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UNITED NATIONS INDUSTRIAL DEVELOPMENT ORGANIZATION
Vienna International Centre, P.O. Box 300, 1400 Vienna, Austria
Tel: (+43-1) 26026-0 · www.unido.org · unido@unido.org

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PROMOTING SECONDARY-WOOD SPECIES

IN SUPPORT OF THE

GLOBAL SHELTER STRATEGY**

Prepared by

UNCHS (HABITAT)

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DEFINITIONS

In this text, the terms, secondary-wood species, lesser-known species, less-accepted species, are used as synonyms. Similarly, the terms primary-wood species, commercially-known species, popularly-adopted species have the same meaning.

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I INTRODUCTION:

SIGNIFICANCE OF SECONDARY - WOOD SPECIES FOR THE GLOBAL SHELTER STRATEGY

1. The shelter crisis facing most developing countries is a subject which has by now been exhausted. In the past, efforts had tended to focus on problem identification and diagnosis rather than the search for pragmatic solutions. The International Year of Shelter for the Homeless in 1987, marked a turning point in efforts towards tackling the Global Shelter crisis. A review of the activities of the year revealed among other things that there are opportunities to actually solve the shelter crisis and moreover the scene had been set for action-oriented programmes and policies which could all contribute to reversing the deteriorating shelter conditions of most developing countries. It is against this background that the Global strategy for shelter to the year 2000 has been launched, thus giving Governments ar entire ten-year period to implement clearly worked-out strategies. The focus of the shelter strategy is the enabling concept; that is, governments creating the most favourable environment for individuals, and the private-commercial sector to deliver the requisite shelter.

2. There is every reason to believe that the enabling concept as portrayed by the Global Strategy will work; it is less resource-demanding compared to direct construction of houses by governments, it takes account of proven potentials and untapped resources, it taps on the few successful experiences of shelter delivery to the poor and above all it focuses government attention on some strategic sectors of intervention which are most critical for effective shelter delivery. One of the areas that the Global Strategy has appropriately identified as critical to facilitate low-income shelter delivery is building materials. The shelter strategy goes beyond simply justifying and identifying the building materials sub-sector by dwelling on actions for effective implementation to create the enabling environment. More importantly, the shelter strategy poses a challenge for promotion of only those building materials which are both technically and financially viable for the low-income population. It is in this broad context that the subject of wood in construction becomes most significant to the targets of the Global Shelter Strategy.

3 The merits of wood as a low-cost building material are first and foremost technical. Wood in it's natural state without any complex processing can be used for almost the entire structure of a house as sub-structure, walling material, roof structure and roof cladding. Wood is relatively easy to work and handle and secondary processing for basic use as structural walling and

roof-cladding material could be attained with rather rudimentary equipment. Basic wood technology is ancient and an almost world-wide traditional construction practice; in almost every low-income settlement basic carpentry skills are obtainable so that unlike other comparable low-cost building materials one is not faced with the challenge of aggressive promotion of entirely new skills in construction. Wood has a unique combination of both thermal efficiency and superb sound insulation qualities. Wood is a structurally sound material and compares favorably with concrete, stone, fired-clay bricks and a variety of roof-cladding materials. Moreover, the natural composition of timber could prove an added advantage in structural uniformity compared to the hazards of bonding technology in brick-work, block-work or stone-work. In fact, wood has a high ratio between structural resistance, weight and resilience. Due to technological innovations, the durability of wood is no longer questionable and indeed, there are low-cost techniques to ensure resistance of wood against bio-degradation. Similarly, design techniques can permit adequate resistance of timber against fire much in the same way as comparable materials will survive a fire attack.

4. One special technical merit of wood as a material for shelter construction is that in most developing countries there already exists some basic local infrastructure. There is already a history of chain-saw operators felling timber, saw-millers dealing in primary processing and joinery workshops dealing in secondary processing albeit with rudimentary equipment and techniques but non-the-less yielding valuable components for timber construction. What matters in all these is that there is a useful starting point which could be built upon. There is also some local knowledge on seasoning of timber and treatment of timber components against biodegradation, even though one could observe gross inefficiencies in this sub-sector.

5. The merit of wood as a building material from the economic or financial point of view is based on three principles. In the first place wood can be promoted as a low-cost building material because in most countries the raw material is widely available and an entire house structure could be built with minimal dependence on foreign exchange. For most developing countries any building materials technology which could be promoted with local inputs is predetermined to be low-cost and above all could lead to tremendous savings in foreign exchange to the national economy. Disregarding savings in foreign exchange, timber housing has proven to be more cost-efficient than comparable technologies in several countries. In Colombia, Ecuador and Peru, savings of between 10 - 18 percent were achieved using timber-based construction compared to material such as block-work, cement and steel. Tables 1, 2 and 3 are

COMPARATIVE COSTS BETWEEN TRADITIONAL AND TIMBER-BASED HOUSING*
(all cost in Dollars)

Table 1:- Comparative costs in Colombia, Ecuador, and Peru

	TRADITIONAL SYSTEM	TIMBER-BASED SYSTEM	SAVING
COLOMBIA*(68m2)	Blocks and panels		
Direct Costs	130.09 (100%)	106.48 (81.85%)	18.15%
Indirect costs	35.12	27.75	-----
Total cost	165.21	135.23	18.15%
ECUADOR* (54m2)	JNV*** (P4)		
Direct costs	128.18 (100%)	115.17 (89.85%)	10.15
Indirect costs	38.45	30.60	-----
Total cost	166.63	149.72	10.15%
PERU** (66m2)	Cement-steel-brick		
Direct costs	113.54 (100%)	100.00 (88.07%)	11.93%
Indirect costs	30.66	27.00	------
Total cost	144.20	127.00	11.93%

* August 1981 rate of exchange
** June 1981 rate of exchange
*** JNV: Junta Nacional de la Vivienda (National Housing Bureau)

* Tejada M. Promoting the use of wood in construction - Background paper for UNIDO-FAO Consultation on the wood and wood products industry. Op. Cit.

Table 2: COMPARISON OF ESTIMATED COSTS IN ECUADOR (1981)

	ACTUAL COMPARISON		ESTIMATED COMPARISON	
	Traditional System	Timber System	Traditional System	Timber System
DIRECT COSTS	$7,034.7 (100%)	$6320.6 (89.9%)	$7,034.7 (100%)	$5,056.5 (71.9%)
INDIRECT COSTS	$2,110.4 (100%)	$1,896.2 (89.9%)	$2,110.4 (100%)	$1,011.3 (47.9%)
TOTAL COST	$9,145.1 (100%)	$8,216.8 (89.9%)	$9,145.1 (100%)	$6,067.8 (66.4%)

It may be seen that, in this way, the reduction in the costs will reduce the cost of timber housing by some 33.6% as compared with building produced on the basis of traditional materials, once massive programmes have been drawn up for the construction of timber houses this implies the manufacture of 1000 or more housing units per year.

Table 3: Comparative Costs in the Andean Pact Countries

	TRADITIONAL SYS.(*)	TIMBER-BASED SYS.
Costs and estimates on the basis of constructing unit houses	$9,145.1 (100%)	$8,216.8 (89.9%)
Estimated costs on the basis of industrialized production	$9,145.1 (100%)	$6,067.8 (66.4%)
Estimated costs on the basis of applying self-manufacture and self-construction system	$9,145.1 (100%)	$4,550.9 (49.7%)

(*) This type of system, and the corresponding costs, represent the greater part of the housing programmes implemented by the governments of the Andean Pact countries. Estimated costs correspond to the year 1981.

Table 4: Cost per Unit Floor Area of Different Types of Structures in Rangoon, and Advantages and Disadvantage

No.	Type of structure	Cost per Unit Area Kyats per sq.ft.	Advants.& Disadvant.
1.	Masonry structure with load bearing walls	180 - 220	Since the walls must be thick enough to carry loads, the walls absorb heat in day time and transmit it in the evening. Least earthquake resistant compared to other structure.
2.	Reinforced concrete frame structures with brick filling walls	200 - 280	Better thermal behaviour, good earthquake resistance, most expensive of all types.
3.	Timber frame structures with brick filling walls (Brick nogging structures)	150 - 200	Better thermal behaviour,good earthquake resistance. The durability can only be that of the timber.
4.	Timber frame structures with timber walling	40 - 60	Good thermal behaviour,good earthquake resistance. Shorter life compared to masonry structures, about 80 years, flammably:
5.	Bamboo structures or mixed timber and bamboo structures	6 - 10	Good thermal behaviour, good earthquake resistance. Shortest life and highly flammably.

