provide fodder if other sources are not available. Selecting for incremental improvement in these multiple attributes, rather than focusing exclusively on, say, high and reliable fruit yields⁴⁴, should

Groot (1992) for Bangladesh (jackfruit), India (ber = *Zizyphus mauritania*), Pakistan (guava) and Sri Lanka (*Annona* spp.) could all be classed as semi-domesticates.

⁴⁴ There might, for example, be a trade-off between yield per hectare and tree size, with the priorities of smallholders and commercial growers differing on how this should be struck.

bring benefits for existing and potential poor growers whilst minimising the risk of triggering entry by large-scale operators.

Conclusion Regarding Option 1

Despite the time-scale issue, we **do** recommend that FRP support work on domestication of indigenous fruit trees in Sub-Saharan Africa as a way of expanding the basket of attractive options open to poor households who wish to plant trees. In South Asia, we recommend that FRP focus on semi-domesticate species, which represent the best trade-off between poverty reduction impact and maintenance of diversity / options.

Where regional species prioritisation frameworks already exist, FRP should use them and should seek to focus on research problems that are not already funded by other organisations. FRP should also pay particular attention to the processes for attribute selection being used by potential research partners to ensure that the voices of poor producers are sought and listened to within domestication and improvement activities.

8) **Market Access**

Although one of the two research options in the terms of reference for this paper specifically referred to market access and the other did not, proponents of domestication generally also recognise the importance of access to markets if poor households are to plant fruit trees. If there is a difference in emphasis between the two options in terms of market access, it is that one sees fruit trees primarily as cash crops whereas the other emphasises the multi-functionality of fruit trees, with cash generation as one valued attribute amongst several.

Experience shows that marketing can be problematic for smallholders whether the products in question are:

- indigenous fruits gathered from woodlands, fruits from domesticated indigenous trees, semi-domesticates or conventional tropical tree fruits
- other agricultural products altogether (Kydd and Poulton 2000);
- domestic or export markets.

Our view is that the problems are not fundamentally different for indigenous and conventional fruits. We have, therefore, left consideration of specific interventions to improve the market access of poor, small-scale producers of tree fruits to the end of this report because many of them are relevant to both of the specified research options. At root, market access problems are a function of the weak asset base and poor access to information and contacts of most smallholders. They are exacerbated by the perishability of (fresh) tree fruit. They are also more acute in more sophisticated and long-distance markets, which is one reason why we advise FRP against a focus on option 2.

The section is organised around Table 2, which lists generic market access issues facing smallholders and attempts to introduce a certain element of prioritisation for FRP. (This prioritisation is interactive with the basic recommendations about research focus already made in this report). Before looking at these individual issues in turn, a couple of explanatory comments are in order:

Firstly, the table attempts to distinguish researchable generic market access issues from problems that basically require marketing action. The intended distinction is as follows:

- Issues identified as researchable generic market access issues are ones where basic questions are not yet answered or the possible solutions not yet known even in fairly general terms. For example, how does one design a sustainable marketing information system – particularly one that is relevant to perishable commodities – for countries where there is minimal public sector capacity or resources?
- Problems requiring marketing action are ones where a range of best practice options is known, but where a solution has not yet been identified or implemented for the particular market system in question. For example, techniques of market research are well known. However, there are many market systems where producers and/or small-scale intermediaries are ill-informed about possible market opportunities and what might be required to respond to them.

The view of the current authors is that most projects (or, perhaps more realistically, clusters of projects) with a plant genetic improvement component will also require some marketing action input. Improvements in market access can thereby provide the necessary incentives for adoption of improved growing stock at the same time as improved growing stock makes increased market penetration plausible.

Secondly, where researchable generic market access issues are identified, the table attempts to distinguish between those that are most appropriately tackled by FRP and those that are more appropriately handled elsewhere (generally by the Crop Post-Harvest Programme). The basis for this allocation is:

- How generalised the problem is within smallholder agriculture, (where it extends well beyond fruit tree producers, CPHP should take the lead);
- How many small-scale fruit tree producers in target poor countries might realistically benefit from a solution to the problem.

