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巻　頭　言

名古屋大学農学国際教育協力研究センター長
竹谷　裕之

農学国際教育協力研究センターの業務活動は、プロジェクト開発と協力ネットワーク開発の２領域にわたって、開発途上国における農学領域の諸問題を実践的に解決できる人づくり協力の研究を推進することである。このミッションを実現するため、基盤調査・ニーズ調査をはじめ、プロジェクトの分析・評価、プロジェクトのコーディネーション手法・マネージメント手法の確立、ネットワーク形成などの具体的研究を進めるとともに、途上国専門家の各種研修を企画・実施し、人材育成に役立てている。

農国センターは、上記の研究を推進するため、2000年４月から2006年３月までに延べ６名の日本人と18名の外国人の研究者・技術者・専門家の方々を客員教授または客員研究員として招聘し、共同研究に取り組んできた。また年度ごとに特定テーマを決め、国内外から関係者を迎えて国際的オープンフォーラムを開催し、共同研究の成果の報告を含め、農学国際協力における学術的・実践的認識の深化と発展に努めてきた。さらに農学分野の国際協力の専門家の協力を得て、毎年10回前後のオープンセミナーを企画し、研究者や専門家はもとより、学生や市民等の参加も得て、知的交流活動を進めてきた。

これらの研究成果のうち、オープンフォーラムにおける研究報告については、農学国際教育協力研究センターが編集し刊行する学術雑誌『農学国際協力』の特集号において、取りまとめ刊行してきた。公刊したNo.1からNo.5までは、いずれも特集号になっている。本号は、客員教授・客員研究員と本センタースタッフとの共同研究の成果のうち、2000年から2001年に招聘した客員教授および客員研究員関係分を取りまとめたものである。中国社会科学院農村発展研究所の元所長陳　吉元先生（招聘期間：2000.5.1 - 7.31）、カンボジア王立農業大学学長補佐のVisalsok Touch先生（2000.8.1 - 10.31）、東南アジア文部大臣機構農業高等教育研究地域センター大学院教育・組織開発部長のEditha Calienta-Cedicol先生（2000.11.1 - 2001.1.31）、インド・ケララ州森林科学研究所木材科学部長のKanthila M. Bhat先生（2001.4.20 - 7.19）の４名の論稿を所収している。

本来、もっと早くに刊行すべきであったが、業務の多忙さなどのために、一日延ばしで編集作業が遅れてしまい、執筆者の方々の期待に背いてきたが、ようやく刊行することができた。センターの責任者として深くお詫び申し上げるとともに、積年の宿題を果たせたことをご報告する次第である。

この『農学国際協力』Vol.6が、既刊の特集号とともに、農学分野の国際協力の発展に関心を持つ方々に幅広く読まれ、人づくり協力の研究と教育、実践活動に役立てられることを強く期待するところである。なお、『農学国際協力』は広く農学国際協力に関わる研究活動の発展に資する学術誌として位置づけているジャーナルである。関係各位に論文投稿による本分野への研究参画を合わせて期待している。

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中国の農業支援システムの構造と機能

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一　中国の農業支援システム研究の背景と意義

市場経済の条件下では、いかなる国家においても、農業という体質の弱い産業に対して、多方面から措置を講じてサポートする必要がある。中国も例外ではありえないが、中国は国情によって、農業に対するサポートが特別に重要な意義を持つことが決定付けられている。中国の農業支援システムの構造と機能の特徴について研究し論述することが、本論文の主旨である。

中国において、農業支援システムを構築することの特殊な意義は、以下の点にある。

1．中国は農業大国であり、国民経済において農業は特別に重要な地位を占めている。1998年の農村人口は８億6,868万人で総人口の69.6％を占め、都市人口は３億7,942万人で30.4％を占める。1996年の中国の第一回農業センサス調査によれば、中国の農村では、農業世帯が１億9,309万戸で90.3％を占め、非農業世帯が2,074万戸で9.7％を占める。農村の総就業人口は５億6,148万人で、そのうち農業従事者は75.7％、非農業従事者は24.3％を占める。農業従事者のうち、95％は依然として作物栽培に従事し、牧畜業、林業、農業サービス業に従事する者はわずか５％である。

2．長い間、中国の農業は全体的に見ると伝統的な農業技術の段階にとどまっており、労働生産性と土地生産性はともに低かった。1999年の全国における栽培面積１haあたりで生産される作物栽培の平均生産高は4,356元であり、食糧が１haあたり4,500kg、綿花が1,013kgであった。1999年の農業労働力一人当たりの平均農業総生産額は4356.4元、一人当たりの食糧生産量は1543.1kg、綿花は11.6kg、油脂は78.9kgであった。二十年近くの間、農業改革は農民の生産に対する積極性や自発性を促し、農業技術や設備が増強され、農民の文化的素養も程度の差はあれ向上したが、いまだに完全に伝統的農業技術の段階を抜け出してはいない。1996年末において農民が所有する５種類の主要な農業機械の総量は、大中型トラクターが67.8万台、小型トラクターが1179.5万台、コンバインが11.3万台、動力脱穀機が752.2万台、農業用運搬車が458.8万台であった。科学技術の応用レベルは、機械耕作面積の比率は39.9％、機械播種面積比率13.8％、機械収穫面積比率8.7％、化学肥料施用面積比率87.3％、農薬施用面積比率67.7％、マルチフィルム覆蓋割合2.8％であった。

3．農業世帯の経営規模は小さく、自然や市場のリスクに抵抗するのは難しい。各農業世帯の経営する耕地面積で計算すると、大多数はいまだに小規模経営に属し、ほどよい規模の経営を行う農家の一群も出現しているが、その数は少ない。農業世帯の経営規模の状況は、３ムー[注1]以下（１ムー＝１haの１/15）が30.3％、３～９ムーが53.1％、９～15ムーが9.8％、15～30ムーが4.9％である。占有耕地面積が30ムー以上の農業世帯

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注１　訳者注：ムー（畝）は、面積の単位。１ムー＝１haの15分の１、6.6667アール）

はわずか1.9％であるが、その経営する耕地が全国の耕地の13.9％を占めていることは、特筆すべきことである。

4．中国の現在の段階は、計画経済体制から市場経済体制への転換段階にあり、農村の社会経済構造はすでに激しい変動が始まっている。中国は計画経済体制下で長期にわたって、「農業が工業を育てる」という政策を実行してきており、全体的に見て農業に対する支援が問題にされることはまったくない。こうした発展戦略は現在でもまだ徹底的には転換されていない。また、計画経済体制から市場経済体制への転換に伴って、衣食の問題が基本的に解決した後、農業生産構造が相応に変化することも求められている。すなわち、主に生産量を追求する方針から相応に質を重視する方針へ転換し、農産物の品種構造と質の構造を最適化し、それによって市場のニーズに適応した効果的な供給を行うことが求められているのである。

5．世界経済発展の全体的趨勢から見ると、中国がWTOに加盟するのは必然であり、問題はいつ加盟するかということだけである。中国のWTO加盟後は、経済全体とその運営メカニズムが顕著に変化し、それによって一連の新しい現象や新しい問題が発生するであろう。「転ばぬ先の杖」として、これらの新しい問題に対して早めに研究と対策を行う必要がある。中国の学者の最近の研究成果によると、WTO加盟は中国経済の全体的発展と福利の向上に積極的な作用を及ぼすとのことである。しかし、WTO加盟の影響は分野によって異なってくる。農業部門について言えば、生産量や就業や収入の点から見ても、貿易の面から見ても、プラスの影響よりマイナスの影響のほうが大きい。これは、中国の農業支援システムをどのように打ち立てるかを考えるとき、考慮しなければならない重要な要素である。

二　中国の農業支援システムの過去の措置に対する歴史的評価

中国が計画経済体制を実行している段階において、特に改革開放政策を実施して以後、国家は農業に対して多方面から支援措置を講じてきており、いくつかの効果的な成果を上げている。しかし、実施してきた農業支援措置とその程度は農業が必要とするものを満たすには程遠く、農業が相対的に停滞している状況はまだ根本的に改善されておらず、都市と農村の経済格差は縮小しないばかりか、かえって広がり続ける傾向にある。

1．国家財政の農業に対するサポートと保護についての評価

改革開放以前、農業に使われる財政上の資金は「農業サポート支出」という予算項目だけであった。現在は国家財政予算内で直接農業に使われる資金の種類だけでも11項目ある。国家はさらに相次いで農業発展基金などの農業支援専門の基金を作り、予算の内外から広範に資金を調達し、多くのルート、多くのレベルにおいて農業支援資金の投入を増加するという態勢を徐々に形成してきた。この他、国家はまた提携投資政策を制定するとともに実行し、地方政府と中央財政がともに農業への投資を増加させるように促している。国家はまた、財政手形割引方式によって、財政資金と信用貸付資金を結合して使用している。1981～1993年の間、各種のルートや各方面からの国家財政農業支援資金の累計額は3,330億元に達し、年平均で12.4％増加し、改革開放以前の国家財政農業支援資金の増加速度を遥かにしのいでいる。

近年、国家は、予算が非常に逼迫している状況でありながら、依然として投資構造の調整を重視し、農業および農業用製造業のインフラ投資を大幅に増加しており、たくさんの農林水産業と、農工業支援の重点プロジェクト建設を組織するとともに実施している。1991年の国家財政において農業支出は、347.57億元であり、1992年376.02億元、1993年440.45億元、1994年532.98億元、1995年574.93億元、1996年700.43億元、1997年766.39億元であって、年々増加する傾向にあり、５年間で倍以上に増加している。

このような状況ではあるが、現在まだ国家財政における農業のサポートと保護には少なからぬ問題がある。主要な問題は、以下のとおりである。(一) 財政の農業支援資金の投入総額が不足している。(二) 財政の農業支援資金の投入が地区間でバランスを欠いている。(三)財政の農業支援資金が適時に投入されない。(四) 財政の農業支援支出を独占する者が多すぎて、資金の有効活用に影響を与えている。(五) 財政マクロ調節システムが、調整手段の不協調や多すぎる資金管理者などの問題があるため、財政の農業支援目標の実現に影響を与えている。

中国の財政の農業支援状況については、さらに国民経済の全体状況から分析を行う必要がある。改革以来、国家財政の農業支援は顕著な効果を生んでおり、国家財政予算の農業用支出は一貫して農業から得られる税収を上回っている。しかし、農村の郷鎮企業[注2]に対して課される税収が、農業部門に対する財政純流入を遥かに上回っているため、財政資源は依然として純流出している。1994年以来、農村から都市への財政純流出は年平均1,020.2億元である。

また、国民経済の発展に伴って、国家の農業インフラに対する支出が絶対額では増加しているものの、農業インフラ支出の国内インフラ支出に占める比率は下降する傾向を示していることを指摘しておかなければならない。その状況については、以下の表を参照されたい。

年	国内のインフラ支出（億元）	農業のインフラ支出（億元）	農業のインフラ支出の国内のインフラ支出に占める割合（%）
1991	559.62	75.49	13.49
1992	555.90	85.00	15.29
1993	591.93	95.00	16.05
1994	639.72	107.00	16.73
1995	789.22	110.00	13.94
1996	907.44	141.51	15.59
1997	1,019.50	159.78	15.67

2．国家の信用貸付による農業のサポートと保護に対する評価

発展途上国において、国家の信用貸付は、農業や農村全体のレベル向上に大きな作用を及ぼし、農業支援システムの重要な構成部分になっている。

中国では、農村の市場経済体制を含む市場経済体制が次第に確立されるのに伴って、国家の信用貸付資金は、農業のサポート面において日増しに重要な役割を果たしている。近年、農業に対する信用貸付資金の投入は大幅に増加している。1999年の国家の銀行と金融機関が農業生産に対して行った貸付金残高は4,792.4億元で、1998年に比べて353.4億元、率にして８％の増加となっている。農業貸付金の、各銀行および金融機関の貸付金残高における比率は５％である。農業信用貸付資金が不足している状況下では、国家の農業政策的信用貸付の投入は、農業自体の発展を直接サポートするだけでなく、農民の農業への投資を促し、感覚的な連動効果を生み出している。中国の大農業地域である江西省を例にとると、1993年から1996年までで、同省の農業政策的貸付金の絶対額は159億元増加し、178.7%伸びた。同時期における江西省の農民の農林牧畜漁業に対する投資絶対額も相応して120.5億元増加し、126%の伸びである。この他、農業政策的貸付金は、農業

注２　郷鎮企業は、農村地域に立地し、末端行政組織や農民が所有・経営する企業である。

資源の合理的配置を促す面でも重要な働きを発揮している。一方では、指令的な特別プロジェクト貸付金計画によって、農民に対して国家の信用貸付資金投入の重点を明らかにするとともに、他方では、農業関連の産業とプロジェクトに対する貸付金を増加することによって、農民の資金がこれらの産業やプロジェクトに流れるように誘導しているのである。

中国の農村では、人口の大多数を占める小規模農業世帯が貸付金を得るのが難しく、また貸付の返済を滞らせることが普遍的であるという状況を考慮して、90年代以来、中国は、外国の経験を参考にして、農村で小額貸付のテストポイントを徐々に広げており、比較的よい効果を上げている。

しかし全体的に見て、近年、金融資源が農村から都市に純流出する状況は依然として続いており、その規模もかなり大きなものとなっている。

農村部門の金融資源純流出の状況

単位：億元

年	農村の預金	農村の貸付金	預金と貸付金の差額	純流出
1994	8,039	6,696	1,343	1,089
1995	10,100	8,276	1,824	481
1996	12,392	10,195	2,197	373
1997	14,640	12,065	2,575	388
1998	16,909	13,824	3,085	510

今後多くの方面から措置を講じて、資金調達ルートを開拓し、農業の政策的信用貸付の投入総額を増加しなければならない。農業の政策的信用貸付の投入は、国家が農業に対して投資を行う主要なルートである。主要なルートの働きを十分に発揮させ、以下の三つの大きな機能をさらに強化しなければならない。第一は、投資安定機能、すなわち多額の農業副産物購入資金の供給を保証する機能である。第二に、農業の政策的業務貸付範囲を開拓し、農業開発、ハイテク農業、および農業産業化に対する投資を拡大することである。第三に、農業の政策的信用貸付資金が農業の経済発展に対する影響を次第に拡大し、影響力を強化し、農業の調整を行い、投資の目標を実現することである。

ここで付随的に述べておかなければならないのは、中国が近年、農業保険システム設立の研究を始めていることである。つまり国家財政が優遇政策と一定の資金投入を与え、中央と地方の政府が再保険を実行するとともに、多くの段階に分かれた分業・協同作業の組織形式を採用することである。しかし、現在の中国は、農業の経済効果が比較的低く、自然災害が農業に損失をもたらす状況がしばしば発生するので、保険部門の農業部門への進出はあまり積極的でない。これは、外国の経験を参考にして解決しなければならない現実問題である。

中国は古くから、自然災害が頻発する国であった。1950～1979年の関連する推算によれば、30年間に全国で、食糧生産だけでも自然災害で年平均約100億キロの減産となっており、自然災害で死亡した大型家畜は年平均で3000万頭であった。このような自然災害による深刻な損失は、単純に国家の支出で補償するのは困難であり、市場経済に適応する農業保険制度を打ち立てて、農業の自然リスクがもたらす損失に充てる必要がある。

改革開放以来の状況から見ると、1982年に中国人民保険公司は農業保険のテストケースを復活させているが、農業保険の引き受け程度（あるいは保険引き受け率）は、依然として非常に低いレベルである。統計によれば、1987年の食糧作物の保険引き受け率はわずか１％で、綿花はわずか0.02％、大型家畜1.6％、家畜

0.8％で、しかも近年農業保険の発展速度は年々急激に低下している。農業保険の経済効果は一貫して低位にある。1982～1988年の農業保険の総保険料収入は3.48億元で、保険金支払いは3.90億元であり、総平均保険金支払い率は112％である。近年の状況から見て、農業保険の状況は好転しているが、依然として根本的には何も変化していない。1998年の農業保険金額は78億元で、総保険金額の1.1％であり、保険料は７億1,472万元で、保険金給付金は５億6,304万元であり、保険金支払い率は77％であった。

農業自体の特徴から見ると、市場経済の条件下では農業保険制度を打ち立てる必要はあるが、中国農業の特徴に適応したものでなければならない。中国では、農民互助協同組織を保険組織システムの礎石として、非営利的な農業協同保険を基礎とした農業保険体制を打ち立てる必要があると考える学者もいる。これは、一つの可能な選択肢と思われる。

３．国家の科学技術が農業をサポートし保護することに対する評価

中国政府は、科学技術による農業のサポートと保護を、すぐに解決すべき問題が少なからず存在するものの、発展趨勢から見て、ますます重視していることは確かである。1996年の中国第一回農業一斉調査資料によれば、全国で農業科学技術普及事務所がすでに４万500箇所建設されており、そのうち平原地区が１万3,191箇所、丘陵地区１万3,481箇所、山間地区１万3,828箇所である。農民の科学技術要員は日増しに増加し、そのうち作物栽培科学技術要員が202万8,552人、牧畜業科学技術要員38万1,680人、林業科学技術要員16万2,928人、漁業科学技術要員12万7,514人である。全国の行政村[注3]で、農業科学技術訓練に参加したことのある人は、作物栽培が1,202万3,638人、果樹園芸358万7,982人、牧畜飼育312万6,207人、林業技術113万2,662人、漁業養殖51万3,585人、農業機械205万289人である。中国の技術進歩による農業経済の成長に対する貢献は、ある学者の推算によれば以下のとおりである。

単位：％

年	農業生産の増加	農業労働の増加	農業インフラ投資の増加	技術進歩	技術進歩の貢献率
1962～1989	3.21	1.57	2.48	1.41	44.00
1989～1996	8.55	-0.04	16.01	4.58	53.54

1990年代初期、一部の農村幹部が市場経済体制への転換に伴って、農業科学技術普及部門は自ら損益に責任を持つべきで、政府はなにもしなくてよいという間違った考え方をしたため、一部の地区では政府が、農業科学技術普及事業に対する組織的援助の手を緩め、極端な場合はある程度放棄してしまい、基層における農業科学技術普及機構に対して「連結をはずし」、「援助を絶つ」という政策を実行した。その結果、農業技術普及システムは「ネットが壊れ、つながりが絶たれ、人が去る」という危機的状況に陥った。農業部の統計によれば、1993年の全国2,200あまりの県レベルの農業技術普及機構のうち、完全に援助を絶たれたか、あるいは一部絶たれたものの割合は44％で、農業科学技術普及事業の農村における展開を著しく阻害した。

現在、中国政府は科学技術による農業振興を特別に重要な地位に置き、科学技術による農業支援と保護に関する発展戦略および有効な措置を以下のように定めることを決定している。(一)新しい農業科学技術革命を一歩一歩進めなければならず、現代的技術、すなわちハイテクを用いて伝統的な農業技術システムを改造または代替しなければならない。特に生物の生命の神秘を明らかにするという基礎の上に、農業科学や生命

注３　行政村は、数個の自然村から組織された末端行政単位である。

科学など多くの学問の交流を徐々に実現することを重視しなければならない。(二)市場経済の実態を基点として、市場経済に適した農業科学技術普及システムを研究し、打ち立てなければならない。こうした市場経済下の農業技術普及システムは、計画経済下のような、利益にも損失にも責任を持たない、あるいは利益だけで損失には責任を持たないという農業技術普及組織とは当然異なる。また、農業が体質の弱い産業であることが、市場経済下の一般の経済組織と同等ではありえないことを決定付けており、政府が一定のサポートを与えることが常に必要なのである。(三) 有償サービスと無償サービスの関係を研究して、きちんと処理しなければならない。農業が弱小であり、農民の収入が極端に低いという状況が、農業科学技術普及に対して無償サービスを行うことが必要であることを決定付けている。だが、中国が現在財政的に逼迫していること、および基層における農業科学技術サービスが、農民の更に増大するニーズを満たすことができないなどの状況を考えると、いくつかの農業科学技術サービス分野において低額の有償サービスを行うという原則も必要なことである。ただし、いずれにしても、農業科学技術普及機関は営利を目的にすることはできない。

４．中国の農業が外資を利用することに対する評価

中国の第八次五ヶ年計画、すなわち1991年から1995年までの間は、外国企業の中国農業への投資が大きく発展した時期であり、プロジェクトの数も投資規模も大いに増加した。統計によれば、この期間の農業における外国企業の投資合計金額は47.98億米ドルに達し、第七次五ヶ年計画の期間に比べて8.7倍増加している。外国企業の農業への投資は主に沿海開発地区に集中しており、広東省、福建省、山東省の三省の投資合計金額だけで約40億米ドルに達し、全国の70％以上を占めた。それ以前の農業の外資利用は主に外国借款であり、外国企業の直接投資は約20％しかなかったが、第八次五ヶ年計画の期間は、外国企業の投資はすでに62.8％に達していた。外国企業による農業への投資は、農産品加工プロジェクトが中心で、家畜や家禽、水産物、花卉などのプロジェクトに集中しており、一方、投資額が大きく、回収期が長く、リスクが大きい作物栽培や養殖のプロジェクトは外国企業の投資が少なかった。

中国では農業資金が非常に不足しており、外資を引き付けて利用することはたいへん重要な作用を持っている。近年この面ではやや成果が上がっているが、他方、外国企業の中国農業に対する投資にもいくつかの問題が存在する。主要な問題は、以下のとおりである。(一) 中国政府は産業政策において、外国企業の農業への投資を導入しようとする努力が不足している。農業プロジェクトの所得税について、期限後10年以内は引き続き15～30％減税できるという点を除き、外国企業の農業に対する投資のほかの面ではほとんど何の政策努力もない。(二) 外国企業の農業に対する投資プロジェクトに合理的な計画が不足している。農業プロジェクトは、ごく少数の大型作物栽培業プロジェクトおよび割当額や許可証に関連するプロジェクトが中央政府に許可されて処理される以外、他の農業プロジェクトは全て各地の政府が自分で審査許可を行っている。そのため外国企業の投資は小型の一般農産物加工プロジェクトに集中し、また少数の省や市や一部分の地区に集中してしまい、合理的な産業配置と地域配置がいまだ形成されていない。(三) 外国企業の農業への投資の全体的規模が小さい。他の業界と比較して、農業における外国企業の投資は、プロジェクト数も投資額も、中国経済における農業の地位と釣り合いがとれていない。1994年の農業プロジェクト数は、その年の外国企業投資総数の2.2％で、合計額は1.2％に過ぎない。以下同じく、1995年のプロジェクト数は2.4％で合計額は1.9％、1997年のプロジェクト数は4.8％で合計額は1.3％、1998年のプロジェクト数は4.4％で合計額は1.3％であった。(四)外国企業の投資するプロジェクトの規模はどれも小さい。外国企業の農業への投資プロジェクトは、大多数が50万米ドル以下の小さなものであり、外国企業の投資プロジェクトの平均規模より遥かに低い。1994年の中国における外国企業投資プロジェクトの平均規模は174万米ドルで、農業投資プロジェクトは92万米ドル、1995年の外国企業投資プロジェクトの平均規模は247万米ドルで、農業プロジェクトは192万米ドルであった。(五) 外国企業の中国農業に対する投資においては、科学技術の要素が低い。一般に農産品

の初期加工が中心であり、ハイテク、新ハイテク、および精密加工や高付加価値加工のプロジェクトは少なく、製品の付加価値が低く、農業投資の比較利益の向上に対する影響が小さい。(六) 農業の合弁企業における中国側の力が一般に弱い。これは主として、現在中国に大型の近代的農業企業がほとんどなく、合弁農業プロジェクトの中国側の多くが、経済力が劣り、技術水準も低く、人材も不足した郷鎮企業であるためである。

中国における農業の特殊な地位と農業が外資を利用することの特殊性を考えると、国家は、農業が外資を利用する場合の優遇政策を定めて、もっと多くの外国企業による農業への投資を促進し、引き付けなければならない。中・低生産性農地の改造、農業に使える荒地の開墾、農業インフラの整備と改善、およびアルカリ性の荒れた窪地、海岸砂丘、浅瀬の開発など、農業の総合的開発プロジェクトへの外資導入を重点的に促進し、作付面積を拡大して、農産物の生産量を向上させなければならない。また、食糧・油脂・砂糖・果物・野菜などの優良品種や新しい畜種の導入、および農産品の貯蔵と高付加価値加工の総合利用プロジェクト、外貨獲得のための農業プロジェクト、ハイテクによるバイオ農薬、高効率の有機化学肥料、農業機械の適用などの開発生産プロジェクトに対して外資の導入を促進する必要がある。

5．国家の反貧困措置による農業サポートと保護に対する評価

中国政府は一貫して、貧困地区の経済発展を援助すること、特に農業を振興して貧困層の衣食の問題を解決することを重要な任務としてきた。20年近くの間に、中国は2.18億人の農村貧困層の衣食問題を解決し、貧困地区の基本的生産・生活条件は明らかに改善され、科学技術、文化、教育、衛生などの社会事業の発展も迅速で、経済社会の様相も大きく変化した。これは、中国の歴史においても、世界においても、特筆すべき成果である。世界でも、貧困人口が常に増加し、貧困状況も日増しに悪化する中で、中国が貧困援助事業で大きな成果を上げることができたのは、主として政府が貧困援助と開発を国民経済と社会発展の全体計画の中に組み込み、実態に基づいて真実を求めるという方法で目標を確定し、救済のための貧困援助から開発のための貧困援助に転換し、付随する措置を講じることによって貧困地区の経済、社会および文化の全面的発展を促進した。これは政府が社会全体の力を動員し組織して、貧困地区の開発と建設をサポートしたことによる。

だが、中国の現在および今後の貧困援助の事業は依然として重要である。現在、全国の貧困層の人口は約3,000～3,200万人である。また、ここ数年の間に衣食の問題が一応解決した貧困層も水準は低く、生産や生活の条件は更に根本的に改善される必要がある。インフラや教育、衛生などの社会事業のスタートと改善に至っては更に骨の折れる仕事である。自然や社会などに起因して、すでに貧困を脱した人々が再び貧困に陥る事例もしばしば起きており、貧困生活に舞い戻る比率はまだまだ高い。

そこで、中国の貧困の実態を基点として、以下のような一連の貧困対策措置を実施する必要がある。(一) 農村の貧困問題を解決するのに、まず農業の発展をサポートしなければならない。貧困層の衣食の問題を解決して初めて工業の発展など、その他の産業について語ることが可能になる。実際の状況から遊離して、貧困地区でハイテク産業を発展させるなどという空論は捨てるべきである。(二)市場経済への転換は貧困地区に前代未聞のチャンスを与えると同時に、前代未聞の難問も突きつける。一方では市場経済は貧困地区の生産要素の合理的流動と組み合わせの最適化を促進するが、他方では適者生存、弱肉強食の市場の法則の前に、貧困地区の人的物的資源が流失するのも必然的である。そこで、政府がいかにして貧困対策措置と市場メカニズムを結合するかは、21世紀において研究し解決することが必要な新しい課題なのである。(三) 政府は貧困援助にもっと力を注がなければならない。国民の収入を支出に転化する機能を発揮することによって、財力の面で貧困地区に対するサポートを強化すべきである。貧困地区の地域分布の特徴を考慮すると、辺境地区、少数民族地区、牧畜地区、深山地区、岩山地区など、自然条件が劣悪な地区に対するサポートを特に重

視する必要がある。(四) 科学技術による貧困援助をやりぬくべきである。技術を普及することによって、衣食の問題がまだ解決していない人々にできるだけ早く衣食をもたらす。また、貧困地区の幹部に対する科学文化知識の教育と研修を強化し、全体の素養を高め、生産を発展させて貧困に打ち勝つ能力を向上させる必要がある。

6．農業総合開発に対する評価

農業総合開発は、中国が農業の発展を加速させるためにとった重要な戦略的措置である。1988年以来、農業総合開発プロジェクトはすでに1,500あまりに及び、改造した中・低生産性農地は2,000万ha、新しく増加、改善した灌漑面積は2,800万haで、食糧生産能力を年平均で5,300万トンあまり増加させた。プロジェクト地域の農民一人当たりの年間純収入増加は、非プロジェクト地域の平均より260元高い。

2000年に中国中央の財政が投入した全国農業総合開発プロジェクト資金は61億元あまりに達し、1999年より8.1億元増加した。今年中央が行う開発プロジェクト資金は三つの部分から構成される。一つは、中央予算内から支出される資金46億元で、1999年より5.1億元増加した。二つ目は、回収した有償資金を利用したもので、9億元あり、1999年より3億元増加した。三つ目は、6.07億元を世界銀行の借款を利用して調達する計画である。

中国では農業の総合生産能力の向上に伴って、特に生態環境保護の必要から現在、農業の総合開発は、中・低生産性農地の改善を中心にする方向に転換しており、できるだけ開墾を少なくするか、あるいは開墾しないように努めている。

中国政府は、農業総合開発において大変重要な機能を果たしている。政府の行動によって分散していた農民が組織され、必要な労働力、物力、財力が投入され、現在ある耕地資源が改善、保護され、各種農業資源が良好に組織され利用された。また、農業インフラの整備が展開強化され、農業生産の自然災害を制御する能力が向上し、それによって豊作が保障された。農業総合開発における多角経営プロジェクトは、プロジェクト地域の資源の優位性を発揮させ、市場のニーズに基づいて土地に応じて適切な措置をとり、農業に適した土地では農業を、牧畜に適した土地では牧畜を、漁業に適した土地では漁業を行い、特色ある農業を発展させて生産構造を調整し最適化した。農業総合開発の新ハイテク模範プロジェクトでは、農業科学技術の新しい成果を農業生産の実践に応用し、模範を示すことによって生産への応用を促進している。

この他、農業総合開発における土地資源開発の主な内容は、農業の水利施設の建設と改善を主な内容とする農地インフラ整備を進めることであり、大量の労働力の投入を必要とする。また、農業総合開発における多角経営発展プロジェクトは、一部の農業余剰労働力に対して就業の機会を提供することにもなっている。

実態から見ると、農業総合開発の実施は農業生産能力と農民の収入を向上させる助けになっており、国家が農業をサポートする一つの戦略的措置であり、すでに明らかな効果を上げている。現在、中国政府内にはすでに専門の農業総合開発機構が設立され、農業総合開発専用の予算があり、農業総合開発の方針は長期的に貫徹されていくであろう。

7．中国の農業情報化サービスの進展に対する評価

情報サービスは農業に対して以下のような特殊で重要な意義を持っている。(一)農業の生産対象は生命のある生物体であり、関わりのある自然、社会、および経済要素は極めて多岐にわたり、複雑で時間的空間的な差異や変異性が大きいので、情報に対して非常に大きなニーズと依存性がある。(二) 農業生産地域は非常に広く、生産組織の規模は小さく、また複雑で変化の多い国内外の大市場に直面しており、情報によるサポートが切実に必要とされている。(三)農業生産の複雑性と地域性が健全で巨大な普及システムを作り上げることを必要としており、情報サービスはこのシステムと広範な普及人員に対して先進的手段を提供するこ

とができる。

中国では、情報サービスのスタートが遅れており、計画経済体制から市場経済体制への移行に伴ってようやく情報サービスシステムの整備が正式に日程に上った。1993年、農業部は率先して国レベルの部と委員会において中国農業情報網を整備した。中国農業情報網は、インターネット方式によって、農業部の各直属部署、農業部に所属する農業大学、中国農業科学院、および各省の農業科学院とネットワーク接続するとともに、20あまりの部や委員会、30余りの省、区、市の農業部門、1,000近くの地方の市や県、200余りの影響が比較的大きい農産物卸売市場、および多くの報道機関とコンピュータ接続し、直接ネットワークに接続する情報集散ポイントはすでに3,000箇所を超えている。現在、中国農業情報網は、農業部門が情報を集めたり発したりする重要なルートになっている。情報センターと専門部局はそれぞれの優位性を発揮し中国農業情報網をよりどころとして、農業科学技術教育ネットワーク、農業放送学校ネットワーク、「農産物」卸売市場情報ネットワーク、作物栽培情報ネットワーク、牧畜と飼料情報ネットワーク、水産品卸売市場ネットワーク、花卉情報ネットワーク、果樹栽培情報ネットワーク、郷鎮企業情報ネットワークなど各種の専門ネットワークを組織した。中国農業情報網を模範として、地方各レベルの農業管理部門の情報化整備を促しネットワークを市、県、および多くの基層組織に伸ばし、農村の情報サービスの発展を推進した。農業情報サービスは小規模生産と大市場との間の問題を解決する面でも重要な働きをしている。情報が即座に得られないために農産品が売れ残り、農民が大きな損失を被る事例が近年多く見られ、情報の遅れは中国において水害、干ばつ、あられの害、虫害、病気、風害、環境汚染に続く「八番目の災害」であると考えている中国の専門家もいる。中国の膨大な数の農民は市場情報サービスを切実に必要としており、農業情報化サービスがそれに次第に応えられるようになる可能性を持っていることをこれまでの実践が示している。

しかし、現段階での農業情報サービス網の建設は以下のような困難に直面している。(一) 農業情報資源が相対的に不足していることの障害。例えば総合的な情報が多く、専門的な情報が少ない、文献資料によるものが多く、市場からのものが少ない、政府の統計によるものが多く、実際の現場から来るものが少ない、単純な言葉を並べた情報が多く、よく考えて作成された情報が少ないなどである。(二) 農業情報の流通がスムーズでないという障害。部門はそれぞれ政治組織や地区で閉じられており、情報の独占や行政の干渉がしばしば発生する。(三) 農業情報サービスの発展のための資金不足という障害。資金が不足しているため、農業情報技術の更新と技術改善が相対的に遅れており、大量の近代的通信情報技術や設備が応用や普及に至っていない。(四) 農業情報技術の人材が不足し、素養が非常に低いという障害。農業情報サービス機構において、技術を理解する人は少なく、市場や管理を理解する人はさらに少ない。(五) 農業情報サービスに統一的な計画が不足しているという障害。農業情報の収集、伝達、保存、処理基準、およびネットワークシステム基準は、まだそれぞれが勝手に行っているという状態であり、インタラクティブなネット通信や、データや情報の共有は困難である。