Source: Rangoon City and Regional Development Project, TDC, UNCHS (Habitat), 1985.

clear examples of the cost superiority of timber dwellings. In the second place, there are proven small-scale and sometimes rudimentary cottage-scale technologies for wood processing;- in principle, any building material which can be promoted through small-scale technologies stands a good chance of being predetermined to be a low-cost material. The best example of this concept is with regard to roof-cladding technology. Here, comparable materials such as asbestos-cement roofing sheets, aluminum roofing sheets and galvanized-iron roofing sheets can only be produced using heavy-scale imported technologies, whereas wood shingles can be produced with rather rudimentary small-scale technologies. The most important factor which predetermines wood as a low-cost material is the fact that it is a renewable building material;- comparable raw materials such as limestone, clay, sand and stone are all exhaustible and indeed there are numerous examples where large-scale cement or fired-clay bricks factories are facing closure due to depletion of raw maternal reserves.

6. A merit of timber construction which is probably more economic than technical is the time-scale within which a timber construction could be erected vis-avis comparable materials such as concrete or brickwork. In principle a prefabricated timber house could be erected in one day and in fact a mass housing scheme could be completed in a matter of days using industrialized large-scale panels with installation machinery on site. This whole concept fits into the potential for mass production of timber components such as door frames, window frames, beams and columns, roof-trusses and eventually prefabrication of timber houses. There are examples of countries where labour is simply too costly and where labour on construction sites alone could account for about 45 per cent of cost of inputs. Under these circumstances, especially where the countries fall into the category of newly-industrialized countries, there should be a clear economic advantage in promotion of wood as an industrialized low-cost building material (See annex 4 on UNCHS (Habitat's) strategy towards promotion of prefabrication technology in use of secondary-wood species).

7. Within the framework of timber as a low-cost material, a distinction is made between primary or commercially accepted species vis-a-vis secondary or less-accepted species. For several reasons, the vitality of wood in the context of the Global Shelter Strategy is dependent on secondary species rather than commercially-accepted species. It is important to stress that the term secondary species does not connote inferiority;- many secondary species have as yet not been characterized and may as well be comparable or even superior to the commercial species. In fact, the focus of this paper is on those secondary wood species which are almost indistinguishable in log-size and form to the commercially known species. In many developing countries

the forests are currently being logged for only a few selected species, with many species and grades left unharvested. A study of tropical forests has estimated that only 5.4 per cent of the total forest stock of wood has been harvested. In South East Asia, there are about 600 commercial species and 460 lesser-known species;-, in West Africa, there are about 125 commercial species and 111 lesser-known species. While in South America there are about 240 commercial species and 260 lesser-used species.[1]

The issue here is that, wood is still an abundant resource considering the large stocks of unexploited species. Contrary to the opinion that wood is scarce and depleting most countries are yet to exploit any of their vast secondary species and even the commercial species are woefully under-exploited. For instance, in South America, out of 470 wood species, classified for international trade only 28 are of significant production out of which a miserable five species represented over 50 percent of total production;- only these five species were exported. Thus the progressive reduction in the supply of popular species on its own call for promotion of secondary species in the timber industry.

8. The notion that timber is scarce and expensive in several developing countries is due primarily to the international trade in timber. Most commercially - known species have been promoted as export commodity. In timber producing countries facing economic reforms, attention has now shifted to secondary processing of timber[2] to boost foreign exchange earnings. The implications of such an export-oriented approach are negative and thus makes the promotion of secondary species a viable option for achieving the target of wood as a low-cost material. Whereas competing building materials such as cement and cement-composite materials galvanized-iron or aluminum roofing sheets and steel are all enjoying hidden-import subsidies and favorable price controls, wood products are in principle prone to high-prices to justify favorable export earnings. This is a clear case of reversal of subsidies to the detriment of the local consumer of timber products.

9. The less commercially-known species are also significant to the targets of the Global Shelter Strategy due to the potential economic gains from secondary processing. If less-commercially accepted species of wood are to be promoted for use in shelter construction, then the secondary processing required to transform logs into trusses, door frames, wood shingles and tongue and groove components for walling will all contribute to employment

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[1]. UNIDO:Measures to promote the use of wood and wood products:- Issue paper No.2 Vienna, 1983, p.7

[2]. UNIDO: Ibid

and skill generation. In addition to secondary processing leading to production of components for prefabricated elements, there will be need for treatment of the raw material. In this regard, the demands for local chemicals and utilization or repair of basic machinery required for the wood industry should all influence local economic growth. Invariably, any strategic promotion of lesser-known timber species for benefit of low-income housing should aim at utilizing small-scale technologies which in turn should rely on adaptation of locally available machinery or the local fabrication of simple tools. Through these backward linkages the use of lesser-known timber species in the housing sector will promote national economic growth.

10. Most developing countries especially in Africa, are pursuing or will be pursuing structural economic reforms and almost invariably these are based on principles of local industrialization and development of viable local markets as opposed to strictly export of raw materials. The timber industry thus affords one of the opportunities for promoting industrial growth through a combination of processing for local markets as well as for exports. However, the development of local markets in the timber industry will imply production of a wider range of products with higher value-added than for the export market. If secondary-species of timber were to be promoted for mass housing as a structural walling and roof-cladding material the implications for industrial expansion could be tremendous. Some developing countries with relatively viable industrial bases could achieve high economic gains by promoting small-scale processing of chip boards and similar composite industrial products using secondary wood species as the principal raw material. [3] Moreover, if developing countries are to slowly shift into an affordable scale industrialization in the construction of buildings then the most viable starting point it seems is the use of timber in low-income housing.

10(a). In some developing countries, secondary-wood species could be promoted for use in shelter construction both for the local market and for export to other developing countries where the raw material base may be inadequate. This strategy would first and foremost require a good local industrial base for secondary-processing of secondary-wood species based on standardized products, and prefabricated components. The advantage with such a strategy is that the exporting countries have the advantage of satisfying domestic shelter needs and at

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[3]. Ademiluyi, E.O. and Badejo, S.O.O.:- The role of Forestry Research Institute, Ibadan, in the use of indigenous raw materials for low-cost housing, published in proceedings of CIB/RILEM symposium on Appropriate Building Materials for Low-cost Housing, Nairobi, November 1983, pp. 183-189.

the same time gaining foreign exchange earnings. The viability of this concept is based on three main issues:- first of all there are a few timber growing developing countries with a relatively advanced local infrastructure for small-scale industrialization and also potential for processing of primary-wood species for export. Secondly, there are some developing countries which are deficient in their resource-base for supply of wood and who in the short-term could be better off with imports from timber-surplus developing countries. Thirdly, timber unlike materials such as concrete blocks and fired-clay bricks has a superior strength to weight ratio as well as value to - weight ratio so that transport costs could be tolerable.

II. STATE OF THE ART

THE ECONOMIC AND TECHNICAL VIABILITY OF SECONDARY SPECIES FOR WALLS AND ROOFS

A. Reasons for secondary-wood species not being used

11. To a large extent, the reasons why secondary-wood species are not being used in construction are mainly the same reasons why timber in general is not used as a walling and roof cladding material. In most developing countries, the available timber species which are predominantly the commercial species are used for simple structural support functions such as for roof structures, doors and window frames or for purely aesthetic functions such as use of plywood for wall and ceiling panelling. The choice for walling and roof-cladding material has always been a variety of industrially processed materials notably concrete blocks, fired-clay bricks and tiles and galvanized or aluminum roofing sheets. Even in circumstances where timber products are abundant on the market in the midst of scarcity or high cost of other comparable materials, the preference has never been timber.

12. Wood is not used as a walling and roof-cladding material mainly because of technological deficiencies or lack of an industrial infrastructure favorable to wood as a construction material. Machinery and know-how for processing wood into walling and roof-cladding components are either non-existent or if available at all simply inefficient. Consequently, the products required for walling and roof-cladding are simply not available on the market or sometimes available in minute quantities at exorbitant costs. Even with the available machinery for primary processing of wood, there are gross deficiencies which lead to an inefficient and unnecessarily expensive product. It is estimated that yields from logs after processing could be as low as 35 percent of actual expected output had the operations been efficient.[4] Perhaps even more important than inefficient machinery or non-available machinery is the plight of inadequate skills in production processes i.e. secondary-processing including installation, maintenance and repair of a variety of machinery.

13. There are obvious social biases against the use of timber. Clients of the construction industry are yet to see timber as a durable and fire-resistant material which incidentally are the most significant factors that could influence the choice of wood.

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[4]. Tejada,.M. Promoting the use of wood in construction. Background paper prepared for UNIDO/FAO consultation on the wood and wood products industry - Vienna 1983.

In fact it is likely that most clients of the industry do not know of any of the technical qualities or superior qualities of timber over concrete blocks as a walling material. However, the underlying reason is that the acclaimed qualities of wood have not been demonstrated effectively. The building industry is easily one of the most conservative sectors and the task of effecting change in practices or acceptability of products is usually a mammoth task;- it requires efforts which transcend beyond what is currently offered in promotion of wood for construction. Unfortunately, the bias against use of wood as a walling and roof-cladding material affects the entire spectrum of the building trade i.e. professionals, contractors, artisans, clients, policy-makers and finance institutions.