Market Systems Analysis

Historically, a major preoccupation of market systems analysis has been with the efficiency of market systems, driven by the suspicion that poor producers and consumers are regularly exploited by powerful, “monopolistic” market intermediaries. In informal agricultural market systems within developing countries – if not in some cash crop systems or in international markets for agricultural commodities (Morisset 1997) – the broad consensus now is that markets generally *are* tolerably efficient, or at least that imperfect information is a more pervasive and serious source of market failure than monopoly power⁴⁵. (Deweese and Scherr 1996) maintain that this general conclusion holds true for most markets for non-timber forest products (NTFPs), although they also note that the multiple product, multiple use nature of NTFPs makes them particularly difficult to analyse.

On the other hand, they argue that a particular constraint confronting the operation of NTFP markets is the continued existence of outdated forestry legislation originally designed to protect forest reserves from unlicensed extraction of forest products. Such legislation may still be used to restrict the sale and movement of indigenous tree fruits (and other NTFPs), even when these have been harvested from private land and/or when the tree(s) in question was planted by a farmer. Although often erratically enforced, this legislation provides opportunities for rent-seeking by law enforcement officials and generally raises the uncertainty surrounding – and hence the cost of – marketing indigenous fruits. Whilst further research might only confirm this existing finding, attempts to quantify the costs of the maintenance of inappropriate legislation could provide a useful basis for engaging in policy dialogue with government agencies. The aim would be to obtain, where necessary, a revision of forestry legislation so as to support, rather than obstruct, tree planting by small-scale farmers.

⁴⁵ Of course, there are dissenting voices – see, for example Harriss-White (1995) and Crow and Murshid (1994).

Table 2: Generic Market Access Issues Relevant to Fruit Tree Growers

TOPIC	MARKET	RESEARCHABLE ISSUE?	ROLE FOR FRP?
Market Systems Analysis	Domestic / Export	Understanding of relationships within market systems should be foundation for marketing action; Impact of regulations and controls needs to be highlighted to policy makers.	Marketing action Advocacy with national policy makers
Marketing Information	Domestic	Design of sustainable information systems still a challenge. However, even for tree growers, need is not limited to fruits – poles, firewood etc.	Primarily CPHP responsibility, but FRP may wish to fund some research in areas where sales of tree products are a major component of household income. Also possible marketing action component?
Development of Producer Groups	Domestic / Export	Best practice exists; needs are - dissemination, networking - resources, LR perspective	Best left to NGOs?
Outgrower Schemes	Export	Yes: 1) long-run benefits for producers – still to be proven 2) role of NGOs (e.g. FAIDA) – sustainable models?	Minor FRP priority: junior partner to broader CPHP interest and/or seek commercial co-funding?
Ethical Trade Channels	Export	Yes: 1) fair trade criteria for specific additional commodities 2) occasional, random monitoring of implementation and poverty impact 3) impact of ethical sourcing developments on smallholders	1) and 2): Co-fund with other stakeholders – FRP enhance credibility of standards? 3) CPHP responsibility
Seasonal Credit	Domestic / Export	Big challenge for smallholder agriculture, but relevance to tree crops limited (initial investment capital is generally more of an issue)	Not an FRP priority
Transportation Efficiency	Domestic	Yes: how to close efficiency gap between Africa and Asia	CPHP + IUD (DFID) responsibility
Quality	Export / Domestic	Yes: 1) Domestication / Genetic improvement of planted trees 2) Improved handling practices and coordination between producers and traders	1) See section 7 2) Marketing action component
Small-Scale Processing Technologies	Domestic	Yes	FRP identify few technologies to work on based on: 1) size of market and number of potential users 2) relevance to other FRP fruit tree projects
Market Place Infrastructure	Domestic	No	Marketing action component

A degree of market systems research will also be necessary wherever marketing action is contemplated by FRP projects. The objective here will be to:

- describe the relevant market system
- understand the relationships (horizontal and vertical) between different players within the system
- identify particular areas where the system performs poorly (e.g. information flows to producers, credit availability for producers or traders, high variability of demand at local level within and across seasons)

in order that appropriate marketing interventions can be designed.