三　中国の農業支援システムの整備とその組織構造

中国では、農業支援システムはほぼ三つのレベル、すなわち中央政府、地方政府、および農村の基層の農業支援関連機構から構成されている。ここでは、主として農村の基層というレベルから、農業支援システムの組織構造の状況について研究し論じるとともに、必要な範囲内で農業に関連する政府内の部門と構造にも言及しようと思う。

改革開放以来、中国の農村はおおむね初期規模の農業社会化サービスシステムの枠組みを形成している。農業支援あるいは農業サービスの内容には、生産前の農業生産材料の提供から生産中の機械耕作、機械播種、排水と灌漑、植物保護、収穫、さらに生産後の貯蔵と輸送、加工、販売などの各部分までが含まれる。現在の状況から見ると、これら農業サービスのための組織はまだ不完全で、地区間でも発展のバランスを欠いて

いる。

1．市場経済の条件下で、農業社会化サービス組織を整備する必然性と切実性

中国では、農家による請負経営が今後も長期的に存在する農業生産経営組織の形式であり、農村の基層の社会と経済の主要な構成部分であり続けるだろう。家族が農業生産経営の基本単位であるため、小規模で力が弱く、農業における自然のリスクに抵抗できないし、市場経済下では避けられない市場リスクに抵抗することもできない。自然や市場のリスクの前では、しばしば一部の農家の農業再生産が中断に陥ったり、農業生産に起伏が生じたりする。時には、ある農産物の供給が需要に追いつかなくなって奪い合いになったり、またある時には、ある農産物が需要を上回って在庫がだぶつき腐敗、変質し、農民の利益が損なわれるという状況になったりする。このことから、一家族単位の農民が市場に進出することは困難であり、そのため、市場の情報を理解・把握し、一定の経済力を持ち、組織管理の経験を持つ機構を作って、農民の市場参加を指導・促進し、組織化し、商品を貨幣に転化する「飛躍」を実現することが要求されており、この要求が現在特別な切実性を持っているのである。近年、農業が連年豊作であり、都市の絶対多数人口の衣食の問題が解決していることに伴い、農産物が売れないということが農業発展の大きな制約要因になり始めている。農産品の需要の制約問題を効率的に解決するために、相応する農業社会化サービス組織を整備して、農民に農産物市場に関する情報を提供し、農民が農業生産構造を調整し、最適化するのを支援し、市場の需要に適応させることが差し迫って必要になっている。

2．現在の農業社会化サービス組織の多様化した状況

サービス組織の構造から見ると、農村の集団あるいは協同経済組織を基礎とし、専門の経済技術部門に頼りながら農民自身がサービス機構を運営するという形の農業社会化サービスシステムが次第に形成されつつある。農業社会化サービスシステムを構成する主要な組織機構には、農村協同経済組織、専門の経済技術部門のサービス組織、農民自身が運営するサービス組織などがある。

現在、中国の農業社会化サービスシステムの基礎は農村協同経済組織である。基層の協同経済組織について言うと、主として県、郷、村の三つのレベルがある。そのうち、村レベルの協同経済組織は、農家と直接交渉するレベルである。県レベルの協同経済組織でも、郷レベルの協同経済組織でも、あるいは各専門部門のサービス組織であっても、一般に村レベルの協同経済組織を通じてサービスを行う。村レベルのサービス組織は、一般にかつての生産大隊あるいは生産隊を基礎として作られた総合サービス組織あるいは専門サービスチームである。主なサービス機構には、物資供給グループ、農業技術グループ、農業機械グループ、植物防除グループ、水力電力グループなどの専門組織、および、総合サービス事務所などの総合サービス組織がある。江蘇省や山東省など、一部の比較的経済が発達した地区では、村レベルのサービス組織が作られるのが比較的早く、発展も速かった。中西部のいくつかの経済が遅れた地域は村レベルの集団の経済力が弱いため、スタート段階では一般に郷以上の専門経済技術部門サービス組織をよりどころとして社会化サービス組織を整備し、その後で積極的に村レベルに発展させている。

専門経済技術部門のサービス組織は一般に、農業、購入販売協同組合、商業、物資、外国貿易、金融、科学技術、および教育などの部門を含み、農業に対して直接あるいは間接にサービスを提供する公共事業部門になっている。1992年の統計によれば、中国がすでに有する農業、牧畜業、漁業の各経済技術サービス機構は21.46万あり、そのうち省レベルは327、地方（市）レベルは2,445、県レベルは18,194、郷鎮レベルは189,501、技術サービス員は117万人で、そのうち国家の技術幹部が約40％を占める。サービス組織の種類別で見ると、直接作物栽培にサービスする農業技術普及センター、種子センター、植物保護センター、肥料センター等、牧畜業にサービスする家畜繁殖改良センター、牧畜獣医センター、草地管理センター、獣医技術サービスセ

ンター等、水産業にサービスする水産技術普及センター、農業機械普及にサービスする農業機械普及サービスセンター、農業機械学校、農業機械供給企業、農業機械修理工場等、および農業経済の利益計算と評価の知識と技術を普及推進するための農業経営管理センターなどがある。

農業社会化サービスシステム建設において、農民自身が運営するサービス組織では、主として農村専門技術協会が急速に発展しており、農民のための社会化サービスの実行において、日増しに重要な役割を発揮している。農業部の調査によれば1990年末には全国にすでに各種の専門協会（技術研究会を含む）が7.7万、専門的な生産サービス組織が41.9万あった。山東省の農業サービス組織では、農民の個人経営や連合体によって運営されるものが37.3万あり、サービス組織総数の70％を占める。中国における農村の専門協会の組織形式および発展の動向には、以下のような特徴がある。（一）専門技術協会の建設は一つの成長過程を持ち、最初は技術交流型の初級形式で、その後技術経済サービス型の中級形式に発展し、さらに技術経済実体型の上級形式に発展する。これは、専門技術協会の一般的発展法則であるが、現実の社会経済生活においては、初級、中級、上級の三つの形式が並存している。（二）農村の専門技術協会の一般的経済属性から見ると、「民営」「官営」「官民共営」の三つの形式が並存しており、市場経済への転換に伴って、民営を官が援助するという形式が主導的地位を占める可能性が予測される。（三）農村の専門技術協会は、主としてある農村地区に限定された協会から地区を越えた協会に発展し、孤立した縦型組織の協会から中央、省、地方、県、郷、村がシステム化された協会に発展し、横型組織の協会は、第一次産業中心の単一専門協会から第一次、第二次、第三次産業を含む総合的な協会連合会に発展するであろう。

3．農村協同組合と農民専門協同組合の成立、発展、および農業社会化サービスシステムの整備

中国の農村に長期にわたって存在した協同組織には、地域社会協同組織、購入販売協同組合、および信用協同組合がある。これら伝統的な協同組織は農業のサポート面で、過去において一定の歴史的機能を発揮した。農業部の統計によれば、1998年末までに、全国の4.4万あまりの郷鎮のうち、4.2万の郷鎮に地域社会協同組織が設置され、73万あまりの村民委員会のうち、64.8万の村に地域社会協同組織が設置され、村以下でも155.8万の地域社会協同組織が建設されている。実態から見ると、地域社会協同組織は一般に郷（鎮）レベル、村レベル、および村民小組（グループ）レベルに相当する集団経済組織である。地域社会協同経済組織は家族請負制の安定と、集団経済の発展について重要な働きを発揮している。また、集団経済の拡大に伴って、その農業社会化サービス機能も強化されている。

中国では、購入販売協同組合は農村の流通分野における重要な組織形式であり、31の省、自治区、直轄市、および2,000あまりの県に協同組合連合が設置されている。1999年９月末において、購入販売協同組合システムは、基層組合が2.8万、村レベルの総合サービスセンターが7.98万、サービスネットワークポイントが70万あまり、農民組合員が1.8億世帯である。近年、農村でも商業は大いに発展したが、購入販売協同組合は農村の流通分野で依然として主導的な働きを持っている。1970年代末から1980年代初めにかけて、購入販売協同組合は改革によって、「官営」から「民営」に転換したことで一歩前進したが、農民協同組織の目標からはまだ遠い。

信用協同組合は農村の金融分野の重要な組織である。1999年末には信用協同組合は法人機構が39,333、県の協同組合連合が2,422、地方の市以上のレベルの信用協同組合連合は20あまりであった。1998年末には信用協同組合は、非法人機構が62,908あり、そのうち信用協同組合支部が46,429、貯蓄所が16,479、信用代行事務所が20万あまりであった。現在すでに、基本的には県や市には協同組合連合があり、各郷には信用協同組合があり、各村にはネットワークポイントである農村信用協同組織が形成されている。信用協同組合は設立初期には、農民が出資し株主になって組織したが、後にその体制は公社に委譲されたり、貧農･下層中農によって管理されたり、国家の銀行に譲渡されるなどの変遷を経験した。改革開放以後信用協同組合は、組織上の

大衆性、管理上の民主性、業務経営上の融通性の「三つの性質」の回復を主な内容として改革を行い、一定の成果を得た。しかし、現在もなおいくつかの問題が存在する。主要な問題は、農民の出資金の占める割合が小さいこと、信用協同組合の管理体制がまだ順調ではないこと、自身の利益がまだ効果的に保護されていないことであり、内部の経営管理がさらに強化されなければならない。そのため、信用協同組合の改革目標は、農民が株主になり、組合員が民主的に管理し、主に株主である組合員のための協同金融組織になることであり、改革によって少しずつ実現しなければならない。

中国の農村協同組合の歴史で強く指摘しておかなければならないのは、農村改革の実践において、農家請負経営制の実施という大きな背景の下に農民専門協同組合がスタートし、発展したことである。専門協同組合の設立方式には二種類あって、一つは農民が自発的に組織したもので、もう一つは農業関連部門または企業が指導して組織したものである。専門協同組合は一般に、若干の専門生産に従事する農民が、技術、情報、生産材料の購入、および農産物の販売など、一世帯では解決するのが難しい問題を解決するために相談して組織したものである。だが中国の農村では、専門生産協同組合を完全に農民が自発的に組織したケースは、現在のところそう多くない。多くの場合、科学技術協会や科学技術普及事務所などの職能部門、および各種農産物加工販売企業の助成の下に組織され発展してきている。農業部の統計によれば、1998年末に、農村の各種専門協同組合は148万あまりで、そのうち作物栽培業63.1%、養殖業14.4%、加工輸送業6.1%、その他の業界16.4%であった。全国の県を越えた専門協同組織は5,240で、郷を越えた専門協同組織は8,140であった。

このような組織を実践してみて、農村の専門協同組合は中国の国情に適しており、大きな力を備えていることがわかった。ここでは、山東省莱陽市専門協同組合を例として分析を行う。分散経営状態における農家の情報が閉塞している、市場参入費用が高い、などの問題を克服するために、照旺荘祝家疃村の42世帯の野菜農家は、莱陽市で初めての専門協同組合を設立した。しかしこのような専門協同組合はレベルが低く、システムを形成できないため、農村流通のメインルート、すなわち国合商業（国有商業企業と購入販売協同組合）と連携して、これら部門のネットワークや資産や人材の優位性を利用して初めて十分に発展することができる。そこで、莱陽市は沐浴店鎮をテストポイントとして選び、鎮の購入販売協同組合の食糧管理所と食品事務所を頼りにして、農民の資本参加を吸収し、生産材料供給、肉類加工販売、食糧と油の買い付けと販売などの専門協同組合を設立した。また、鎮の各種食品加工企業も、資源の安定、原料買い付けコストの低減、および品質の保証のために、率先して各種専門協同組合を設立し、農民と安定した提携を確立した。このように、莱陽市の各種専門協同組合は徐々に発展してきている。現在、各種専門協同組合は400余りあり、全市の80%近い農家が組合に参加し、莱陽市の農業発展に重要な推進力を与えている。

しかし、中国の現在の社会経済環境においては、専門協同組合の発展は以下のいくつかの制約も受ける。（一）現行経済の体制面の制約。現在、中国の経済体制改革は転換局面にあり、例えば食糧や綿花などの重要な農産物の買い付けと販売は今も完全に自由価格になっておらず、その結果、商品の流通を主要業務としているいくつかの専門協同組合の営業活動は大きな制限を受けている。特に食糧と綿花の主生産区が厳しい。（二）社会環境、およびマクロ政策と法規の制約。過去の国家の専門協同組合に対する注目度はずっと低かったため、中国はいまだに協同組合法や関連する立法がなく、専門協同組合は法律的地位を持たない。そのため、独立法人の資格で各主体と交易を行うことができず、その合法的権益の保証を得ることも難しい。（三）農民自身における制約。第一に、農民の専門協同組合に対するニーズが現地の商品経済の発展レベル全体の制約を受ける。商品経済の発展レベルが低く、多角経営が発展していない地域では、農民の専門協同組合に対するニーズが不足しているのである。第二に、中国の農民は現在に至るまで「合作恐怖」心理があり、一部の農民は、専門協同組合の建設が中国の歴史における二回目の合作化だと考えている。第三に、中国の農民は自分で組織して、自分で管理する能力が不足している。時間の推移と、上述の制約要素が少しずつ変化したり、最終的には消失したりするのに伴って、中国の専門協同組合が大いに発展していき、中国農

村の社会化サービスシステムの主要構成部分になることが予想できる。

4．農村の社会化サービスシステム整備に関する海外の経験

いくつかの市場経済が発達した国家では、早くから農村の社会化サービスシステムが作られており、豊富で成熟した経験を積み重ねている。中国の国情に合った有益な経験を研究し吸収することは、中国農村の社会化サービスシステムの整備と改善にとってたいへん重要な意義がある。農村の社会化サービスシステムの整備においては、アメリカと日本が二つの典型的成功例である。

アメリカの農村の社会化サービスシステムは、(一) 政府部門の農業教育、科学研究、普及のシステム（二）農業にサービスを提供する個人資本主義企業のシステム（三）農場主の協同組合システムという三つの部分から構成されている。ここで特に述べておくべきことは、アメリカの契約制と農業の社会化サービスシステム整備における働きである。個人企業は農場主と契約を交わすことによって、双方の責任、権利、利益を厳格に明確化した上で、農場主にサービスを提供する。契約によって農業生産と販売双方を結びつける紐帯関係こそが、アメリカ企業が農業に進出する主導的な形式なのである。

日本が作り出した「農業協同組合」は、農村の生産と流通分野で広範に活躍し、農業の社会化サービスにおいて、多方面で代わるもののない重要な働きを発揮した。他国の農業協同組合と比べた場合、日本の農協の一大特色は半官半民の性質を持っていることである。政府の援助の下にあって、農協の政治的影響力はたいへん大きく、経済的影響力も農村の隅々にまで行き渡っている。農協は、農業の生産、購入、販売、信用貸付、保険事業などを行って農業にサービスするだけでなく、組合員や管轄地域の住民に対して農業技術指導、医療衛生保険、および文化活動も行う。また、農協は施設の共同利用、情報サービス、経営委託、土地改良などの他の事業も行うとともに、政府に協力して農民や農村の各作業に対する指導と管理を強化している。

アメリカと日本の両国の経験から見ると、中国農業の社会化サービスシステムの整備においては、以下のいくつかの点を特に重視すべきである。(一)政府が農業社会化サービスシステム整備における重要な働きを発揮する。ここで言う政府の働きとは、行政手段によって農業社会化サービスシステムの整備と運営に直接参与することではなく、主として市場メカニズムが作用する土台の上に、経済手段によって社会交易コストの低減を促進し、それによって農業社会化サービスシステムの整備と改善を推進するということである。（二）農業社会化サービスシステム整備の過程において、サービス機構の全面性、完全性に注意して、農民の社会化サービスに対する多方面のニーズに適応するとともに、システムが何もかもカバーしてしまったために競争力が不足するようなことにならないように注意する。(三)契約制を主とした商工業システムを積極的に発展させる。農家とサービス事業体の間に契約制を打ち立てることによって、生産販売関係と利益分配関係を安定させ、それによって農業社会化サービスシステムの正常で効果的な運営を保証する。(四) 農業社会化サービスシステム整備において、農業協同組合を優先的に発展させる。アメリカと日本の両国の経験から見て、協同組合は農業社会化サービスシステムにおいて重要な働きを発揮しており、特に日本の農協は主導的働きをしている。

四　「農業が工業を育てる」から「工業が逆に農業を育てる」への戦略的転換を徐々に実現する

農業は国民経済の基礎であり、特に中国のような農業大国が、国民経済の持続的成長を全面的に推進し、社会の安定を保障するためには、農業の強化を最優先するとともに、長期的な発展戦略としてしっかりと貫徹しなければならない。

ここ半世紀という長い期間、中国は「農業が工業を育てる」という発展戦略を実行して、農業が創り出した価値を用いて工業の発展を支え、農村に累積した資金で都市経済の発展を促進してきた。それは、過去に

おいては是非とも必要なことであったし、中国の何億何万の農民はこのことに対して大いなる貢献をし、弱小な民族工業を迅速に強大なものとし、国家経済を維持し、政治的に独立するために、不滅の歴史的功績を打ち立てたのである。だが今日になって、中国の社会経済情勢はすでに、以下のような大きな変化を起こしている。(一) 工業と農業の生産額構造は、建国初期の約30対70から、現在の約80対20に発展した。(二) 長期にわたって工業の発展速度はたいへん速く、農業の発展速度はたいへん遅く、都市と農村の住民の収入格差、および地区経済の発展の格差は、日増しに拡大している。改革開放以来、中国の都市と農村の収入格差は、当初大きかったのが縮小し、再び大きくなった。1999年の都市と農村の住民の収入格差は、2.65対 1 で、ほとんど1978年の2.56対 1 の水準に戻っている。近年、東部地区の農民は西部地区の農民に比べて、一人当たりの純収入が引き続き拡大する傾向にあり、1995年の両者の差は（単位：元）1,066.5、1996年は1,260.3、1997年は1,340.9、1998年は1,366.3、1999年は1,448.0であった。(三) 中国の計画経済体制から市場経済体制への転換に伴って、家族経営農業の弱い立場は日増しに顕著になっている。農業は自然のリスクだけではなく、市場からのますます大きくなるリスクも受け入れなければならない。上述の状況から見ると、中国の経済発展戦略に対して時期を失することなく調整を行い、農業を圧迫する政策を一日も早く終わらせ、「農業が工業を育てる」という戦略から「工業が反対に農業を育てる」という戦略への転換を実現しなければならないと考えられる。

1990年代から、中国の経済理論界は上述のような経済発展戦略の調整に関する重大問題について討論しているが、今に至るまでこの問題は理論的な論争に留まっており、農業を圧迫する政策は依然として続いている。現在に至るまで、中国の農村資金は純流出し続けている。統計によれば、財政ルートと金融ルートから純流出する資金だけでも、1994年には2,378億元、1995年には1,486億元、1996年には1,278億元、1997年には1,439億元、1998年には1,361億元となっている。その上、ここで言う農村資金純流出額には、農村から来る大量の予算外資金や各種の雑多な名目で恣意的に徴収される費用項目、および農工業製品価格のはさみ状価格差が引き起こす農村資金が都市に向かう純流出額には含まれていないということを指摘しておかなければならない。

中国の農業が新しい世紀における発展において直面する情勢や任務から見ると、この伝統的な経済発展戦略は調整せざるを得ない局面まで来ている。そして、それによって必要な資金を引き出して、農業を発展させ強化するために使わなければならない。(一) 中国農業における生態環境の改善を高度に重視し、それによって生態環境が脆弱な状況を少しずつ改善し、生態環境が引き続き悪化する傾向を制御するとともに、環境汚染の改善と生態環境の保護を行わなければならない。(二)水利を中心とした農業インフラの強化に力を入れなければならない。洪水防止工事をしっかり行って、大規模河川の洪水防止能力を高める。また、農業水利建設を強化し、様々な方法で水源を増加し、節水と灌漑をしっかり行い、有効な灌漑面積を拡大し、中･低生産性農地を改造し、畑作農業を発展させなければならない。(三) 新しい農業科学技術革命の推進に力を入れ、中国と世界の農業科学技術発展水準の差を縮めるように努力し、世界の農業科学技術革命の歩みに次第に追いつき、これを中国農業の総合生産能力を向上させる重大な措置にしなければならない。

言うまでもなく、上述の発展戦略の転換を実現するには、中国の実際状況を基点としなければならない。現在の中国の経済情勢を全面的に観察すると、上述の戦略転換を実現するには、確かに困難が存在する。それは主として、中国の国有企業改革が今に至るも大きな進展がなく、企業の損失額と損失面が大きいという状況が、いまだ根本的に改善されていないということである。また、今後国家がしばらくの間直面するであろう政治経済情勢を考えると、財政資金の逼迫状況は短期内に緩和することが難しい。従って、現在このような戦略転換を全面的に行うことは、やはり現実的ではない。だが、いずれにしてもこの戦略転換は、まず理論的に明確かつ明晰に認識すべきであり、条件が整って時期が熟したときに一歩一歩実施していくべきであろう。

現在、農民の負担を軽減する政策、すなわち農民の「三提（積立金、公益金、行政管理費）」と「五統（教育費附加、計画出産費、民兵訓練費、道路建設費、傷痍軍人や軍人遺族の救済費）」の負担を農民の年平均純収入の５％以内に厳格に制御する政策を断固として具体化し、可能な条件下で、農工業製品価格のはさみ状価格差を少しずつ縮小する措置をとる以外に、各地の実際状況を基点として、郷鎮企業、地方の国有企業、および商業貿易などの産業発展状況に基づいて、条件のある地方において、地区ごとに少しずつ、「工業が反対に農業を育てる」という発展戦略に転換していくことを考えることも可能である。中国がまだこの戦略転換を全面的に行うという条件が整っていない状況において、一部の条件の整った地区でそれぞれの実態に基づいて、異なる方式でこの発展戦略を少しずつ転換し、局部的戦略転換を積み重ねて、最後には全面的戦略転換に導くことが、中国の現在の情勢では現実的な選択かもしれない。

五　簡単な結論

1．中国は農業大国でありながら、もともと農業の基礎が脆弱であり、農民の収入が極端に低いという状況を考慮し、特に中国がまもなく市場経済体制に全面的に転換し、WTOに加盟するときに当たって、農業支援システムを整備し、健全にし、強化することには特別な意義と切実性がある。

2．中華人民共和国建国からの半世紀、特に改革開放以来、国家は農業発展のサポートのために、財政、信用貸付、科学技術、外資の利用、貧困援助、総合開発、情報サービスなどを通じて農業に支援を与えるなど、沢山の取り組みを行ってきた。だが、農業発展のニーズから見ると、まだまだそれは不十分で、いまだに解決しなければならない多くの問題に直面している。これらの問題をさらに研究し、解決することが、農業支援システムを健全にし、強化するのに必要なことなのである。

3．中国の農業支援システムは、中央政府、地方政府、および農村基層の農業支援関連機関から構成されている。現在基層の農業社会化サービスシステムは、購入販売協同組合、信用協同組合などを含む多くの種類の形態から構成されており、そのうち注目されているのは、改革開放以来設立された農民専門協同組合であり、近年農業の発展のサポートと農民の収入向上の面で重要な役割を発揮している。中国の改革開放以来の実践と国際経験から、専門協同組合が強い生命力を持ち、中国基層の農業支援システムの重要な構成部分になるであろうことがわかる。

4．中国の農業支援システムを強化するためには、中国の実態を基点とし、「農業が工業を育てる」という戦略から、「工業が反対に農業を育てる」という戦略への転換を少しずつ実現していく必要がある。中国の現在の社会経済条件では、この戦略転換を直ちに全国の範囲で行う力はまだない。この戦略転換を行うための可能な選択肢は、条件の整っている地区でまず転換を行い、その後で一つ一つの地区を転換することの積み重ねによって、最後に全体的戦略転換に発展させるという道であろう。

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4．国務院研究室課題グループ「農業社会化サービスを論ず」中国財政経済出版社　1992年９月第１版

弔　辞

陳吉元先生は、名古屋大学農学国際教育協力研究センターの客員教授として、2000年５月１日～2000年７月31日の３ヶ月間、「農業支援システムの形態と機能」について竹谷との共同研究に当たられた。帰国後、研究や後進の指導、さらには農業全般の指導に尽力されたが、2003年７月５日、病気により他界された。本論文は、陳先生の日本での遺稿となってしまった。ここに改めてご冥福をお祈りし、先生の略歴をご紹介する次第である。

陳吉元先生は、1952年に中国東北人民大学に入学し、1956年同学部を卒業された。同年、中国科学院経済研究所に入所し、助理研究員、副研究員、研究室主任などを経て、1985年中国社会科学院農村発展研究所研究員兼副所長になり、1988年同研究所所長になられた。

陳吉元先生は、40年余の研究活動において、全国各地の農村調査を行い、中国農村の現場事情を詳しく把握し、多くの研究成果を発表された。研究は農業発展理論、農村経済体制改革、食料生産構造、農産物流通と市場、農業技術普及、郷鎮企業発展等の多分野に及び、それらの成果として70編余りの論文を発表し、12冊の著書並びに多くの編集本を発刊した。近年出版されたのは、『中国農村の変革と発展』（広東高等教育出版社、1992年）、『陳吉元集』（山西人民出版社、1992年）、『中国農村社会経済変遷』（山西人民出版社、1993年）、『中国農村工業化への道』（中国社会科学出版社、1993年）、『当代中国の集落経済と村落文化』（山西経済出版社、1995年）、『人口大国の農業成長』（上海遼東出版社、1996年）、『農村市場体制建設』（江蘇出版社、1999年）等がある。これら研究成果は、中国農業経済学会にも中国人文社会学会にも高く評価された。陳吉元先生は、中国において唯一５回ほど孫冶方経済賞（中国の最高の経済学賞）を受けた研究者である。1988年、中国農業経済学会副理事長に選出され、中国農業経済研究組織と学術レベルの向上に貢献し、中国農業経済学会の代表的研究者として公認されている。

陳吉元先生は、近年では、各種の緊急な農業問題について、研究責任者として中国政府の委託を受け、国家レベルの重大問題研究プロジェクトを組織し、政府の政策づくりに貢献された。中国農業省委託の「中国農村第二次改革」研究プロジェクト（1996年）、中国国家計画委員会委託の「中国食糧問題」研究プロジェクト（1997年）等がそれである。

陳吉元先生は、国際的共同研究にも豊富な経験を持っておられた。1982年には世界銀行と協力し、中国側の責任者としてアメリカ、イギリスなどの研究者と共に、「中国国有企業改革」（世界銀行研究プロジェクト）に従事された。同プロジェクトは文化大革命後の中国初の大型国際共同研究である。その後、オーストラリアのQueens Land大学と協力し、「中国羊毛生産と流通」研究プロジェクトに中国側の研究責任者として従事された。1990年から1995年まではSwedenのStockholm経済学院と協力し、「中国郷鎮企業の政策決定行為」研究プロジェクトに従事され、1997年には日本国際交流基金の「中日食糧政策問題」研究プロジェクトに従事された。その他、アメリカ、ドイツ、日本などの研究者や研究機関と学術交流を行ってこられた。

教育面では、1982年から、中国の大学院制度復活以来、中国社会科学院附属大学院の指導教授として農業経済分野で多くの大学院生を育成された。その他、北京大学、中央共産党学校、吉林大学、浙江大学の客員教授として、大学院生の講義と論文指導に携わられた。

（竹谷裕之）

Agricultural Education in Cambodia

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1. Introduction

Agricultural sector in Cambodia contributes about 45 percent to the GDP, and more than 80 percent of the population earns their livings from the agriculture. Apparently, a process of agricultural development is considered to be an effective approach to promote the economic growth with a broadest possible base. Nonetheless, the development of this sector is mainly constrained due to the exceptionally low productivity if compared with the neighboring countries. Research on agricultural development in developing countries has clearly shown that the fundamental problem of agricultural growth is an agricultural education as it plays a vital role in providing qualified manpower for agricultural requirements and conducting agricultural research, thus providing farmers with new techniques of production and new input. Indeed, innovation of technology and management capacities for more intensive and modernized agriculture becomes paramount to maximize agricultural output to ensure food security and to alleviate rural poverty in the country. Needless to say, this can be accomplished through the upgrading of human resources employed in the sector at all levels from the basic education to higher education.

The main objectives of this paper are to discuss agricultural education systems, problems and issues of agricultural education and strategies for the development of agricultural education in Cambodia.

2. Agricultural education systems in Cambodia

Generally speaking, there are two kinds of agricultural education in Cambodia, namely formal and non-formal agricultural education.

2.1. Formal agricultural education

Shown in Table 1 are the number of staff, graduates and current student enrollments of each agricultural institution in Cambodia.

1 Visiting Research Fellow of the International Cooperation Center for Agricultural Sciences (ICCAE), Nagoya University, Japan: August 1-October 31, 2000

Table 1. The number of staff, graduates and current enrollments of agricultural institutions in Cambodia (as of 2000)

Institutions	Number of Staff	Graduates			Current enrollment			
		Elementary level	Intermediate level	BSc.	Elementary level	Intermediate level	BSc.	MSc.
PLNSA	180	930	1819		34	389		
KCNSA	117		141			255		
MVU	9			84			90	
RUA	207			1572			813	13

PLNSA : Prek Leap National School of Agriculture
KCNSA: Kampong Chham National School of Agriculture
MVU : Moharussey Vedic University
RUA : Royal University of Agriculture

2.1.1. Agricultural education in schools

There are no definite agricultural courses offered in the agricultural education curricula in Cambodia. Indeed, many countries in the region have already introduced agricultural teaching in the agricultural education curricula, even starting from primary schools. Incorporation of agricultural courses into the curricula of general education is thought to be very important since a great majority of the students in Cambodia, especially in rural areas, are engaged in farming after the completion of their general education. In this effect, the agricultural education will provide students with knowledge and skills in the basic agricultural sciences to enable them to be proficient and literate farmers.

2.1.2. Agricultural education at elementary and intermediate levels

The elementary and intermediate levels of agricultural education in Cambodia have been conducted by two schools of agriculture, namely Prek Leap National School of Agriculture (PLNSA) and Kampong Chham National School of Agriculture (KCNSA) . The duration of elementary and intermediate levels is 1 and 3 years, respectively.

2.1.3. Higher education in agriculture (undergraduate and graduate degrees)

Higher education in agriculture in Cambodia is offered by the Royal University of Agriculture (RUA) and Vedic Moharussey Vedic University (MVU) located in Prey Veng Province.

a. Roles of RUA in agricultural education

Undergraduate degree. The current curricula of RUA include agronomy, animal science and veterinary medicine, forestry, fisheries, agricultural technology and management, agricultural economics and rural development and agro-industry.

Graduate Degree. RUA offers a course leading to Master Degree on integrated farming system. RUA plans to offer graduate degrees in agronomy, animal sciences and veterinary medicine, computer science and natural resources management in the forthcoming academic years.

Continuing education. A wide range of short training courses have been and being organized by the University for staff of the Ministry of Agriculture, Forestry and Fisheries, agricultural extension agents, other organizations involved as well as farmers. In principle, there are two kinds of programs.

-*Degree Program*: The program has been specifically designed for those holding diploma certificates from the governmental institutions and private sectors involved.

-*Non-degree Program*. This program has been designed to offer a wide range of short training courses to government officers, and agricultural extension agents in the fields of agricultural techniques, environment, management and administration so that they can become to effectively implement their duties. Meanwhile, the University offers directly to farmers with short training courses at gathered sites and/or training centers about fundamentals of agriculture in order to improve the farmer's knowledge and agricultural technologiges such as utilization of high producing crop varieties, land use and management, pest control, identification of simple symptoms for disease control, animal feeding, economics of fruits and vegetable production, sanitation for agricultural products, processing and community organization.

b. Roles of RUA in research and development

Undeniably, effective teaching of agriculture requires more than just subject matter competence. Accordingly, it is compulsory for the University to conduct agricultural research in the region for the sake of better education as well as agricultural products improvement. To this end, research on such paramount themes as job analysis in agriculture, comparison of farmers' incomes and expenses throughout the country have been thoroughly studied by RUA in close cooperation with local and international organizations as well as consortium universities in the world.

2.2. Non-formal education (agricultural extension)

Agricultural extension is the most important non-formal education for farmers. At present, there are many agencies providing extension services including the Department of Agricultural Extension, Non-governmental Organizations (NGOs), commercial traders and input suppliers. The agricultural extension in Cambodia has recently gained more advocates from donors as there is a rapid increase in number of extension agencies. The extension activities are mainly carried out by extension workers working closely with farmers. The basic feature of extension programs is based on an efficient flow of useful information. Farmers provide extension staff with information about their farming systems and production problems, whereas the extension workers give information to the farmers on new varieties and practice that have been developed by agricultural researchers. The principal objectives of the agricultural extension are to help educate farmers in basic knowledge of agriculture so as to improve the production of rice, other crops, poultry, and other animals. The salient extension programs include integrated pest management, integrated soil management, and integrated animal disease management.

The Department of Agricultural Extension, under the aegis of Cambodia Australia Agricultural Extension Project, is the main governmental agency performing extension activities throughout the country. However, the extension activities have been carried out only in the targeted provinces due to the high ratio between extension workers and farming population.

3. Problems and issues of agricultural education

3.1. Infrastructures

Most of the agricultural institutions are still short of practical farms, laboratories and classrooms.

3.2. Equipment and teaching materials

The curricula of most of agricultural educations focus on lectures due to the lack of equipment in laboratories. Meanwhile, teaching materials have also been found to be constraints.