14. The available supply of wood on the market is certainly not cheap;- in comparison to concrete, steel, bricks, stone and other comparable materials. There are several reasons why popular-species of wood are exorbitant in cost. There is an under-developed local market;- the multiplicity of marketing operations from the source of raw material to the final consumer plus the high-cost of transport relative to other production factors, on their own pre-determine unaffordable costs. In addition the obsolete technologies in operation with plants or machinery operating at extremely low capacities lead to diseconomies. In timber exporting countries the international trade scenario is perhaps the single most important factor which has led to the high cost of wood on the local market. The high-cost of commercially-accepted species has indirectly created an environment which could predetermine a similar pattern for secondary-wood species unless appropriate strategies are adopted.

15. The lack of regulations, and codes of practice and technical manuals in support of wood construction is yet another factor hindering efforts to promote the use of secondary-wood species in construction. Experience has proven that lack of regulatory procedures precipitates any biases against a specific building material and worse of all this leads to low-quality of products, faulty construction practices and unnecessarily high-cost of end product. Design guidelines and codes of practice which normally could influence Architects, Engineers and Contractors to opt for use of wood are non-existent. There are authentic design manuals and codes of practice from countries in Europe and America however these are specifically for coniferous wood-species rather that tropical woods and thus not relevant to the needs of most developing countries.

16. Reasons for unpopularity of wood as a walling and roof-cladding material which are specific to secondary-wood species are mainly to do with inadequate knowledge about the broad characteristics of these species. The tropical forests are characterized by several unknowns;- it is estimated that there exist more than five thousand species in the tropical forests but

the limited knowledge available suggests that only one thousand five hundred species are suitable for construction purposes whereas in industrialized countries where timber has a long tradition as walling and roof-cladding material, there are only twenty coniferous-wood species in use. Quiet apart from this, inherited reason, there are more pressing man-made reasons; ie there is very little investigational work to characterize and understand the botanical and engineering properties of secondary-wood species. In a few countries, some basic data exists on properties of secondary wood species but this covers only a negligible proportion of the total stock of species and moreover the data is not comprehensive enough to lead to any strategic planning. Experiments carried out in the National Forest Products Laboratory, Merida, Venezuela, have solved the problems of sawing high-density species. On the basis of these experiments, the timber industry has introduced lesser-known species onto the market which could not previously be marketed because of sawing problems. Again, on the basis of the technological studies carried out on 105 forest species for the five countries of the Andean Group, an Andean Classification System for Structural Timbers (SACLAME) has been developed-in addition to a design manual for tropical timbers and a system for grouping species into three structural groups.[9]

17. The general scenario in most developing countries is that whereas there are several proven research findings on production and use of local building materials there is hardly any mechanism to translate research into viable commercial production. This phenomenon applies to a wide variety of building materials including timber and most certainly secondary-wood species. In timber-rich countries such as Cote D'Ivoire, Nigeria, Gabon and Ghana, so much effort is put in local research into forest products and in several instances very innovative findings remain stuck at the research laboratories with no opportunity of ever being implemented. This situation of gap between research findings and actual commercial use of research results is easily one of the most important factors hindering prospects for wide adoption of secondary-wood species on shelter construction.

B. Identification of current practices of use of secondary-wood species in construction

18. There are currently no significant examples of use of secondary-wood species as a walling material or roof-cladding material in developing countries. There are examples of use of residual timber such as the bark of trees and poles for construction of houses but these are almost invariably in

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9. Tejada, .Mromoting the use of wood in construction Op.Cit pp.25-26

squatter settlements or predominantly rural areas. The image created by use of wood in these circumstances is rather negative. There are isolated examples where secondary-wood species have been used in construction of low-income housing in a modern and improved context but again these are too limited to have any meaningful impact.[6] In some cases the wood elements are only restricted to internal partitioning. The use of lower-grade secondary wood species such as bamboo which has a great potential of being a low-cost innovation has been demonstrated in a few countries such as in China and some parts of the far East as well as in Central America notably Costa Rica. (See annex 2 on case study of use of bamboo in low-cost housing).

19. The use of secondary-wood species for construction especially for walling purposes is slowly showing potential in industrially-processed wood products where the secondary species serve as raw material. The use of wood chips for composite boards in some countries dwells on timber species which are less suitable as sawn wood due mainly to their irregular form. There is potential to use chips from secondary-wood species to manufacture wood-cement boards. In some countries where these products are on commercial sale, there is an unfavorable market trend probably due to the unattractiveness of the finish of the boards.

C The international Timber trade as a factor hindering or enhancing prospects for use of secondary-wood species in shelter construction.

20. As mentioned previously, the international timber trade has on its own led to lack of interest in use of secondary-species for construction. The international timber market has clear preferences for species that are well known in their properties and reliability of supply. In rare cases, secondary species such as rubber-wood find their way unto the market as is the case in Malaysia. The fact that the international market deals in only a fraction of the total number of species available to developing countries, has directly limited interest in secondary species available to developing countries. This tendency has also affected any immediate prospects for secondary-species being low-cost.

21. In another respect, the international timber trade could also be seen as a possible means of enhancing prospects for use of secondary-wood species. In the first place, the focus on only a limited number of species has predetermined an abundant reserve of timber resources for eventual exploitation;- if and when

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[6]. See chapter III on case studies: Examples of successful case studies on economic and technical viability of secondary-wood species.

secondary species become an option for use in construction there is no likelihood of competition between the export market vis-a-vis the local market. In the second place, there are no prospects for a future programme of exporting secondary-species as low-cost building material because in the timber-importing countries there also exist local alternatives to imported low-cost secondary species: ie there are sufficient reserves of low-cost temperate softwoods on the market.

D The economic advantage of secondary-wood species as a construction material

22. Secondary-wood species have the potential of being low-cost and highly accessible to the low-income population. Most of the problems which currently will predetermine the high-cost of secondary-wood species can actually be tackled and eliminated. Most secondary-wood species have an inherent botanical advantage which is of economic significance;- many of then have more than average density and have strength commensurate with any known commercially-popular species. Several secondary-species may not possess the aesthetic qualities of the primary-species but nonetheless can meet the functional requirements for use as a walling material. Construction technology using timber in general offers particular ease and speed of erection and moreover, requires little investment in heavy plant on site. Timber has a good strength-to-weight ratio and it is easy and quick to cut and join using basic hand tools;- Once foundation and services have been provided or sometimes ignoring foundation erection, construction in timber can proceed very fast and thus lead to worthwhile savings in the otherwise long gestation periods which are characteristic of fixed-asset investment.

E. Technical merits of secondary-wood species as shelter construction material

23. As indicated earlier on, there are some timber species currently classified as secondary purely for the fact that they have no traditional value on either the international or local timber markets but certainly not because of their technical inferiority. For this reason, it could be argued that the technical merits of a number of secondary-species are similar to those of the commercially-adopted species ie advantage in strength and flexibility in use to name a few. For the purposes of low-income shelter construction the functional requirements of materials for construction in terms of structural soundness, durability and water resistance can all be fulfilled by several secondary-wood species. In principle, the strength properties of timber correlate with the density and it is precisely in this respect that some secondary-wood species have an advantage over the primary species.

24. The two areas which pose a threat to wide adoption of secondary species are with regard to;

(i) fire resistance

(ii) durability against bio-degradation.

Fire resistance of timber members is also largely a function of density of the timber;- timber in structural dimensions which have high densities are particularly difficult to ignite. The threat to fire attack is in timber as external wall-cladding material. Houses with timber cladding could be given some fire resistant treatments or coatings. There are as yet no truly low-cost simple alternatives for fire resistance of secondary-species as walling material except for normal principles of architectural design, layout of houses and community training of dwelling inhabitants to minimize fire hazards. Durability of secondary wood species against fungal or termite attack is however not a problem since, there are established low-cost methods of ensuring longevity of timber as a structural and walling material.

F. Selected small-scale technologies for treatment and preservation of secondary-wood species

25. Timber preservation and treatment against bio-degradation is one aspect which parades an array of technologies from rudimentary through small-scale to sophisticated high-cost technologies. Of particular interest to promotion of secondary species for shelter construction, are the available rudimentary/small-scale technologies. Apart from short term treatment of logs and lumber to protect wood from stain and insect attack, there are proven methods for protection from insect attack, especially protection of wood in ground contact or exposed to the vagaries of the tropical weather.