Marketing Information

Establishing and sustaining effective market information systems in developing countries has long been recognised as a major challenge, particularly where state capacity is weak (Schubert 1983). However, international efforts to date – focused largely on the regular collection and dissemination of market price information - have met with, at best, mixed success (Shepherd 1997). The problems are particularly acute where crops are perishable, so prices tend to be especially volatile. Informing producers about marketing channels and requirements, rather than prices⁴⁶, is a possible response in the case of short season horticultural products (Poulton, Mukwereza et al. 1999). However, the long gestation period limits the usefulness of this approach in the case of fruit trees.

An interesting area for exploration concerns the potential for new information and communication technology to assist the dissemination of marketing information in poor countries, as piloted, for example, by the Grameen Bank in Bangladesh (World Bank 2000).

Where efforts are made to provide relevant market information to tree growers in an attempt to encourage greater planting and commercialisation, these should not focus on fruit markets alone. As references cited earlier in this report make clear, the same households may equally well be interested in markets for poles, fuelwood etc. Ideally, information on markets for tree products would be provided through the same channels as information on important non-tree crops.

Development of Producer Groups

There exists a wealth of experience – good and bad – with the establishment and equipping of marketing groups to strengthen the position of smallholder producers in agricultural markets. These groups exist in market systems for perennial crops (e.g. cocoa, tea, coffee) as well as annuals. The main constraint to successful group development is the initial resources (training, facilitation) required to build groups that can then sustain themselves and, if possible, develop further. This is important work, but the long-term commitment required to a particular area or set of groups may not fit well with the more strategic objectives of a programme such as FRP.

Outgrower Schemes

So far the view that we have expressed in this report is that participation in export markets for (fresh) tree fruits is beyond the capability of most smallholder producers in South Asia and Sub-Saharan

⁴⁶ The emphasis here is on enabling producers to make better informed planting decisions, recognising that there is little that can realistically be done to influence the returns that they receive for crops already produced.

Africa. At best, one would expect only the most progressive, best located producers to participate successfully.

One of the mechanisms commonly cited for linking smallholders into export agriculture is contract farming or outgrower schemes. Baumann (2000) reviews experience with such schemes for five perennial crops – cocoa, coffee, palm oil, rubber and tea – although his evidence is largely drawn from the 1980s or earlier. He finds that enduring schemes⁴⁷ have brought benefits to smallholder participants, but that the level of these benefits has often declined over time. One factor behind this is what has been termed “agribusiness normalisation”, whereby attractive terms are offered to smallholders initially, but then prices are squeezed over time once farmers are committed to the scheme. It may be that initial terms have often been genuinely unsustainable. However, tree crop producers are particularly vulnerable to this type of price squeeze, because of the “sunk” aspect of their investment. Ellman (1998) reports on attempts by an NGO, FAIDA, to act as an intermediary between outgrowers and agribusiness, ensuring that fair contracts are drawn up between the two rather unequal parties and that both sides then keep to their commitments. The pricing formula is one of the most difficult aspects of these contracts to get agreement on.

Meanwhile, Baumann (2000) observes that scheme participants have generally been “middle peasants” or even wealthier smallholders. Where schemes have occupied a particular geographical area (perhaps in conjunction with a resettlement plan), there has often been excess demand for places on the scheme, so managers have been able to select better resourced, more skilled or more experienced farmers⁴⁸. It has also been observed that contract schemes for tree crops naturally suit households that have a relative abundance of land compared to labour. These tend to be the wealthier smallholders.

Meanwhile, according to Baumann (2000), the multiplier effects from contract farming schemes have not been as large as many proponents would perhaps have predicted. This is because:

- as already noted, the labour requirement for many tree crops is low (however, the bush crops - coffee and tea - have rather greater labour requirements);
- other purchased inputs are generally supplied through the scheme;
- scheme participants have often been observed to spend much of their additional income on education, which has low multiplier effects (in the short term). This may reflect the type of farmers selected to participate in such schemes.