3.3. Staff capacity

Most of the staff and lecturers are young and have limited experience. The linkage between the theory and practice is considered to play an important role in enhancing the quality of agricultural education.

3.4. Budget allocated for institutional development

Each institution depends entirely on the governmental support because the private sector does not show any interest in investing in agricultural education. As a consequence, highly qualified manpower tends to work for the private sector because of the big gap in salaries offered by the private and public sectors.

4. Strategies for improving the agricultural education in Cambodia

Previously, the agricultural education was performed in compliance with the governmental demands for human resources. However, after the economic reform in 1990s, the agricultural education has needed to be re-designed for national and market demands. The study on job analysis in agriculture conducted by RUA has clearly shown the demands for manpower in agriculture (Table 2).

Table 2. The future demands for manpower in agriculture (2002-2007)

Qualification	Quantity	
	2002	2007
Graduate level	82	180
Undergraduate level	856	1,200
Intermediate level	1,200	900
-Elementary level	228,250	228,250
-Young farmers graduated from schools	200,000	200,000
-Model farmers	150,000	15,000
-Labors	3,250	3,250

Management, organization, communication and coordination skills, in addition to specialized skills, are also compulsory for the contribution towards the agricultural development. To achieve this goal successfully, it is imperative for all agricultural institutions to develop key strategies for betterment of agricultural education. More importantly, the curricula should be reformed in line with the conditions of soil and water in Cambodia context and the national and market demands of the country.

4.1. Curriculum development

The credit-based curricula, being more flexible, should be developed and implemented. The curricula should provide the sequential development of the knowledge required for professional practice, the development of skills in critical analysis and problem solving. Likewise, the general education curricula should be reformed by incorporating the agricultural courses. However, in doing so, it is necessary to train the agricultural education

teachers before the courses are incorporated into the curricula.

4.2. Improvement of infrastructures, equipment and teaching facilities

Infrastructures such as classrooms, experimental laboratories and stations, and research institutions should be appropriate and parallel with the demands of training/education, being at least consistent with a minimum standard. Experimental laboratories must be well equipped in order for students to have access to conduct practical and research work, thus becoming qualified researchers and extension workers. The lecturers, on the other hand, can also use the equipment to conduct basic and applied research activities in addition to their teaching activities.

4.3. Teaching staff capacity improvement

The success of agricultural education, to a greater extent, is contingent upon the quality of the lecturers/teachers. In this sense, they must be competent to effectively transfer their knowledge to students. The rapid and effective approach to improve the staff capacity is to start graduate programs in the country. Cambodia should not rely entirely on other countries to train research level manpower in agriculture. This approach not only requires less input but also helps increase the professional satisfactions and commitments of research activities to identify and solve problems facing in the country where the conditions and contexts may differ from the other developed countries. Furthermore, faculty members and students exchange programs with other international institutions should be promoted in pursuit of the academic excellence.

4.4. Enhancement of research capacities

The agricultural universities must play key roles as centers of exploration and discovery. As such, the faculty members must do research in their particular fields no matter how simple or small in scale. The research would enable them to keep pace with developments in the dynamic field of agricultural sciences and technology and to have effective teaching of agriculture. Undeniably, in doing so, adequate financial resources are required for the agricultural institutions.

5. Conclusion and recommendations

It is obvious that the development of agricultural education in Cambodia has confronted many problems, including the lack of oriented and responsive curricula, poor infrastructure, equipment and facilities, staff capacity, budget allocations. Therefore, there is an urgent need to invest in the agricultural education since it plays a key role in ensuring the implementation of the governmental policies aimed at food security and rural poverty alleviation. Although investing in agricultural education is costly and time-consuming, it has a multiplier effect if trained personnel is properly employed as extension agents, trainers/teacher, researchers, program managers, and policy makers as well as in the private sector.

Regional and International Cooperation in Higher Education: the SEAMEO SEARCA Experience

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I. Introduction

The advent of globalization brought about rapid changes in societies worldwide. Change, slow or fast, is a constant factor that characterizes the world. Diversity often accompanies change. But despite the diversities, visions and missions have provided the road map to the future of many organizations. In education, variations in terms of systems and approaches, focus, needs, priorities, and expertise among countries generally serve as bases for academic requirements and skills that human resources have to develop and acquire.

Academic institutions help shape the future development of international education through unity of purpose and direction despite geographical boundaries, and political and socio-cultural diversities. These institutions help develop human resources who will have the proper orientation and capability to adapt to the rapidly changing environment, and the flexibility to make adjustments in diverse situations. But how do academic institutions attain success in providing the needed orientation and exposure to students and faculty in order to widen their perspectives and enhance understanding of education and development at the international level? With several constraints such as limited resources and institutional capacities, low government support, and the resistance among faculty members to redirect efforts towards a more inter-disciplinary approach to teaching and research, educational institutions face the dilemma of how to globalize education.

One strategy that is now widely adopted by most institutions is the development and/or strengthening of cooperation through partnerships, strategic alliances, and consortia at the regional and international level.

The main subject of this paper is to present the experiences of the Southeast Asian Ministers of Education Organization Regional Center for Graduate Study and Research in Agriculture (SEAMEO SEARCA) in enhancing higher education in agriculture for global competitiveness through regional and international cooperation.

II. SEAMEO SEARCA: Over three decades of agricultural human resource development in Southeast Asia

The Southeast East Asian Ministers of Education Organization (SEAMEO) is a network of ministers of education that continuously responds to the challenges of global education. SEAMEO is a treaty organization founded in 1965 to promote regional cooperation in education, science, and culture. It has 10 members, namely; Brunei Darussalam, Cambodia, Indonesia, Lao People's Democratic Republic, Malaysia, Myanmar, the Philippines, Singapore, Thailand, and Vietnam. Its associate members include Australia, Canada, France, Germany, the Netherlands, and New Zealand.

The SEAMEO Regional Center for Graduate Study and Research in Agriculture (SEARCA) is one of the centers of excellence of SEAMEO established in 1966 to assist in the development of high-level professionals in agriculture in

1 Visiting Professor of the International Cooperation Center for Agricultural Education (ICCAE) , Nagoya University, Japan: November 1, 2000-January 31, 2001.

the region. For the next five years, SEARCA's vision is to be Southeast Asia's leader in sustainable agriculture. Its mission is to strengthen institutional capacity in sustainable agriculture for a food secure Southeast Asia through human resource development, research, knowledge exchange, and policy support.

Other SEAMEO centers are focused on the following areas: archaeology and fine arts (SPAFA), Thailand; tropical biology (BIOTROP), Indonesia: tropical medicine (TROPMED), Thailand; distance learning (SEAMOLEC), Indonesia; higher education (RIHED), Thailand; educational innovation and technology (INNOTECH), Philippines; language education (RELC), Singapore; vocational and technical education (VOCTECH), Brunei Darussalam; training (RETRAC), Vietnam; and science and mathematics education (RECSAM), Malaysia

Organization

SEARCA is hosted by the Philippine government on the campus of the University of the Philippines Los Banos. Operating autonomously from UPLB, SEARCA's policymaking body is the Governing Board which is composed of representatives from each of the SEAMEO member countries. The Board is responsible for approval of operational policies, strategic planning, annual evaluation, and review of the Center's programs and budget within the framework of its approved five-year development plan.

Functions

Specifically, SEARCA's functions include:

1. To promote and facilitate high-quality graduate study programs leading to the masters and doctorate degrees through collaborating institutions;
2. To provide graduate scholarships, fellowships, and/or assistantships for students from member countries;
3. To provide direction and funds for research by graduate students, faculty members, and other cooperating research workers of member countries;
4. To promote, undertake, and coordinate research programs, as instituted and supported by the Center, with special emphasis on research related to the needs and pressing problems of agriculture in the region;
5. To publish the findings of agricultural research done in the region, or other pertinent research done elsewhere;
6. To hold short-term training courses, seminars, workshops and conferences on selected agricultural problems and topics;
7. To provide advisory and consulting services to member countries, through staff visits and exchanges, seminars, and fellowships.

Funding

SEARCA derives its funding from several sources: from contributions of member and associate member countries for its human resource development programs, meetings, and seminars and conferences; from friendly governments and donor agencies interested in development work through research and other projects in Southeast Asia; from the Philippine government which is the Center's host country; and from partner institutions, collaborators and networks which provide counterpart funds to SEARCA for collaborative undertakings.

Over thirty years of regional and international cooperation

Since the beginning, SEARCA has employed the strategy of developing linkages through multilateral and bilateral agreements with agencies and institutions at the local, regional, and international level. Fund assistance came from

these agencies, and from member and associate member countries. The type of support in the past was more of an *aid* or *direct grants and donations* from friendly governments, and therefore more donor-driven. Then came a time when donors were tightening belts, and had to refocus their priorities. Funds became scarce so that SEARCA then had to look farther beyond the horizon. The Center realized that it could not keep on depending solely on donations. It has to sustain its activities and safeguard its existence to be able to achieve its mandate of assisting in the agricultural human resource development of the region, far beyond the expectations of SEAMEO. Armed with a strong will, sincere intentions, competent and dedicated staff, and a good track record, the officers implemented the one most important viable strategy: *to intensify resource generation efforts through partnerships, collaboration, cost-sharing schemes, and developing networks*. Funding for projects then slowly graduated into more of counterpart-type. Here, a more participatory approach is done during project design, activity-based allocation of resources, and shared responsibility in project implementation and monitoring among partners and stakeholders.

Through thick and thin, SEARCA had withstood the test of time. At present, SEARCA takes pride of its over thirty fruitful years of service to the Southeast Asian region. SEARCA's main strength is in human resource development.

SEARCA's human resource development mandate is primarily carried out by its graduate education and training programs. Initiated in academic year 1968-69, the Graduate Education Program of SEARCA provides scholarships to qualified nationals of SEAMEO member countries to pursue advanced studies leading to the MS and PhD degrees in agriculture, forestry, and related fields. Through the scholarships, SEARCA seeks to prepare the grantees for positions of leadership in their respective countries. So far, it has produced 810 masters and doctorate degree fellows who now continuously show a high 'return-on-investment' manifested through their contributions to development work in their respective areas of work. A number of these fellows (12.75%) now occupy top positions in government, positions that help influence policies and reforms. Majority (58.35%) of the fellows are occupying teaching, research, and extension positions; 18.31% are handling supervisory administrative and technical positions, while 1.08% remain in the administrative positions in government agencies. A few (9.52%) are in consulting firms and occupying middle to top management positions in private companies in Asia, the US, Canada, and Australia.

Aside from the graduate fellows, the Center has produced 11,000 training alumni in Asia. These training alumni are now tapped by the Center to take the lead in in-country trainings within and outside Southeast Asia thereby implementing a multiplier effect.

In research and development, SEARCA has moved from the more basic and production-oriented type of research to a more downstream and applied one. SEARCA's R&D program has coordinated and facilitated the conduct of over 100 research projects in selected pilot sites in Southeast Asia. Results of researches have been disseminated through the Center publications for use by agricultural colleges and universities, local government agencies, and information centers.

But despite the track record of SEARCA, the regional financial crisis, and questions on quality and relevance continued to pose a challenge to its existence. SEARCA has to strategically position itself in order to align its thrusts not only to the needs of the region but also to partner with other agencies with similar thrusts for complementation of activities and maximization of available resources. A refocusing needed to be done during the strategic planning stage for its next five-year plan. To do that, SEARCA has to do an environmental scanning of the trends, needs, issues/concerns, challenges and opportunities in agricultural education and research upon which the focus of regional or international cooperation should be anchored.

III. Issues and trends in agricultural higher education and research

The continuing importance of agriculture has been emphasized in many reports and scientific fora. Issues on food security, sustainability in food production, poverty alleviation, nutrition and health, point to the significance of agriculture development as one of the major foci and agenda for support. Thus, with it comes the need to enhance agricultural education and research in order to respond to the increasing agricultural requirements of the region and the world.

The proliferation of agricultural education institutions in some countries in Southeast Asia was attributed to the emphasis on agricultural prosperity in the 1970s and 80s. Table 1 shows the number of tertiary institutions in agriculture existing throughout Southeast Asia.

Table 1. Agricultural tertiary institutions in Southeast Asia.

Country	Number of institutions
Brunei Darussalam	1
Cambodia	1
Indonesia	28
Lao Peoples Democratic Republic	1
Malaysia	1
Myanmar	1
Philippines	≥50
Singapore	nd
Thailand	13
Vietnam	4

The development of human resources through education and training has always been recognized as critical to economic growth. But is the world producing the right human resources to assist in economic growth? This question remains to be the major concern of agricultural higher education and training institutions.

The role of agricultural colleges and universities

It should be recognized that agricultural education is not only the responsibility of traditional learning institutions such as universities, colleges, and agricultural training institutes, but also the people's organizations, and informal community structures and workgroups that facilitate information exchange. People involved in agricultural education includes not only the educators, researchers, and extension workers, but also the whole farm household, in which each member has a direct or indirect role and share in agricultural development.

Agricultural education institutions submit to the trilogy of functions, i.e, teaching, research, and extension. In the past, these institutions espouse the production-orientation in agriculture, and practice the compartmentalized, single discipline studies. Nowadays, the dimensions of teaching, research and extension in agriculture have to be suited to the changing needs of the times in the light of the quest for agricultural modernization and globalization. Table 2 presents the evolving roles of agricultural education institutions in Asia as gathered by Sung (1996) in Fellizar (1999).

Trends

The current trend in agricultural education is geared towards modernizing agriculture. Agricultural colleges and universities now tend to build on partnerships, consortia and information networking to enhance education and

research programs. The use of information and communication technology (ICT) has rendered information virtually available at one's fingertips. It has provided opportunities for greater access to education to a wider group of clientele across the globe through distance education.

Universities across Southeast Asia have made strides towards modernizing agriculture and seizing opportunities to compete globally.

In Vietnam, for example, the government has started to merge small universities and colleges into a few, strongly focused, western-modeled universities. Although higher education institutions are still under the direct control of the Ministry of Education and Training, heads of universities and academic departments have been given increased autonomy in managing their internal affairs. Foreign education is being encouraged to further equip the country to respond to a market-oriented economy. Agricultural education is geared towards agroindustrialization and natural resources conservation. Vietnam is changing and developing rapidly, and activities to enhance higher education are continuously intensified.

Table 2. Newly evolved roles of agricultural education institutions in Asia (after Sung 1996 in Fellizar 1999).

Areas	Traditional Roles	Newly evolved roles
Extension and Policy	• Diffusion of agricultural technologies and information to increase agricultural productivity among farmers • Provision of technical advice to farmers	• Diffusion of agricultural technologies and information on land use, environment, and natural resources management • Provision of technical advice to farmers and policy makers • Agricultural services (credit, marketing, etc) and empowering informal community structures
Research	• Development of technologies to increase agricultural productivity • Compartmentalized research or single discipline studies • Focus on traditional crops and lowland ecosystem • Livestock production	• Sustainability of crop production • Organic farming and sustainable agriculture • Development and introduction of soil and water conservation technologies • Integrated Pest Management • Environmental Pollution • Agro-industrialization • Biotechnology • Ecosystem-based research in a landscape continuum • Integration of livestock production in farming systems • Environmental protection and protected area management • Environmental impact assessment • Food security • Multi-and inter-disciplinary approach in research

Table 2. (continued)

Education/training	• Providing good quality agriculture education	• Providing good quality agricultural education by developing responsive issue and demand-driven agriculture curricula for teaching and training • Developing innovative tools and methodologies to provide incentives to agriculture professionals • Networking among educational institutions

In Cambodia, a National Higher Education Task Force was established in 1995 to formulate a National Action Plan for higher education designed for the unique needs and conditions of Cambodia. The following objectives were identified to characterize the higher education system of Cambodia: a) development of human resources; b) contribution to national development; c) quality of output; d) efficiency of operation. Among the priorities identified by the Committee are: a) the development of a plan at the institutional level for the professional training for academic staff for higher degrees, short term-training, and continuing education; and b) to train new academic staff via the development of graduate degree programs in selected disciplines in collaboration with regional and international scientific communities. The Institute of Agricultural Technology, now known as Royal University of Agriculture, after it has been renamed in1994, is the only agricultural university in Cambodia and is now engaged in the re-establishment or re-engineering of its agriculture programs. It, therefore, needs assistance in terms of curriculum development of specific disciplines both at the undergraduate and graduate level, and development of more responsive research and training programs.

In Lao Peoples Democratic Republic, the national government has adopted a national education policy towards increasing the education system's ability to provide the skilled work force at all levels needed to be able to meet the demands of a free market economy. Major issues confronting higher education in Lao PDR include: a) shortage of tertiary-level human resources; b) lack of capacity to plan and develop curricula responding to the needs of society; c) low quality of higher education because of program inadequacy; d) poor teaching and research facilities; and e) under-qualified teaching staff. Problems related to agriculture and forestry include: drought and flood which reduce rice paddy production; slash-and-burn or shifting agricultural cultivation; a vast potential of natural resources remain unexploited because of lack of resources and technical expertise. The government's strategies include the following: a) establishment of an agro-forestry structure linked to industry and services; b) promotion of market economy; c) integration of rural development to improve living conditions of rural and ethnic people; and d) improving the economic management mechanism in the government to increase favorable conditions to the market economy. The National University of Lao PDR, a merger of eight faculties, including the Faculty of Agriculture and Forestry, needs assistance from external agencies in terms of funds and experts to address the major issues mentioned.

In Myanmar, the Yezin Agricultural University (YAU) underwent many changes from 1924 to 1999, which affected the structure of the course curricula. The Myanmar government is currently engaged in joint venture projects with foreign agencies to protect, conserve and improve the environmental conditions in the country. This includes human resource development activities to produce people trained to do and teach specific disciplines. The YAU needs

assistance in curriculum development to improve the present agriculture curriculum to include the latest developments in the agriculture science and make it attuned to the needs of the present times. Such subjects as GIS, remote sensing, and use of IT in agriculture need to be included in the curricula. There is also a need to strengthen the IT facilities in the university. Continuing education or training is very badly needed.

In Indonesia, three strategic programs have been formulated to carry out the mission of higher education: 1) higher education management programs; 2) programs for increasing quality and relevance of higher education; 3) programs for equity. Three areas of action have been identified to accelerate Indonesia's contribution to agricultural development in the region: 1) active involvement of educational institutions in human resource development; 2) active involvement in research programs with emphasis on policy recommendations; and 3) intensification of partnership and cooperation, and increased involvement in development processes.

In Malaysia, the demand for distance learning by nontraditional students and agricultural practitioners, who could not leave their workplaces for long periods of time to attend formal courses, is increasing. Universiti Putra Malaysia (UPM) has responded to this through a wide application of information technology in agricultural education and bioindustrial services. Its Institute of Distance Education and Learning (IDEAL) offers courses at a distance. Incubator IT farms and the MultiMedia Corridor, a joint venture between UPM and the industry, are now in place on campus to serve as practical IT laboratories for students. The agriculture curricula are designed to produce graduates who shall espouse the philosophy of sustainable agriculture; are well-versed in precision agriculture; competent in economics and business to be able to compete globally; possess the necessary communication and interpersonal skills; competent in the field of molecular biology and biochemistry; and must possess problem-solving and critical thinking skills.

In Thailand, higher education programs are integrated into the long-term national education development plans. The recent national development plan takes a more aggressive and dynamic approach in responding to global environmental concerns. Education programs particularly in the tertiary level have put more premiums on curriculum development towards more relevant programs that meet modern demands. At present, Kasetsart University and Chiang Mai University are taking the lead in the development of sustainable agriculture curricula at the undergraduate and graduate level. The Open University system introducing more courses at a distance is being enhanced.

In the Philippines, initiatives to develop the agriculture sector include: 1) development of highly-trained manpower in agriculture; 2) strengthening regional state colleges and universities and providing them fiscal autonomy; 3) rationalizing agricultural education system. The Agriculture and Fisheries Modernization Act (AFMA) of 1997 mandated the establishment of a National Agriculture and Fisheries Education System (NAFES) aimed at unifying, coordinating and improving academic programs in agriculture and fisheries, upgrading the quality, ensuring sustainability, and promoting global competitiveness at all levels of agriculture and fisheries education.

Issues

In the process of scanning the environment for agricultural education, several issues common to agricultural universities in Southeast Asia emerged. These are:

1. Inability of many agriculture practitioners to attend formal courses in agricultural education institutions. This points out to the need to enhance distance education and application of IT to access agricultural education.
2. Lack of documentation on innovative tools and replicable extension methodologies to respond to the educational needs of agricultural stakeholders (farmers, fishers, forest dwellers, rural communities, etc.)
3. Slow rate of professional advancement. This is attributed to inadequate funding for fellowships, postdoctoral studies, and the too bureaucratic traditional promotion procedures that continue to delay the advancement of young scientists, researchers and academicians within the universities. The attractive compensation package offered by private and international firms, and the wide array of opportunities outside one's country result to brain drain.
4. Education and employment misfit. This usually happens when education fails to address or respond to the emerging concerns and needs of the different sectors, as well as opportunities available at different levels. Many educational institutions tend to concentrate on the supply of manpower for a particular field without really looking at the demand for that field.
5. Inadequate funding for academic and research activities. Many agricultural higher education institutions in developing countries lack the financial support to conduct full-blown researches and run training programs.
6. There is a need for universities to forge alliances with other universities and agencies, that are engaged in agricultural education, research and development in order to share information, pool resources, and strategically position themselves as a strong driving force for development in the region.

IV. Sharpening SEARCA's focus

Given the above scenario, the challenges of agriculture in the region become much more complicated. There is a need to develop and extend more efficient and sustainable production technologies to meet the growing demand for food and other agricultural products without damaging the long-term production potential of the resource base. The development of agriculture professionals who shall be responsible for planning, policy formulation, and decision-making for agricultural development will continue to be an important undertaking. But then again, the question is, 'how could SEARCA respond to the challenges, take advantage of opportunities, and achieve its mission with limited resources?'

SEARCA's Seventh Five-Year Plan covering the period 1999 to 2004 called for a sharper focus in its institutional development efforts. This was done by concentrating resources on areas that will provide the greatest impact on sustainable agriculture development in the region, and to non-SEAMEO member countries. This required the center to be more efficient and creative in its search for alternative funding mechanisms and sources. It must operate in a setting of strong collaborative relationships with donors and partners in the region and beyond for joint programming and funding. It must look at innovative models for its various programs to attract new and keep past clients and donors. It must strengthen its internal resources generation efforts for greater flexibility in setting and pursuing its priorities and ensuring sustainability of its programs. Finally, it must be able to leverage its greatest assets, i.e., its own human resources and those that comprise its most valuable network--- the SEARCA fellows, alumni and the SEAMEO and University Consortium partners.

SEARCA has identified the priority areas, which fall under the five Consortium-identified broad themes of rehabilitation of degraded resource systems, food and agriculture policy, environment-friendly agriculture, coastal resource management, and agro-industry/agribusiness. These themes which will serve as the bedrock of SEARCA's

programs and activities are as follows: 1) food security; 2) biotechnology (risk assessment and management, ethical and policy implications of bio-safety standards set by governments); 3) water resource management; 4) biodiversity conservation; 5) environmental risk management, 6) cross cutting concerns such as gender, policy support, and sustainable agriculture indicators.

Twinning as a human resource development strategy is being adopted through a project called Project SHARE, which is in the process of implementation for Indochina countries. The project involves the assistance to selected agricultural universities in Cambodia, Lao PDR, Myanmar and Vietnam in the improvement of teaching, research, and extension capabilities and make their programs competitive at the regional and eventually at the international level. It will involve inter-institutional partnership where there is shared goal setting, decision-making, implementation and evaluation. Aside from sharing its resources, SEARCA will serve as coordinator and broker between and among participating universities. SEARCA will utilize its pool of experts and contacts from Southeast Asia, Australia, Canada, and other countries in Asia, Europe and United States. Members of SEARCA's University Consortium shall be involved in this project. SEARCA is now looking for additional partners and funding collaborators in this activity. Specific programs and activities per university and per country will be discussed and firmed up as soon as partners and collaborators are identified and memoranda of agreement are in place.

SEARCA is also pushing for the implementation of Project LINK, also focusing on Indochina countries, to promote the research-extension-farmer linkage in agriculture. This project will also involve partners among stakeholders and interested funding agencies.

Another major initiative of SEARCA is assistance to agricultural colleges and universities in the development of a curriculum geared towards sustainable agriculture in the region. This activity is ongoing at the national and regional levels. SEARCA is now facilitating the establishment of a network of sustainable agriculture centers for Indochina.

V. Enhancing cooperation

For SEARCA, enhancing cooperation in agricultural higher education at the regional and international levels would entail efforts to attract new partners while maintaining close contacts with past donors, partners and clients for new initiatives and opportunities.

SEARCA is aware that cooperation through partnerships, linkages and consortia should start in one's own institution before it could successfully be applied at different levels. The following highlights such experience at the institutional, national, regional and international levels:

* Institutional

Inter-unit collaboration was institutionalized among the Human Resource Development (HRD) (composed of the Graduate Education and Institutional Development (GEID) and Training Programs), the R& D, Publications, and Consulting Services at SEARCA to ensure better effectiveness of program implementation, complementation, synergy and optimum use of resources. This arrangement enables the Center to render more comprehensive and holistic outputs. Thesis topics of scholars coordinated by the HRD group are focused on R&D priority themes and therefore aligning these to SEARCA's thrusts. This will give the scholars the priority to be attached to any of SEARCA's ongoing research projects. Needs for enhancement courses for scholars are relayed to Training Unit for designing of tailor-made training courses that could be open to scholars and outsiders. The pool of experts in HRD's database, which is composed mostly of University Consortium experts and SEARCA fellows is also tapped by

R&D for their experts needs. Results of students' theses researches and faculty fellowships/professorial chairs are then submitted to SEARCA's Publications Unit.

New programs developed at either the HRD and R&D Units are fed into the Consulting Services Group for promotion and marketing. The Group also has a pool of experts that cater to outside clients. Information gathered by the Group on prospective projects at the national, regional and international levels that may be handled by SEARCA are immediately relayed to the Program Units for proposal development. In addition, each of the Program Units is required to market and promote SEARCA's programs and activities.

The GEID Unit, which handles the networking and linkage activities, serves as the main contact point of the Consortium, the fellows, and other academic networks.

* National

SEARCA's mandate cannot be carried out efficiently without the cooperation of its target beneficiaries, stakeholders and partners at the national level. These include bilateral arrangements with the local communities, universities, government agencies, research institutions, the industry, private sector, and NGOs per country. In the Philippines, for example, SEARCA developed alliances with the Association of Colleges of Agriculture in the Philippines (ACAP), the government agencies such as the Philippine Commission on Higher Education; Department of Agriculture, Department of Environment and Natural Resources, Department of Science and Technology, farmers organizations, and the Philippine Council for Agriculture, Forestry and Natural Resources Research and Development (PCARRD) with its network of National Agriculture Research Systems (NARS) for Philippine projects.

In Indonesia, the following partners collaborate in human resource development activities for nationals of Indonesia, namely: The Directorate General of Higher Education of the Department of Higher Education, Ministry of Education and Culture; the Ministry of Forestry and Estate (MOFE); Rubber Plantation Research Institute, Agency for Agricultural Research and Development (AARD) and selected agricultural universities.

This type of cooperation is also done for other countries.

* Regional

SEAMEO Network

This is an example of an inter-organization type of cooperation. The network of Ministries of Education gives SEARCA the most advantage especially at the policy level. SEARCA is always represented in annual meetings at different levels where policies are formulated, strategies are reviewed, and plans, programs, and budgets are approved. These meetings are the SEAMEO Council Meeting, the High Officials Meeting, and the Center Directors Meeting. The network of SEAMEO Centers also provides opportunities to SEARCA to learn about other initiatives in education and research and to develop collaborative undertakings.

University Consortium

This is an example of an inter-university type of cooperation but managed by a central coordinating body which is not a university. SEARCA serves as partner and coordinator of the Southeast Asian

University Consortium for Graduate Education in Agriculture and Natural Resources. The University Consortium (UC), initiated and established by SEARCA in 1989, is a commitment made by leading Southeast Asian education institutions to share academic expertise and resources and serve as a primary vehicle for delivering high quality graduate degree programs in agriculture and natural resources necessary to ensure the development of topnotch graduates in the region to make them globally competitive.

The five founding members of the UC are: Institut Pertanian Bogor (IPB) in Bogor and Universitas Gadjah Mada (UGM) in Yogyakarta, both in Indonesia; Kasetsart University (KU), Thailand; Universiti Pertanian Malaysia (now Universiti Putra Malaysia, UPM), Malaysia; and the University of the Philippines Los Banos (UPLB), Philippines. In 1992, the University of British Columbia (UBC) in Canada and in 1993, the University of Queensland (UQ) in Australia, became the University Consortium's associate members. Applications for associate membership were received from the University of Göttingen in Germany, and Nagoya University in Japan. These applications are currently being evaluated by the Consortium Board.To sustain the activities of the UC, members pay an annual membership fee. SEARCA being a partner and coordinator, contributes an amount equivalent to 100 % of the total fees from members. SEARCA serves as the Secretariat of the UC.

The following subnetworks of the University Consortium shall soon be set up in the region: gender subnetwork; policy studies subnetwork, and the acid soils management subnetwork.

Asian Association of Agricultural Colleges and Universities (AAACU)

One big network that has been in existence since 1972 is the AAACU, an association of agricultural colleges and universities in Asia whose main mission is to improve human welfare through agriculture education, research and extension. This is another example of an inter-university cooperation but coordinated by a non-university organization. SEARCA, being an affiliate member of this network, collaborates with AAACU by providing counterpart funds and participating in the implementation of its activities, by providing office space and managing its Secretariat, and by helping in the sourcing of project funds. Operational funds of AAACU come from the annual membership fees.

There are 48 regular and 4 affiliate members of AAACU composed of agricultural institutions and research agencies in Bangladesh, Guam, India, Indonesia, Iran, Korea, Japan, Malaysia, Nepal, Pakistan, the Philippines, Saudi Arabia, Taiwan, Thailand, Turkey, and Vietnam.

Within the AAACU itself are networks of universities which are also members such as the Indian Agricultural Universities Association (IAUA) and the ACAP of the Philippines.SEARCA hopes to tap AAACU members also for its Projects SHARE and LINK.

Regional SEARCA Fellows Association (RSFA)

This is an example of cooperation among individuals where membership is based on individual interest to serve and not on the interest of the institution where the individual is employed. This association, formed in 1992, is a very potent regional organization for strategic alliances, with sub-chapters existing in almost all SEAMEO member countries. The association comprises of SEARCA graduate fellows and training alumni. The SEARCA fellows and alumni are now being tapped for collaborative in-country projects. SEARCA believes that because of the commitment of these fellows

borne out of their sense of loyalty and gratitude to SEARCA and their benefactors, chances of success in collaborative undertakings are high and eventually create a stronger impact of SEARCA's HRD within and outside the region.

Country chapters include the Thai SEARCA Fellows Association (TSFA); the Indonesian SEARCA Fellows Association (ISFA) Bogor and Yogyakarta chapters; Vietnam SEARCA Fellows Association (VISA), the Malaysian SEARCA Fellows Association (MASFA); and the SEARCA Fellows Association of the Philippines (SFAP). The formation of the Cambodian SEARCA Fellows Association (CASFA); the Brunei SEARCA Fellows Association, and the Lao SEARCA Fellows Association are in the offing.

Several projects at the country and regional level have been implemented by the associations in collaboration with SEARCA. A big project involving the regional SEARCA fellows is the Regional Volunteer Experts for Agricultural Modernization (REVEAM), which is funded by the ASEAN Foundation, Inc. and has attracted the World Bank for a possible partnership in research and extension. The project is anchored on the spirit of voluntarism and intends to showcase the impact of SEARCA's human resource development through the volunteer expert services of its fellows.

Southeast Asian Network for Agricultural Extension (SEANAE)

This is a network of institutions interested in promoting agricultural extension work in the region. This network was initiated in 1997 by SEARCA and the Centre National d' Etudes Agronomiques de Regions des Chaudes (CNEARC), a French organization. The network has initiated in-country activities and meetings. SEARCA's Training Unit is currently coordinating its activities. The SEANAE Newsletter provides the vehicle for information dissemination.

* International

SEARCA's activities are not intended to be myopic in scope and reach as it aims not only to be recognized internationally but mainly to make its programs and products (especially the human resources) globally competitive. It has to look far beyond the horizon for opportunities to tap international partners who have keen interest in the development of Southeast Asia and input international perspectives into its regional programs. The following are SEARCA's present and past partners and collaborators: ASEAN Foundation; International Rice Research Institute (IRRI); International Development Research Center of Canada (IDRC), Canadian International Development Agency (CIDA); ASEAN-Canada; German Academic Exchange Service (DAAD); GTZ; CNEARC; International Center for Agro-Forestry (ICRAF); International Center for Land and Aquatic Resources Management (ICLARM); International Potato Center (CIP); International Plant Genetic Resources Institute (IPGRI); Food and Agriculture Organization (FAO) of the United Nations; United Nations Educational, Scientific, and Cultural Organization (UNESCO); Asian Development Bank (ADB); World Bank- Economic Development Institute; ISNAR; Winrock International; University of Göttingen-Center for Tropical and Subtropical Agriculture and Forestry (CeTSAF), Germany; University of Bonn; University of Newcastle-Upon-Tyne International Center for Sustainable Agriculture; United Nations Development Program (UNDP); International Institute for Rural Reconstruction (IIRR); and the Australian International Development Assistance Bureau (AIDAB).