26. Dip diffusion treatment with sorates is relatively cheap and at the same time effective as first time treatment;- dip diffusion requires little capital investment, copes with impermeable species since diffusion is through the water in the green timber and it is environmentally attractive. For timber components prone to more harzadous attacks, waterbórne copper/chrome/arsenic could be applied by means of a double diffusion process which is equally low-cost, as a simple first-time treatment. Drying of sawn timber is feasible in tropical climates without reliance on artificial methods. The equilibrium moisture content of wood in service in naturally ventilated buildings is in the region of 15 percent but this can further be reduced to acceptable limits by simple natural processes over a longer period of time. For large volume treatment of secondary species, there are small to medium-scale drying methods available namely, low-temperature kiln drying, dehumidification and solar drying. Depending on local circumstances, one method may prove

lower cost than the other. However combination of these methods is also feasible.

III. CASE STUDIES

EXAMPLES OF SUCCESSFUL CASE STUDIES IN ECONOMIC AND TECHNICAL VIABILITY OF SECONDARY SPECIES [7]

(A) Shingles and shakes in Papua New Guinea

27. Timber is a common roof cladding in some countries, but this is not so in the tropics. It was therefore of considerable interest when the Forest Products Research Centre published their "Papua New Guinea Shake and Shingle Manual" in 1976. This resulted from the availability of suitable methods of preservation which facilitated the use of timber for a form of roof tiling that was admired locally. There was some considerable use of preservative treated shingles on public and other buildings in the PNG capital in 1975 and 1976. The manual was aimed at the use of secondary species. It provides guidance on roof construction details as well.

28. Shakes are made from short blocks of wood cross-cut from logs, and are split with hand tools along the grain. The manual gives the optimum sizes as 450 or 600 mm long, 150 to 250 mm wide, and 10 to 25 mm thick. Very little skill or equipment is necessary for the production of shakes, and they do not need workshop facilitates. They are very suitable for self-help projects. Shingles are taper sawn using either a band resaw or a specially designed shingle saw; if no mechanised saw is available the use of shakes is better. The optimum sizes are 450 or 600 mm long, 150 mm wide, and 8 mm thick. They should be sawn from logs of 350 mm diameter. The suitability of species for shakes and shingles depends on their being reasonably free of knots and straight grained, having a smooth finish from the saw, having small shrinkage and movement, and being either naturally durable or permeable to preservative treatment. For shakes, the species need to split easily, and both require nails to be held well. Both are cut when green.

29. Those species with natural durability may be used without treatment, and the manual acknowledges that there may be local knowledge of the durability of some species. Other species must

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[7]. Jayanetti .L.: Inputs to UNCHS background paper for UNIDO/UNCHS consultation on the wood and wood products industry. Unpublished, UNCHS 1989.

be treated and the chosen methods are double diffusion and soaking which are cheap and easy to set up and operate; this is followed by a period of natural drying. The preservative treatments listed as being suitable are double diffusion with copper sulphate and sodium dichromate, and unspecified water repellant preservatives. Pressure/vacuum methods can be used to treat shakes and shingles without any problem. In Papua New Guinea however, dipping and soaking methods are used. The comments made elsewhere in this paper on fire hazards apply also to shake and shingle roofs.

(B) Rubber-wood - Malaysia

30 There are 2 million hectares of rubber tree (Hevea brasiliensis) plantations in Malaysia, producing nearly half of the world's natural rubber. Rubber trees have a limited productive life and are regularly replaced; Rubber-wood is consequently a large and regular resource available to any country with substantial plantations; these include Indonesia, Thailand, India, China and Sri Lanka. Rubber-wood is not a timber plantation species and there was no reason to presume that it had potential as a commercial timber. In Malaysia especially, it was described in the past as being soft, of low quality and fit only for firewood. In fact, it is moderately hard though not very strong with problems of low quality and it was used by Malaysian industries as fuel-wood and for producing charcoal. Today, there is strong competition between its use as commercial timber for construction vis-a-vis its use as fuel-wood alongside other secondary species.

31. Rubber-wood logs are likely to be up to 10 metres in length with a diameter of up to 0.5 metres; they have a strong taper. There are two main problems: rubber-wood is perishable and it is prone to distortion on drying. Its perishability results in staining, decay and insect attack; the distortion results in the sawn-wood being generally limited to 2 metres in length with widths up to 150 mm. The relevance of rubber-wood to this paper is therefore not so much its use for building construction but the way in which the problems restricting its utilisation were identified and solved, and how a 'new' species can take the place of another in short supply. Rubber-wood today is mainly a light-coloured furniture wood which is filling some gaps created by the reducing availability of Ramin. It has however been used for joinery, roof trusses, flooring, cement board and laminated timber. Its continued use for such purposes will depend on the price it can command as a furniture and export timber.

32. The perishability of rubber-wood is balanced by its permeability which makes it very amenable to preservative treatment. As a result of well-directed research the log and green lumber can now be protected against stain and insect attack, and the dry wood can be promoted as having the requisite

durability for construction purposes. Dip diffusion methods can be used. Drying problems have been traced largely to the presence of tension wood as well as to the high ratio between tangential and radial shrinkage. The wood is best used for short furniture components to avoid the need for excessive machining allowances. Currently there are well-directed research programmes in Sri Lanka and India as well as Malaysia on use of rubber-wood. A notable feature of the development of rubber-wood as a very important timber species has been the insistence on good production and quality control, and the acceptance by industry of technical advise.

IV. GAPS BETWEEN RESEARCH EFFORTS AND THE COMMERCIAL APPLICATION OF SECONDARY-WOOD SPECIES IN SHELTER CONSTRUCTION

33. The extent to which the gap between research efforts and commercial application of research results poses a limitation to wide adoption of a host of local building materials has been a matter of concern to several national governments in developing countries and the international community as large. Currently this theme is the focus of UNCHS (Habitats) activities aimed at strengthening national capacities in the area of local building materials. In fact, experience acquired by UNCHS(Habitat) indicates that this single issue remains at the centre of a comprehensive set of strategies required to reverse the current impasse.

34. If efforts at bridging the gap between research and commercialization are demonstrated, it is likely to be of high significance with regard to secondary-wood species mainly because timber is a renewable material and there are vast resources yet to be tapped. Currently not many developing countries have embarked on those types of research innovations which for lack of proven methodologies have not had any impact on the actual needs of the construction market. However, it is likely that once a few innovations become commercially viable the scene would be set for other countries to either replicate the results directly and embark on commercially-attractive research undertakings. The main constraints which widen the gap between research efforts and commercialization of research results can be summarized as follows;-

(A) Inadequacies in research efforts.

35. Unlike the industrialized countries where wood construction is widely adopted, research efforts in timber-growing developing countries often have no relationship with the actual needs of the industry; - the actual needs of building professionals, artisans, contractors, timber-component producers and clients of building products, are all ignored in research practice. Funding is often a limitation but again experience from Europe and America and to some extent Asia suggest that once the needs of the building industry especially the research needs of the private sector are catered for, there will be adequate funding to carry out the respective research. The value of research to product promotion in a developing country is amply demonstrated by the example of rubber-wood in Malaysia, which has been developed from a source of fuel-wood to a competitive material for construction. Investigations into detailed properties of a variety of secondary species are lacking; - grouping and nomenclature will for instance be of interest to the industry and so will research on stress grading and other specifications be of commercial interest.

36. The extent to which efforts in research and development activity in primary-wood species has helped to promote export-oriented wood species in some developing countries should serve as a clear lesson of how research remains at the foundation of any meaningful progress. Demonstration activities have also played a role in promoting primary-wood species. However, the few demonstration projects on use of secondary-wood species suffer from the general lack of thrust and a rather non-aggressive dissemination of technology.

(B) Lack of access to appropriate technologies.

37. Although an array of small-scale technologies exist for treatment and preservation of secondary-wood species, not the same could be said of secondary-processing technology. Affordable, modern small-scale technologies to process secondary-wood species into panels for wall-cladding and roof shingles are not easily accessible if available at all. The available tools and machinery are obsolete and technically inadequate to produce a low-cost, technically-efficient and most of all aesthetically-pleasing component. In advanced levels of secondary-processing such as for composite materials i.e. wood-chip boards and wood-cement panels, the existing machinery are almost invariably at a scale which may not be commensurate with the size and effective demand of the local market.

(C) Lack of standards, codes of practice, and other regulatory instruments.

38. In countries where research and demonstration work has led to a near break-through in use of secondary-wood species for walling and roof-cladding the lack of standards and codes of

practice and schedules for bills of quantities specific to the secondary-wood species could pose a severe limitation to any prospects for commercial adoption of the findings. In the first place, the reluctance of finance institutions to provide credit for potential investors in timber processing ventures and house-builders alike, could jeopardize any dreams of wide adoption of secondary-wood species. In the second place, and even more importantly, the competition from other materials such as concrete blocks, fired-clay bricks and aluminium roofing sheets which are all covered with ample regulatory instruments puts secondary-wood species in an unduly uncompetitive situation. In this way, the already existing bias by both builders and consumers is aggravated.