For the purposes of the present study, a key finding concerns the role of the state in establishing contract farming schemes for tree crops. Few smallholders will invest in tree planting based only on an assurance from a company that it will come back in five years’ time to buy the resulting produce. Thus, long-term loans to the contract growers (often on concessionary terms) have generally been a prerequisite for scheme establishment. However, few private companies will extend five-plus year, unsecured loans to large numbers of smallholders. Such loans have, therefore, often been supplied by state agricultural or development banks. Alternatively, state / party involvement or the terms of resettlement contracts might be used to assure private agribusinesses that their loans will be repaid. However, in post-structural adjustment, multi-party states, such state involvement is much less likely, whilst resettlement schemes are generally out of favour for good reasons⁴⁹.

⁴⁷ Many have apparently collapsed after a season or two.

⁴⁸ More recent experience with wholly private sector cotton outgrower schemes in southern Africa shows a similar pattern, as companies seek out the smallholder contract growers whom they perceive to be most creditworthy (T.Jayne, *pers.comm.*).

⁴⁹ It would, however, make eminent sense for outgrower schemes to form a (voluntary) part of a pragmatic land resettlement programme in Zimbabwe. Even if redistributed parcels were somewhat smaller than those allocated in the first wave of resettlement, they would still allow plenty of scope for planting of fruit trees.

If citrus crops are to be produced, one also has to ask why the companies concerned would choose contract farming arrangements in low income countries. Whilst agro-ecological considerations restrict where cocoa, coffee, palm oil, rubber and tea can be grown, citrus can be sourced from a much wider range of countries throughout the world. Furthermore, the relatively low labour input reduces the advantages of smallholder producers over commercial / estate production. South Africa is one of the few countries where the conditions would seem to exist for the establishment of outgrower schemes for citrus and other fruit trees. The country has a strong, commercial citrus sector and there is a strong policy thrust to spread the benefits of agricultural development to smallholder producers. However, even here outgrower schemes do not (yet) seem to have developed for fruit trees⁵⁰.

Ethical Trade Channels

Organic production and ethical trade issues have been reviewed by Browne, Harris et al. (2000) in relation to the British consumer market. Here we use the term “ethical” broadly here to encompass fair trade activity, the ethical sourcing policies of UK supermarkets and other businesses, and even trade in organic products. Our primary interest is whether or not the recent interest in the ethics of agricultural production and trade opens up new opportunities for poor fruit tree producers from low income countries to supply high value western consumer markets. As few indigenous fruits are consumed in these markets, this is currently relevant primarily to conventional tropical fruits. However, there is no reason why indigenous fruits could not one day be offered on, say, a fairly traded basis as well.

Fair Trade

Fair trade is promoted as a way of getting producers in poor countries a better deal from their sales into markets in developed economies. In the context of the current report, the most important questions are:

- whether fair trade channels provide a means by which producers who would otherwise be excluded from international markets are able to participate (because, for example, fair trade enterprises in developed economies make deliberate efforts to identify smallholder suppliers in low income countries);
- the volume of such trade that these channels could support.

On the first question, the evidence is mixed. Most fair trade produce is sourced from established producer groups, who already sell produce through conventional market channels⁵¹. Indeed, typically only a tiny fraction of the production of any producer group is sold through fair trade channels (Collinson and Leon 2000). On the other hand, some fair trade enterprises do offer new players a chance to sell into international markets. One example is Tropical Wholefoods, which, amongst other things, imports sun dried mango into UK from Uganda and Burkina Faso. The number of producers who have benefited from these opportunities to date is, however, small⁵².

⁵⁰ By contrast, Department of Water Affairs and Forestry (1997) reports that some relatively small-scale producers are engaged in contract farming for the production of timber for pulp and paper industries and also for the production of wattle. Whilst the conditions that permit these contracts to function would need to be further investigated, we suggest that an important factor may be that processing factories can exert effective monopsony power over nearby producers, thereby ensuring that they recover their loans.

⁵¹ OPM/IIED (2000) argue that smallholder producers have benefited from fair trade relationships, but not primarily from the supposedly “fair” price that they are paid for their produce. Rather, they have gained through the assistance provided to their producer organisations and the extra bargaining strength that their fair trade links have given them with other buyers with whom they deal.