The above agencies collaborate with SEARCA on its graduate scholarship, research and training projects. A new project intended to serve a wide group of clientele at the international level is the UC's Distributed Learning Project. This involves the multi-campus offering of the Master of Science in Sustainable Resource Management on distributed learning scheme using mixed mode of approaches: on-line, face-to-face, at a distance, on campus. The following participating universities contribute courses to the program: University of British Columbia, Canada; University of Queensland, Australia; and Universiti Putra Malaysia. The university where the student takes majority of the courses will confer the degree. SEARCA issues an international certificate to the student upon completion. The project has been launched in November and the information on the program is now on the Web. SEARCA is currently also looking for partners to fund scholarships for DL students, course development and training of tutors for this project.

VI. Lessons

From SEARCA's experience in the establishment, management, and coordination of networks and partnerships, several lessons can be gleaned to show why people or institutions succeed or fail in cooperation work. It must be realized, however, that there is no perfect recipe for cooperation work, and that one can only apply various modalities that suit best the situation and the intentions. But there are critical elements that should be observed as anyone ventures into the realm of networking and partnerships.

One of SEARCA's success stories is the University Consortium, which is recognized as one of the best contributions to agricultural graduate education in the region. The following critical elements make the UC network succeed in achieving its goals:

First, the UC has ***clearly defined the problem*** that it needs to address and has stated this as the guiding principle and mission in setting up the Network.

Second, the UC ***objectives are clear***, as manifested by the identification of components of the Program on student and faculty exchange, research fellowship, professonal chair, and thesis grants, which generally seeks to improve the quality and relevance of graduate education in the region.

Third, it must have sustainable ***activities***. The network remains to be a network in name only if it does not have any work. Since it has expanded its activities from the regular components of exchange programs, fellowships, professonal chairs and scholarship grants to projects such as distributed learning, summer course in sustainable agriculture for credit; specialized training courses on topics identified by the UC; international forum on policy research, and gender related issues.

Fourth, although there are differences in terms of systems and resources available at each university, each one adheres to the principle of ***reciprocity***, where one contributes to the other's welfare, and with knowledge and resources flowing in both directions. The members, therefore, perceive ***mutual benefits derived from the network*** such as strengthening of graduate students and faculty through exchange programs; establishment of broad equivalency of admission standards for graduate programs among member universities; development of cooperative programs in instruction, research, and extension; and information exchange.

Fifth, the UC is composed of ***interested and committed individuals and institutions with complementary expertise, technology, and resources***. The members of the network constitute its main body. Being the ones who committed to contribute to the network to achieve a purpose, the members themselves are immersed in the works and are expected to

harvest the benefits of the collaboration. Therefore, the members should be those that have the capacity to contribute and provide unique experiences to the other members. The members of the UC have complementary expertise and resources. Programs of strengths have been identified so that students and faculty members of a particular member university could avail of the strengths and abundance of resources in another member university. The academic and research expertise at UBC and UQ offers an international perspective to the regional universities.

Sixth, it has ***a very good management and coordination system*** that effectively facilitates communication, information dissemination and implementation of the programs and activities with the presence of a strong Secretariat at SEARCA as the central coordinating body, that facilitates the meetings, manages the activities, and takes charge of publishing the brochures and the UC Newsletter. Added to this is the existence of the UC Coordinators who serve as the main contact persons at each member university.

Seventh, the UC ***has the physical, financial, and manpower resources*** to sustain its activities and operations for a period of time with the presence of Consortium Coordinating Offices, the staff of each office, and the establishment of the Consortium funding scheme.

Eighth, the UC ***follows a planning and problem-framing process*** through its series of meetings at different levels. . The steering group is The Board composed of the Consortium Chief Executives and Executive Officers who give directions on programs and activities.

Ninth, the ***selection of new Network members is governed by a set of criteria*** developed by the UC members themselves. A few years after its establishment, the UC has attracted many educational institutions in other parts of the world to become associate members so that the UC had to come up with a set of criteria for regular and associate membership. The criteria covers aspects like strength in programs, faculty and facilities, willingness to share resources and funds, and keen interest in the development of Southeast Asia.

In addition to the above elements as manifested in the UC example, there are **important factors** that need to be considered in regional and international cooperation in higher education as follows:

1. The strategic plans of universities should be developed with the participation of stakeholders. The plan then serves as the stakeholders' guide in supporting the universities. The plan should include the mission statement of the university, the strategy or strategies to be employed; and a three to five-year operational plan, which should clearly define the roles and responsibilities of the various stakeholders.
2. The need to look at course equivalencies in academic programs offered at participating universities to be able to arrive at a consensus for certain requirements without sacrificing standards and quality in order to effect a successful exchange program.
3. The need to institutionalize a standard monitoring and evaluation system to be used by the network to regularly assess performance and impacts.
4. People involved in cooperation work should have good interpersonal skills to be able to create an atmosphere of friendliness and goodwill among partners and prospective collaborators.
5. The need to know potential partners or collaborators in terms of structure, functions, thrusts, and priorities.
6. The need to exercise diplomacy in dealing with people. Establishing relationships most often touches sensitivities (political underpinnings, socio-cultural issues, bureaucratic processes, etc.). One must be careful not to destroy diplomatic relations between institutions and between countries.
7. Cooperation work should be anchored on mutual trust.

VII. Prospects

The prospects are high for the advancement of higher education in agriculture at the national, regional and international levels through enhanced cooperation not only because it is the trend, but because it is the most viable strategy and approach to internationalizing education, and to address the never-ending question posed to higher education institutions: that of ***sustainability*** and ***increased relevance***.

Despite the varying stages of development in developing countries which make the implementation of cooperative programs and projects not only difficult but also exciting and challenging, a cooperating institution can make adjustments by assessing each country and categorizing the levels of development first, before determining the type and the kind of cooperative work to implement, and choosing the agency or institution to partner with. There are countries at the forefront of modernization and development, employing high-tech strategies and gradually even moving away from the conventional agricultural concerns. On the other hand, there are countries with more basic agricultural concerns and with still developing educational capabilities. For the former, the cooperating institutions will have to employ a more upstream strategy such as implementing biotechnology and geographic information systems (GIS) projects; and for the latter, the focus of activities may have to be on capability improvement and institutional capacity-building (Villareal 1999).

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Development of Effective Training Program for the Specialists of Developing Countries in Wood Science

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CONTENTS

1. Visiting Professor of International Cooperation Center for Agricultural Education (ICCAE), Nagoya University, Japan: April 20 - July 19, 2001

FOREWORD

This treatise serves as a document prepared by the author as a Visiting Fellow during the period 20 April - 19 July 2001 at the instance of the International Cooperation Centre for Agriculture Education (ICCAE), Nagoya University. The theme of the visiting programme is "Developing effective training programme for the specialists of developing countries in the field of wood science and technology". The document was prepared, in line with the rationale of ICCAE, presenting briefly the scenario of forestry education in the Asia Pacific Region in general and the Indian situation of forestry/wood science in particular appending with available information on course curricula.

The International Cooperation Center for Agricultural Education (ICCAE) was established in 1991 with the generous support from Nagoya University, the Ministry of Education, Science, Sports and Culture (Monbusho), the UN Centre for Regional Development, Japan International Cooperation Agency (JICA) and the Aichi Prefectural government. As the theme is to focus on developing training programme in wood science, the concerned lead/core institutions and the availability of human resources are indicated in the Appendix to facilitate the future networking. As the attempt was made based on the readily available sources within a relatively short period, it is not necessarily exhaustive and complete. This should be updated as and when more information is forthcoming.

The rationale of ICCAE includes:

- There is a large demand for international cooperation in the field of agricultural education in the context of increasing poverty, food shortage and environmental devastation in many developing countries.
- Develop human resources and create a new strategic science, by unifying the intellectual power, for developing a long-term plan for building a database for researchers and for developing various networks among agricultural schools in Japan.
- It will serve as the international center for developing human resources through agricultural education with the continued support and cooperation received from various national and international organizations.

I take this opportunity to sincerely thank Professor Hiroyuki Takeya, Director of ICCAE for inviting me, as a visiting fellow, to participate in this challenging programme that also provided me a window to look into the Japanese culture. Particular gratitude is expressed to the staff of ICCAE, particularly Professor Katsuhiro Kitagawa, Professor Tetsuo Matsumoto, Associate Professors Mutsuyo Kadohira and Yutaka Takeda who, with their traditional Japanese hospitality, not only made me to "feel at home" but also provided various opportunities for closer interactions and for looking deeper into the values of the rich cultural heritage of Japan. I am also deeply indebted to my long-associated colleagues: Professor Takashi Okuyama, Hiroyuki Yamamoto, Associate Professor and MasatoYoshida, Assistant Professor of Biomaterial Physics Laboratory, Graduate School of Agricultural Sciences for extending generous study facilities, scientific interactions and close cooperation throughout my stay in Nagoya for making visit very fruitful and memorable. At last but not least, my sincere thanks are due to Ms. Kyoko Kato, Ms. Emiko Kawamura, Ms. Ikawa and Dr. Daigo Makihara for helping me in various ways to feel comfortable. I am also indebted to Dr. J. K. Sharma, Director, Kerala Forest Research Institute India for granting me leave to complete this assignment.

July 2001

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EXECUTIVE SUMMARY

Lack of adequate training is recognized as one of the major causes of mismatch of the technology with the real needs of end-user communities particularly in rural areas of many developing countries. While attempting to develop an effective training programme for specialists of developing countries in the field of wood technology, the scenario of forestry education was briefly reviewed in the Asian Region in general and Indian situation of forestry/wood science in particular.

Existing system of forestry education

The brief review of forestry education in developing countries of Asian Region reveals that inadequacy of staff strength is a constraint in countries like India and Pakistan. However, staffing pattern was noted to be adequate and often superfluous causing managerial problems in some countries, viz. China, Indonesia, Malaysia and Philippines. The short-term courses being offered in the region include: computer application in forestry, quarantine training, landscape gardening, satellite remote sensing and aerial photo interpretation, resource and environmental conservation, forestry planning, agroforestry, watershed and wildlife management, forest products engineering, timber identification, social forestry and forestry extension. Variability of forestry education curricula in the region is often so wide that there is a need to standardize the professional forestry courses to achieve a degree of comparability and commonality. Unlike many other countries, in India the forest education in higher level was under the control of Government of India while in lower levels State Governments managed the schools.

The major problems identified in the existing system are given below:

- Inadequacy of funds and staff with suitable educational background/qualifications remains as a major constraint to forestry development in India both in the context of new plantation establishment and resource management.
- Due to the fact that major part of forests has state ownership, education and training programmes are limited to the personnel of the Forest Departments.
- A large number of trained personnel is required for development of a large scale forestry sector in vast country like India.
- Non-recognition of the potential of non-wood forest products in the existing curricula of education and training.

Although some of the recommendations of Indian National Agriculture Commission (1976) are being implemented with wider education courses in agricultural universities, some of the problems afflicting the developing countries are encountered in India, on varying levels of severity in inadequacies of institutions, technological weakness, insufficiency of investment funds, lack of meaningful participation of the people and so on.

The possible solutions and new strategies include:

- Forest research development funds be created by tapping the resources of various financial institutions for meeting the needs of research and education
- Central, regional and the state level research/education organizations be strengthened according to the recommendations of the National Commission on Agriculture (1976)
- The courses at the existing management institutes including Indian Institute of Forest Management should be

availed to increase managerial efficiency

- Suitable courses for continuing education and training of the serving forestry/research personnel should be evolved by various institutions including Indian FRI and Colleges

Aspects to be considered in developing effective training programme

For the problems of Southeast Asia, a newly designed programme should work in the context of "sustainable development in an environmentally sound, economically viable and socially acceptable way".

- Although utilization of trees and forests is inherent aspect of forestry, tourism, recreation, non-wood forest products (NWFPs), water and wood production aspects in the context of sustenance should be considered.
- While obtaining the graduate/postgraduate qualifications in the universities, the degree courses should include sections on the design, scientific conduct of research, monitoring and evaluation of research.
- Role of Regional Networks should be realized and implemented, comprising industry linkages and inter-disciplinary and inter-institutional collaborations.
- It should be multidisciplinary in nature including genetics and biotechnology, resource mensuration, biodiversity and sustainable management, appropriate silviculture, harvesting, economics and resources evaluation and social sciences.
- There is a tremendous need for research into all aspects of technology entailed in the utilization of NWFPs.

Model Training Network

While proposing a model training network in the field of wood science and technology for developing countries, an Indo-Japanese bilateral training programme is illustrated as a case example, particularly for establishing the training consortium by the ICCAE. In doing so, lessons drawn from the success stories of two regional networks, viz. FORSPA (Forest Research Support Program for Asia Pacific) and INBAR (International Network for Bamboo and Rattan) are highlighted. Also documented are the potential lead/core institutes of Japan and several developing countries indicating the availability of human resources in the field of wood science and technology to build partnerships and facilitate the establishment of effective training network by ICCAE.

Mission of ICCAE - Training network

The proposed model training network of ICCAE in wood science shall foresee:

- Building country capacity in training and technology transfer and enhancing the technical capabilities of rural communities, farmers, forest resource managers and small-scale forest-based industrialists in responding effectively to the changing social, economic and environmental needs.
- Assisting in building capacity in national institutes through training program planning, human resource development, increasing access to information, and facilitating technology transfer and adaptation.
- Developing training networks which lead to greater collaboration among the institutions within and between the countries.
- Providing technical and managerial support for networking, organization of meetings and seminars, development of databases, and publishing of newsletter, case studies and monographs.
- Initiating problem-oriented training programmes of regional and local importance.
- Assisting in twinning arrangements to promote inter-institutional collaboration, sharing of knowledge, and transfer of know-how and technology.

Chapter 1

Forestry education in developing countries of Asian region: a brief overview

It was estimated that about 122 forestry schools have already existed in the 1980s in the Asia Pacific Region, spread over in 17 countries, to impart professional forestry education at graduate and post graduate levels (FAO, 1989). Although some structural changes did occur, Japan had the maximum number of schools accounting for 34. Country-wise education and training institutions are given in the Appendix. According to FAO (1989), the following countries are yet to develop training facilities/organizations in the region:

1. Bhutan
2. Cook Islands
3. Democratic Kampuchea
4. Democratic Republic of Korea
5. Fiji islands
6. Islamic Republic of Iran
7. Laos
8. Maldives
9. Solomon Islands
10. Tonga
11. Vanatu
12. Western Samoa

Chronologically, the oldest institutions established before 1970s include those in China, India, Indonesia, Pakistan, Philippines and Thailand. During the period 1970-80s, the main institutions started operating include: Forestry Department of Shanxi Agriculture University, China, Faculty of Forestry of the Universiti Pertanian Malaysia, Forestry Department of in the University of Technology, PNG and many Forestry Colleges of Philippines. Relatively recently, during 1980s, many forestry colleges were opened under the Agriculture Universities in India to give formal degree programmes in forestry while professional training organizations were established in Bangladesh and Nepal (FAO, 1989).

1.1 Staff capacity

While inadequacy of staff was recognized as a constraint in older set ups in India and Pakistan, in countries like China, Indonesia, Malaysia and Philippines staffing pattern in most forestry colleges was noted to be adequate as seen from the following staff strength:

China

Beijing Forestry University - 590 members with 9 Ph.Ds
Northeastern Forestry University - 914 members with 33 Ph.Ds
Nanjing Forestry University - 663 members with 9 Ph.Ds
Fujian Forestry College - 324 staff members with 9 Ph.Ds.

Indonesia

Faculty of Forestry, Gadjah Mada University - 67 members with 7 Ph.Ds.

Faculty of Forestry, Bogor Agriculture University - 98 members with 21 Ph. Ds

Malaysia

Universiti Pertain Malaysia - 45 members with 9 Ph.Ds.

Philippines

College of Forestry (UPLB) - 67 members with 28 Ph.Ds

Thailand

Faulty of Forestry, Kasetsart University - 62 members with 28 Ph.Ds

In India, the staff shortage was compensated by the teaching responsibility taken over by the research staff although new staff capability is being built recently in various agricultural universities.

1.2 Intake of students/trainees in forestry education

Generally, 12 years' schooling including often pre-university/junior college courses will suffice to enter into the B.Sc (bachelor's degree) course in forestry through entrance examinations. In India and Pakistan, recruitment into forest service through competitive examination precedes the entry into the training institutions while in Philippines, Indonesia and Thailand, 10 years basic education is the requirement for entry to be made by the University Entrance Board or by the Ministry of Education as the case may be.

The number of annual intake of students is below 100 in countries like India while it is relatively high in China (500-550) and other South East Asian countries like Indonesia and Thailand (124-200).

Foreign students are admitted in countries like India, Pakistan and PNG, where media of instruction is English, while foreign student entry was restricted in China and other South East Asian countries due to the language problem. However, for advanced or higher studies there was no problem where no much course work is involved.

Short courses are being offered in various institutions of the Region for in-service professionals and often for foreign students with the aid of international aid agencies like ICRAF and IDRC.
A few recent courses organized are given below (FAO, 1989).

1.3 Short-term courses on the themes of current relevance offered in the region

Venue/Country	Course/Subject	Beneficiaries
Department of Forestry, South China	Computer application in forestry Quarantine training Landscape gardening	In-service professionals

Beijing Forestry University, China	45 different short training courses	
Indian Forest College/State Forest Service Colleges, India Indian Institute of Remote Sensing	Refresher courses on topics of current relevance Satellite Remote Sensing	In-service forest officers Open
Faculty of Forestry, Gadjamada University, Indonesia	Forestry Planning	
Universiti Pertanian Malaysia	Agro-forestry	Open
Pakistan Forest Institute, Peshawar	Watershed and Wildlife Management Forest Products Engineering	Open
University of Technology, PNG	Wood identification Aerial photo interpretation	Open
Faculty of Forestry, Kasetsart University, Thailand	Resource and environmental conservation	
Institute of Forestry, Tribhuvan University, Nepal	Forest conservation Fodder trees	Farmers
College of Forestry, Laguna (UPLB), Philippines	Social forestry, Agroforestry, Forestry extension, etc.	In-service and others

1.4 Variability of curricula of forestry education in developing countries of the region

Although changes are expected from country to country depending the local importance, a suggested model curriculum (FAO, 1989) has essentially the following elements:

1. Basic sciences and humanities, including languages - 20%
2. Forestry and Forest Products - 70%
3. Electives and/or research - 10%
4. Field experience - During vacation period although it is a pre-requisite

Each of the above course may be quantified in terms of credit hours to measure the depth of a subject. For instance, a 50-minute lecture hour or a 2-3 hour laboratory/field work is considered equivalent to 1 credit hour. Thus a 3 credit hour course may consist of :

a) 3 lectures per week or
b) 2 lectures + 1 lab / field work per week or
c) 1 lectures + 2 lab / field work per week or
d) 3 lab /field works per week

Often there is a wide variation in the number of credit requirements for graduation in different institutions. For instance, it is only 123 in Malaysia as against 192 in recently introduced forestry courses of agriculture universities in India. Therefore, it is felt that there is a need to standardize the professional forestry courses of the Region to achieve a degree of comparability and commonality.

Although the course duration generally for basic degree in forestry is 4 years with 16-18 weeks per year, it varies in some countries. For instance, the University of Malawaram Samarinda in Indonesia runs 5 year course with 10 semesters and the final being devoted to the research work. Whereas in Indira Gandhi National Forest Academy (Formerly Indian forest College) Dehra Dun, B.Sc. being the entry qualification, the professional course runs only two years with a postgraduate diploma. However, it is not recognized as equivalent to M.Sc. degree of forestry in other countries. Pakistan had both B.Sc. and M.Sc. degree courses of 2 years duration each. In Nepal, successful science graduates undergo a "pre-requisite Course" of 3 months to get exposed to biological aspects of forestry before entering into the 2-year forestry course work. Alternately, practicing foresters or persons with a 2-year proficiency certificate in forestry can obtain entry after one year service experience in the Department Forestry, soil conservation and wildlife. If selected, they can take one year of science course work followed by two years of forestry course work.

The number of subjects taught and the emphasis given also vary considerably from country to country. The coverage of basic sciences including humanities may vary from 15% to 46%, the average being 20%. In Indian universities, the element of agricultural sciences plays greater role in the context of the recent agro-forestry and social forestry practices. Modern subjects including Information Technology (IT) and Biotechnology also find their way gradually into the curricula.

Chapter 2

Education and training in forestry and wood science: Indian scenario

In contrast to many countries of Asia Pacific Region, in India till recently the forest education in the higher level was under the control of the Government of India while in the lower levels the State Governments had run schools and utilised the facilities available in the neighbouring states to train their personnel. In 1988, the Indian Council of Forest Research and Education (ICFRE) was established by the Government of India under the Ministry of Environment and Forests as an independent body to focus greater attention on research and education programmes of the country. The Forest Research Institute and Colleges at Dehra Dun, the main institution formerly responsible for education and training of the officers for Indian Forest Service (IFS), was made the headquarter of ICFRE with six different regional institutes of the country. Recently, the ICFRE was granted the status of deemed university to recognise graduate, post graduate and Ph.D. degrees. However, the two-year IFS course, followed by 4-month probationer training course was entrusted to a separate organisation as Indira Gandhi Forest Academy, Dehra Dun. Under the Ministry of Environment and Forests, three State Forest Service Colleges located in Dehra Dun, Burnihat and Coimbatore also run two-year courses for Assistant Conservatory of Forests (ACF) to cater to the needs of the State Forest Services, for which competitive examinations are conducted by the respective State Public Service Commissions.

2.1 Forestry education structure in India

Level	Course Duration	Minimum Entry Level	Location
Forest Guard	3-6 months	High School	State
Forester	1 year	Pre-University (Science)	State
Ranger	2 years*	Pre-University (Science)	Ranger Colleges of different regions
State Forest Officer (ACF)	2 years	Graduate	Dehra Dun, Burnihat and Coimbatore
B.Sc.-graduate level	4 years	Pre-University (Science)	State Agricultural universities
IFS Officer	2 years	Graduate	Dehra Dun
Postgraduate	2 years	Graduate in Forestry	Dehra Dun, State Agricultural universities

* Recently reduced to one year

Till recently, there were four colleges offering graduate study facilities in forestry. There were (*a*) Indira Gandhi Forest Academy, Dehra Dun, (*b*) Forest College at Burnihat, Meghalaya, (*c*) Forest College Coimbatore and (*d*) Forest College Dehra Dun. In the former, the officer probationers of Indian Forest service and students from foreign countries coming for advanced study are admitted and in others candidates of Provincial Forest Service are admitted. Both the colleges run a two year study programme leading to the diploma AIFC (Associate of India Forest College). The curriculum of this course is given in Appendix.

The Forest Research Institute Dehra Dun has recently got the status of Deemed University with post graduation and doctoral programmes including wood science and technology.

There were six colleges at the undergraduate level. They include Forest Rangers Colleges at Dehra Dun, Coimbatore, Kurseong, Chanda, Angul and Balaghat. Some colleges offer two years certificate courses, with intermediate/pre-university course of Science as minimum educational qualification of the students and others one year certificate course with Bachelor in Science as the minimum qualification for candidates seeking admission.

In recent years especially 1980s, some agricultural universities of the country have started forestry study as a subsidiary subject in agriculture colleges (Appendix).

Graduate and postgraduate studies

The Indian Forest Service (IFS) probationer officers, selected through the national level competitive examination conducted by the Union Public Service Commission, are trained in the Indira Gandhi Forest Academy, Dehra Dun. The State Forest Service (SFS) candidates enter after getting through the competitive examinations conducted by the State Public Service Commissions and undergo two-year training course in forest colleges located in Dehra Dun, Burnihat and Coimbatore.

The reconstitution of the I.F.S in 1966 was a positive step towards better forest management as it attracted brilliant students of the country selected on All India basis to join the service. But the changes made in the education pattern to fit into All India Services rules and regulations created situations in which the standard of forest education, it is a apprehended, may come down.

The graduate forestry courses with B.Sc. degree, introduced in several agricultural universities in the 1980-90s, have basically four-year programme with semester systems. (Appendix). Currently, opportunities do exist in the universities at postgraduate level (M.Sc.) for specialisation in the fields of silviculture, agro-forestry, tree physiology and breeding, forest management, wood science/utilisation, wildlife, etc.

Undergraduate study (for forest range officers)

The sixth undergraduate colleges called Forest Rangers College, train forest technicians on regional basis. For example, all candidates of the northern states are sent to the Northern Forest Rangers College, Dehra Dun, for training. The northern states have temperate forest with conifers in the Himalayas which is quite uncommon to the other parts of the country. Similarly each region has its own speciality which has been taken into consideration while drafting the study programme in the colleges. However, the main frame work of the course remains the same and candidates of all colleges get opportunity to visit all types of forests and get themselves acquainted with them.

Out of the six colleges, at present, the colleges at Dehra Dun and Coimbatore are very well equipped and have good traditions in forest education and training. The other colleges have been recently started and will take some times to get themselves established. India is a vast country and requires a large number of forest technicians for managing the forests. With intensification of forest management and opening of other avenues in the spheres of forest based industries, social forestry, nature conservation, departmental working of forest and for managing the Forest

Development Corporations which are public sector projects, more and more personals will be required in future. Hence, establishment of new forest colleges will be welcome but not without a note of caution. It is not enough to start a college in an applied field science like forestry. The infrastructure requirements must be sufficient to maintain a good standard. The performance of Burnihat and Kurseong colleges till now is not very satisfactory. It is hoped that the experience gained will make planning for forest colleges in future more realistic.

Entry requirements to Ranger Course

Intermediate science of an Indian university or its equivalent (minimum 3 semesters study in the university after higher secondary examination of European universities.) in basic science has been kept as the minimum educational requirement of candidates seeking admission into the undergraduate colleges offering two years certificate courses. Where the courses durations is one year the entrance qualifications prescribed is Bachelor in Science (pre-degree or 4 semesters study of European universities). The Director of Forest Education, Dehra Dun, contacts a qualifying examination and candidates are selected on the basis of the results of that examinations. An oral examination is held in addition to the written one. Physical fitness standards are prescribed including working of 25 kms in 4 hours time which must be fulfilled in order to be finally selected for Ranger's training.

The number of candidates to be selected in any year depends on the posts likely to fall vacant during two years of the training period in the college so that by the time the candidate finish their study and return to the states there will be a post vacant for them. Once selected the candidate is educated and trained at State cost and assured of a job after the successful completion of the course. The inter-seniority of the candidates is determined on the basis of their performance in the forest college. Failing in the examination or not confirming to the standard would make a candidate liable to be expelled from the college and in such an event the candidate not only looses his job but also has to return all money spent for his education at the forest college of State Government. In the forest college the students are taught the fundamentals of silviculture and management, forest mensuration, protection, forest products and their utilization survey and engineering. Besides these main subjects, other subsidiary subjects like forest botany, wild life management, entomology, soil science, soil conservation are also taught. At the end of the course an examination is held and successful candidates are awarded certificate.

After the college education part is over the candidates return to their respect states and are appointed as forest range officers. To undergo practical training, they are first attached to a senior range officer for one year, during which time they get acquainted with all types of forestry work. They are now deemed fit to hold independent charge of a Forest Range. Within two years of service, the range officers are required to pass a departmental examinations in Financial Accounting, Forest Law and Land Revenue Matters.

Though the minimum educational qualification prescribed is Intermediate Science. Due to unemployment problems persons having M.Sc. degrees also come for ranger's training. Hence the educational background and forestry training of this class of officers are generally good. They constitute the back-bone of India's Forest Resources Management.

Lower level courses

The Foresters

The range officer is assisted in his field work by technical assistants called foresters. These technicians are trained in

the Forest Schools of the States. The minimum educational requirement of a Forester candidate is a pass certificate of the higher secondary stage. Recruitment is done at forest division offices. Those who possess the minimum physical fitness of height and chest are allowed to sit for a written test. Those who come out successful in the written test are allowed to appear in an oral examination which is held by a committee consisting of three Deputy Conservator of Forest for final selection of the candidates. Those who provisionally qualified, undergo walking test of covering 25 kms in four hours. Successful completion of this test finally qualifies a candidate for appointment in the forest department as a Forester. The same walking test is prescribed for candidates of all rank and file of forest officials beginning from A.C.F. down to Forest Guards.

After two-three years of practical work in the field, the Foresters are sent to the Foresters Schools for training. The experience gained in the field helps them to understand and assimilate the subject better. During the course period more stress is laid in the practical aspect of the study than on the theoretical aspects. Among the subjects taught, survey, forest mensuration, plantation and nursery techniques, road and building works, practical aspects of silviculture and forest management, forest products and their utilization and identification of trees and shrubs constitute the main subjects. Public liaison, forest rules and regulations, wild life management, first aid are also taught a subsidiary subjects. The students travel all over the state and also to states nearby, and acquire knowledge on the practical aspects of forest management.

At the end of the course a written and oral examination in all subjects and practical examination in survey, Engineering and field Botany is held. The Deputy Conservator of Forests of the States examine the students. Orissa and Bihar appoint at least one examiner by convention from the forest schools of either states. The successful candidates get a certificate. In Orissa the candidate who stands first in the examination in order of merit automatically gets the chance of being sent to the Forest Rangers College for further study.

The Forest Guards

They are selected for appointment in the same manner as the foresters but with a less minimum educational qualification. They are also sent for training after two-three years of practical field work. The duration of training is 6 months. The course consists mainly of all types of field work and the students learn as they do the works themselves. They also travel extensively in-side the state and are required to appear in an examination at the end of the course.

2.2 Problems and constraints in the existing system

The major problems identified in the existing system include:

- Inadequacy of funds and staff with suitable educational background/qualifications remains as a major constraint to forestry development in India both in the context of new plantation establishment and resource management.
- Due to the fact that major part of forests have state ownership, education and training programmes are limited to the personnel of the Forest Departments.
- A large number of trained personnel is required for development of a large scale forestry sector in vast country like India.
- Non-recognition of the potential of non-wood forest products in the existing curricula of education and training.

Although some of the recommendations of National Agriculture Commission (1976) are being implemented with wider education courses in agricultural universities, some of the problems afflicting the developing countries are encountered in India, on varying levels of severity in inadequacies of institutions, technological weakness, insufficiency of investment funds, lack of meaningful participation of the people and so on.

2.3 Possible solutions/ New strategies

- Forest research development funds be created by tapping the resources of various financial institutions for meeting the needs of research and education
- Central, regional and the state level research/education organizations be strengthened according to the recommendations of the National Commission on Agriculture (1976)
- The courses at the existing management institutes including Indian Institute of Forest Management should be availed to increase managerial efficiency
- Suitable courses for continuing education and training of the serving forestry/research personnel should be evolved by various institutions including Indian FRI and Colleges

2.4 Aspects to be considered in developing effective training programme

For the problems of Southeast Asia, in newly designed programme should work in the context of "sustainable development in an environmentally sound, economically viable and socially acceptable way".

- Although utilisation of trees and forests is inherent aspect of forestry, tourism, recreation, non-wood forest products (NWFPs), water and wood production aspects in the context of sustenance should be considered.
- While obtaining the graduate/postgraduate qualifications in the universities, the degree courses should include sections on the design, scientific conduct of research, monitoring and evaluation of research.
- Role of Regional Networks should be realised and implemented, comprising industry linkages and inter-disciplinary and inter-institutional collaborations.
- It should be multidisciplinary in nature including genetics and biotechnology, resource mensuration, biodiversity and sustainable management, appropriate silviculture, harvesting, economics and resources evaluation and social sciences.
- There is a tremendous need for research into all aspects of technology entailed in the utilizations of NWFPs.

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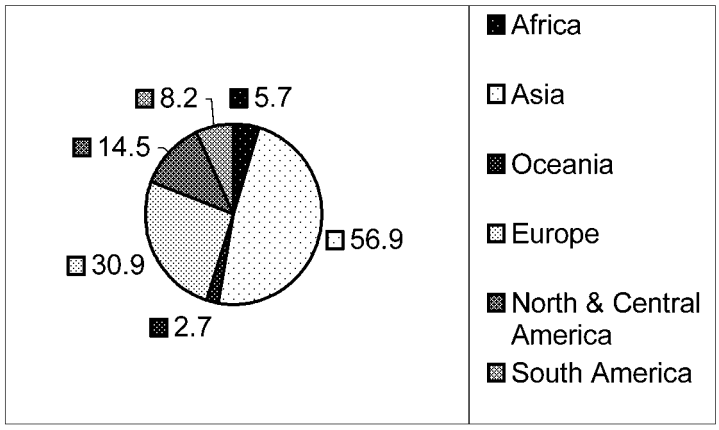
Chapter 3

Changing pattern of plantation resources and training needs for sustainable utilization of tropical forest products: India - a case study

3.1 Global trends

With the approach of 21st century, it seems, gone is the era of wood utilization from large trees of natural growth. Numerous recent estimates of global supply and demand suggest that forest plantations will significantly increase roundwood supply to the year 2010 and beyond (Whiteman and Brown 1999). The global forest plantation area estimated for the year 1995 is approximately 119 million ha while half of it is located in Asia with major shares from China, India and Japan (Fig. 3.1). According to one predictive model, the current level of potential roundwood supply from plantations is around 370 million m^3 per year, which is 25% of global industrial roundwood production and is expected to increase to around 30-33% of total supply in the year 2010, pointing to the range of production of 560-620 million m^3 per year depending on different assumptions of rate of change in plantation growth. With the assumption of significantly higher rate of planting, the predicted proportion of future potential supply from plantations is much greater by 2050 (Whiteman and Brown, 1999).