(D) The impact of the international trade in timber.

39 The International trade in timber affects development of secondary-wood species for local consumption by indirectly precipitating the gap between research and commercialization. As in many developmental sectors, efforts by international research organizations and research institutions based in Europe and America in the timber industry has been of tremendous assistance to developing countries. However, unlike materials such as cement, aluminium and even fired-clay bricks where research and development activities in industrialized countries could be directly applied in some developing countries, the situation is entirely different with regard to timber and more so secondary-species. Some international institutions and research or development agencies in Europe and America have done useful work on some primary-wood species but this is mainly because the species are of interest to the industrialized countries. To the extent that only a few wood species will remain of interest to the industrialized countries, the much-needed outcome of developmental research emerging from these countries which could result in appropriate machinery and jointing techniques for secondary-wood species will remain illusive to developing countries.

(E) Government-policy related issues

40. To a large extent, the gap between research and actual commercialization of useful results on secondary-wood species is due to ineffective, inappropriate or non-existent government policy. The government in most instances stipulates policies to promote the timber industry but experience has proven that these policies are too general to meet the specific interest of secondary-wood species or sometimes strictly geared towards promotion of exportable timber to the detriment of otherwise viable innovations i.e. use of secondary-wood species for shelter construction. Most research institutions dealing in local building materials in developing countries are government-sponsored so that orientation, programming and redirection of

funding could all be influenced by government policy so as to have a desirable impact.

V. OPTIONS FOR PROMOTING SECONDARY-WOOD SPECIES IN CONSTRUCTION

A. Technology transfer from industrialized wood-technology countries

41. If developing countries are to achieve any break through in promoting secondary-wood species for shelter construction, then the logical first step and probably the most cost-effective approach should be based on a system of transferring existing proven technologies rather than initiating entirely new technologies. Projections of industrial wood products consumption between 1980 and 2000 indicate that there is a world-wide increase in the use of wood largely in the developed countries but also in some developing countries. In fact, in some developed countries there is a noticeable increase in the use of wood in construction to the extent that currently financial institutions and insurance companies deal with wooden construction in much the same way as brickwork or concrete block houses, when negotiating with clients. All these point to the fact there is an established and growing technological base for wood products in shelter construction which could facilitate any programme of technology transfer for the benefit of low-income settlements.

42. The botanical differences between the timber species of the tropical forests vis-a-vis the coniferous woods of the developed countries poses a severe limitation to technology transfer from developed countries to developing countries. However, the concept is still valid. Unlike the brick, cement and concrete industry where similarities between developed and developing countries permit relatively straight forward approach to technology transfer, the wood sub-sector especially secondary-species is under-developed in most developing countries, thus requiring an entirely different strategy to technology transfer. The issues at stake in promoting secondary-wood species are rather basic; - first and foremost to ensure the existence of a general culture in wood technology and then more importantly, identify, classify and understand the operational characteristics of existing secondary species. In this regard, what is transferable is the methodology or software for assessment of stock, classification of stock, biological and engineering characteristics of stock.

43. In most developing countries which could be classified as

timber growing or timber-surplus economies there is still a deficiency in basic know-how even of the primary-wood species. Issues such as stress grading, and dimensions have still not been dealt with adequately. The transfer of methodologies from industrialized countries could initially aim at ensuring rapid improvement in primary-wood species technology so that once the basic infrastructure is in place, the recipient countries could adapt the know-how to secondary species. In countries such as Sweden, Norway and Finland to name a few, so much work has been done on timber resource assessment, nomenclature, grading rules and standardization of dimensions which could all be of benefit to developing countries. Another area which is ripe for transfer from developed countries to developing countries is with regard to preservation of timber. Again, here the techniques or simple tools for seasoning and preservation against fungi and termites should form the basis for technology transfer. Design and construction techniques are often ignored or understated in any programme for promotion of local building materials. In timber technology, design and construction considerations are probably even more cost-effective than wood treatment and such botanical considerations. In this respect, the experiences of the industrialized countries become relevant. However, the principle of technology transfer should aim at careful adaptation rather than outright replication because of the obvious differences in the factors which predetermine design and construction details.

44. The differences in levels of wood technology and general resource profiles of developing countries should come into prominence in any system of technology transfer from the industrialized countries. Ultimately, the technology transfer would only be effective if the exact deficiencies of the recipient countries are taken into consideration. In some countries, the stress may be on the very basics of primary-wood species that is, stress grading, classification and dimensioning. Emphasis may even have to shift to strengthening of secondary processing of primary-wood species so as to consolidate any little gains in local wood-technology culture. However, in some countries the emphasis on technology transfer would go beyond assistance in strengthening the promotion of primary-wood species, and overlap into basic issues of secondary-wood species especially classification and grading methods.

B. Establishing a wood-technology culture.

45. Most developing countries where strategies for promotion of secondary-wood species are feasible would by definition have an already existing wood construction practice based on popular wood species. Thus, there is already an existing basis for promoting use of wood in shelter construction. However, in most of these countries there is hardly any local wood-technology culture. One of the fundamental pre-requisites in ensuring a successful promotion of secondary-wood species is that there should be

local acceptance of wood in general, regardless of the species. Currently, even in timber exporting developing countries, there is limited use of knowledge of timber as a material for construction. Most countries have not as yet gone beyond accepting the use of timber as a material for purlins and rafters. There are cases where wood has been accepted for use as material for ceiling cladding and partitioning of rooms but even in these cases wood is accepted largely as a decorative material rather than its functional features.

(C) Establishing a local promotional exercise which should focus initially on popularly adopted species.

46. Once the use of popularly-adopted species has been widely accepted, the scene is then set for introducing secondary species. The promotional exercise should not be targeted at the consumers alone - in fact, more important than the end-user are those at the production end of the sector i.e. those engaged in primary processing and those engaged in secondary processing. Perhaps, the most strategic component in the array of activities required for securing a local wood-technology culture is the design and construction component. Ultimately, it is the carpenters, architects, foremen, structural\civil engineers, quantity surveyors and building contracting personnel who would influence the wide adoption of wood in construction. In order to facilitate this task the a deliberate effort should aim at promoting availability of wood components such as beams, columns, frames and tongue and groove pieces for wall cladding.

47. The technology gap between developing countries in the area of timber technology - i.e. timber production and utilization in construction, should be seen as an opportunity for promoting technology transfer between developing countries. Even though there are no remarkable achievements in the major timber-producing developing countries, the isolated successful experiences in a few countries are worth transferring to the others. Unlike the technologies from the developed countries which often cannot be replicated directly in developing countries, experiences form one developing country can be replicated in another with relative ease. In this way, technology transfer becomes more readily affordable. Developing countries from the same ecological zones are likely to have similar wood species so that the concept of replicating experiences and achievements becomes meaningful. Similarly, developing countries with the same level of basic industrial and wood-technology infrastructure are likely to benefit effectively if a successful country transfers its experiences to the needy.

48. One area in which a few developing countries have made reasonable progress in secondary-wood species is in primary research. Countries such as Malaysia, Venezuela, Cameroon, Ghana and Nigeria all have basic research centres and laboratories

dealing specifically with timber and timber products. The little experience acquired by these countries so far, could form the basis of research know-how that could be transferred to the remaining countries which are yet to make a start in investigations on secondary-wood species. In Malaysia, the use of rubber-wood as a construction material has been demonstrated yet other rubber producing countries such as Liberia, Nigeria and Ghana have not made any progress in this area. Another area of concern, where disparities exist between developing countries in the level of know-how and local initiative is with regard to wood-preservation technology. Advances have been made by a few developing countries in simple methods for wood preservations including developments in solar-drying techniques for timber seasoning, wood impregnation technology and above all initiatives in treatment for termite protection. All these initiatives are directly applicable to secondary-wood species and could thus form the basis for technology transfer between developing countries. In countries such as Costa Rica and China to name a few, low-grade secondary species such as bamboo have successfully been cultivated in large volumes to prove its versatility in rapid supply of raw materials and this has formed the backbone of an accelerated low-cost housing delivery programme. Again, the breakthrough in the ease of renewability of species such as bamboo and poles relative to other species coupled with initiatives in design and construction techniques using same materials could be strategic tool for technology transfer between developing countries.

49. The concept of technology transfer between developing countries at least in the area of building materials is relatively new and untested. At the same time, there are some basic limitations facing developing countries for which reason only a limited scope of technology transfer could be feasible. In isolated cases, technology transfer between developing countries could take the form of supply of simple tools, training of personnel in tool fabrication, training of personnel in a variety of skills related to production aspects of secondary wood processing, training of personnel in a variety of research and laboratory test methods and installation of laboratory equipment. However, in a majority of cases technology transfer could be pitched at the most rudimentary level, that is exchange of information between developing countries:- general information on country-specific work in the area of timber technology as well as information pertaining to secondary-wood species could be sent from those countries pursuing active programmes in the respective areas to the recipient countries.