⁵² Tropical Wholefoods (www.wholefood.co.uk/tropical.html) currently deal with around 100 small-scale enterprises, so the number of direct beneficiary households is unlikely to be in excess of 2000.

There is still some dispute over the second question. Fair trade enthusiasts note that the number of products for which there are agreed fair trade standards is gradually rising, thus enabling the volume of fairly traded produce sold in UK and other developed economy markets to rise. On the other hand, the number of consumers of fairly traded products is not expanding that rapidly, perhaps because of the sizeable price premia attached to many fairly traded products. OPM/IIED (2000) suggest that the impact of fair trade will depend on whether or not any major agrifood manufacturers develop and promote fair trade products, as has happened with organic produce. They provide several reasons for pessimism on this score:

- An insistence on formula-based price mechanisms, which depart from the basic forces of market supply and demand, is unlikely to be accepted by major agrifood manufacturers;
- Related to this, major agrifood manufacturers fear that the development of a “fair trade” label would have negative impacts on their overall brand management strategies by calling into question the conditions of trade of their existing brands;
- Thirdly, fair trade labelling is currently almost entirely a domain of NGOs, so is treated with some suspicion by large businesses.

In the context of the current report, the commodity with the largest fairly traded market segment is cocoa. However, Collinson and Leon (2000) reports that in 1999 imports of fairly traded cocoa into western Europe, whilst hitting a new peak, were only around 1000 tonnes or less than 0.1% of total cocoa imports into the region.

Organic Production

The demand for organic produce in western destination markets is growing fast and the majority of such produce has to be imported, as domestic production cannot keep up. As poor smallholder producers often struggle to afford inorganic fertilisers and crop protection chemicals anyway, there is a *prima facie* case for exploring the possibilities of organic certification for potential exporters of tree fruits. Monitoring the certification process and subsequent production practices would be a major problem, however, and it is not clear that there is a role for FRP in this area.

Ethical Sourcing

The ethical sourcing programmes of the major supermarkets have been designed with their main commercial suppliers in mind. Thus they emphasise employee rights, responsible pest control etc – conditions that it is almost impossible for smallholders to adhere to and/or prove that they adhere to. The primary issue in the context of the current paper, therefore, is how to prevent such programmes from further excluding smallholder producers from participation in international markets for agricultural produce by the setting of inappropriate standards.

In summary, there are important research issues surrounding ethical trading, although it is not clear that they represent the best use of scarce FRP resources in terms of poverty reduction impact. Moreover, they are not a priority if the overall decision of FRP is to focus on domestication of indigenous fruit trees.

Seasonal Credit

Although there are exceptions, e.g. financing sulphur dusting of cashew trees in Tanzania (Poulton 1998), credit to finance the purchase of seasonal inputs is not generally the major problem for fruit tree producers that it is for smallholder producers of many other agricultural commodities.

However, Dewees and Scherr (1996) argue that lack of working capital to hire labour for fruit harvesting can be a problem. Poor tree owners in Africa (Schreckenberg, Degrande et al. 2000) and South Asia (N.Haq, *pers.comm.*) may let traders bring their own labourers to harvest selected fruit trees, because they themselves cannot afford the costs of labour hire and the subsequent marketing of the products. The price that the tree owners receive for the fruit as a result of these contracts, even taking into account the costs borne by the traders, can be extremely low.

Transportation Efficiency

Easy and reliable access to traders and markets is a precondition for participation in supra-local markets by poor fruit producers. Particularly in Sub-Saharan Africa, the limited density and poor state of the rural road network is a major obstacle to market access. Ultimately, however, this can only be overcome by major investment. In the meantime, Hine and Rizet (1991) and others have shown that Africa's freight costs per tonne-kilometre are 2-5 times as high as those in Asia, even on comparable roads. These analyses have indicated some of the causes of high African costs. However, much remains to be done to try and bring about the necessary efficiency improvements. This, though, is well beyond the scope of FRP funding.