Source: Whiteman and Brown (1999)

Fig. 3.1 Global distribution of forest plantation resources by main regions in the year 1995 (million ha)

While plantation programmes are expected to continue in many countries especially Argentina, Brazil, Chile, China, India, Indonesia, Morocco, Thailand and Uruguay, the Asia Pacific Region leads the world in tropical forest plantation development in addition to most of the world's 26.5 million ha of non-forest plantations of rubber, coconut and oil palm trees as fibre resources. (FAO, 1999). Of the total plantations of 42 million ha in 1995, 19 million ha are represented by tropical plantations with annual planting rate of 3.3 million ha. Industrial roundwood production is, however, expected from only 14 million ha with annual planting rate of 1.5 million ha. Species wise, eucalypts constitute the largest area (30%) of hardwood industrial plantations, followed by acacias (12%) and teak (7%) while pines make up most of softwood plantations. However, teak constitutes about 75% of high quality hardwood plantations that receives increasing attention in investing on plantation programmes in the context of sustainable forest management (SFM), in many tropical countries including Brazil, Costa Rica, Ghana, India and Malaysia (Keogh 1999).

The recent trend in the Region is that the trees outside forests (TOF) will emerge as an important source of industrial roundwood in addition to wood residues of 1,000 million m^3 with the composition of 70% logging residues, 10% industrial residues, and 20% non-wood/recycled fibres (Fig. 3.2). It is estimated that 80% of all woody biomass harvested in tropical forestry operations ends up as logging or processing residues, 50% of tree wood volume is left behind on the felling site (as branches, bark, etc.) and another 30% as residue (slabs, sawdust, trimmings/shavings, etc.) after conventional wood processing (FAO 1998). The current potential wood and fibre supplies from industrial forest plantations, TOF and other sources are summarised in Table 3.1.

Table 3.1 Current potential of wood and fibre supply (million m^3 EQ) trends in Asia Pacific Region

REGION	FOREST PLANTATIONS		TOF		WOOD RESIDUES		RECYCLED / NON-WOOD FIBRE
	Sawlog	Pulp / fuel wood	Sawlog	Pulp / fuel wood	Logging	Mill	
Industrialised countries	40	15	NA	NA	25	15	55
Newly industrialised countries	5	<5	NA	NA	<10	<5	20
North Asia	35	70	80	360	150	25	85
Southeast Asia	8	-	30	175	380	35	15
South Asia	2	25	35	165	150	13	13
Oceania	-	-	NA	<5			

Source: FAO (1998)

The annual global production of roundwood as well as wood product production and consumption are expected to increase at an annual rate of 1.7% to the year 2010 amounting to 1.9 billion m^3 of roundwood equivalent with highest rates of growth in Asia and the Pacific (Whiteman and Brown, 1999). While North and Central America will remain the largest producing and exporting region, it will remain behind Asia in terms of its share of global consumption. The Asian Region is expected to continue to produce more finished products than industrial roundwood and remain as a net industrial roundwood importer.

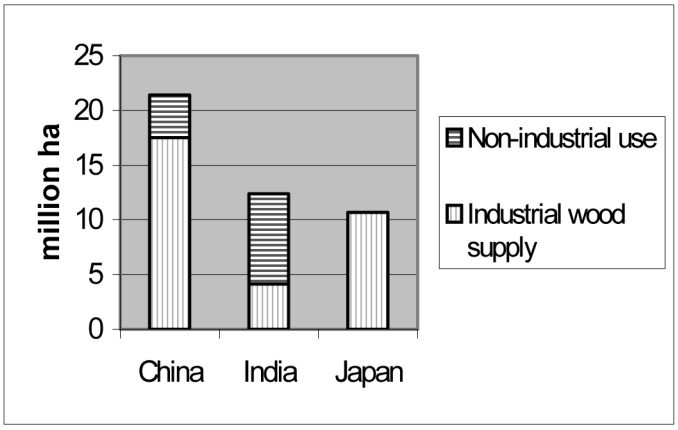
Supply-demand models for wood products indicate that paper and paperboard is expected to grow faster than other products to the year 2010 with an annual increase of 2.4%. Supply and demand for solid wood products is expected to grow with an annual rate of 1.1% for sawnwood and 1.3% for wood-based panels while reconstituted panel products are expected to grow highest (Whiteman and Brown, 1999). In terms of wood products, the Asia Pacific Region is characterised by (FAO, 1998):

- relative stagnation of sawn wood consumption in view of shortage of suitable timbers/large diameter logs and substitution of solid wood products by reconstituted products in furniture, joinery, etc.

- improved roundwood utilization due to better conversion efficiencies, enhanced utilization of wood residues and recycled fibres in paper manufacturing and increased reconstituted/composite product manufacture especially in more industrialised countries.

3.2 Indian scenario

In contrast to 80% and 100% in China and Japan respectively, in India only 33% of plantation area, accounting for 4.1 million ha, is estimated to contribute to the total industrial roundwood production with 9:1 ratio of hardwoods and softwoods (Fig. 3.2). With an annual increase of 8% in total roundwood production, the major share of 92% goes as fuelwood and a meagre 8% (about 25 million m^3) as industrial roundwood (FAO, 1998). The slower rate of annual increase is mainly due to the decline in round wood production from the state forests especially from natural forests.



Source: Whiteman and Brown (1999)

Fig. 3.2 Proportion of industrial roundwood supply from plantations in three major Asian countries

The total area of forest brought under plantations of economic species was 4.75 million ha by the end of the 7th Five-Year Plan (1985-1991) (ICFRE, 1995). This is about 7% of the total forest land in the country. Most of the teak and plywood or matchwood species plantations have merged with the natural forests and mixture of natural species between them. Inventory data for agro-forestry sectors of only selected districts of Haryana, Madhya Pradesh and Orissa are currently available (FSI, 1997). The DBH classes of 10-20 cm, 20-30 cm, >40 cm were recognised in farm forestry, block plantations, roadside plantations and village woodlots which include species such as eucalypts, babul (*Acacia* spp.), poplar, mulberry, shisham (*Dalbergia* spp.), teak, mango, etc. The average growing stock of wood in agricultural land is estimated at 3.42 m^3/ha.

There is an increased dependence on plantation grown timbers and non-forest resources such as rubber wood and palm stems (coconut and oil palm) which are grown for non-timber purposes (Fig. 3.3). The areas of coconut palm and rubber plantations in India are estimated at about 1.632 and 0.523 million ha respectively (Krishna Kumar, 1997; Markose, 1997). Evidently, TOF will be increasingly recognised as an important element in industrial roundwood production. For instance, in southern states like Kerala for the year 1993-94, State forests including plantations accounted for only 9%, in contrast to 46% by households/home-gardens and 31% by estates with 14% imports of industrial roundwood (Chandrasekharan, 1997). For the year 2000 the projections for Kerala indicate 56% from homesteads, 17% from estates, 17% from state forests/public lands and 10% from imports (Krishnankutty, 1990).

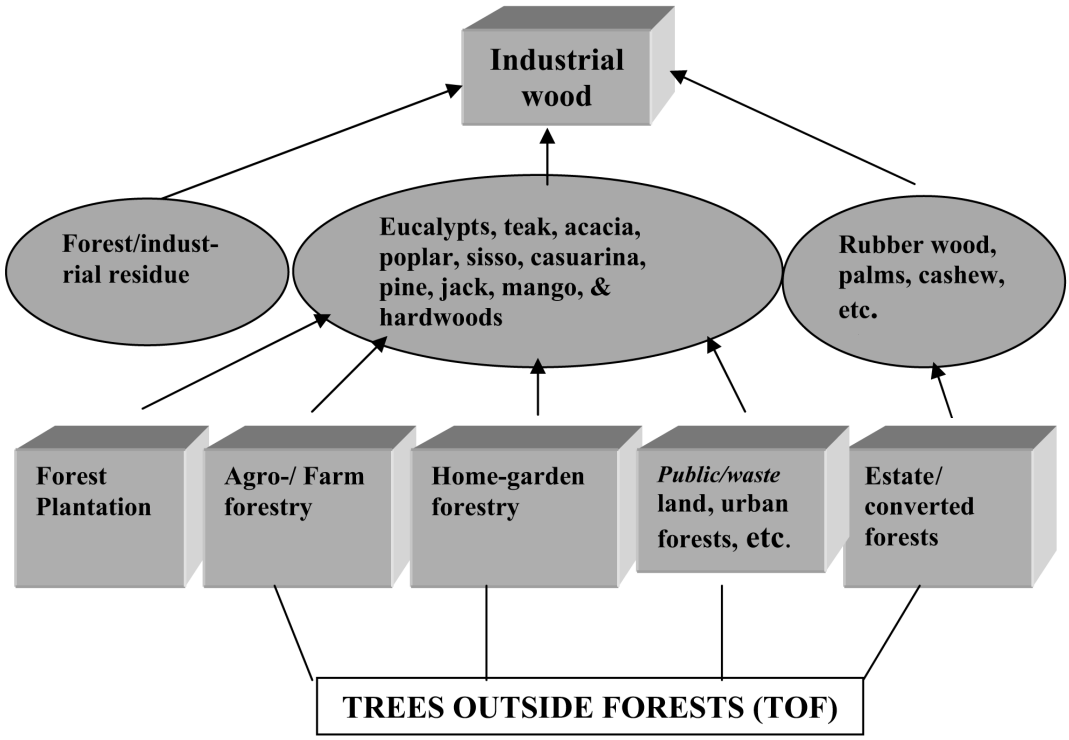


Fig. 3.3　Major sources of futuristic industrial wood supply in India (Bhat, 2000)

The total wood requirements and production by forest and non-forest plantations estimated for the country by FSI (1996) are given in Table 3.2. It is important to note that small woodlots (of less than 25 ha) together could account for 16 million ha of forest area, about 25% additional area to the official figures given for roundwood production, contributing to 72% of the total supply in India (NFAP, India, 1999), not accounted in the Forest Survey of India Report. For the country, at least 60% of industrial roundwood production will be expected from such non-forest lands while import will maintain at the level of 15-16% (FAO, 1997).

Table 3.2　The medium term demand and potential production trends of industrial roundwood in India

(million m^3)

Year	Total industrial wood demand	Production source		
		Forest	Plantation	Farm forestry
1996	64	23	10	31
2001	73	26	11	36
2006	82	29	13	40

Source: FSI (1996)

The estimated average annual industrial growth was 8-9% during the period 1985-2000 (FAO 1998). The contribution of manufacturing sector to the gross value added would have increased from 15% to 20% by 2000. The general production, consumption and trade patterns estimated by FAO (1999) are presented in Table 3.3. India will also increase dependence on import for all industrial wood products by 2010, at least 16% of industrial roundwood, 18% of sawn wood, 28% of wood-based panels, 9.2% of paper and paper-board and 11.6% of fibre furnish in the country

(FAO, 1998).

Table 3.3 Production, consumption and trade patterns of timber products in India

(1,000 m^3)

End-use sector	Production	Import	Export	Consumption
Fuelwood and charcoal	279,359	0	7	279,343
Industrial round wood	24,989	336	23	25,302
Sawnwood	17,460	17	27	17,450
Wood-based panels	348	20	20	348
Pulp	1,870	265	3	2,132
Paper and paperboard	3,025	350	6	3,369

Source : FAO (1999)

The demand and shortfall of different products estimated for the years 1990 and 2000 are given in Table 3.4. The values indicate that there is an increased deficit of industrial roundwood and wood products in spite of expected increase in supply from plantations. Of the 20,000 sawmilling units estimated, 99% are considered to be small-scale and very tiny units and only 1% may be considered to be medium size. There are about 300-400 large, medium and small-scale units of plywood manufacture in the country. Their production has gone down and capacity utilization has reached near critical levels as shown in Table 3.5.

Table 3.4 Estimated demand and shortage trends of wood in India from the year 1990 to 2000

PRODUCT	1990		2000 (ESTIMATED)	
	Demand, million m^3	Shortfall %	Demand, million m^3	Shortfall %
Roundwood	272.61	-1.2	335.15	-5.3
Industrial roundwood	28.22	-4.8	40.39	-15.9
Fuelwood & charcoal	243.81	-0.5	293.65	-3.5
Sawlog & veneer logs	22.37	-6.3	34.30	-20.5
Sawnwood & sleepers	24.48	-11.6	53.60	-40.1
Other industrial roundwood	4.90	-1.0	6.13	-5.7
Plywood	0.57	-17.4	1.49	-52.3
Wood-based panels	0.65	-11.8	1.54	-44.9
Particle board	0.031	34.4	0.036	61.6
Fibreboard	0.068	14.5	0.164	-49.9

Pulp & Paper	Demand, million MT	Shortfall %	Demand, million MT	Shortfall %
Pulp	1.41	-18.3	3.49	-49.3
Chemical	0.70	-17.4	1.7	-49.6
Dissolve grade	0.28	3.3	0.41	9.2
Other fibre pulp	3.05	-19.9	8.62	-56.3
Paper & paperboard	2.60	-18.1	4.87	-36.2
Newsprint	0.51	-34.8	0.74	-20.3

Source: The Price of Forest, CSE Computed on linear projection, Economic Times

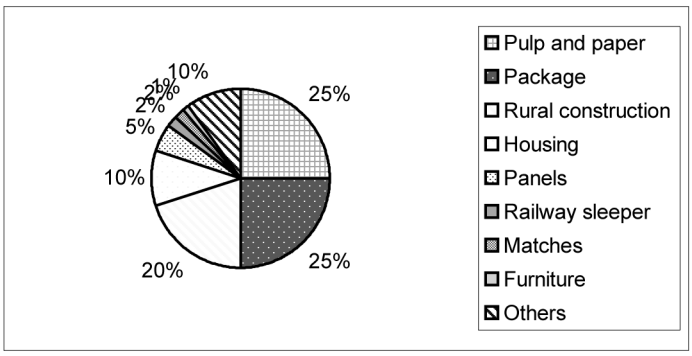
Table 3.5 Generalised patterns of industrial wood consumption during 1990-2000

Industry	Estimated number of units	Installed capacity in 1,000 m^3	Production (1990), 1,000 m^3	Capacity utilization, %
Sawmilling	20,000	48,000	17,460	36
Veneer	13	15	4	27
Plywood	400	1,011	640	63
Particle board	11	116	51	44
Fibreboard	3	55	49	89
Pulp and Paper	250**	4,051.7*	2,350*	58

Source: Ganapathy (1992) ; * in tonnes, ** Exclusive of many small mini-scale/sick units

There is a general agreement among the estimates over the requirements for paper and pulp being in the range of 24-27% (5 to 8 million m^3) of the total demand (Fig. 3.4). As observed in southern India, other major consuming sectors include packaging (roughly 25%), agricultural implements and temporary construction (20%) and housing (about 10%) (Bajaj and Bhat, 1996). Smaller but still significant end users include wood-based panels (3-7%), railway sleepers (1.8%), matches (1.5-3%) and furniture and panelling (about 1%). The remainder 10% of wood is shared between multifarious users including makers of fishing boats, truck bodies, sport goods, bobbins, shoe lasts, pencils, toys, and handicrafts, etc. generally concentrated in a few regions or centres.

The recent estimates (FAO, 1993) suggest that overall production and import and therefore by implication, consumption have remained more or less stagnant over the last decade and there is little evidence to suggest large scale departures from the above pattern of utilization in recent years. The trends of growth in the economy suggest some increase in the share of wood based panels, furniture and construction at the expense of artisans and rural users. The recent wood user survey (Bajaj and Bhat, 1996) established beyond doubt that the sawmilling, which processes 70-80% of industrial wood, is the major sector of roundwood consumption.



Source: Bajaj and Bhat (1996)

Fig. 3.4 Current pattern of wood uses in southern India

Limitations to wood utilization in India

- The National Forest Policy (1988) recommends for: reduction of wood supply from forest sources, import for shortages, substitutes and utilization of marginal farm lands for production of pulpwood to meet the future demands. Accordingly, forest-based industry should raise the raw material needed for its own requirements, by establishment of a direct relationship between the factory and individuals who can grow the raw material by supporting the individuals. As the result, panel and pulp industries established based on past industrial policies are struggling to keep up their production. For instance, the outlook study by the Hindustan Newsprint Ltd. (1999) estimates that the forest raw material availability in Kerala state is sufficient to meet only 50% of the requirements of two main pulp mills of the state.
- India is one of the world's 12 mega-biodiversity countries. The objective of National Forestry Action Programme (NFAP) is to enhance the contribution of forestry and tree resources to ecological stability and people-centred development through qualitative and quantitative improvement in investment on sustainable conservation and development of forest resources (FAO, 1997).
- According to FSI (1997), only 19.3% have forest cover, although nearly 22% or 65 mill. ha, of the land have been recorded as forests, which is much less than the goal of 33% set by the National Forest Policy (FSI, 1997).
- According to some predictive models (Kale, 1995) the percentage production from forest raw materials for pulp and paper production to the total will be expected to gradually decline to 27% by 2010 because of reduced felling of trees in government forests as a result of the implementation of Forest Conservation Act 1980, as amended in 1988 and prescriptions of National Forest Policy 1988.
- Non-forest trees (rubber wood, coconut wood, etc.) and tree-crops (multipurpose species from farm lands/ homesteads) will emerge as significant volume of industrial fibres. For instance, in Punjab (India), farm trees account for 86% of the state's growing stock (FAO, 1998).
- The fragmented low-capacity marginal farm lands call for higher investment, dispersed supervision, higher cost of transport, inability to apply modern technology, larger extent of land to meet the gap in availability, problems of legal arrangement with owners for supply of raw material, difficulty in flow of credit, higher supervisory and protection costs, etc.
- India cannot afford to divert better farm lands for tree crops for fear of shortfall of agricultural production. The best available natural resource is therefore degraded forest land.
- Disproportional increased investment in the forestry sector with substantial qualitative changes in terms of

country capacity in the absorption and planned use of the resources (FAO, 1997).

Future targets for wood utilization in India

Industrial wood is increasingly in short supply in India and the situation is likely to worsen further. One of the strategies to lessen the wood shortage is to substitute wood with alternative materials such as aluminium, steel, cement in construction uses. Appropriate fiscal measures (excise duties, tax, and royalties) and policies have been adopted to encourage competitiveness, enhance cost effectiveness, and promote greater use of wood substitutes.

Efficiency in wood production and utilization has generally been low and the following measures have been taken to increase output from the declining domestic wood flow (Pande, 1995):

- promoting and supporting the use of juvenile/thinning wood from plantations and trees outside forests (TOF) especially from farm/agroforestry sectors and non-forest plantations.
- adoption of improved processing techniques, better logging practices, and use of small dimensional timbers.
- improved use of low quality timbers in plywood and veneer, by substituting high quality timbers such as teak and rosewood.
- improving the productivity of plantations, processing of smaller trees, opportunities for increased use of wood residues and recycled fibres and efficient utilization of non-timber crops.
- Trade policies are designed to fill the gap between supply and demand, encourage wood substitution, and increase the indigenous supply of raw materials for forest-based industries. The objectives are to support value-addition, enhance income and employment generation, make use of local knowledge, reduce dependence on foreign supplies of critical commodities, and ensure growth and development of village-based and small industries.
- The plantations raised in strips along roads or canals or railways are managed under clear felling system with a rotation of 8-15 years for eucalypts and poplars, 15 years for acacias, and 50-years for relatively slow growing species such as Dalbergia sisso and teak. Raising large-scale captive plantations of high yielding varieties on degraded forest and Government forest lands in the vicinity of existing and/or new industrial units should be expected to maintain the current level and future demands. The plantations would become viable only if technological advances in production forestry are practised so as to optimise the outputs from high silvicultural inputs from 15 m^3 to 70 m^3 MAI per ha as shown in Brazilian pulpwood plantations. This will mean that the requirement of raw material can be met in 15-20% of the area required 2 decades ago (Adkoli, 1995).
- While the timber supply for industries will be mainly from homesteads, farm-/agro-forestry, converted forests/estates of private holdings, large industries have now accepted the model of involving small farmers in the production of raw materials especially for pulp mills. For instance, it is estimated that by 2010 the farmers in Andhra Pradesh can supply 1 million MT of pulpwood while the major portion of current consumption of 0.6 million MT is met by them. Because of clonal technology and involvement of farmers in the supply model, the area of agricultural tree crops is expected to increase considerably by 2010. The annual increase of 8% in roundwood production is expected due to large areas of plantations raised under various social forestry schemes, regular teak plantation programmes and the existing eucalypt plantations of State Forests which will be due for harvesting during the period of first decade of 21st century.
- The production of wood from estates/non-forest plantations, is also expected to increase although from

homesteads/private holdings, it is likely to decline due to reduced stock of the tree crops despite the positive indication of regenerating the stock in the latter. The area under rubber plantations for replanting in Kerala alone is assumed to increase at a range of 3-5% compound per annum. The future production from state forests and public lands is also assumed to increase by 4-5% of current level of production in Kerala (Krishnankutty, 1990).

- ❖ Agro-forestry efforts have to be vastly increased along with improved technologies for clonal pulpwood production and root trainer nurseries for the supply of quality seedling to farmers as has been done in many states like Andhra Pradesh and Orissa with the contract between the pulp industries and farmers (JK Corp., 1999).

3.3 Research and training vs. plantation and utilization technology

There seems to be no substitute for research as it is a vital tool for knowledge-based society in achieving sustainable development in the new millennium. While reviewing the evidence and future prospects of global plantations, Evans (1999) was optimistic about increasing the productivity of plantations by appropriate management methods including intensive silviculture and relatively long-term genetic improvement programme. Biotechnology seems to play a crucial role in genetic alteration and clonal multiplication of trees for higher yield of tailor-made wood. There is therefore a need for different type of plantation technology instead of traditional methods of managing plantations in the tropical developing countries.

The major options to meet the increasing product needs are (FAO, 1998):

- Increase productivity of plantations
- Improve harvesting and conversion efficiency of low-quality/small dimensional materials for new/value-added products and utilization of logging and mill residues
- Improved utilization of non-forest wood and non-wood forest products including recycled fibre from waste paper
- Implementation of structural changes of the industries especially in developing countries with technology transfer.

Plantation technology for wood production

There is an increasing awareness that *wood quality/processing aspect is an integral part of total plantation technology* for high quality timber from sustainable forest management (SFM). For quality sawlogs, it is important to consider minimising the timber defects such as fluting, bole taper, knots, etc. right from the stage of seed selection (appropriate provenances/genetically superior individual trees/clones as a part of breeding programme for planting material) at grower's level. This would save considerable efforts, energy and resource at processing stage to overcome the timber defects for high quality products. Common plantation species, viz. teak, eucalypts and acacias seem to have potential to meet sawn wood requirements from relatively short rotation plantations in view of maturity of timber strength and often durability, in a relatively short period of 15-20 years (Kumar et al., 1987; Bhat, 1999 & 2000; Bhat and Maria Florence, 2000). Although eucalypts are planted mainly for pulpwood production with 5-8 year rotation, trees allowed to grow up to 14-15 years were found suitable for excellent furniture, wall panelling, etc. (Bhat, 1992). Studies also indicate their responsiveness for genetic selection and clonal multiplication for increasing plantation productivity (Bhat and Benny, 1995). Preliminary assessments of the mechanical properties of timber from a 7-year-old *Acacia*

auriculiformis and 8-year-old *Acacia mangium* plantation showed that the strength is low for the lower aged material (Jayaraman *et al*., 1992; Dhamodaran and Chacko, 1999), when compared with the strength values reported for higher age groups. This indicates that the structure - property - end-use correlation's are also equally important and worth considering in fixing the rotation age. As sawlog production is expected to be very critical in many developing countries, especially for high quality solid wood uses, these recent findings have far reaching implications for timber management. Some aspects of timber quality such as figure (colour, grain, texture), natural durability, preservative treatment of sapwood, as well as quality standards/grading rules for fast growing plantations species merit due consideration in R & D programmes as they directly influence the market value of the end products.

Processing of non-conventional timbers

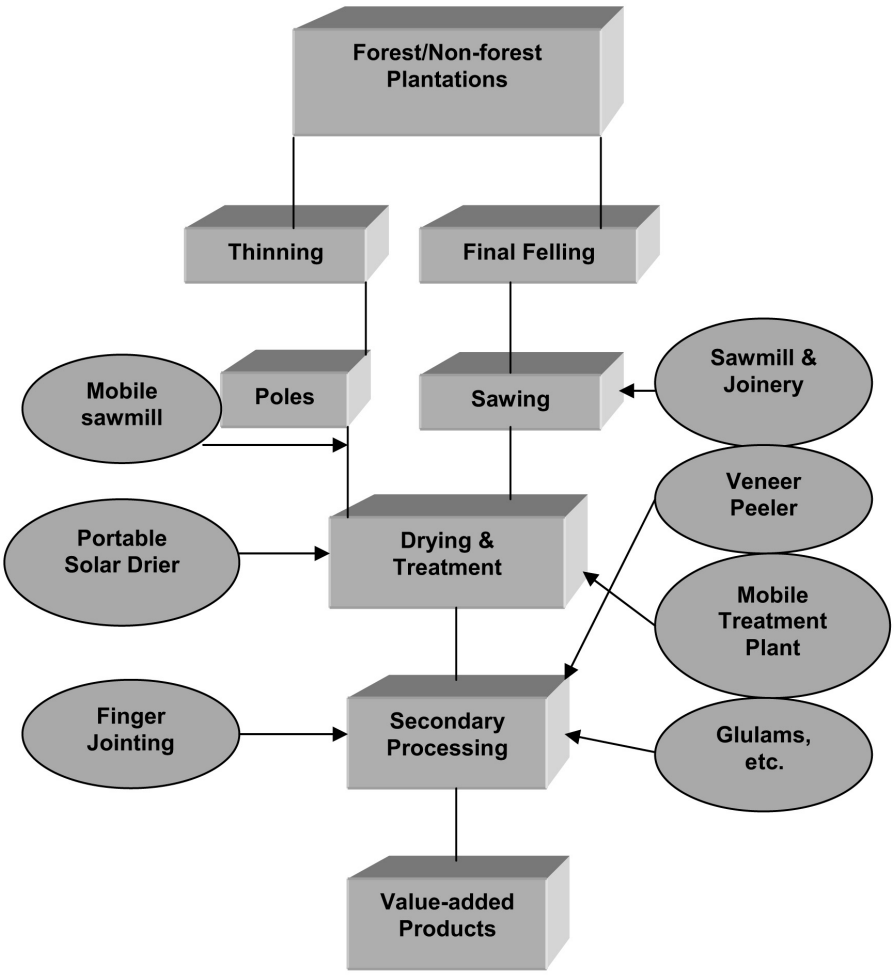
Recent work in Kerala on enhancing the service life of non-conventional timbers such as rubber wood and coconut wood and their processing offered considerable promise for developing appropriate processing technologies (Dhamodaran and Gnanaharan, 1994 ;Dhamodaran, 1996, 1999). India is one among the leading rubber growing countries in the world. According to the estimates of Rubber Board of India (RRII, 1992), the total annual wood production is about 1.27 million m^3, of which 60% is stem wood and the remaining 40% branch wood. A study conducted by Krishnankutty (1989) showed that rubber wood, excluding sawmilling, accounted for about 65% of the total consumption of industrial wood in Kerala, implying significant contribution to the industrial economy of the State. The consumption pattern of rubber wood in India, as reported by the Rubber Board of India (RRII, 1992) clearly shows the need for more value addition and more efficient utilization, as is evident form the insignificant share (3.9%) of processed rubber wood in the total consumption. Similarly considerable progress has been made on preservation and conversion methods of coconut wood in Kerala (Gnanaharan and Dhamodharan, 1988 a & b, 1989 a & b).

Technological interventions and structural changes in wood industries

Advances in processing technologies allow the use of smaller and younger trees. In Europe, North America, Japan and Oceania processing machines have been developed to efficiently process and utilise small diameter logs for finger-jointing and glulams that could find application in both structural and non-structural uses such as joinery, furniture, etc. (Barbour et al., 1997; Willitis et al., 1997). Though the manufacturing cost is higher, the quality of wood products manufactured from small-diameter trees is generally as good or better than that manufactured from the traditional timber resource. Modified equipment in processing for sawn wood/veneer recovery from small diameter logs has been suggested for many plantation grown timbers. For instance, peeling lathes should be capable of handling logs up to a minimum diameter of 7 cm (Sivanada, 1992). An arbitrary model showing scope for technological interventions in the down-stream processing for manufacture of value-added products from low quality/ small diameter trees given in Fig. 3.5.

Modification of sawmilling equipment and installation of portable processing units

The opportunities seem to exist for advanced technologies in both plantation and processing sites. For instance, small portable or mobile sawmills (with a capacity of 5,000 m^3 log intake) with portable solar kilns and preservative treatment plants (for sapwood), that can be easily moved from site to site during thinning or final felling operations of small land holders, may be appropriate for improved utilization of small timber (FAO, 1981). This can facilitate the supply of sawn wood requirements of rural communities, building contractors, and furniture manufacturers of remote areas, apart from promoting the handicraft potential from small dimensional materials in toys/wooden souvenirs by



Source: Bhat (1999)

Fig. 3.5 An arbitrary model showing scope for technological interventions for greater processing efficiency in manufacture of value-added (non-pulp) products from small dimensional timber resource of tropical plantations

employing rural artisans. This may promote the supply of sawn wood to meet the small timber demands of rural communities from road-side/railway development and agroforestry plantations. The building contractors and furniture manufacturers of remote areas will be the major users in addition to the handicraft industries which employ skilled rural artisans. However, it demands initial one-time capital investment (capital cost of such a mobile sawmill estimated in 1981 was $226,200 with a working capital of US $ 8,000) for installation of imported mobile sawing equipment.

Erecting a preservation plant, easily accessible to the felling/thinning sites, with the possibility of using "simple" methods of preservation (with local know-how) including sap displacement techniques would enhance the durability of poles and high proportion of sapwood of short rotation timber. Simple dipping of poles in trenches filled with preservatives and covered in polythene sheets (sap displacement technique) would give often adequate protection as demonstrated by the Institute of Wood Science and Technology, Bangalore. Based on the work done in Indian Plywood Industries Research and Training Institute, simple cost-effective prophylactic and end-coat treatment techniques are available in India. The code of practice as per the Bureau of Indian Standards (IS 9104), provides guidelines for protection of logs in felling site, during transportation and storage.

Installation of cost-effective solar kilns with @ Indian Rs. 400 per m^3, approximately US $10 for *nomad* solar kilns with an annual capacity of about 200 m^3 timber in remote areas would be appropriate to meet the seasoning requirements of small farmers in village level (Plumptre and Jayanetti, 1996). The initial cost of installation would be to the tune of US $7,000-8,000.

Modernisation of industry demands improved skill and know-how at all organizational levels in the industry by providing training to use suitable machinery, proper production flow, and material handling and sound sawmilling (Muraleedharan and Bhat, 1990; Noack, 1995). The basic conventional band saw machines are to be newly designed for processing small dimensional materials. Prototypes of such machines developed in India are being demonstrated through training programmes organised in Indian Plywood Industries Research and Training Institute (Damodaran, 1996).

Installation of machines for glulam/wood panel composites

Recently, selected processing sectors have introduced semi-automatic finger-jointing machines, that are manufactured locally with imported cutters, or planned to invest on automatic imported machines for manufacture of jointed and glue-laminated structures. Often poor quality fingers and weak joints were noticed due to the vibrations of cutter spindle and movement tables.

Attention should be focused on low-cost mechanization in general and the finger-jointing, glulam and peeling and ultra-sonic veneer grading techniques in particular for the improved utilization of small dimensional material of tropical plantations. Related to this, strict quality control, both internal (by the manufacturer) and external (e.g. by a standards institution), is a need of the hour to gain acceptance for finger-jointed timber and to maintain confidence in the product (Bhat, 1999). Standards or codes of practice are an integral part of most external quality control systems. The thrust areas of technology transfer include: development of glue spreading devices and gluing technology, non-destructive testing and criteria for engineered uses (laminated timber/veneer; light-frame construction) and non-engineered uses, optimum length of joints and long finger-jointed members, new production techniques and equipment.

3.4 Challenges of 21st Century - Investment needs and industrial structural changes

Apparently, industries in developing countries have not yet geared up for efficient processing of small dimensional logs with the current structural set up and machinery. The comprehensive analysis of Asia Pacific Forestry sector indicates that total annual investment needs for plantation development and structural changes of the industries in South Asia alone range from the level of US $891 million in the year 1994 to US $1,237 million to the year 2010 (Table 3.7). Additionally, 10-15% of these figures are estimated for institutional infrastructure/support, research, training/human resource development, technology development and dissemination. International/regional networking approach both within and between the countries, with the participation of FORSPA, IUFRO and APAFRI, is suggested to pool the limited available resources for research and technology, that would facilitate sharing knowledge and avoid duplication of efforts. This would increase the opportunities for mobilisation of support from national/international developmental agencies including private forestry sectors (Enters et al., 1998).

The major challenge is - *how the industries will respond to the changing pattern of wood supply for adopting and implementing codes of conduct in the context of sustainable utilization through plantation management practices,*

Table 3.7 Estimated annual investment needs (US $ millions) for plantation development and structural changes of the industries in South Asian Region

INDUSTRIAL SECTOR	YEAR 1994	YEAR 2010
Forest plantation development	303	398
Non-forest (TOF) resources	160	240
Wood harvesting	123	186
Sawmilling	83	166
Wood-based composites/panels	34	37
Paper and paperboard sector	188	210
Total	891	1,237

Source: FAO (1998)

technology transfer and investments? As Leslie (2000) puts it, tropical forestry must somehow react and perform quickly in the following lines, failing which rapid decline and low returns and outputs are inescapable:

- the market R and D for identification, characterization and implementation of the high-value strategy.
- the production, distribution, marketing and quality control systems to capture the high-value market will become the norms and reality in the industries.