D. Secondary processing of secondary-wood species.

50. One of the most viable strategic options for promoting use of wood in construction or even for promoting use of unpopular wood species is for timber-growing developing countries to embark

on intensified secondary-processing of lesser-known wood species. The merits of secondary processing need not be over-emphasized. The strategy fits well into the overall economies of developing countries;- the superiority of the building materials sector as a viable sector for industrial gains is based mainly on the multiple linkages to the national economy in both outputs and ability to stimulate a parallel growth in the input sectors. In the first place, the abundant reserves of secondary-wood species plus the fact that timber is a renewable resource could all serve as a solid base for continuous supply of raw materials required in secondary-processing plants. In the second place, the promoting of secondary processing could lead to the availability of a multitude of products which could then satisfy the rather complex market for shelter construction. Thirdly, there are relatively simple tools and technologies available on the market for secondary processing of timber and this on its own will enhance prospects for the strategy to prove feasible to both potential producers and consumers of end product. Finally, the promotion of accelerated secondary-processing of lesser known species of timber is consistent with the targets of facilitating shelter delivery; in the final analysis, an intensive use of wood in construction is only feasible if processed or prefabricated components or composites of timber are widely available on the market.

51. Some timber-growing developing countries have come a long way in a relatively short period of time regarding timber processing. From the initial stages where focus was strictly on harvesting sawn logs for export and for saw-mills, there is now a shift into secondary-processing to increase value added but mainly to generate foreign exchange. A few developing countries have however moved into production of pre-fabricated door frames, window frames, roof trusses and panels for wall framing. There is scope for further diversification of products through secondary processing of timber, utilizing lesser-known species strictly for the housing construction market. Fortunately, most developing countries already have an established technological infrastructure for primary processing of timber and to some extent some rudiments for secondary processing which could be consolidated upon to intensify and diversify secondary-processing of wood. Opportunities exist to embark on chip boards, wood framing and cladding components and other structural elements using chips from secondary species and cement or other additives to form a monolithic composite material.

E. Joint programmes:- sub-regional joint demonstration projects on adaption of internationally-sponsored technology transfer

52. Despite the fact that a few developing countries have made some little progress in wood technology the general picture is that of a total lack of direction and focus on the actual task of promoting secondary-wood species for shelter construction. Most

developing countries are yet to embark on any programme of promoting timber for construction let alone promoting secondary-wood species for low-income shelter. Even if such programmes were to be launched there are severe technical and financial limitations that could make it virtually non-feasible for any one country to attain the targets of the Global Shelter Strategy. One way to overcome this problem is to optimize use of the little available resources by undertaking communal programmes amongst a group of developing countries.

53. The merits of a joint sub-regional project of secondary-wood species are several. First, the resource requirements of each individual country to attain minimal targets in wide-adoption of timber for construction are massive compared to what is normally available from international support sources;- the resource requirements will normally comprise of assistance in technical expertise, supply of information packages and software, supply of laboratory equipment, supply of machinery and training of local experts. In the second place, most developing countries requiring assistance to promote secondary-wood species for shelter construction will tend to have identical problems such as in raw material assessment, classification, treatment, processing and design techniques so that economies will be achieved by intervening in their problems on a communal basis. Thirdly, a strategy of joint projects takes account of the contribution that the recipient countries could make to project success;- the little expertise and facilities available in some of the recipient countries could all be mobilized into the project to secure some savings and ensure rational or efficient use of all available resources.

VI. PROGRAMME OF ACTION

A. National Governments

54. By now, most governments in developing countries would have embarked on a programme of formulating national shelter strategies within the overall guidance of the Global Strategy for shelter by the year 2000. If stipulated targets are to be met then the underlying philosophy should be to promote basic shelter;- first and foremost the shelter must be affordable by the majority of the population and secondly shelter must be provided in adequate quantities. Given these challenging criteria, not many available building materials can fulfil the requirements. Fortunately, however, secondary-wood species have the potential to play such a role;- the technical limitations currently facing secondary-wood species are indeed solvable. Some of the solutions required to make secondary-wood species cheap, technically-appealing and above all available in large quantities as walling and roof-cladding material are already unknowingly being pursued by national governments. There are on-going general policy reforms and programmes to promote wide

adoption of local building materials which if sustained would have an impact on use of secondary-wood species for housing. However, the peculiar requirements of secondary-wood species would in addition to general policy reforms benefit from the following specific interventions of national governments.

(a) Strategic programme of assured supply-base.

55. The primary task of national governments if secondary-wood species are to be widely adopted for low-income housing, is to embark on a strategic programme of an assured supply base. The unique advantage of wood over other local building materials is its renewability;- if timber is treated as a depletable raw material just like limestone, clay or sand then its versatility as a potentially viable low-cost material is threatened. For this reason, governments should outline a vigorous policy of afforestation for any exploitable secondary-wood species as fundamental pre-requisite to any other policy interventions aimed at promoting them as walling and roof-cladding material for low-income housing.

(b) Promotion of standards, specifications, building regulations, codes of practice and contractual reforms.

56. By definition, regulatory instruments for governing the operations of the construction industry have legal implications so that it is the unique task of national governments to undertake any reforms of this nature. Like other local building materials, the strategy for promotion of standards should first and foremost aim at incorporating the use of secondary-wood species into existing building regulations. However, in order to facilitate the fast adoption of secondary-species, requisite standards and specifications should be formulated and effectively disseminated. Similarly, codes of practice and simplified manuals should be prepared to guide operations in secondary-processing as well as design and construction of wooden houses. In this regard, governments need not search for new methodologies to achieve this target. See annex 3:- Promotion of standards and other regulatory instruments for wide adoption of secondary-wood species in construction - Adoption of a proven methodology. There is sufficient experience and proven methodologies to achieve this target. There is sufficient experience and proven methodologies which can be directly applied or adapted. Unfortunately, secondary-wood species are characterized by such a variety of groups with almost every group requiring specific considerations in codes of practice and specifications which could require some additional efforts.

(c) Strengthening research capacity, curriculum revision and provision of specific skill requirements.

57. To the extent that governments are directly in charge of

most institutions dealing with timber research in developing countries, it must be seen as their prime responsibility to first bring about reforms in research programming and secondly to take positive steps towards strengthening the resource base of the institutions. Again here, governments need not devote additional resources to carry out the reform but simply reorient the approach and set-up of the research institution to link them up with the private-sector producers of timber products and the construction industry. The target should be research into areas of direct benefit to housing estate developers, timber product manufacturers, Architects, Contractors and the like. Apart from general topics of investigation requiring immediate attention such as raw material assessment, identification, grouping and nomenclature there is also need for specific studies into items such as:-

i. Strength and durability
ii. density characteristics
iii. stress grading
iv. low-cost techniques for seasoning and protection against bio-degradation
v. field tests for brittleness, vulnerability to splitting, grain, level of distortion to name a few.

58. If wood construction technology is to become a priority issue in national housing strategies then governments must address themselves to the manpower requirements of this strategic sub-sector. The training programme should cover a vast range of skills in the timber industry-; operatives for secondary processing, machine and equipment installation plus maintenance specialists, forestry management personnel, wood treatment and preservation expertise and then wood design and construction technology. In all these endeavors, there must be a focus on training of skills specifically geared towards the promotion of secondary-wood species for walling and roof-cladding. The training programme need not lead to setting up of entirely new institutions. One useful strategy is to strengthen existing institutions through programme reform and most of all curriculum revision. The curriculum revision should prove most useful to institutions training high-level artisans or technicians for the construction industry as well as professionals such as architects, Building technologists, Civil/Structural engineers, quantity surveyors and mechanical engineers.

(d) Effective dissemination of research and development of innovations

59. The few living examples of demonstration projects aimed at popularizing research in the building materials sector have all been failures in several developing countries. However, the

concept of demonstration projects is still valid and remains a vital tool for linking up research to practice. Wood construction technology would require particularly effective and aggressive demonstration projects considering the unfavorable position that wood occupies relative to other comparable local building materials. Governments should take advantage of the fact that they are, in most instances, the single largest client of the building industry and use this position to demonstrate the viability of secondary-wood species as a low-cost material for shelter construction. Apart from physical erection of habitable structures, there are other modes of research dissemination which the government could manipulate to achieve the desired results. Governments can for instance, take full advantage of their television and radio broadcast network as well as informal systems using agricultural extension officers, health officials and teachers.

(e) Fiscal policy reform and investment incentives.