Quality

Achieving reliable quality standards is a recurring theme in discussions of smallholder market access, even though quality requirements vary considerably according to market type. Quality needs to be achieved / maintained throughout the supply chain, so encompasses (amongst other things):

- Quality of planting material
- Cultural practices in production, including protection against pests and diseases
- Post-harvest handling, packaging and, for some markets, chilling
- Coordination of functions through the supply chain, so as to minimise delays in product movement and, hence, opportunities for spoilage.

At one end of the spectrum, the intense competition in international markets for conventional tropical fruits, accompanied by the increasing vertical coordination of supply chains serving western markets, means that quality requirements for successful participation in export markets are extremely high. With regard to citrus, Lespinasse and Bakry (1998) note that the twin pressures of "increasing biotic (diseases) and abiotic (drying, high salinity soils) constraints" on the one hand and "increasing demands of citrus markets throughout the world" on the other pose particular challenges for (internationally competitive) citriculture in developing countries. They argue for intensified breeding research effort to match varieties with the attributes demanded by international consumers with rootstocks "adapted to specific soil conditions and soil pathogens present in a given region".

In the case of many fruits targeted at Asian domestic and regional markets (de Groot 1992), quality issues are focused on:

- transportation difficulties and their consequences for product spoilage and wastage;
- the informal techniques used for propagation, such that attributes of the fruit cannot be predicted or controlled;
- lack of improved varieties.

These issues were covered in section 7 and should be addressed as part of domestication and improvement programmes for indigenous and semi-domesticated fruit trees. Problems of product

handling, packaging and of coordination between producers and traders might appropriately be addressed in the circumstances of specific projects by marketing action interventions.

Small-Scale Processing Technologies

Although these have only been the subject of passing references so far in this report, these would appear to have an important part to play in maximising the flow of benefits from the cultivation of tropical tree fruits that accrue to poor households. Processing activity can:

- generate income and employment through adding value to unprocessed fruits
- give producers additional assurance of a market for their fruit
- strengthen the bargaining position of producers vis-à-vis traders of fresh fruits by providing an alternative marketing outlet
- ensure that fruit products are available throughout the year, despite seasonality in fresh fruit production.

It is thus a partial answer to problems of fruit perishability and – particularly given the relatively low labour requirements in the production of many trees – may be an important determinant of the growth and poverty reduction multipliers arising from cultivation of fruit trees.

We have not encountered detailed studies of local processing specifically related to fruit trees. However, examining the employment generated by local processing of cassava, soyabean and tobacco in Java, Indonesia, Kawagoe (1994), found that:

- as much, or more, labour was required in the small-scale processing of cassava chips, tapioca and tobacco as in the actual production of the basic commodity;
- the same was true in the case of soyabean cake, except that value added and labour input were much higher in the production of soyabeans for direct sale to market intermediaries than in the production of soyabeans for cake.

Even in this latter case, it should be noted, total local benefits in terms of employment and income were similar across the two soyabean activities. However, the distribution of those benefits was more equitable in the “with local processing” case.

Okafor and Lamb (1994) list a range of possible processing opportunities (jams and jellies, juice, confectionery, beverages, seasoning, fats and oils, livestock feeds, medicinal uses) for indigenous fruit tree products in Nigeria and Malaysia. Sun dried mangoes imported into UK from Uganda and Burkina Faso show that low cost methods do not necessarily preclude access to high value markets, although local markets will more often be the destination.

Research should look to develop small-scale processing options for tree fruits widely grown by smallholders that can be located within fruit producing villages. Such accessibility will be particularly useful to poor households who wish to make occasional fruit sales to a processor and cannot afford the transaction costs of dealing with larger operators in a local business centre. At the same time, it is vital that technology development is based on a thorough assessment of (potential) market demand for the end product.

Even the poorest households may be able to engage in some processing activities (e.g. toffee and biscuit making, sun drying) as self-employed business people⁵³. However, in other cases (e.g. juice

⁵³ An interesting test is how the most basic capital requirements compare with the size of loans advanced to such households by microcredit organisations.

making, where significant investment in packaging is normally necessary), the choice may be between cooperative ownership of the processing assets and ownership by wealthier individuals or local companies. In Africa, the experience with collective ownership of physical assets has often been an unhappy one (Coulter, Stringfellow et al. 1996), suggesting that encouraging local businessmen to work with smallholder producers may be the best option under these circumstances. Benefits to poor households would thus accrue primarily through (possibly seasonal) wage employment. This need not be a universal prescription, however, especially where there is evidence of strong, local cooperative action.