Conclusions

The industrial roundwood supply from plantations is expected to increase from the current level of 25% to 33% of total global supply in the year 2010 and beyond. With the major shares in China, India and Japan, the Asia Pacific Region leads the world in forest plantation development in addition to its most of the world's 26.5 million ha of non-forest plantations of rubber wood, coconut and oil palms as fibre resources. Apart from forest plantations of eucalypts, teak, acacia and pines, the recent wood supply is from the trees outside forests (TOF) especially farm lands, estates/ converted forests, small woodlots, etc. Additional sources of industrial wood identified are logging and mill residues as well as recycled fibres. Extensive research work has been carried out in the region including India for characterization and enhancing the service life of most these wood resources as industrial material. The changing pattern of wood supply, however, calls for a new approach for integrating wood research with plantation technology for wood farming and for increased conversion efficiency of small diameter logs in the manufacture of value-added/new products. Because most of the technologies are available in industrialized countries, technology transfer/adoption appears to be a need of the hour in developing countries including India. The current situation demands considerable investments on plantation development and structural changes of the industries for processing small dimensional materials with new or modified machinery for sawmilling, veneer production and manufacture of reconstituted products, including glue-laminated composites/finger-jointed structures and pulp and paper. Regional networking approach is suggested to pool the limited available resources and share infrastructure/expertise for research, training and technology transfer and to mobilise support from national/international developmental agencies including private forestry sectors. The major new challenge is - how industries respond in implementing the voluntary codes of conduct through management practices, technology transfer and investment.

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Chapter 4

Training network for wood specialists of developing countries: Basic areas of training requirements in wood technology

The following three basic areas are proposed to meet the training requirements of wood specialists of developing countries (Fig. 4.1).

1. NWFP-Net (Non-wood Forest Product - Net)

   Mission: Production, harvesting, processing and utilization of NWFPs (bamboo, rattan, phyto-chemical and pharmaceutical products, gums, resins, tannins, etc.)
2. Timber-Net

   Mission: Timber quality modification - by Silviculture and/or genetics (GMOs), bio-chemical modification - application of biotechnological tool, harvesting and processing technology for small diameter logs (from short rotation plantations/thinnings, TOF including non-conventional timbers like rubberwood, palm stems), grading and marketing
3. Residue Utilization-Net

   Mission: Utilization of agro- and forest/logging residues, industrial mill residues and recycled products, manufacture value-added composite boards, panels, etc.

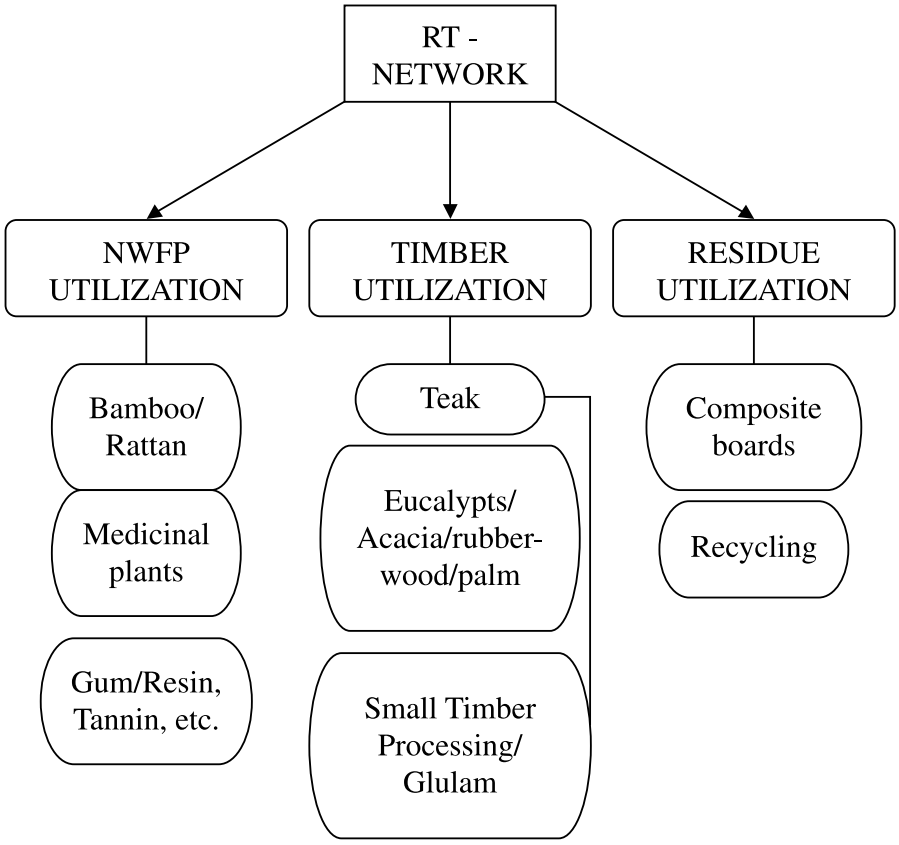

Fig. 4.1 Major areas of Research and Training needs of developing countries in Asia Pacific Region

4.1 Strengths of the core institutions for training in wood science in three major countries' players of the Asian region for forest-based industries: China, India and Japan

CHINA

I. Research Institute of Wood Industry (Chinese Academy of Forestry: CAF)

Established in 1957, the Chinese Research Institute of Wood Industry (CRIWI) being the largest research and development center for wood science and technology in China, is mainly engaged in applied research, development research and applied basic research related to wood industry. CRIWI is capable of offering post doctoral program, Ph.D. program and Master degree program.

The Major objective of CRIWI is to develop technologies of utilizing wood raw materials rationally and economically so as to make better use of forest resources and meet the needs of national economy and people's livelihood.

With 161 staff including 140 research and technical personnel, CRIWI consists of 6 research divisions such as Wood Property, Wood Drying, Wood Protection, Wood-based Panels, Wood Adhesives and Panel Surface Finishing, as well as Machinery and Automation. Additional two units, viz. Department of Civil Engineering Designing and National Quality Monitoring and Testing Center for Wood-based Panels provide further support. The Technical Committee for Wood-based Panels Standardization, the Chinese Society of Wood Industry and the the Basic Technical Committee for Wood Standardization are also attached to CRIWI.

II. Research Institute of Chemical Processing and Utilization of Forest Products (RICPUFP)

The National Engineering and Technology Research Center of Forest Chemical Industry is the only specialized centre of forest chemical technology and industry in China. Taking efficient utilization of forest resources and their by-products in down-stream processing, the Centre has chemical engineering of aspects of natural organisms. Priorities are given to chemical properties, chemical technology, chemical engineering, biotechnology, the application of new products, etc. in tree extractives, and development and utilization of new forest resources. The Centre is also responsible for working out national standards for various silvi-chemical products and quality inspection and supervision of forest chemical products in China. The Research Institute of Chemical Processing and Utilization of Forest Products (RICPUFP) in the Chinese Academy of Forestry (CAF) affiliates to the Centre. RICPUFP keeps in possession of the First, Second and Third Classes Certificate for the designing of pressure vessels. Chinese Society of Forest Chemical Products and Engineering; National Scientific and Technological Information Centre for Chemistry and Chemical Engineering of Forest Products; Quality Inspection and Supervision Station of Forest Chemical Products, Ministry of Forestry; and Forest Product Chemical Industry Consultation and Services, Ministry of Forestry are all attached to the Centre.

With the advantage of outstanding specialists and technicians engaged in research and development, design and trial, the Centre has great potential in undertaking national key projects and offers study programs for graduates at master's and doctor's degree levels in the specialty of chemical processing of forest products. In addition, a postdoctoral station is set up here. The Centre includes the following sessions: Engineering and Technology Committee, Nanjing General

Company for Science and Technology Development and an administrative office. In view of the major basic and technical problems existing in forest chemical industry, the Centre, depending on its research and development superiorities and abundant funds, has frequently transferred the research achievements and high-value new products to the production so as to promote the scientific and technological advancement and the forest chemical industry and its relevant industries on the upgrade.

Main research fields:

1. Pulping and paper-making from wood and non-wood fibers. With internationally advanced refining pilot plant and determination instrument, carrying on the research of wood properties, fiber anatomy, pulping and paper-making technology, effluent treatment and products determination. Research and Development Center of Pulping and Papermaking of CAF is set up here.
2. Chemical utilization of Oleoresin. Mainly working on the research of chemistry and chemical processing of rosin and turpentine, from which having developed many kinds of products such as modified rosins, rosin resins and turpentine resins, as well as surfactants and plasticizers.
3. Chemical utilization of forest resources. Studying the separation and identification of valuable chemical components of plant materials in forest, mountain and desert areas. Having gotten many scientific achievements in the development of series products from plant tannin, pine needles, popular bark, ginkgo leaves, Gynostemma Longipes and Adeaophora, as well as the processing of woody plant oils and natural essential oils.
4. Activated carbon and wood-based energy (The Institute is the council of National Activated Carbon Association).
5. Adhesives. Having developed the series products of emulsion adhesives, urea formaldehyde and phenolic resins, polyurethane adhesives for wood working and other industries (The Institute is the council of the Chinese Adhesive Association).
6. Manufacture of Furfural and Furfuryl Alcohol by hydrolysis of plant cellulose materials, and Chemical modification of cellulose.

Forest chemical engineering and equipment. The Design Institute of Forest Chemical Engineering of CAF is set up in RICPUFP, and it has the Second Class Certificate of engineering consulting and design, and specific engineering design for environmental pollution control, and the qualifications of design of pressure vessels of 1st to 3rd class. Institute of Scientific and Technical Development Company of NRCFCET (National Research Centre of Forest Chemical Engineering and Technology) is responsible for the routine management and comprises the following branches as:

1. Management Department
2. Production Department
3. Marketing Department
4. Research Department of Adhesives
5. Research Department of Activated Carbon
6. Nanjing Longyuan Natural Polyphenol Synthesis Factory
7. Nanjing Ambition Chemical Plant
8. Nanjing Natural Fine Chemicals Company

9. Jiangsu Phyto Company.

Other Accessory Institutions:

1. Quality Inspection and Supervision Station of Forest Chemical Products.
2. Chinese Society of Forest Chemical Products and Engineering, Chinese Society of Forestry.
3. National Scientific and Technological Information Center for Chemistry and Chemical Engineering of Forest Products.

III. Bamboo Research and Development Center (BRDC)

Bamboo Research and Development Center (BDRC) of State Forestry Administration, located in Hangzhou, Zhejiang Province, was established in November, 1995 and attached to Chinese Academy of Forestry. At present, there are 9 staff in BDRC, of which 6 are scientific and technical personnel including 5 senior ones. The main task of BRDC is to research and develop the bamboo resources in the following lines:

- To drive and promote industrial development of China in bamboo-related areas.
- As an international cooperation industrial exchange programme, BRDC organizes the scientific research and technical development programs in cultivation, utilization and development of bamboo, resources especially through practical training and techniques for both domestic and overseas' organizations.
- It will provide research and training with excellent working conditions. It also organizes the programs for scholars and experts in the field of bamboo research to conduct the international economic and technical cooperation.
- BRDC is a standing direct unit of the Council of South Cooperation Network and it undertakes periodically the training program and projects assigned by UNDP, Ministry of Foreign Trade and Economic Cooperation of P. R. China and other ministries.

INDIA

I. Forest Research Institute (FRI), Dehra Dun

Established in 1906, the Forest Research Institute, Dehra Dun, is the pioneering institution concerned with forest research and education in India. Set in a lush green estate spread over 450 hectares, it has well equipped laboratories, library, herbarium, arboreta, printing press and experimental field areas for conducting forestry research. Forestry research in the FRI is organized under fourteen divisions. The Institute's achievements in forest products research, particularly during the world wars, have contributed valuably to the development of forest-based industries in the country. The Arsenic-Copper Chromate treatment for wood preservation, developed by the Institute, is now widely adopted throughout the world. The Institute has also pioneered the process of pulping bamboos for paper making. Notable among achievements in Forest Genetics are the development of hybrids of Eucalyptus, capable of producing a larger biomass, viz, FRI-4 and FRI-5, creation of model seed orchards of teak and semul, and tissue culture of eucalyptus. Xylarium, with a collection of over 18,000 wood specimens from India and abroad, qualifies the Institute as the best source of reference for wood identification.

Status of Deemed University

On the basis of recommendation of the UGC (University Grant Commission), the Ministry of Human Resource Development (Government of India) declared the Forest Research Institute to be a Deemed University in December,1991.

The Forest Research Institute 'Deemed University' conducts the following academic activities:

- Ph.D. programmes for postgraduates students.
- Specialized courses - Postgraduate Diploma courses in Pulp and Paper Technology, Wood Technology and Plantation Technology have commenced from 1992.
- Networking with other training institutions involved in the field of forestry education.

II. Indian Plywood Industries Research and Training Institute (IPIRTI), Bangalore

An autonomous body of the Ministry of Environment and Forests provides training in saw-milling and plywood industrial sector to improves skills, upgrade products quality, optimize production cost and enhance international competitiveness of the products. The institute has a sanctioned staff strength of 104 and regional centers in Calcutta and Tinsukhia (Assam) in addition to the main facility in the head quarter at Bangalore.

Thrust Areas

- ❑ Finger-jointed and glulam structures from plantation grown timbers and bamboo mat boards from bamboos
- ❑ Training in mechanical wood industries and processing small diameter logs

Recent Achievements

- ➢ Developed new products like bamboo mat boards and application in various uses for housing

III. Institute of Wood Science and Technology (IWST), Bangalore

Initially established in 1938 as a Forest Research Laboratory by the erstwhile state of Mysore and later in 1956 taken over by the Govt. of India and made a Regional Research Centre of the FRI and Colleges, Dehra Dun. IWST was declared, in April 1988, as an independent Institute under the ICFRE to cater to the research needs of the states of Karnataka, Andhra Pradesh, Goa and Daman and Diu. The Institute maintains three field stations for forestry research in Karnataka state, and two outstation marine centres at Vishakapatnam and Cochin (Kochi). The current areas of forest products research include:

- Processing/utilization of lesser known timber of plantation species.
- Development of indigenous substitutes for imported raw material in perfumery industries.
- Utilization of alternative timbers for catamarans, the traditional craft of poor coastal fishermen of A.P.

IV. Kerala Forest Research Institute (KFRI), Peechi

Kerala Forest Research Institute (KFRI) was established in 1975 as a registered society under the aegis of the Science and Technology programme of the Kerala State government. In the context of fulfilling the economic, social and environmental objectives of forestry, the institute conducts research and training in all aspects of forestry, wildlife management and wood science and technology. The overall control, administration and management of the institute are vested in a Governing Body appointed by the state government while day-to-day administration rests with the Director who is also appointed by the government. The institute has 14 Research Divisions with 48 scientists in addition to Library and Engineering services.

Profile of Wood Science Division, KFRI

The Division of Wood Science at Kerala Forest Research Institute has well qualified scientists, all with Ph.D degree and overseas training in specialized areas of wood technology and non-wood forest products (NWFPs). The multidisciplinary expertise of scientists covers: biology, anatomy, material quality, preservation, harvesting and processing of both wood and non-wood forest products including bamboo and rattans.

The main mandate of the Division of Wood Science includes:

(a) Project identification and conduct of research in problems relating to production and efficient utilization of wood and non-wood resources.

(b) Technology transfer to forest-based industries and impart of training/technical advice to all end-user sectors for optimum utilization of forest resources.

(c) Facilitation of adoption of quality standards in processing and marketing of forest products in the context of sustainable of utilization of forest resources.

(d) Advancement of knowledge in pursuit of academic excellence in forest products and allied fields.

Commercial activities/services offered to wood users

1. Timber and bamboo/cane identification and certification for quality assurance
2. Wood testing for moisture content, specific gravity, chemical preservatives, etc.
3. Consultancy in various fields of wood technology including bamboo/cane product manufacture

Recent Research and Developmental Activities of practical relevance to user agencies

- Economic schedule for preservative treatment of rubber wood
- Utilization of wood from wilt-diseased coconut palms
- Pulpwood quality of eucalypts from short rotation plantation
- Protection of pulpwood in storage
- Rural technology for rattan (cane) curing
- Grading rules for rattan (cane)
- Harvesting tool for reed bamboo
- Harvesting tool, preservative treatment and storage methods for reed bamboo
- Local tools, equipments and technologies for processing bamboo and cane
- Wood quality of fast grown teak and other plantations species

Recent Activities of Technology Transfer and selected beneficiaries

1) Transfer of oil curing technology to sole-cane supplier of East and North-eastern India for quality products of cane furniture manufacture in cottage industries of Southern India.
2) Simple preservative treatment technology was transferred to numerous rubber wood processing industries in Kerala (Aspinwall & Co., Plantation corporation of Kerala, etc.) and other states.
3) Utilisation technology for rubber wood, coconut wood and other conventional timbers in low cost buildings of Nirmithi Kendra, Thiruvananthapuram and Costford, Thrissur.
4) Sawmilling (processing), seasoning and preservation technology to many industries like Kerala Wood Industries, Poabson Industries, Thiruvalla, Forest Industries Travancore Ltd, Aluva, etc.

5) Storage techniques for bamboo/reeds and pulpwood raw materials to industries like Hindustan Newsprint Ltd., Gwalior Rayons, etc.
6) Coconut wood utilization technology to Coconut Development Board, Cochin.
7) Appropriate Sawing technology (SDR Technique) for processing eucalypts was transferred to: Wood processing unit of Gujarat State Forest Development Corporation, Vadodara.
8) Rural technology for cane (rattan) curing and steam bending was transferred to:
   a) Karnataka Forest Department (in Honnavar Forest Division) - 1989
   b) For different cane furniture manufacturers through field demonstration programme at KFRI Sub-centre, Nilambur 1991-92
   c) Bondage Industries, Ahmedabad - 1993
   d) Shiney Indoors, Aleppy - 1995-96
   e) Kothari Cane Industries, Calcutta - 1998
9) Project Report prepared for Forest industries Travancore Ltd., Alwaye on Establishment modern cane furniture manufacturing unit.
10) ICFRE technology was transferred for solar drying, ammonia plasticization in bent wood furniture, ammonia fumigation for better colour of furniture products and cost effective preservation techniques to various wood industries by conducting wood technology clinics in different parts of the state.

Courses/Training being offered to Students/Forestry Professionals

1. Timber/bamboo/cane identification and wood quality assessment
2. Wood preservation, drying and processing
3. Oil curing/product conversion technology of canes under the UNDP Program
4. Any customized training programme in wood technology

New Areas of Training Needs

Lack of adequate training in newly emerging areas of wood energy sector and product manufacture or/and testing especially wood composite products/glulams and building codes from jointed structures, pulp modification with hydrolytic enzymes/biotechnology and gene transfer technology for desired wood quality and Chemical processing for product development from NWFPs. Equally important area is the role of tropical plantations in carbon sequestration and environmental issues.

The Ministry of Environment and Forests in India recognized the institute (KFRI) as the **Centre of Excellence for Non-wood Forest Products (NWFPs) like Bamboo and Rattans**.

V. Agriculture Universities and Other Organizations

In addition to the above Core institutes; the following agricultural universities and institutions, where the course of wood science was recently introduced at different levels, may also serve the purpose of education and training purposes within the network, but needs immediate human resource development programmes. Additionally, for specific needs of technology modification and transfer through inter- and multi-disciplinary programmes, Indian Institutes of Technology from Chennai, Kanpur and Mumbai can also be involved.

1 COLLEGE OF FORESTRY, KERALA AGRICULTURAL UNIVERSITY
Vellanikkara, THRISSUR, KAU POST 680 656
Tel: +91-487-370050
Fax: +91-487-370019

2 COLLEGE OF FORESTRY, UNIVERSITY OF AGRICULTURAL SCIENCE
Ponnampet 571216, Karnataka
Tel: +91-8274-49370
Fax: +91-8274-49365

3 DEPARTMENT OF FORESTRY, COLLEGE OF AGRICULTURE, P. K. V., AKOLA
Punjabrao Krishi Vidyapeeth, Krishinagar, Akola 444104
Tel: +91-26841/42/43 (PBX)
Telex: 0725-025

4 DR.Y.S. PARMAR UNIVERSITY OF HORTICULTURE AND FORESTRY
P. O. Box Nauni-173230, Solan (H.P.)
Tel: 333 (Solan)
Fax: +91-1792-2288

5 TAMIL NADU AGRICULTURE UNIVERSITY, FOREST COLLEGE AND RESEARCH INSTITUTE
Mettupalayam-641301, India
Tel: +91-425-42010
Fax: +91-422-41672

6 UNIVERSITY OF AGRICULTURAL SCIENCE, DEPARTMENT OF FORESTRY
Bangalore 560 065, Karnataka
Tel: +91-80-330153
Fax: +91-80-320840

7 UNIVERSITY OF SHIMLA
Himachal Pradesh

8 NORTH-EASTERN RESEARCH COUNCIL, WOOD SCIENCE DEPARTMENT, ITANAGAR
Arunachal Pradesh

JAPAN

I. Division of International Environmental and Agricultural Science, Graduate School of Agriculture, Tokyo University of Agriculture and Technology

Thrust Area:

1. Mechanical wood processing, industrial safety, etc.

II. Graduate School of Bioagricultural Sciences, Nagoya University

Division of Biological Material Sciences : Biomaterial Physics (BMP)

The major research objective is to understand the physical behavior of biological materials and the process of tree growth, from a physical point of view. Methodology extends over the physical, mechanical, chemical and computing

methods.

Generation processes of the physical properties and the growth stresses of biological materials are investigated by means of the field measurement in the worldwide forest, laboratory research involving material testing, electron-microscopic observation, X-ray and UV spectroscopy, image analysis, chemical analysis and other instrumental analysis as well as theoretical modeling. On the other hand, some applied research is carried out especially on the reduction of residual stresses in logs, the quality of tropical fast growing species as well as non wood forest resources, and about some problems on environmental functions of dwelling.

Thrust Areas:

1. Growth stresses and wood quality, anatomy, reaction wood, lignin formation in wood, etc.
2. Wood physics

III. Graduate School of Agricultural and Life Sciences, University of Tokyo

Thrust areas:

1. Utilization of agricultural residues like rice straw, pulping, recycling of wood resources
2. Bio-polymer chemistry, bleaching and lignin chemistry

IV. Asian Natural Environmental Science Center (ANESC), University of Tokyo

The Asian Natural Environmental Science Center was established in April, 1995 as one of the Cooperative Education and Research Centers of the University of Tokyo. The Center, composed of two Divisions, one of which is the Division of Biological Environment Assessment (DBEA), promotes cooperative studies on sustainable utilization of bio-resources in the Asian Region. Its activities will be coordinated with environmental conservation aimed at preventing the exhaustion of bio-resources and environmental destruction now obvious in many are around Asian region. The staff of DBEA have responsibilities to develop novel systems for land use based on regional characteristics, and the effective and sustainable utilization of untapped bio-resources. The development of novel and low-energy-input systems to increase the quantity of bio-resources will be undertaken by the staff of the DBEA using symbiotic and stress-tolerant functions of plants.

Global changes, especially in the Asian region, occasioned by the population explosion, exhaustion of bio-resources and environmental destruction, requires the urgent development of countermeasures through short- and long-term programs to increase the output of food while improving the utilization of bio-resources in the Asian region, it is also true that the developments foreshadowed will not control effectively the destruction of regional and global environments.

Of course, the accumulation of bio-resources depends heavily on the characteristics of the diverse ecological situations (forests, cultivated land and coastal areas) which are closely linked with one another. It is essential to devise ways of appropriately using land, taking into consideration the mutual relationships between their ecologies and the effective utilization of bio-resources without environmental destruction. Novel and low-energy-input systems are needed to increase the quantity of bio-resources. This may be achieved by augmenting the symbiotic relationships between plants and microorganisms. In addition, it is very important to search for plants in the global genetic pool that are resistant to

environmental stress, pathogenic microbes, viruses or pests, which would be useful in the development of bio-resources. The Center has been established to investigate, in a comprehensive way, the effective utilization of bio-resources, and has been constituted to cover these subjects as widely as possible. The activities of the Center and will promote and integrate investigations by scientists in this university and other institutions in Japan. In addition, collaboration with institution in the Asian region will be promoted through the activities of the Center.

V. Forest Tree Breeding Centre (FTBC)

This is an organization of Forestry Agency, the Ministry of Agriculture, Forestry and Fisheries (MAFF). FTBC conducts various forestry-related surveys, research, and technical guidance, and generally promotes Japan's forestry industry. FTBC operates in five blocks throughout Japan, in Hokkaido, Tohoku, Kanto, Kansai, and Kyushu. Each block has each Breeding Office. Also, in order to promote overseas technical cooperation, the Iriomote Tropical Tree Breeding Technical Garden was established in Okinawa Prefecture in 1996. The Center was changed into an Independent Administrative Institution on April 1, 2001.

Thrust Area :

One of the areas is breeding for wood quality with application of gene transfer technology with DNA markers and clonal multiplication.

VI. Institute of Wood Technology (IWT), Akita Prefectural University

Research Thrust Areas and available expertise:

1. Manufacture and application of cylindrical laminated veneer lumber (LVL) and properties and manufacture of composite panels
2. Machinery development for processing plantation thinnings (specialized machines for flaking mill and veneer production)
3. Drying technology
4. Preservation of all lingo-cellulosic materials including wood
5. Chemical modification of lingo-cellulosic materials and charcoal production from agro-forestry residues

VII. Faculty of Agriculture, Kyoto University

Thrust Areas:

1. Wood and heartwood formation in fast growing tropical hardwoods
2. Anatomy of palms, bamboo, monocotyledons, etc.
3. Genetic engineering of bamboo
4. Anatomy, ultra-structure, quality of tropical woods and biomass utilization

VIII. Wood Research Institute (WRI), Kyoto University

1) Laboratory of Structural Function, Division of Wood Material Science

The laboratory aims to develop new wood composites harmonized with both global and regional environment by making use of the functions of wood as a cellular solid;

1. Fundamental methodology, machines and systems for producing the high-performance of wood composites and their characteristic functions

2. The development of wood carbon materials with new functions by thermal conversion and the technology for bio-energy
3. The development for improving fire-resistant performance of wood composites.

The projects taken are as follows:

1. Lumber Composite Products
   a. Continuous production process of cylindrical LVL
   b. Numerical analysis of mechanical properties of cylindrical LVL and paper pipe
   c. Prediction of mechanical properties of oriented materials from different element sizes based on fracture mechanics
   d. Development of joint plates with compressed LVL
   e. Grading and fire-resistant performance of tropical fast-growing species
   f. Production technology of stick-lumber and stick-ply
   g. Production of thick LVL/fiber-reinforced LVL using continuous steam-injection press
2. Panels Products
   a. Development of kenaf boards
   b. Kenaf binderless board and its composites
   c. Production and properties of vertically oriented fiberboard (VOF)
   d. Properties of the sandwich panels with VOF core
   e. Production and properties of high performance bamboo fiberboard with a hollow structure
   f. Shear performance of sandwich panels
   g. Development of reed/wheat-straw board
   h. Development of food attractant particleboard for termites using steam-injection pressing
   i. Improvement of dimensional stability for panel products by using steam pretreatment
3. Acoustic Materials
   a. Acoustic properties of wood for musical instruments
   b. Improvements of acoustic properties of wood by use of chemical treatments
   c. Production of soundboards from Japanese cedar logs with a small diameter
4. Bio Oil & Wood Vinegar
   a. Pyrolysis of chromium-copper-arsenate treated wood at low temperature
   b. Fast pyrolysis of chromium-copper-arsenate treated wood in a fluidized bed reactor
   c. Energy from wood biomass by fast pressurized heating equipment
   d. Chemical components and anti-fungal efficiency of wood-vinegar-liquor prepared from different species
5. Biomass Carbon Materials
   a. Adsorption and desorption of wood charcoal carbonized at high temperature
   b. Investigation of microstructure formed in wood charcoal during carbonization - observation by electron microscopy andalysis by XPS
   c. Development of wood-based carbon materials by direct pulse sintering
   d. Micro structural investigation of bio carbon composites
   e. Catalytic carbonization at high temperature of biomass carbon by aluminium oxide
   f. Improvement of fire resistant performance of wood composites by overlaying the carbon materials

6. Densification/High-strength Wood Plastic Composites
   a. Politicization of wood by use of wood rotting fungi
   b. Changes in thermal softening behaviors of wood due to removing of wood constituents
   c. Production of plastic-like wood flour molding
   d. Plastic-like molded products made from Radiata pine bark or its extractives
   e. High strength and bio-degradable moldings made from pulp
   f. Selective densification of wood
   g. Production of high strength wood based materials
   h. Production of natural plant fiber reinforced plastic
   i. Densification, drying, and impregnation by roller-press
7. Mineral Bonded Composites
   a. Rapid curing technology of cement bonded particleboard with mineral additives
   b. High-performance cement bonded particleboard and fiberboard by curing with carbon dioxicide
   c. Production of cement bonded fiberboard from oil palm fibers
   d. Durability and weathering of cement bonded particleboard
   e. Study on wood-based materials with multi-functions
   f. High-performance gypsum bonded particleboard
   g. Propose to new methods of cement bonded boards' manufacture - search for alternative solutions to the high specific gravity problem
8. Adhesive Resins/Durability of Adhesion
   a. Properties and durability of MDI (Methylene Diphenyl Diisocyanate) resins
   b. Bonding properties of gluco-mannan
   c. Durability of urushi coating films
   d. Production of high durable wood adhesives from bark of fast growing trees
   e. Decomposition with lactic acid of wood and utilization of the fragment to adhesive
9. Integrated Projects
   a. Life cycle assessment of wood composites
   b. Zero-emission processes for oil palm residues
   c. Total processing and utilization system of domestic small-diameter low-grade logs
   d. Durability of timber construction and wooden cultural properties
   e. Development of bio energy from chromium-copper-arsenate treated waste wood.

2) Laboratory of Gene Expression, Division of Wood Bioscience

The institute undertakes studies on gene expression in woody plants to elucidate function of target genes. They are also studying transformation for better understanding trees and for developing new traits.

Thrust Areas:

1. Cell wall loosening
   This study focuses on the structure and function of endo-1,4-beta-glucanase.
2. Biosynthesis of cellulose
   Molecular and cell biology of cellulose biosynthesis in higher plants

3. Characterization of genes in woody plants
   One of the aim is to understand gene expressions in the secondary metabolism and is to discover unique genes or expression that are characteristic in woody plants. The others are to serve those genes for new traits.
4. Research and development of transgenic trees
   This project focuses on introducing new traits into a tree. Gene transfer systems for woody plants have been developed to produce useful substances and traits.

The Wood Research Institute (WRI), Kyoto University, will serve as a core university to coordinate the activities of collaborating universities, institutes and individual researchers in Japan and to plan and actually implement the activities hand in hand with the counterpart core institute, R & D Centre for Applied Physics, Indonesian Institute of Sciences (LIPI), Indonesia.

WRI and the R & D Centre for Applied Physics, LIPI, have been conducting a cooperative research on "The characterization and efficient utilization of wood and forest residues" as part of the Cooperative Program of JSPS since 1983. A new program started in 1996 under the "Core University System", for the following three activities in the fields of wood science and technology;

1. Organization of cooperative research
2. Exchange of scientists
3. Organization of symposia.

Scientific activities in this program cover all fields of wood science and technology including material science, physics, chemistry, biology, genetics and environmental science. Leading scientists from 17 Japanese and 15 Indonesian universities and institutes are expected to join this program.

4.2 Lessons from success stories of regional/international networks: FORSPA and INBAR

I. What is FORSPA?

The Forestry Research Support Programme for Asia and the Pacific (FORSPA) is an FAO Program that was established in 1991 to assist research institutions in the Asia-Pacific Region to strengthen their science and technology capabilities in forestry research.

FORSPA Phase I (Nov. 1991 to Dec. 1994) was funded by Asian Development Bank, with an Intermediate Phase (1995) supported by AusAID and the United Kingdom's ODA. Seeing the need for continuing support for the enhancement of national forestry research systems and based on the lessons learned in Phase I, Phase II was launched in January 1996. The project document signed by the Dutch Government envisaged the provision of support for 19 countries in the Asia Pacific Region, viz. Bangladesh, Bhutan, Cambodia, China, India, Indonesia, Fiji, Lao PDR, Malaysia, Myanmar, Nepal, Pakistan, Papua New Guinea, Philippines, Solomon Islands, Sri Lanka, Thailand, Vanuatu and Vietnam. The Phase II (1996-2000) is being funded by the Netherlands Government.

FORSPA's Mission

To promote conservation and sustainable management of forest and tree resources in the Asia Pacific Region by building country capacity in research and enhancing technical capabilities of communities, farmers and forest resource managers in responding effectively to the changing social, economic and environmental conditions facing them.

How FORSPA Operates

FORSPA does not undertake research. It supports:

- By developing research networks which lead to greater collaboration among researchers in the region;
- By providing technical and managerial support for networking, organization of meetings and seminars, development of databases, and publishing of newsletter, case studies and monographs;
- By initiating topic-specific research studies of regional importance;
- By assisting in capacity building of national institutes through research planning, human resource development, increasing access to information, and facilitating technology transfer and adaptation; and
- By assisting in twinning arrangements to promote inter-institutional collaboration, sharing of knowledge, and transfer of know-how and technology.

Project Objective

The long-term objective of FORSPA is to promote conservation and sustainable management of forest and tree resources in the Asia Pacific Region. This long-term objective is to be achieved through country capacity of communities, farmers and forest resource managers in responding effectively to the changing social, economic and environmental conditions confronting them.

Immediate objectives of FORSPA Phase II are:

i. To support networks on topics of national and regional significance and undertake studies with regard to development and adaptation of technologies by disadvantaged groups like women and to sensitive

researchers and users of research to incorporate the social, economic and cultural dimensions of technologies on conservation, management and utilization of forest and tree resources;

ii. To assist capacity building in forestry research in countries with insufficiently developed research systems through research planning support, training, increased access to information and supporting the establishment of twinning arrangements to facilitate technology transfer and adaptation; and

iii. To develop and strengthen the Asia Pacific Association of Forest Research Institutions (APAFRI) through providing technical and managerial support for networking, including organization of meetings and seminars, development of supporting databases, publication of monographs, case studies and newsletters.