60. There is need to review existing fiscal policies and incentive strategies not only for the timber industry but for the entire local building materials sector. It is likely that most timber exporting developing countries would have put in place fiscal policies and related incentive strategies to boost production for export. The danger in such a strategy is that it could serve as a disincentive to investments in exploitations and processing of secondary species. If the timber industry is treated as an aggregate sub-sector of the economy with uniform tax incentives and equalization of reductions in import levy then there is every chance that the exportable species of timber would attract all the local and foreign private-sector investment. In this regard there is need for tax and similar fiscal incentives to be targeted to the promotion of secondary-wood species especially the secondary processing of the species for shelter construction;- the incentives should be covering entrepreneurs at the production end of timber as well as those investing in the use of timber components for shelter construction. The extent to which timber is disadvantaged in relation to other competing local building materials should also be reviewed so that corresponding adjustments are made on existing fiscal policies to reflect any peculiar requirements of secondary wood species.

61. The lack of standardization of timber components for use in construction poses a problem with several negative consequences, in particular the high-incidence of wastage of timber which eventually makes timber seemingly costly. The lack of standardization also leads to delays in construction time and the quality of finish in timber-framed buildings. Governments bear the responsibility for promoting standardization of measurements of timber components. Once standardization has been accomplished for simple components, the process of industrialization of wooden houses could be initiated. The important aspect of promoting

standardization in measurements for components of timber for dwelling construction is that it can all be tied into a gradual process of prefabricated housing at a semi-industrialized scale. (See annex 4 on UNCHS (Habitat's) strategy towards promotion of prefabrication technology in use of secondary-wood species.

62. There are two distinct advantages of a semi-industrialization of housing utilizing secondary-wood species. The first is of immediate national consequence in terms of improving housing delivery and stimulating national growth. The second is that governments could explore possibilities of exporting industrial components to other developing countries that may be facing a deficit in supply of secondary-wood species. In this way timber for shelter serves a dual market and sustains the foreign exchange earning capacity of the timber industry.

B. International support

(a). Information flow.

The rich experiences of some developed countries in the use of timber for dwelling construction plus relevant research projects under-taken by specialized international agencies could all prove useful to the needs of some developing countries who may wish to promote secondary-wood species for shelter construction. In this regard, the international community could support efforts of national governments through supply of relevant information to selected focal points in the recipient countries. One important requirement for information flow of this nature to be effective, is that the information must as much as possible be targeted to the needs of the recipient countries;- implying that information must be further refined or processed before being disseminated. For instance, in the area of grouping of species and similar areas what may be required is only the methodology or concept. Similarly what may be of interest to local Architects in developing countries os the design guidelines rather than detailed drawings.

(b). Joint research and demonstration projects.

64. The international community could support the efforts of national governments through bilateral programmes in research and demonstration covering a variety of aspects for promotion of secondary-wood species. The possible areas of co-operation include raw-material assessment, species identification, grouping and nomenclature, treatment and preservation techniques, field tests for classifications, secondary-processing into panels and shingles and construction techniques. Depending on the particular focus of the joint project and also depending on local

infrastructure and other variables of the recipient country, the project could be hosted by the recipient country with specific components being hosted by the donor country. There could also be twinning arrangements whereby expertise from individual developing countries are attached to selected specialist companies or research institutions in the developed countries to undertake joint research programmes.

(c) Equipment and machinery

65. Perhaps the most obvious support that the international community could give to the developing countries is in supply of equipment and machinery. The range of equipment and machinery required is extensive, broadly covering equipment for research laboratories, tools for treatment and preservation of secondary-wood species, tools for species identification and most of all tools for secondary processing especially those required for processing of walling panels and roof-cladding shingles. It is important for donor countries or multi-lateral agencies taking up this challenge to aim at technologies which can be sustained by the recipient countries. This may call for some adjustments on the part of the donor countries;- adaptation of existing technologies rather than outright technology replication. Donors of machinery and equipment may also explore possibilities of assisting the recipient countries in local fabrication of rather simple tools.

(d) Manpower development

66. In the long-run, developing countries will only achieve the target of adequate local capacity in the promotion of secondary-wood species if the gaps in available manpower are dealt with in a comprehensive manner. The international community's support in this area is vital and should more importantly prove a cost-effective approach to development. Manpower development should cover both professionals and middle=level technicians and the entire range of activities required to effectively promote secondary-wood species should be considered. The training programme to be offered should as much as possible be specific to the subject with adequate balance between classroom academic-oriented courses vis-a-vis on-the-job practical training schemes. With regard to the latter, attachments to private sector ventures for on-the-job training has always proven beneficial to potential entrepreneurs from recipient countries.

(e) Support for co-operation between developing countries.

67. The responsible international agencies could initiate collaborative research and demonstration projects involving joint efforts of a few developing countries from one sub-region with logistics support from the international community. The concept

of such a collaborative project has been rehearsed by agencies such as UNCHS (habitat) and this should not prove too difficult to adapt to the task of promoting secondary-wood species. The main areas of support from the international community are for equipment and machinery and assistance in expertise. The concept entails a group of developing countries being hosted by a single collaborating country for the purpose of undertaking a project of mutual benefit to the group. After the successful demonstration stage, the international community could provide a lower margin of logistics support to replicate the initiatives to the remaining participating countries.

VII ISSUES FOR DISCUSSION

68. Participants should address themselves to two main issues

Issue No I:

<u>What justifies the technical and economic viability of secondary-wood species in the context of the global shelter strategy bearing in mind that:-</u>

(i) timber is a renewable resource and vast quantities of untapped secondary-wood species exist.

(ii) through a process of appropriate-scale industrialization components of secondary-wood species could be standardized and prefabricated to accelerate local shelter delivery and enhance foreign-exchange earnings through export promotion.*

(iii) the technical defects of secondary-wood species especially limitations relating to secondary processing are not beyond solution.

(iv) the functional requirements for construction of low-income shelter are so basic that even with simple rule of thumb principles and hand-operated artisanal tools, secondary-wood species could be used to satisfy the basic needs of walling and roof-cladding material?

Issue No 2:

<u>What strategic measures could be adopted to promote the use of secondary wood species in shelter construction so as to have an impact on the targets of Global Shelter Strategy bearing in mind that</u>

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*. See annex 4 on UNCHS (Habitat's) strategy towards promotion of prefabrication technology in use secondary-wood species.

(i) National governments could create an enabling environment for rapid adoption of secondary-wood species for low-income shelter construction by ensuring sustainable supply of the wood species; promoting appropriate standards, regulations and codes of practice; adopting curriculum revision and strengthening local research activities; undertaking fiscal policy reforms to attract investments in secondary-wood species and by promoting effective demonstration projects?

(ii) The international community comprising of bilateral and multi-lateral donors and specialized agencies could provide support to national efforts by providing relevant information, providing training in a variety of skills, joint research projects, basic equipment and machinery and technical expertise?

ANNEX I

OUTLINE OF A MODEL FOR COST COMPARISON

In order to undertake a cost comparison of a house built predominately of secondary-wood species vis-a-vis other comparable materials, the key indicators are as follows (assuming the comparison is between timber housing and concrete block housing of the same dimensions)

A. Cost on site

(i) Cost of all materials delivered on site

(ii) Cost of use of machinery and equipment on site (operational cost plus depreciation)

(iii) Cost of professional and artisanal labour on site

(iv) Cost of unskilled labour

The main elements of the house on which the cost comparison would be based are

(i) Roof structure including roof cladding (note that for wooden houses the roof-cladding could be shingles)

(ii) Ceiling

(iii) Internal partition

(iv) Exterior wall with openings

(vi) Floor and floor finish

(vii) Foundation

B LIFE-CYCLE COST MAINTENANCE

It could be assumed that each building has a life span of 50 years. Even if the two buildings have predetermined variable life spans a cost caparison on maintenance could be worked out. The assumption being made is that both buildings would have a routine maintenance schedule NOT repair, i.e. yearly periodic painting, replacement of components with short life - span etc. Again the units of costing should be based on raw materials cost plus labor cost.

C. Production cost of the timber components compared to concrete components.

While items A and B give basic indicators of cost advantage in use of alternative materials they ignore other critical issues which are of interest to the decision maker. The cost to the national economy for producing alternative materials is very vital for decision makers to make a choice. The key issue is in a cost comparison in mainly to do with local inputs versus imported inputs and also employment plus skill generation implications production cost vis-a-vis imported inputs. For instance, the unit cost of wood shingles may be higher than that of aluminum sheets but upon a break down of the inputs leading to final production cost one may determine that about 80 percent of the cost of producing the aluminum sheets is accounted for in foreign exchange. There are more complex variables which could be used to support this argument, such as opportunity cost, supply, elasticity and sensitivity tests to name a few but for the purpose of convincing politicians a basic import versus local inputs analysis should suffice.