Market Place Infrastructure

Improved market place infrastructure (particularly secure cold storage for perishable crops) would reduce the risks faced by producers in taking their produce to an established market, rather than trying to sell on or around the farm. Better preserved produce might also attract more buyers to come to a particular market, thus raising prices (though possibly at the expenses of sellers elsewhere). A matter for marketing action?

8) *Recommendations*

7) In light of:

- the nature of the barriers to entry confronting poor producers in low income countries if they wish to enter international markets for tropical fruits
- our analysis of the benefits to poor households that may be expected from the production of fruit trees as cash crops,

we do **not** recommend that FRP concentrate its fruit tree research efforts on reducing the barriers which prevent poor people from participating in conventional tropical tree fruit markets.

8) Despite the time-scale issue, we **do** recommend that FRP support work on domestication of indigenous fruit trees in Sub-Saharan Africa as a way of expanding the basket of attractive options open to poor households who wish to plant trees. In South Asia, we recommend that FRP focus on semi-domesticate species, which represent the best trade-off between poverty reduction impact and maintenance of diversity / options. The time-scale within which benefits from the improvement and commercialisation of semi-domesticate species will be felt could be considerably shorter than that for pioneering work on the domestication of new species. Important factors here are the capacity for multiplication and dissemination of improved growing material and the observed expansion of markets for semi-domesticate fruits.

9) Improving market access is important to poor producers of fruit trees, irrespective of the type of tree (indigenous, semi-domesticate, conventional tropical fruit tree). Domestic markets will remain the most important focus for most poor fruit tree growers in the foreseeable future. Researchable generic market access issues related to domestic markets include:

- The impact of forestry regulations and controls on the planting of indigenous fruit trees and marketing of their products;
- The design of sustainable market information systems for perishable tree fruits;
- the development and promotion of small-scale processing technology for tropical fruits. It is felt that this could both contribute to the potential of tropical fruit systems to generate employment for poor households and strengthen the position of small-scale tree growers within such systems.

- 10) In addition to generic research issues related to market access, we recommend that most projects (or project clusters) focusing on plant genetic improvement also have a marketing action component. This would tackle specific marketing problems within the relevant market system, drawing on knowledge of best practice from elsewhere, so that improvements in market access can provide the necessary incentives for adoption of improved growing stock at the same time as improved growing stock makes increased market penetration plausible.

Finally, we note that how domestication and improvement programmes are carried out will be as important as whether or not they are carried out in achieving poverty reduction impact. This ties in closely with DFID's current focus on achieving uptake of research findings in order to achieve impact. In the specific case of domestication and improvement work, we recommend that:

- 11) Where regional species prioritisation frameworks already exist, FRP should use them and should seek to focus on research problems that are not already funded by other organisations. FRP should also pay particular attention to the processes for attribute selection being used by potential research partners to ensure that the voices of poor producers are sought and listened to within domestication and improvement activities.
- 12) Particular attention should be paid to the "downstream" stages of domestication and improvement work, such as dissemination of information about propagation techniques, the establishment of local nurseries and the training of extension staff (public sector and NGO) to assist farmers in all aspects of fruit tree growing. Active involvement of intermediate users of project outputs should be checked for both at the design / approval stage of projects and during the project's life.
- 13) The terms of reference for the current study focused on fruit trees and have required a particular focus on the production and marketing of fresh fruit. Whilst fruit trees have been the top ranked species in most regional prioritisation exercises for domestication programmes undertaken with farmers around Africa, these trees have often been valued for many reasons other than just the production of fresh fruit. Indeed, the nut and its associated products (less perishable than fresh fruit) are often valued more highly for income generation than is the fruit. Research funding, therefore, should not make an artificial distinction between fresh fruit and nuts from the same trees (let alone ignore the other values that poor households attribute to these trees). Moreover, it should not ignore other types of trees (e.g. fodder trees) where these have clear potential and are desired by farmers.

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