Project Philosophy

FORSPA's working method is based on the belief that there is enough know-how and potential in the region to deal with the many problems and challenges that lie in the filed of forestry research. Many of the problems are common throughout the region, and so it will be much more effective if the know-how and information on common issues can be shared and problems are solved jointly. This is the reason for the strong emphasis on regional networking. FORSPA's efforts are directed to establish durable forestry research networking platforms, in which the Asia Pacific Association of Forestry Research Institutes (APAFRI) should play the central co-operation role.

This concept forms the basis for the approach applied in FORSPA's activities to enhance the forestry research capacity of countries with insufficiently developed forestry research systems. The activities are mostly implemented in line with the South-South co-operation. Expertise is sought within the region for strengthening the capacity of the weaker forestry research institutions in specific countries.

FORSPA's Activities

FORSPA engages in activities at regional and country levels as following:

- **Regional Level Activities (regional networking):**
  - o Asia Pacific Association of Forest Research Institutions (APAFRI)
  - o Topic specific networks
  - o Regional studies relevant to R&D development
- **Country Level Activities (strengthening national forestry research systems):**
  - o Research Planning Support
  - o Human Resource Development
  - o Information Support Services
  - o Twinning Arrangements

Overview of Accomplishments

The overview of accomplishments can be judged from the distribution of FORSPA's resources to the different activity types, for the implementation period (1996-2000) as given below.

- ➤ Country capacity building
- ➤ Regional networks (APAFRI, TEAKNET, etc.)
- ➤ Regional meetings and studies
- ➤ Regional Databases.

II. What is INBAR ?

The International Network for Bamboo and Rattan (INBAR) is an international organization established by treaty in November 1997, dedicated to improving the social, economic, and environmental benefits of bamboo and rattan. INBAR connects a global network of partners from the government, private, and not-for-profit sectors in over 50 countries to define and implement a global agenda for sustainable development through bamboo and rattan.

As of March 2001, INBAR's Establishment Agreement has been signed by 22 countries: Bangladesh, Benin, Bolivia, Canada, Chile, China, Colombia, Cuba, Ecuador, Ghana, India, Indonesia, Kenya, Malaysia, Myanmar, Nepal, Peru, the Philippines, Sri Lanka, Tanzania, Togo and Vietnam. Following a recent review by INBAR, the number of potential members is about 75-80.

Why Bamboo and Rattan?

- A sixty-foot tree cut for market takes 60 years to replace. A sixty- foot bamboo cut for market takes 59 days to replace.
- Over one billion people in the world live in bamboo houses.
- The world trade in bamboo and rattan is currently estimated at 14 billion US dollars every year.
- The majority of bamboo and rattan harvested for market is harvested by women and children, most of whom live at or below subsistence levels in developing countries.

How INBAR came into existence

Recognizing the socioeconomic importance of bamboo and rattan to the developing countries in the tropics and sub-tropics, the International Development Research Centre (IDRC) has, since 1979, fostered research efforts aiming to better understand, utilize and develop these resources, principally in the Asian region.

National research institutions and NGOs were linked in an informal network involving funding of over US$ 8 million in the past decade. In 1990, an IDRC-sponsored meeting of interested donors and organizations recognized that research investments in bamboo and rattan have substantially benefited the poor in developing countries of the tropics and sub-tropics. The resulting study on the strategic needs for further research identified key areas and also suggested the creation of a formal network to consolidate and strengthen existing research activities in the region and broaden their scope. Acting on these recommendations, IDRC, with support from the International Fund for Agricultural Development (IFAD), established the International Network for Bamboo and Rattan (INBAR) in 1993.

Chronology

- o In 1979, IDRC initiated support for research aimed to better understand, develop and utilize bamboo and rattan resources.
- o In 1984, the national programmes were linked together into an informal network to provide a forum which was sustained by IDRC until 1993.
- o In 1991, IDRC, IFAD, the Rockefeller Foundation and the Overseas Development Administration (ODA, UK), commissioned a review of past research and requested recommendations for future action. The study recommended that the research be reoriented and there should be an independent, autonomous International Network for Bamboo and Rattan (INBAR) established either within or outside of the Consultative Group on

International Agricultural Research (CGIAR) system.

- o In June 1993, INBAR was established by IDRC and IFAD.
- o In May 1995, senior research managers from Asia and representatives of IDRC and IFAD met with the INBAR network to discuss and recommend institutional and funding options. At that meeting the representative from China, Prof. Chen Tongai, President of the Chinese Academy of Forestry (CAF), offered to host a headquarters for a new independent international centre for bamboo and rattan. As a result, Dr. Keith Bezanson, today ex-President of IDRC, convened a Task Force to explore the way ahead.
- o In August 1995, the recommendation that INBAR work toward achieving independent international status was endorsed by a task force struck by IDRC.
- o In September 1996, IFAD approved US $900 thousand funding for a Phase II programme of INBAR.
- o In October 1996, IDRC approved a US $1.6 million grant for the Phase II activities of INBAR and a further core grant for US $750 thousand in January 1997.
- o In January 1997, the State Council of China formally approved the establishment of INBAR and made a commitment of at least US $4 million support in kind to the new institution. The President of IDRC constituted an interim board of INBAR to oversee the transition into an independent centre.
- o On November 6, 1997, representatives from 10 countries, including Canada, signed the international treaty to establish INBAR as the first international research and development organization headquartered in the People's Republic of China.

Achievements of INBAR

Resource Improvement and Management

- o Creation of Anji Bamboo Garden, in China - largest in the world, extending over 20 hectares and including 221 species. This garden has produced over 40,000 offsets for cultivation in China and elsewhere. Visited by 10,000 researchers, producers and tourists each year.
- o Five thousand hectares of rattan plantation established in China. A rattan herbarium of over 1,000 species established.
- o Rattan incorporated in 7,000 hectares of rubber plantations in Malaysia.
- o A 500-hectare demonstration bamboo plantation was established in Bangladesh.
- o Investment/return ratio on rattan plantation increased by more than 25% by employing technology developed by the INBAR.
- o Intensive bamboo management technology developed through INBAR research was adopted in 72,000 hectares in Southeast Asia resulting in income of US $50 million to farmers.
- o Improved vegetative propagation techniques developed in Bangladesh and India.
- o Protocols developed for in-vitro propagation in Bangladesh, India, Philippines and Thailand.
- o Six national bamboo and rattan living collections were established.
- o Remote sensing techniques and Geographical Information Systems (GIS) interventions were applied for resource assessment in India and Thailand.

Processing and Product Technology

- o Various improvements were made in the preservation process and utilization of bamboo shoots, resulting in improved profitability for processors and farmers alike.

- o Developed economical preservative treatment methods for bamboo in Bangladesh and India.
- o Simple preservative treatments were standardized for bamboo culms ("stems") used as support for agricultural crops in India.
- o A simple rattan pole dryer, using local materials was developed in the Philippines.
- o Twenty-five bamboo and rattan processing technologies and machines were developed/designed, 11 of which were patented in Malaysia.
- o Improved bamboo mat board was developed in India.
- o Bamboo container floorboard was developed in China.
- o A cement-bonded, rattan-residue building board was developed in the Philippines.

National and International Policy

- o Listing of bamboo as a priority planting species in Bangladesh as a result of data generated in network-supported research.
- o Recognizing the successes of INBAR, Indonesia established a national version of the network.
- o Inclusion of bamboo research, as an area for assistance to developing countries, by the Department of Foreign Affairs of China.
- o Bamboo was included for the first time in the National Five year Plan (1995-2000) of China as a result of the thrust given by network- supported research.

Human Resources Development

- o Thirty-four training courses were conducted for entrepreneurs in bamboo and rattan based enterprises (700 people trained) in Malaysia.
- o Training in bamboo cultivation techniques for 5,000 people (foresters, farmers, NGOs) in Bangladesh.
- o Nine hundred local and 200 foreign people trained in bamboo cultivation in China.
- o Based on network-supported research, a cane training and technology centre was developed in India.
- o INBAR workshops conducted in India demonstrated bamboo and cane craftsmanship.
- o Three INBAR Information Centres (two for bamboo and one for rattan) were established and maintained in Malaysia, China and India.
- o Sixteen INBAR publications and eight issues of INBAR's quarterly newsletter were published.

4.3 Concepts of arbitrary model training network of ICCAE in the field of wood science

It is evident from the foregoing account of success stories of networking organizations that effective training programmes can be developed by stronger partnerships built, both within and between the countries, by pooling the limited available resources and share infra-structure and expertise to mobilize the support from among various international and national donor/ developmental agencies including private sectors. For instance, a tentatively established teak wood network integrates the collaborative efforts of IUFRO 5.06.02 Working Party (Timber quality from teak plantations) with other teak institutions such as TEAKNET and TEAK 2000 with the participation of various Research and Development Organizations possibly within the umbrella of IUFRO and APAFRI.

Mission of ICCAE - Training Network

The RT-network of ICCAE shall foresee:

1. Building country capacity in Training and Technology Transfer and enhancing the technical capabilities of rural communities, farmers, forest resource managers and small-scale forest-based industrialists in responding effectively to the changing social, economic and environmental needs
2. Assisting in building capacity in national institutes through training program planning, human resource development, increasing access to information, and facilitating technology transfer and adaptation
3. Developing training networks which lead to greater collaboration among the institutions within and between the countries
4. Providing technical and managerial support for networking, organization of meetings and seminars, development of databases, and publishing of newsletter, case studies and monographs
5. Initiating problem-oriented training programmes of regional and local importance
6. Assisting in twinning arrangements to promote inter-institutional collaboration, sharing of knowledge, and transfer of know-how and technology.

How ICCAE Training Network will Operate?

Within the each basic network area, viz. NWFPs, Timber net and Residue Utilization, formation of several sub-networks are suggested to meet more specific objectives and training requirements (Fig. 4.1).

- It is envisaged to develop training programmes at two levels to be effective in order to deliver the goods and reach to the level of users and rural communities (Fig. 4.2)

  Level I - Trainer's Training and

  Level II- End-user's training for rural communities.
- Each such sub-network, for instance, TEAKNET, has clearly defined activities to accomplish the targeted training needs with participation of lead/core institutions and their identified resource persons (See Appendix V) through net-workshops, training programmes and by awarding internships/fellowships. This will serve the purpose of Trainer's Training Needs.
- Subsequent follow up action might be warranted from ICCAE to transfer and implement the technology at grass-root level by using the human resource developed through the first level trainer's training programmes. To organise the second level training effectively, trainers of various organizations of developing countries obtain requisite expertise and orientation to effectively transfer the technology from lab-to-land and lab-to-industry in order to improve the living conditions of the rural poor communities as shown in the general

multilateral training network model (Fig. 4.2).

- The first level HRD (Human Resources Development) can be achieved by developing training programmes through exchange programmes of wood specialists of North-South and South-South Cooperation basis. Once this is achieved, local lead organizations can arrange a variety of rural training programmes as relevant to local conditions. In later stages, even to tackle the common problems of similar nature, South-South Cooperation can be promoted by ICCAE.

International Net-workshops for Training Consortia

To establish the training consortium, ICCAE shall organise the net-workshops of environmentally crucial and socially relevant themes with the participation of the experts of both developing countries and Japanese lead/core institutes and donor agencies. Frequent such net-workshops will help to develop the documents/publications of strategic training plans to meet the specific requirements of the concerned countries.

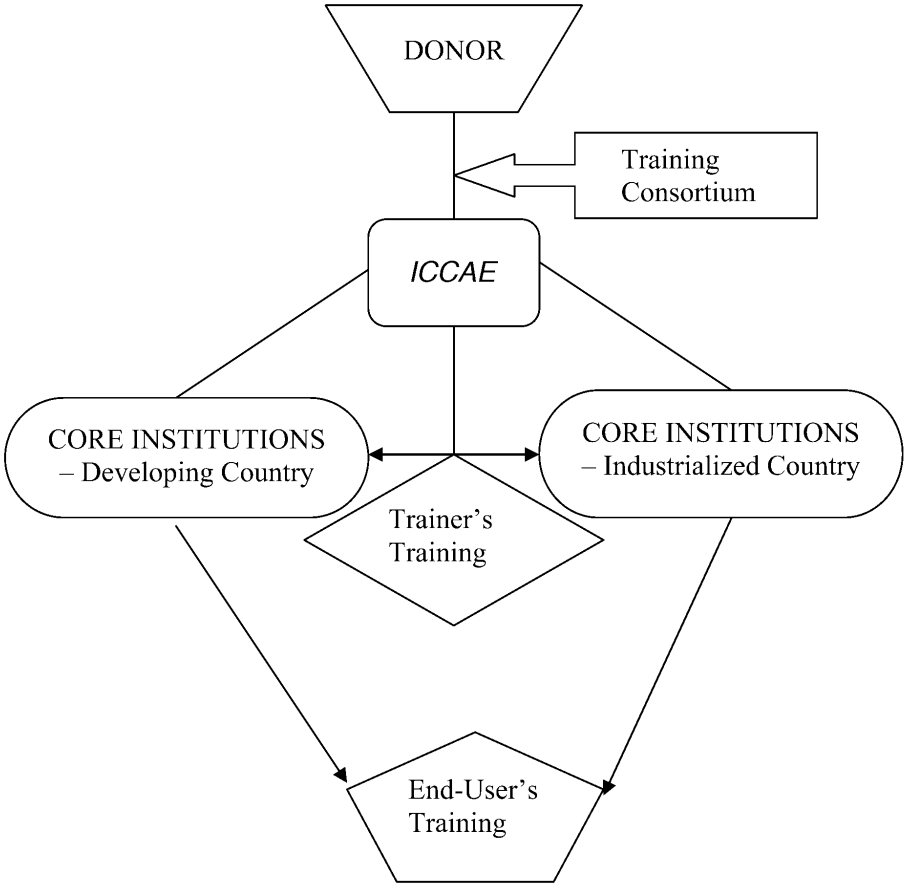

Fig 4.2　Arbitrary model of ICCAE's multi-lateral training network

4.4 Strategic plans for proposed Indo-Japanese bilateral training programme

I. Establishment of Training Consortium

1. ICCAE will initiate to organise the Net-workshops with the representatives of potential donor/government agencies of India and Japan, and the Directors/Research Managers of the Lead Institutes identified with the objective of establishing Training Consortium.
2. Prior to this, if found necessary, Consultative Group Meetings will be held to receive the ideas/technical inputs from the experts of the identified Lead institutes of both countries to set the training priorities that may need the approval of donors for establishing the training consortium in the net-workshops. The potential participants can be identified from the list furnished in this document elsewhere. Such Consultative Meetings will also be useful to establish databases in critical areas of training needs in the form concrete documents.

Decision making bodies/ Government agencies

The main concerned Indian decision making and government bodies include: Ministry of Human Resource Development (MHRD), Ministry of Environment and Forests (MoEN), Ministry of Science and Technology (MS&T) and University Grant Commission (UGC).

In Japan, as already identified, Nagoya University, the Ministry of Education, Science, Sports and Culture (Monbusho), the UN Centre for Regional Development, Japan International Cooperation Agency (JICA) and the Aichi prefectural government appear to be the potential donors for establishing the consortium.

Core institutions and their linkage for training network

Depending on the identification of base nets and the defined activities potential experts can be chosen from the list furnished in this document for the first level of trainer's training programmes.

The second level of user's training programmes will be organized by the lead institutions of India in the rural community levels. Wherever necessary, for instance, in the modification of machinery of wood processing industries, North-South Cooperation will be sought to participate the Japanese institutions (Fig. 4.3).

II. Institutional Linkages for Potential Training Networks : Japan and India

From the list of lead/core institutions and the availability of human resources from them (Appendix V), various networks can be established to meet the specific training requirements. The linkage of potential institutions in different thrust areas are indicated below. This represents only arbitrary list and more organizations can be involved in the network if they have the proven record of scientific achievements in the concerned areas. It is also strongly recommended that human resources from various other countries/institutions, as identified in the Appendix V, can be employed and the expertise shared to render effective training programme.

Similar networks of multilateral training programmes can be arranged by employing the human resources available in the Asia Pacific Region as given in the Appendix V.

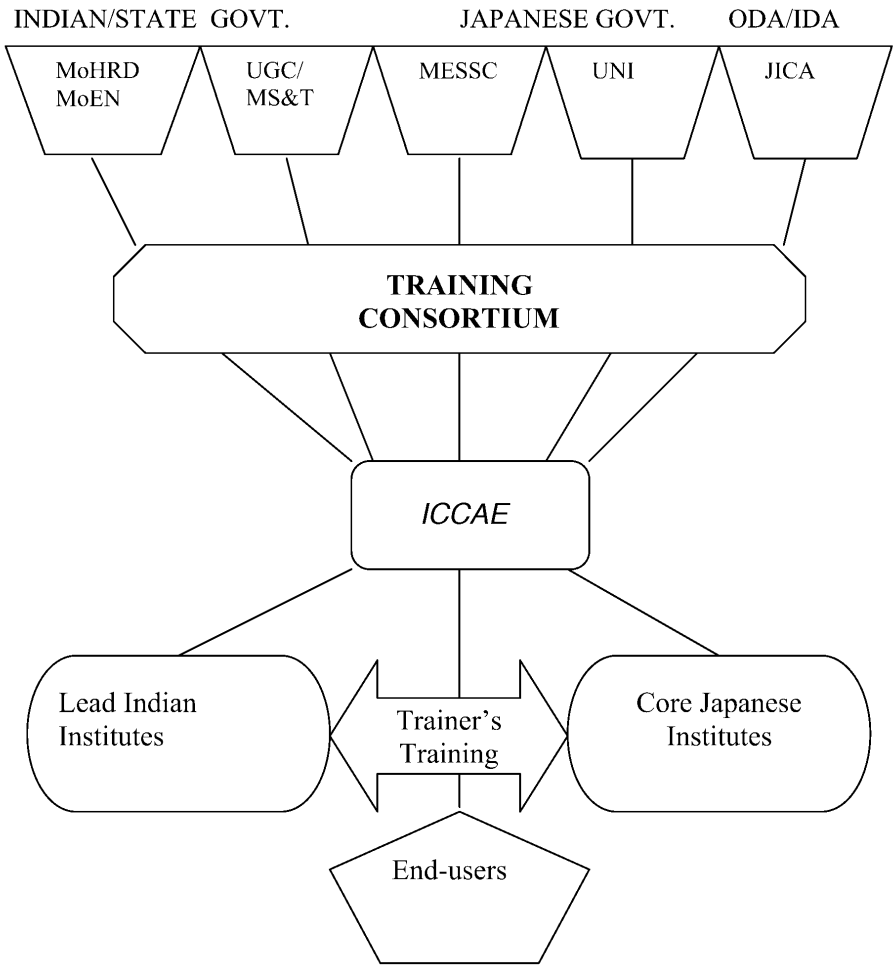

Fig. 4.3　Proposed Indo-Japanese bilateral training network in Wood Science

NWFP Utilization - Potential Training Networks			
Training Activity and sub-networks		Lead Institutes-India	Core Institutions-Japan
Bamboo and Rattan	Bamboo production / genetic engineering, harvesting, properties, processing, product development, marketing	KFRI, IPIRTI, FRI, IWST, IFGTB	ANESC, FA-KytU, BMP-NU, FA-SHZU
NWFPs	Extraction and Chemical processing of plant constituents	IWST, FRI, KFRI	FA-GIFU, FA-YU

TIMBER TECHNOLOGY - Potential Training Networks			
Training Activity and sub-networks		Lead Institutes -India	Core Institutions-Japan
Timber quality improvement /modification	Growth stresses and quality of fast grown wood	KFRI, IWST, FRI	BMT-NU, FA-KytU
	Breeding for wood quality in Teak	KFRI, IFGTB, IWST	FTBC
	Eucalypts, Acacia/other hardwoods	IWST, IFGTB,	FTBC
	Gene Transfer Technology/GMOs	KFRI, IWST, IFGTB	WRI-KytU, FA-KyshU
	Timber preservation/protection	FRI, IPIRTI, IWST, KFRI	FA-KytPU, FA-KyshU
Carbon sequestration through tropical plantation management	Carbon inventory/dynamics of teak/eucalypt/acacia plantations	KFRI, IWST	ANESC
Mechanical Processing of small diameter logs and industrial safety	Sawmilling, saw doctoring, Finger-jointing & Gluing, Glulam and composite products/panels, etc.	IPIRTI, FRI, IWST, KFRI	TUAT, KytU-WRI, FA-IU, FA-KyshU, FA-SZKU, FA-TU, FSE-SHIU
	Grading of timber from TOF	IPIRTI, IWST, FRI, KFRI	KU-WRI
	Marketing of Tropical timber/wood products	FRI, IFM, KFRI, IPIRTI, IWST	Kyt-U
Chemical properties, Processing, Utilization	Utilization of wood phenolics/extractives, constituents	IWST, FRI, KFRI	FA-GIFU, FA-KytPU, SA-EhU, SA-KochU

RESIDUE UTILIZATION - Potential Training Networks			
Agro-, logging- and mill-residues	Developing composite boards	IPIRTI, FRI, IWST, KFRI	GSALS-UT, FA-SHZKU, FA-TotU

* No adequate information is readily available on the human resources of agricultural universities in India

Multilateral training programs

The proposed bilateral training network can be extended depending on the needs by involving the concerned countries for developing the human resources and sharing the existing expertise. Such a network can be built up by choosing the institutions identified in the Appendix V.

Merits and Demerits of Networking Approach

A. Merits

1. Partnerships offer more scope for higher productivity for given/limited resources (human and financial resources) and avoid duplication of wasteful efforts
2. Cultural exchange/diversity may yield more fruitful outputs and even minimize the effects of racism and xenophobia

B. Demerits

1. Competition between the institutions/countries for sharing resources and credibility
2. Reduction in self reliance and credibility

Appendix I

List of educational/training institutions for forest management and forest service in India

Sl. No.	Organization/Address	Year of Establi-shment	Areas of Teaching/ Training	Teaching Staff Strength
1	ASSAM FOREST GUARDS' SCHOOL Makum JN, Tinsukia, Assam Tel: 0091-5685	1980	Forest Management, Silviculture, Wild life	Lectures 6
2	CENTRAL FOREST RANGER'S COLLEGE Mul Road, Chandrapur 442401 Maharashtra Tel: 0091-2519	1976	Forest management, Silviculture, Law, Protection, Wild life	3
3	FOREST RANGERS' TRAINING COLLEGE Balaghat (M.P.) Tel: 0091-2549	1907	Forest Management, Silviculture, Law	7
4	FOREST TRAINING SCHOOL, SEPAHIJADA P. O. Sepahijada, P. S. Bishalgarh, West Tripura 799 102 Tel: 0091-227 (BSL)	1969	Silviculture, Forest Management	4
5	FORESTRY TRAINING INSTITUTE P. O. Box 24, P.O Haldwani Dist. Nainital, UP 263 139 Tel: 20653	1979	Forest Management, Silviculrure	8
6	GUJARAT FOREST RANGERS' COLLEGE Vadia Palace, Rajpipla, Dist. Bharuch, Gujarat, Pin No:393145 Tel: 11, MSTD-0264012	1979	Silviculrure, Mensuration, Forest Management	4
7	INDIAN INSTITUTE OF FOREST MANAGEMENT P. O. Box 357, Nehru Nagar, Bhopal 462003, Madhya Pradesh Tel: 0091-755-65998 Fax: 0091-755-555751	1982	Forest Management	18
8	KERALA FOREST SCHOOL Walayar Dam, Palghat, Kerala Tel: Walayar 62260 Cable: Kerala Forest School, Walayar	1961	Forest Management, Mensuration, Silviculrure, Social Forestry, Law	5
9	ORISSA FOREST RANGERS' COLLEGE P. O. Box Angul Dist. Dhenkanal, Orissa Tel: 0091-6764-454	1979	Silviculrure, Forest Management, Protection, Wildlife	8
10	SOCIAL FORESTRY, FOREST SCHOOL, SHIUPURI Shiupuri 473551, Madhya Predesh Tel: 2610		Silviculrure, Protection, Mensuration, Law, Social Forestry	7

11	STATE FOREST SERVICE COLLEGE P. O. New Forest Dehra Dun 248006 Tel: 26168	1981	Watershed Management, Economics, Policy, Law, Silvicultrure, Entomology, Pathology, Timber Harvesting, Forest Soils, Protection, Social Forestry	8
12	STATE FOREST SERVICE COLLGE- TAMIL NADU R. S. Puram, forest compound Coimbatore 641002, Tamil Nadu Tel: 42605	1981	Forestry/Fundamentals of Wood Science	6
13	TAMIL NADU FOREST COLLEGE Vaigai Dam P. O.: 626 512 Andipatti Taluk, Madurai District, Tamil Nadu Tel: 2236	1961	Environmental Conservation, Mensuration, Forest Management, Silviculrure, Law, Forest Soils	9

Appendix II

List of Agriculture Universities offering graduate/post graduate courses in forestry in India

Sl. No.	Organization/Address	Year of Establi-shment	Areas of Teaching/ Training	Teaching Staff Strength
1	COLLEGE OF FORESTRY, KERALA AGRICULTURAL UNIVERSITY Vellanikkara, THRISSUR KAU POST 680 656 Tel: +91-487-370 050 Fax: +91-487-370 019	1986	Forestry, Wildlife, Wood Science	14
2	COLLEGE OF FORESTRY, UNIVERSITY OF AGRICULTURAL SCIENCE Ponnampet 571216, Krnataka Tel: +91-8274-49370 Fax: +91-8274-49365		Forestry, Wood Science	3
3	DEPARTMENT OF FORESTRY, COLLEGE OF AGRICULTURE, P. K. V., AKOLA Punjabrao Krishi Vidyapeeth, Krishinagar, Akola 444104 Tel: +91-26841/42/43 (PBX) Telex: 0725-025	1985	Silviculrure, Tree Improvement, Forest Management, Wood Technology, Agro-forestry, Social Forestry	5
4	DR.Y.S. PARMAR UNIVERSITY OF HORTICULTURE AND FORESTRY P. O. Box Nauni-173230, Solan (H.P.) Tel: 333 (Solan) Fax: +91-1792-2288	1985	Forest Management, Silvicultrure, Forest Product Technology	
5	H.N.B. GARHWAL UNIVERSITY, DEPARTMENT OF FORESTRY P. O. Box 59, Srinagar (Garwal) 246174, U.P. Tel: 2143	1974	Forest Management, Silviculrure, Protection, Agroforestry	6
6	PUNJAB AGRICULTURAL UNIVERSITY, DEPARTMENT OF FORESTRY AND NATURAL RESOURCES, COLLEGE OF AGRICULTURE Ludiana 14100, Punjab Tel: +91-161-51960 Fax: +91-161-51794	1962	Silviculrure, Tree Improvement, Forest Management, Agroforestry	10
7	TAMIL NADU AGRICULTURE UNIVERSITY, FOREST COLLEGE AND RESEARCH INSTITUTE Mettupalayam-641301 Tel: +91-425-42010 Fax: +91-422-41672	1985	All aspects of forestry, Wood Science, Agroforestry, Project Formulation, Research Methodology	22

8	UNIVERSITY OF AGRICULTURAL SCIENCE, DEPARTMENT OF FORESTRY Bangalore 560 065, Karnataka Tel: +91-80-330153 Fax: +91-80-320840	1973	Silviculrure, Forest Management,. Farm Forestry, Social Forestry, Biotechnology, etc.	11

Appendix III

List of forest research institutions offering training/educational courses in India

Sl. No.	Organization/Address	Year of Establi-shment	Areas of Teaching/ Training	Teaching Staff Strength
1	ARID FOREST RESEARCH INSTITUTE 12/10 Nandanvan, Jodhpur 342008	1988	Aspects of arid zone forestry	
2	FOREST RESEARCH INSTITUTE (ICFRE-Deemed University) P.O. New Forest 248 006, Dehra Dun (UP) Fax: +91- 0135-23258 E-Mail: icfre@envfor.delhi.nic.in	1906	All aspects of forestry, Wood Science	
3	INDIAN PLYWOOD INDUSTRIES RESEARCH AND TRAINING INSTITUTE PB No. 2273, Tumkur Road Bangalore 560 022			
4	INSTITUTE OF RAIN AND MOIST DECIDOUS FOREST RESEARCH P.O. Jorhat 785 001, Assam	1988		
5	INSTITUTE OF FOREST GENETICS & TREE BREEDING P.B. No. 1031, R.S. Puram, Coimbatore	1988	Tree improvement of dry deciduous & plantation species	
6	INSTITUTE OF WOOD SCIENCE AND TECHNOLOGY P.O. Malleswaram 18th Cross Bangalore 560 003 Tel: +91-80-3341731 Fax: +91-80-3340529	1988	Main research areas: All aspects of Wood Science	
7	KERALA FOREST RESEARCH INSTITUTE P.O. Peechi 680 653, Thrissur Dist. Kerala Tel: +91-487-282037 Fax: +91-487-282037 Website: http:// www.kfri.org	1975	Main research areas: All aspects of tropical forestry and Wood Science	
8	RESEARCH AND TRAINING DIVISION PINJORE, DIVISIONAL FOREST OFFICE, Pinjore, Ambala, Haryana Tel: 2469 (Kalak)	1966	Silvicultrure, Forest Management, Wood Technology, Social Conservation, Forest Industries	5

Appendix IV

Curricula of different courses/universities in India

(1) G.B. Pant University of Agriculture and Technology, Pant Nagar

Four-year B.Sc. (Forestry) Programme (as on 1990)

I.	Remedial Courses		
A.	Inter Agric. Group:		Semester Credits
1.	BPC-131	General Chemistry	2 (1-0-3)
2.	BPM-209	Elementary Mathematics	4 (4-2-0)
3.	BPP-123	Introduction to Physical Measurements	2 (1-0-3)
			8
B.	Inter Biology Croup:		
1.	APA-100	Elementary Agriculture	2 (1-0-3)
2.	BPM-209	Elementary Mathematics	4 (4-2-0)
			6
C.	Inter-Maths Group:		
1.	APA-100	Elementary Agriculture	2 (1-0-3)
2.	BBB-100	Elementary Botany	3 (2-0-3)
3.	BBZ-110	Elementary Zoology	3 (2-0-3)
			8
D.	10+2 Science Group (Biol./Maths)		6/8
E.	10+2 Science Group Biol.+ Maths :		
1.	APA-100	Elementary Agriculture	2 (1-0-3)
F.	Hindi courses for those students who have not studied Hindi at High School or euivalent		
1.	BHS-105	Elementary Hindi	2 (1-0-2)
			2
II.	Basic Supporting Courses:		
1.	BHS-215	General English	3 (2-0-2)
2.	BHS-210	Tech. Writing	2 (1-0-2)
3.	BHS-271	Pub. Org. & Rural Soc. Problems	4 (3-0-3)
4.	AFC-110	General Economics	2 (2-0-0)
5.	BPS-210	Elements of Statistics	3 (2-0-2)
6.	APH-206	Elements of Horticulture	4 (3-0-3)
7.	AAS-202	Principles of Animal Husbandry	3 (2-0-3)
8.	APA-200	Princ. & Prac. of Agronomy	3 (2-0-3)
9.	APS-215	Introductory Soils	2 (2-0-0)
10.	APB-220	Elements of Genetics	3 (2-0-3)

11.	ACE-200	Introd. Communication & Extn.	3 (2-0-3)
12.	APP-204	Introd. Plant Pathology	2 (1-0-3)

III. Core Courses:

1.	BBB-210	Systematic Botany of Forest Species	3 (2-0-3)
2.	BBB-220	Physiology of Forest Species	3 (2-0-3)
3.	APB-221	Princ. of Breed of Forest Trees	3 (2-0-3)
4.	AAS-213	Utilization of Forest Products as livestock feed	3 (2-0-3)
5.	AFS-232	Human Food and Nutrition	3 (2-0-3)
6.	APE-208	Forest Entomology	3 (2-0-3)
7.	APP-252	Forest Pathology	3 (2-0-3)
8.	BBB-221	Forest Ecology	4 (3-0-3)
9.	AEC-248	Introductory Forest Economics	3 (3-0-0)
10.	APA-APS231	Forest Soils and Their Management	2 (2-0-0)
11.	APA-APS 240	Erosion and Conservation of Forest Lands	3 (3-0-0)
12.	AAS-251	Introduction to Wild Life	3 (2-0-3)
13.	TMP-201	Forest Engineering-I	3 (2-0-3)
14.	TSW-205	Forest Engineering-II	3 (2-0-3)
15.	APF-240	Principles of Silviculture	3 (2-0-3)
16.	APF-242	Silviculture Regeneration Methods	3 (2-0-3)
17.	APF-244	Silviculture Systems	3 (2-0-3)
18.	APF-247	Silviculture of Indian Trees	3 (2-0-3)
19.	APF-255	Forest Mensuration-I	3 (2-0-3)
20.	APF-256	Forest Mensuration-II	3 (2-0-3)
21.	APF-260	Forest Management & Working Plans	3 (2-0-3)
22.	APF-265	Forest Logging & Harvesting	4 (3-0-3)
23.	APF-251	Fundamentals of Forest Protection	2 (1-0-3)
24.	APF-271	Forest Policy, Law and Planning	3 (3-0-0)
25.	APF-280	Forest Surveying & Mapping	3 (2-0-3)
26.	APA/APF-	285 Silvipasture	3 (2-0-3)
27.	APF-290	Social Forestry	3 (2-0-3)
28.	APF-291	Wood Science	3 (2-0-3)
29.	APF-292	Wood Processing & Utilization	3 (2-0-3)
30.	APF-293	Minor Forest Products	2 (1-0-3)
31.	APF-294	Special Field Practices in Forestry	2 (0-0-2)
	(1 credit - each in two semesters)		91
	N.S.S.		2
	Elective		18
	Work Program		1
			112

Optional Courses:

APE-305	Introductory Apiculture & Sericulture	2 (1-0-3)
APE-232	Plant Protection Equipment	1 (0-0-3)
APF-252	Advances in Forest Protection	3 (2-0-3)
APF-261	Forest Plantation Management & Yield Regulations	3 (2-0-3)
APH-340	Medicinal & Aromatic Plants	3 (2-0-3)
APH-341	Cultivation of Condiments & Spices	2 (1-0-3)
APH-301	Ornamental Gardening	3 (2-0-3)
APP-301	Principles of Plant Diseases Control	3 (2-0-3)
APE-302	Insecticides	2 (1-0-3)
AEC-348	Forest Economics	3 (2-0-3)

Note: Semester credits 2 (1-0-3) denotes the following; one lecture period of one duration, none tutorial, and one practical of 3 hours duration per week in semester of about 18 weeks.