ANNEX 2

The Use of Bamboo in Low-Cost Housing, Case Study of Costa Rica*

The economic crisis which hit Costa Rica in the early 1980's was particularly severe in the construction industry. House construction in 1982 was 26 percent below that of 1980. Worse still, the public sector which has always been the lead sector in low-income housing, was able to construct only a third of its 1987 output. As a result, the housing requirements grew to an estimated 125,000 units in 1984, a rather high figure for a population of about 2.5million. Disregarding the need for a large number of new dwellings, there was a large stock of deteriorated houses among the existing units - as many as 32 percent of existing dwellings were in a deplorable state. The Government's response to such a challenging crisis was to promote bamboo housing because it offered the most viable technical solution in the shortest possible period but mainly because of the cost efficiency.

In Costa Rica, until recent times, timber was the predominantly used material in dwelling.

Construction, especially among the low-income population. However, the rapid deforestation has suddenly made the material scarce and expensive, giving way to the use of masonry and pre-cast concrete. In fact, timber housing dropped from 86 percent of the total housing stock to 60 percent between the period 1963 to 1984. Not only did timber become scarce and expensive but also timber construction technology declined and available skills diminished, all making timber housing generally unfavourable.

The government's initial strategy for the revival of timber housing was to promote bamboo technology for rapid rural housing construction. Apart from the fact that bamboo satisfied the minimum technical requirements of wood, it has added advantages in cost, accessibility to rural population and ease of renewability. The Costa Rican National Bamboo project was initiated in 1986 - 1987 as a collaborative effort between the government of Costa Rica, the government of Netherlands, and the United Nations notably by UNCHS Habitat/UNDP. The project had three objectives namely:-

i. the construction of 760 bamboo houses in 38 rural communities as model units for eventual replication leading to a construction programme of 7500 houses per year in the

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* Chaves A.C. and Gilierrez. E.J.:_ "The Costa Rica Bamboo project". San Jose, Costa Rica.

rural sector

ii. cultivation of 700 hectares of bamboo to provide the raw material base in strategic locations of the country

iii. training or re-training of 1000 professionals, technicians and heads of households in cultivation, production, preservation and use of bamboo in housing.

The construction technique adopted was the use of round bamboo as structural material for columns, braces, wall frame, floor and roof structure, while the split bamboo was used as cover for walls, floors, and ceilings. The bamboo - framed walling is eventually filled with mortar of either soil composite or cement composite, mainly for insulation purposes but also to preserve the bamboo. The first step in the bamboo construction programme was the erection of 4 pilot units running concurrently with a research programme to increase knowledge about bamboo as a construction material. The research programme has been focusing on the following areas:-

i. physical and mechanical properties of bamboo
ii. bamboo preservation techniques
iii. behaviour and capacity of structure components and joints
iv. Siviculture
v. construction management
vi. social organization

ANNEX 3

PROMOTION OF STANDARDS AND OTHER REGULATORY INSTRUMENTS FOR WIDE ADOPTION OF SECONDARY WOOD SPECIES IN CONSTRUCTION - ADOPTION OF A PROVEN METHODOLOGY

1. The lack of standards and specifications for local building material has long been recognized by UNCHS (Habitat) as one of the main reasons perpetuating the inadequacies of the building materials sector in most developing countries. In response to this, UNCHS (Habitat) devoted considerable time in its research and development efforts towards formulating an innovative approach to promotion of standards for local building materials. With the support of the Commonwealth Science Council, the methodology was tested in three countries namely:-

i. Ghana - promotion of standards and specifications for soil blocks and building lime;

ii. Malawi - promotion of standards and specifications for fibre-reinforced concrete tiles;

iii. Kenya - standards and specifications for stabilized soil blocks.

The underlying principles of the UNCHS (Habit) strategy are as follows:-

i. There must be some local capacity to undertake basic research on the materials to be promoted alternatively, there should have been some basic research work already undertaken prior to promotion of standards;

ii. There must be sufficient evidence that the lack standards has made the material unpopular on the market, the corollary to this is that, the material to be promoted must stand a good chance of competition on the local market once standards have been promoted;

iii. Standards can be original and peculiar to one country and even when adopted from foreign sources must as much as possible be modified to reflect true local circumstances;

iv. Standards and specifications must be presented in the most simplified manner and effectively disseminated. Ultimately, Standards are enforced not by a policing approach but rather a counselling and persuasive process;

v. Standards and specifications are an integral part of a whole culture of regulations in the building sector:- a newly - formulated standards must be incorporated into a corresponding set of revised building regulations which in turn must be adequately supported by codes of practice for production of the materials, codes of practice for the use of the material in construction and modifications in contract/tendering procedures;

vi. The effective promotion of standards require that quality-control procedures be formulated and made accessible to the ultimate field workers and technicians. Similarly, basic tools which facilitate quality-control should be available on the market.

3. The steps adopted by UNCHS (Habitat) in the three country-case studies were as follows:-

i. Identifying a lead agency in the country to coordinate the programme and monitor all aspects of standards formulation and promotion. Experience has proven that such an agency is never the national standards board but almost invariably, the lead agency responsible for promotion of housing especially low-income housing;

ii. Identifying all the agencies in the country private and public with interest and responsibility in the production and use of the specific building material - basically, this comprises of policy makers, researchers, standards institute, testing laboratories, equipment fabricating units, contractors and the building profession, enterprises producing the building material and regulatory agencies;

iii. Preparing an authentic technical report on local state -of-the-art on characteristics of raw materials and inputs, characteristics of finished products, actual production practices, techniques for use of product in construction, performance of material in use, local fabrication of equipment,and use of local tools, and technical recommendations for national standards;

iv. Organizing a local workshop, using above technical report as background paper plus carefully prepared

discussion guides and bringing together all the identified agencies/resource persons to discuss background paper and arrive at a consensus on national standards based mainly on technical recommendations of the report in comparism to standards from comparable countries;

v. Field visits to sites producing materials using materials and demonstrations on field tests of materials to workshop participants;

vi. Laying in place follow-up activities mainly to do with finalizing workshop technical recommendations into draft national standards, incorporating draft standards into regulations; preparation and dissemination of quality-control guidelines, promotion of locally-fabricated tools, revision of local curricula to reflect use of standards, and formulation of codes of practice for production and use of materials.

4. Results so far in the three countries following the adoption of the UNCHS (Habitat) strategy have been impressive - in Ghana soil blocks are now officially accepted for use in the urban areas by the regulatory authorities and commercial production units have sprung operating favourably alongside the concrete-block manufacturers; in Malawi, fibre-concrete tiles are no longer exclusive to rural application, the city of Blantyre has adopted its use in the urban context and a large scale World Bank sponsored project is on the way using the tiles for urban housing in Blantyre; in Kenya, the Ministry of Lands and Housing has taken steps to incorporate the use of soil blocks in construction projects within urban boundaries. The success of the UNCHS (Habitat) methodology was the topic of discussion at an international workshop held in Nairobi in June 1989 and attended by 11 African countries and over several international agencies notably, G.T.Z., USAID, SKAT, BRE, ITDG, A.T.I., and ECA. The purpose of the latter workshop was to disseminate the UNCHS (Habitat) methodology and thus pave the way for wide replication in other developing countries.

ANNEX 4

UNCHS (Habitat) strategy towards promotion of prefabrication technology in use of secondary-wood species

1. In principle, prefabrication in the building industry leads to cost reduction, speed of construction and accuracy in construction which are all favourable requirements for promoting an efficient construction industry. In this way the introduction of prefabrication technology should go a long way in correcting some of the deficiences facing the construction sector in developing countries. However, these are obvious operational reasons which make the introduction of prefabrication technology rather doubtful, especially when related to housing construction for the low-income population. If the targets of the Global Shelter Strategy are to be met, then the housing delivery culture should capitalize on:-

i. maximum employment generation from both the building materials production and construction processes - here labour - intensity and skill intensive operations come to play;

ii. mobilization of community - participation and self-build strategy;

iii. minimal dependence on transportation of materials components;

iv. optimum use of available local skills rather than introducing new techniques and skills;

2. Not withstanding the limitations of prefabrication technology in low-income dwelling, there could be some merit in its promotion taking due consideration of the level of development, especially the technological infrastructure in the construction sector of each country. One to bear in mind that there are several levels of prefabrication some of which are clearly beyond the reach of most developing countries. What needs to be tackled most urgently is at the primary - processing level of the wood industry, where fortunately most developing countries have the basic infrastructure. Once a culture of standardized dimensions and some form of modular co-ordination can be introduced into the building industry, there are opportunities to achieve savings or minimize wastage of timber through prefabrication of basic components such as door frames, adoors, timber posts and beams, purlins and rafters and components for roof trusses. Prefabrication of walling components such as panels for eventual cladding on site should

all be feasible within the available infrastructure. If prefabrication is to be interpreted as production of large-scale panels or industrial production of roof trusses, floor panels, ceiling systems and similar large-scale components which are mainly dependent on specialized haulage systems plus heavy equipment for site-handling then, the technology is non-applicable to most developing countries.

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