(2) Kerala Agricultural University, College of Forestry, Vellanikkara

This College of Forestry started from 1986 under the Kerala Agricultural University offers both graduate (B.Sc.) and postgraduate (M.Sc.) courses with intake of 15 and 9 students respectively. The 4-year graduate course imparts theoretical and practical knowledge in forest ecosystem, dynamics/production and protection forestry, wildlife, social- and agro-forestry, forest management, tree physiology and genetics, environmental management, wood science and allied aspects. Field experience by frequent visits to various forests in the country and a 3-month long field training in forest ranges expose the students to practical problems of the forestry. The M.Sc. course includes specialised areas of silviculture and agroforestry, tree physiology and breeding, forest management and utilization and wildlife sciences.

The Department of Wood Science offers courses in introduction on forestry (2+0), wood anatomy (2+1), wood science and technology (2+1), forest products (1+1), forest research methods (1+0), wood-based industries (2+0) and global forestry (1+0), etc.

MSc - Fundamentals of Wood Science (1 + 1)
BSc - Wood Anatomy (2 + 1)
Wood Science and Technology (2 + 1)
Forest Products (1 + 1)
Wood based industries (2 + 0)

Note: (2 + 1) means 2 credit hours a week for theory and 1 credit hours for practicals equivalent to 2 lab. hours

(3) Panjabrao, Krishi Vidyapeeth, Akola

Layout for B.Sc. (Forestry) Degree Programme

S.No.	Course No.	Title of Course	Credits
		FIRST SEMESTER	
1.	LANG-111	Language-II (English)	1 + 1 = 2

2.	BIOC-111	Biochemistry	1 + 1 = 2
3.	PLPHY-111	Fundamentals of PI. Physiology	2 + 1 = 3
4.	AHDS-111	Livestock Management in Forest	1 + 1 = 2
5.	AGRO-111	Introduction to Indian Agriculture	1 + 0 = 1
6.	HORT-111	Fundamentals of Horticulture	2 + 0 = 2
7.	ENT-111	Introduction to Entomology	1 + 1 = 2
8.	RUSO-111	Rural Sociology	1 + 1 = 2
9.	MATH-111	Mathematics-I	1 + 1 = 2
			11 + 7 =18

SECOND SEMESTER

1.	LANG-122	Language-II (Marathi/Hindi S English)	0 + 1 = 1
2.	MET-121	Meteorology	1 + 1 = 2
3.	GNPS-121	General Psychology	1 + 0 = 1
4.	ENGG-121	Surveying & Mapping	1 + 2 = 3
5.	AGRO-122	Principles of Crop Prod.	1 + 1 = 2
6.	ACSS-121	Soil Science - Farm, Comp & Prop.	2 + 1 = 3
7.	ECON-121	Elements of Economics	1 + 0 = 1
8.	ANTH- 121	Anthropology	1 + 0 = 1
9.	MATH-122	Mathematics-III	1 + 1 = 2
			9 + 7 =16

THIRD SEMESTER

1.	BOT-231	Genetics & Cytogenetics	1 + 2 = 3
2.	ENGG-232	Soil Water Conservation & Drainage	1 + 1 = 2
3.	AGRO-233	Weeds & Weed Control	1 + 1 = 2
4.	PATH-231	Introduction to Plant Pathology	1 + 1 = 2
5.	FOR-232	History & Geography of Indian Forests	1 + 0 = 1
6.	FOR-232	Plant Propagation - Seed and Vegetable	1 + 1 = 2
7.	FOR-233	Silviculture I - Nursery Management	1 + 1 = 2
8.	FOR-234	Farm & Social Forestry	1 + 1 = 2
9.	FOR-235	Forest Seed Technology	1 + 1 = 2
10.	MATH-233	Mathematics-III	1 + 1 = 2
			10 +10=20

FOURTH SEMESTER

1.	STAT-241	Elements of Statistics	2 + 1 = 3
2.	BOT-242	Plant Breeding	1 + 1 = 2
3.	AGRO-244	Crop production in Dry Farming Areas	2 + 1 = 3
4.	ACSS-242	Forest Soils	2 + 1 = 3
5.	FOR-246	Tree Improvement	2 + 1 = 3
6.	FOR-247	Forest Ecology Tour	0 + 2 = 2
7.	EXTN-241	Forest Tree biology	1 + 1 = 2
8.	ENGG-243	Forest Eng. Road & Structure	1 + 1 = 2

			11 + 9 =20
		FIFTH SEMESTER	
1.	STAT-352	Introduction to Computer Programming	1 + 1 = 2
2.	EXTN-352	Communication & Diffusion of Innovation	1 + 1 = 2
3.	FOR-358	Dendrology	2 + 1 = 3
4.	FOR-3510	Silviculture-II Regeneration Methods	1 + 1 = 2
5.	FOR-3511	Silviculture-III Systems	1 + 1 = 2
6.	FOR-3512	Minor Forest Products	1 + 1 = 2
7.	FOR-359	Forest Ecology	2 + 1 = 3
8.	MATH-354	Mensuration	2 + 1 = 3
			11 + 8 =19
		SIXTH SEMESTER	
1.	ENGG-364	Forest Engineering - Equip. & Machinery	1 + 1 = 2
2.	ENT-362	Forest Entomology	2 + 1 = 3
3.	PATH-362	Forest Plant Pathology	2 + 1 = 3
4.	FOR-3613	Forest mensu. - Inventory	1 + 1 = 2
5.	FOR-3614	Integrated Pest Management	2 + 1 = 3
6.	FOR-3615	Forest Management - Planning & Evaluation	1 + 1 = 2
7.	FOR-3616	Fire Ecology & Management	1 + 1 = 2
8.	FOR-3617	Forest Management Tour	0 + 2 = 2
			10 + 9 =19
		SEVENTH SEMESTER	
1.	VET-471	Introduction to Wild-life	1 + 1 = 2
2.	AGRO-475	Grassland Management	1 + 1 = 2
3.	ACSS-473	Soil Survey & Land Use	1 + 1 = 2
4.	FOR-4718	Forest Mens. - Modelling & Analysis	1 + 1 = 2
5.	FOR-4719	Agro-forestry	1 + 1 = 2
6.	FOR-4720	Forest Management - Reg. & Harvesting Sched.	2 + 1 = 3
7.	ELE-471	Elective - I	1 + 1 = 2
8.	ELE-472	Elective - II	1 + 1 = 2
9.	ENGG-475	Forest Hydrology & Watershed Management	1 + 1 = 2
			10 + 9 =19
		EIGHTH SEMESTER,	
1.	VET-482	Wild Life Management	1 + 0 = 1
2.	ACSS-484	Aerial Photos & Remote Sensing	1 + 1 = 2
3.	FOR-4821	Forest Management Resource Analysis	1 + 2 = 3
4.	FOR-4822	Forest Economics	1 + 1 = 2
5.	FOR-4823	Forest Policy & Legislation	2 + 0 = 2
6.	FOR-4824	Forest Products Utilization	1 + 1 = 2
7.	ELE-483	Elective - III	1 + 1 = 2
8.	ELE-484	Elective - IV	1 + 1 = 2

9.	EXTN-483	Extension Administration & Programme Planning	1 + 1 = 2
			10 + 8 =18

(4) University of Agriculture Sciences, Bangalore (as on 1990)

FIRST YEAR

Trimester I

Eng.	104	A course in Scientific & Technical Language	1 + 1
Soc.	102	Sociology	2 + 1
Mic.	101	Microbiology	2 + 1
Zool.	105	General Zoology	2 + 1
Econ.	102	Principles of Economics	2 + 1
NCC/Ph.Edn.	101	National Cadet Corps (NCC)/Physical Education	0 + 1
			15

Trimester II

Eng.	105	Language Laboratory	0 + 1
Psy.	102	Psychology	2 + 1
Ph.	103	Physics and Meteorology	2 + 1
Chem.	104	Organic Chemistry	2 + 1
Star.	101	Elements of Statistics	2 + 1
Bot.	104	Morphology and Anatomy	2 + 1
NCC/Ph.Edn.	102	NCC/Physical Education	0 + 1
			17

Trimester III

Math.	108	Mathematical Methods	1 + 1
Phy.Chem.	105	Physical Chemistry	2 + 0
Bot.	106	Systematic Botany	2 + 1
Agron.	101	Principles of Crop Production	2 + 0
Ag.Econ.	101	Introductory Agricultural Economics	2 + 1
Ag.Engg.	201	Surveying	2 + 1
NCC/Ph.Edn.	103	NCC/Physical Education	0 + 1
			16

SECOND YEAR

Trimester I

Hort.	101	Fundamentals of Horticulture	2 + 1
Ag.Chem.	103	Introduction to Soil Science	2 + 1
Pl.Path.	101	Introduction to Plant Pathology	2 + 1
Agron.	105	Forage Crop and Production	2 + 1
Ag. Mic.	303	Soil Microbiology	2 + 1
Ag.Ent.	101	Introductory Entomology	2 + 1
			18

Trimester II

Hort.	201	Plant Propagation	2 + 1
Ag.Extn.	201	Fundamentals of Extension Education & Rural Development	2 + 0
Ag.Bot.	302	Genetics	2 + 1
Ag.Chem.	303	Soil Fertility & Fertilizer Use	2 + 1
PN.	105	Principles of Nutrition	3 + 0
			14

Trimester III

For.	101	Introduction to Forestry	2 + 1
Crop Phy.	201	Crop Physiology	2 + 1
Agron.	103	Water Management	2 + 1
Seed Tech.	201	Seed Technology	2 + 1
D.Sc.	202	Dairy Science	1 + 1
Ag Engg.	301	Soil & Water Conservation Engineering	2 + 1
			17

THIRD YEAR

Trimester I

For.	109	Tree Physiology	2 + 1
For.	121	Forest Engineering	2 + 1
For.	123	Wood Anatomy, Properties and Uses	2 + 1
For.	125	Minor Forest Products	1 + 1
Ag.Maco.	341	Principles of Marketing, Finance and Cooperation	2 + 1
For.	102	Fundamentals of Silviculture & Silviculture System	2 + 1
			17

Trimester II

For.	103	Silviculture of Indian Trees	2 + 1
For.	105	Forest Soils	1 + 1
For.	106	Forest Microbiology	1 + 1
For.	108	Dendrology	2 + 1
For.	111	Forest Pathology	2 + 1
For.	112	Forest Entomology	2 + 1
			16

Trimester III

Seric.	101	Introduction to Sericulture	1 + 1
For.	104	Forest Inventory, Photo interpretation and Remote Sensing	1 + 1
For.	110	Forest Cytogenetics & Tree Breeding	2 + 1
For.	113	Elementary Forest Management	2 + 0
For.	114	Forest Mensuration	2 + 1
For.	119	Forest Protection	2 + 0
For.	131	Waste Land Management	1 + 1

AG.Extn.	301	Communication and Diffusion of Agricultural Innovation	1 + 1
			18

FINAL YEAR

Trimester I

For.	107	Forest Ecology and Conservation of Natural Resources	2 + 0
For.	116	Forest Hydrology & Watershed Management	2 + 1
For.	127	Social Forestry	2 + 1
For.	129	Farm Forestry & Agro-forestry	2 + 1
For.	130	Forestry Extension	0 + 1
For.	132	Energy Plantations and Alternate Energy Sources	1 + 0
For.	122	Forest Economics	2 + 1
		Educational Tour	0 + 1
			17

Trimester II

For.	115	Forest Policy and Law	2 + 0
For.	117	Wild Life & Range Land Management	2 + 1
For.	118	Industrial Forestry	1 + 0
For.	128	Environmental Forestry	1 + 1
		Major	2 + 1
		Elective	2 + 1
			14

Trimester III

For.	120	Forest Stay and Preparation of Working Plans (Placement Training)	0 + 4
For.	124	Wood Science and Technology	2 + 1
For.	126	Harvesting and Post-harvest Technology of Forest Produce	2 + 1
		Major	2 + 1
			13

(5) Dr. Y.S. Parmar University of Horticulture and Forestry

B.Sc. Forestry (4 years degree program - as on 1990)

		Course Title	Credit Hours
BASIC SCIENCES			
BOT	122	General Botany	2 + 1
EAP	011	Introductory Zoology	2 + 1 NC
ORI	011	Orientation	1 + 0 NC
BOT	011	Fundamentals of Biology	2 + 1 NC
MTH	011	Algebra and Trignometry	3 + 0 NC
MTH	012	Matric Algebra and Calculus	3 + 0 NC
ENG	011	Grammar and Composition	1 + 1 NC

HND	011	Elementary Hindi	2 + 0 NC
MTH	121	Analytical Solid Geometry and Differential Equations	3 + 0
BCH	121	Introductory Biochemistry	3 + 1
MBG	211	Basic Microbiology	2 + 1
GEN	211	Fundamentals of Genetics	2 + 1
STA	311	Elements of Applied Statistics	2 + 1
OEN	311	Introductory Plant Breeding	2 + 1
COM	411	Introduction to Computers	1 + 1
BTC	411	Introductory Biotechnology	1 + 1
			27

AGRICULTURAL SCIENCES

ESC	111	Elements of Economics	2 + 0
SWM	111	Fundamentals of Soil Sciences	2 + 1
ESC	113	Forest Typology and Anthropology	2 + 0
ESE	122	Elements of Rural Sociology and Behaviour of Psychology	2 + 0
SWM	221	Principles of Hydrology and Soil Conservation	2 + 1
SWM	222	Surveying and Mapping	2 + 1
SWM	311	Chemistry and Fertility of Forest Soils	2 + 1
FCM	221	Principles of Horticulture	2 + 1
VGC	121	Fundamentals of Crop Production	3 + 1
FLS	321	Introduction to Floriculture and Land Scape	2 + 1
SLV/ASC	122	Livestock Management in Forestry	2 + 1
MPP	222	Introductory Forest Pathology	3 + 1
MPP/EAP/VGC	323	Integrated Pest Management	2 + 1
SWM	421	Soil Survey, Remote Sensing and Land Use	2 + 1
			41

FOREST SCIENCES

FBI	111	Meteorology and Climatology	2 + 1
SLV	111	Introduction of Indian Forest and Wildlife	2 + 0
SLV	112	Fundamentals of Silviculture	2 + 0
SLV/ASC	122	Livestock Management in Forests	2 + 0
SLV	211	Forest Mensuration	2 + 1
FBI	211	Dendrology	2 + 1
FBI	212	Forest Ecology	2 + 1
SLV	212	Grassland Management	2 + 1
SLV	213	Practical Field Forestry	0 + 2
SLV	221	Practices of Silviculture	2 + 1
FPU	222	Forest Utilization (non-timber products)	1 + 1
FPU	223	Practical Field Forestry	0 + 2
EAP	312	Forest Entomology	3 + 1
ESE	312	Forest Economics	2 + 1

SLV	312	Silviculture Systems	2 + 0
FHI	311	Practical Field Forestry	0 + 2
FPU	325	Forest Utilization	2 + 0
FBI	321	Tree Physiology	2 + 1
FPU	322	Wood Anatomy	1 + 1
SLV	321	Silviculture of Indian Trees	2 + 0
FBI	324	Tree Improvement and Seed Technology	3 + 1
SLV	323	Practical Field Forestry	0 + 2
ESE	411	Forest Resource Analysis	1 + 1
SLV	413	Wildlife Management	2 + 0
SWM	422	Forest Engineering	2 + 1
SLV	421	Forest Policy and Legislation	1 + 0
SLV	422	Agroforestry	2 + 0
SLV	412	Ergonomics	2 + 0
		Total	71

Electives	10
1. Social Forestry and Environmental Conservation	
2. Tree Improvement and Production Forestry	
3. Forest Protection	
4. Medicinal and Aromatic Plants and Forest Products Professional Training	0 + 5
Total	86
GRAND TOTAL	153

(6) A.I.F.C. Diploma, Indira Gandhi National Forest Academy, Dehra Dun

FIRST YEAR

Sl.No.	Subject	No. of Lecture.hours	
		Theory	Practical
1.	Silviculture I (Foundations of Silviculture)	50	1
2.	Silviculture II (Practice of Silviculture)	50	-
3.	Mensuration I (Measurement of Characteristics of Individual Trees and Forest Inventories)	55	10
4.	Mensuration II (Volume and Growth Estimations of Crops and Use of Aerial Photographs)	45	20
5.	Forest Soils	30	30
6.	Geology	25	16
7.	Utilization (Logging)	35	25
8.	Utilization II (Forest Products other than timber)	35	-
9.	Forest Surveying	40	50
10.	Land Management and Soil Conservation	42	-

11.	Optional Elementary Mathematics or Optional Botany	25	10
12.	Botany I (Histology, Physiology, etc.)	38	40
13.	Forest Engineering I (Building Materials, Building Construction, etc.)	40	30
14.	Wildlife Management and Recreation	35	-
15.	General Forest Protection	25	-

SECOND YEAR

Sl. No.	Subject	No. of Lecture hours	
		Theory	Practical
1.	Silviculture IV (Silviculture of Indian Trees and Silviculture System)	20	-
2.	Forest Management	22	-
3.	Working Plan	50	-
4.	Forest Economics	20	-
5.	Forest Valuation	48	10
6.	Utilization III (Wood Technology)	28	-
7.	Forest Botany II (Systematics)	57	31
8.	Forest Engineering II (Road, Bridges, Water Supply, Timber Structures)	50	30
9.	Forest Policy and Law	40	30
10.	Forest Entomology (including Zoology)	25	-
11.	Mycology and Forest Pathology	30	30
12.	World Forestry	23	10
13.	Environmental Conservation	20	-
14.	Utilization IV (Wood Based Industries)	10	-
15.	Electives	15	-
	Elective I (Genetics and Tree Improvement) or	30	20
	Elective II (Forest Ecology) or	30	20
	Elective III (Forest Statistics)	30	20

(7) Proposed course curriculum for B.Sc. (Forestry) degree programme for Indian Agriculture Universities (Patil and Burley 1985)

The course curriculum for B.Sc. (Forestry) degree programme has been standardized based on the basic framework of other professional degrees offered at the University of Agricultural Sciences, Bangalore, and at other Agricultural Universities in India. The course curriculum and course outlines would particularly suit to the Agricultural Universities where the Trimester System of education is followed.

The proposed degree programme in Forestry is of four years' duration, with a total of 192 credit hours. In each year, there are three trimesters each of 14 weeks' duration. A course with (2+1) credit hours will have two theory classes, each of one hour duration and one practical class of three hours' duration (in the field or in the laboratory) per week. The list of courses suggested and broad course outlines are given in the following paragraphs.

In the fourth year there are opportunities to specialise in different disciplines. Initially, the following major fields of specialization may be offered and the students should be given an opportunity to specialise in the discipline of their choice.

1. Silviculture
2. Forest Soils
3. Forest Mensuration
4. Forest Botany and Taxonomy
5. Forest Genetics and Tree Breeding
6. Tree Physiology
7. Forest Ecology
8. Forest Entomology
9. Forest Pathology
10. Wood Science
11. Wildlife Management
12. Forest Economics
13. Social Forestry
14. Agroforestry

I year		II year	
I Trimester	Credit hours	I Trimester	Credit hours
Botany	2 + 1	Forest Economics	2 + 1
Zoology	2 + 1	Silviculture - I: Ecological	2 + 1
Organic Chemistry	2 + 1	Forest Engineering	2 + 1
Mathematics	2 + 1	Forest SoiIs	2 + 1
Psychology	1 + 1	Horticulture - II	2 + 1
Economics	2 + 0	Crop Production	0 + 1
National Cadet Corps (NCC) / Physical education	0 + 1		
TOTAL	17	TOTAL	16
II Trimester		II Trimester	
Biochemistry	2 + 1	Silviculture - II: Practices	2 + 1
Geology and Soils	2 + 1	Forest Ecology	2 + 1
Sociology	2 + 0	Forest Surveying	2 + 1
Tree Physiology	2 + 1	Agronomy	2 + 1
Forest Botany	2 + 2	Microbiology of Forest Soils	1 + 1
English: Language laboratory	0 + 1	Soil and Water Management	2 + 1
N.C.C./Physical education	0 + 1		
TOTAL	17	TOTAL	17

III Trimester		III Trimester	
Meteorology & Hydrology	2 + 1	Silviculture - III:	2 + 1
Microbiology	2 + 1	Important Species/Systems	
Horticulture - I	2 + 1	Forest Entomology	2 + 1
Soil Science	2 + 1	Harvesting	2 + 1
Principles of Crop Production	2 + 0	Forest Utilisation	2 + 1
English: Scientific &	1 + 1	Anatomy, Wood Properties	2 + 1
technical language		Wood Science and Technology	2 + 1
N.C.C./Physical education	0 + 1		
TOTAL	17	TOTAL	18

III year		IV year	
I Trimester	Credit hours	I Trimester	Credit hours
Forest Genetics	2 + 1	Landscaping, National Parks &	2 + 1
Economic Entomology	1 + 1	Forest Recreation	
Forest Mensuration	2 + 1	Environmental Forestry	2 + 0
Statistical methods	2 + 1	Forest Planning	2 + 0
Watershed Management	2 + 1	Forest Management	2 + 0
Forest Production - I	0 + 1	Management Plan	1 + 2
Study tour - I	0 + 1	Work study	1 + 0
		Study tour - II	0 + 1
TOTAL	16	TOTAL	14

II Trimester		II Trimester	
Tree Breeding	2 + 1	Agroforestry	2 + 1
Forest Pathology	2 + 1	Computers in Forestry	2 + 1
Photo Interpretation &	2 + 1	Forest Policy and Law	2 + 0
Remote Sensing		Forest research methods - I	1 + 1
Forest Inventory &	1 + 2	Major field of specialization	2 + 1
Yield Prediction		Forest stay	0 + 1
Livestock Husbandry	2 + 1		
Forest Production - II	0 + 1		
TOTAL	16	TOTAL	14

III Trimester		III Trimester	
Forest Seed Technology	2 + 1	Forest Extension	2 + 1
Forest Protection	2 + 1	Social Forestry	2 + 1
Forest Industries	2 + 1	Forest research methods- II	0 + 1
Wildlife & Range Management	2 + 1	Major field of specialization	2 + 1
Ergonomics	1 + 0	Philosophy and Professional Ethics	1 + 0
Arboriculture	1 + 0	Global Forestry	2 + 0

Cropping scheme & crop planning	1 + 1	Tribal Ethnology	1 + 0
TOTAL	16	TOTAL	14
		GRAND TOTAL	192

Syllabuses of the proposed course curriculum for B.Sc. (Forestry) degree programme for Indian Agriculture Universities

I YEAR I TRIMESTER

Botany (Credit hours 2+1)

Morphology, anatomy, and development of plants. The relations of structure with vegetative and reproductive function. Principles and methods of taxonomy. Physiology: photosynthesis, respiration, nutrition, water relations, and growth. Stimulus and response.

Zoology (Credit hours 2+1)

Elementary principles of zoology. Animal biology, animal groups, animal behaviour, comparative physiology, comparative neurobiology, structural molecular biology, cell and developmental biology, animal ecology.

Organic chemistry (Credit hours 2+1)

A study of the general characteristics of the following classes of compounds: Alkanes, alkenes, alkyl halides, hydroxy compounds, amino compounds, oxo-compounds. Fatty acids and their derivatives, arenes and derivatives, heterocyclic compounds; poly functional compounds: Bifunctional and trifunctional compounds, carbohydrates, peptides and proteins, Configuration, confirmation and optical activity.

Mathematics (Credit hours 2+1)

Algebra, trigonometry and geometry, elementary theory of differentials, integrals, derivatives, power series, complex numbers, differential equations, limits, and some of their applications.

Psychology (Credit hours 1+1)

Behaviour, motive and emotions, perception, learning and memory, thinking, human abilities, personality, social behaviour.

Economics (Credit hours 2+1)

Basic economic theory, contemporary economic institutions and problems; the theory of production, demand, supply, and employment; the role of money and the banking system; monetary and fiscal policy; price determination; the role of competition; international trade and finance. Investment and development. Cooperatives.

National cadet corps (N.C.C.) - I (Credit hour 0+1)

Organisation. Drill without and with arms, cane drill, rifle, bayonet, map-reading, section leading, field craft,

smartness and turnout. One annual training camp is compulsory for the year. OR (Operations Research).

Physical education - I (Credit hour 0+1)

Foundation of physical education, physiological, sociological and psychological; Tournaments and competitions, construction and laying out of the track and field and playground events. Rules of various games. General conditioning compulsory on all days. Games: Football, Basketball, Kabaddi, Badminton (shuttle and ball).

I YEAR II TRIMESTER

Biochemistry (Credit hours 2+1)

Biochemistry in relation to the structure, metabolism, growth and heredity of plants and animals. Enzymology; the chemistry and biogenesis of wood cellulose, hemicelluloses, lignin, exudates, extractives etc., including species differences. Energy feedstock.

Geology and soils (Credit hours 2+1)

Physical geology, mineralogy, petrology, palaeontology, stratigraphy and structural geology with some aspects of geophysics. Soil fomation, constitution and classification.

Sociology (Credit hours 2+0)

Sociological theory; Modern social institutions; Rural, industrial and political sociology; Social group, social control, social change and development.

Tree physiology (Credit hours 2+1)

Form and life of forest trees; growth and development, movement, structure, physiological functions and processes in trees, reproduction of trees. Water, light and food relations, ageing and abscission. Chemical composition of the plant, absorption and conduction of water and mineral salts, root pressure; transpiration; ascent of sap; photosynthesis, translocation, storage and assimilation; respiration, fermentation: Responses of woody plants to environmental stress: Role of plant growth substances, growth analysis.

Forest botany (Credit hours 2+2)

Developmental morphology and anatomy of trees; Taxonomy; A systematic study of tree and shrub families, genera and species with emphasis on identification of species. Students need to make a labelled collection of woody plants. Ecology of flowering plants: vegetation types and experimental methods; physiology and genetics of habitat and distribution.

English - language laboratory (Credit hour 0+1)

Spoken English, group discussion and public speaking.

National cadet corps (N.C.C.) - II (Credit hour 0+1)

Drill without and with arms, cane drill, rifle, bayonet, map-reading, section leading, patrolling, platoon tactics. OR (Operations Research).

Physical education - II (Credit hour 0+1)

Rules of sports events, recreation and agencies promoting recreation. Various types of recreational activities. General conditioning compulsory on all days. Games: cricket, volleyball; gymnastics.

I YEAR III TRIMESTER

Meteorology and hydrology (Credit Hours 2+1)

Weather and climate, composition and structure of atmosphere, insolation, air temperature, variation and measurement and energy transformation. Atmospheric pressure and winds - cyclones, depressions and anticyclones. Atmospheric moisture, relative humidity, evaporation, condensation, precipitation and seasonal changes in them. Water resources, hydrologic cycle. Monsoon phenomenon; clouds and their classification. Cyclic and quasi-periodic phenomena. Meteorological instruments and measurement of weather parameters. Weather data analysis and interpretations - weather forecasting and interpretations of synoptic charts. Agro-climatic classification.

Microbiology (Credit hours 2+1)

Mycology, bacteriology and virology: Structure, life cycles, mating systems and physiology of fungi, bacteria and viruses, their interactions with other organisms: disease and symbiosis.

Horticulture - I (Credit hours 2+1)

Phases of growth, growth and fruiting habits. Principles and methods of training and pruning horticultural plants. Fruitfulness, picking, grading, packing and transport of flowers, fruits and vegetables. Plant propagation: sexual propagation, apomixis, polyembryony, fruit and seed development; Asexual propagation by cutting, budding, grafting, layering of specialized, structures; micro-propagation, embryo and tissue culture, commercial propagation methods for important crops. Establishing the orchard and management practices.

Soil science (Credit hours 2+1)

Soil properties, chemical and physical processes in soil as they affect root development and function, and the availability of water and nutrients. The rhizosphere. Soil organic matter. Plant nutrients and their effect on plant growth. Source, classification and effects of organic manures and fertilizers on soil and crop growth.

Principles of crop production (Credit hours 2+0)

History and development of agriculture. Factors of plant growth. Soil and water management, and weed control in relation to crop production. Economic of crop production.

English: scientific and technical language (Credit hours 1+1)

Scientific and technical writing and the technique of indirect narration. Passive form, use of articles and punctuation in technical literature. Tense forms, sequence of items of the nominal group in english, distinct characteristics of qualitative and quantitative adjectives. Skill in composition.

National cadet corps (N.C.C.) - III (Credit hour 0+1)

Drill without and with arms. Rifle, patrolling, platoon tactics, outdoor exercise. OR (Operations Research).

Physical education - III (Credit hour 0+1)

Recreation facilities, personnel and supervision, schedule, camp activities, organisation of rural recreation, constructive activities and productive reaction. General conditioning compulsory on all days. Games: Hockey, kho-kho; Track and field events.

II YEAR I TRIMESTER

Forest economics (Credit hours 2+0)

Application of economic prtinciples to forestry and land-use. Renewable and non-renewable resources; economics of forestry enterprise; marketing, trade, investment; conservation economics, sustained yield; subsidies, loans and tax relief as instruments of policy. Financial and economic analysis: social costs and benefits. Linear programming.

Silviculture - I: Ecological basis (Credit hours 2+1)

Role of forests, general nature of vegetation of the world; forest environment: factors of site, site quality, climate and weather; physiographic conditions; edaphic and biotic factors; interactions of locality factors. Influence of forests on their environments. Factors of production, primary production, biomass production; classification of forest types, principal forest types of India and their distribution.

Forest engineering (Credit hours 2+1)

An elementary account of the machines used in forestry for silvicultural operations, harvesting and forest engineering. The technical and economic aspects of the spacing, alignment, construction and maintenance of forest roads, bridges and culverts, including the selection of appropriate materials and equipment. The design and construction of buildings required by forestry enterprises. The use of lumber, plywood, glued-laminated timber and composite materials in construction. Analysis and design of timber architectural components and their connections and their use in building construction.

Forest soils (Credit hours 2+1)

Major soil groups, study of forest soils; soil - vegetation relationships; soil chemistry, tree nutrition and nutrient cycling, deficiency symptoms; interaction of forest production, soil fertility and management. Water relations, maintaining and improving forest productivity. Acid, saline and alkaline soils. Soil Survey and Soil Mapping. Attributes and limitations imposed on tree growth by various soil types.

Horticulture - II (Credit hours 2+1)

Study of important fruit crops: Mango, banana, citrus fruits, grape, guava, papaya, sapota, pineapple, pomegranate and fig. Study of important spice and plantation crops: Betel-vine, pepper, cardamom, clove, cinnamon, nutmeg, coconut, cashew nut, arecanut, coffee, tea, cocoa and rubber. Olericulture: Study of important vegetable crops - solanaceous vegetables, cucurbits, cole crops, greens, salad vegetables, tuber crops, bulbous vegetables, leguminous vegetables, perennial vegetables and other miscellaneous vegetable crops; layout of vegetable and kitchen gardens. Floriculture: Ornamental gardening. Garden types and designs. Preparation, layout and maintenance of lawns, flower beds and hedges.

Crop production (Credit hour 0+1)

Cultivation of crops in a plot of at least one tenth of a hectare by individual students. Students should carry out all the operations and maintain regular cultivation sheet and record observations on season, crop growth, yield, etc. They should prepare a note at the end of the trimester on the crop condition as influenced by various agronomic, climatic and soil factors. The net profit will be retained by the students.

II YEAR II TRIMESTER

Silviculture - II: practices (Credit hours 2+1)

Biological factors underlying stand manipulation; regeneration, tending and harvesting of forest stands; pure, mixed, even and unevenaged stands; selection of species, nursery management, plantation establishment, weed control, drainage, competition and protection; relationships of soil fertility and moisture availability to the growth of forest stands. Analysis of stand responses such as growth rate, stem form, tree quality, product quality and value; energy plantations; afforestation and management of problematic sites like acid, saline and alkaline soils, eroded soils, swamps, sand dunes, windy climates etc.

Forest ecology (Credit hours 2+1)

The ecosystem concept; basic ecological principles and concepts of forest ecology. Forest environments, forest community, vegetation - environment relations. Ecological adaptation and evolution. Succession, production and radiation ecology. Concepts of ecosystem analysis. Pioneer and competitive life cycle strategies; adaptive leaf and crown morphology. Inter and Intra-specific competition, reciprocal yield and self-thinning laws. Aut-ecology of important tree species.

Forest surveying (Credit hours 1+2)

The basic principles of plane table surveying, measurement of horizontal and vertical distances and angles together with an analysis of their source of error; survey calculations and adjustments; chain and compass surveying; topographical surveying; computation of areas; maps, scale and reading; copying, enlargements and reduction of maps.

Agronomy (Credit hours 2+1)

Study of important cereals, millets, pulses, oilseeds, forage crops, fibre crops, and commercial crops, with reference to: their importance, origin, history and distribution; the soil and climatic requirements for their cultivation; cultivation practices covering preparation of land, varieties, planting, irrigation, manure and fertilizer application, after care, harvesting, processing, storage and marketing. Seed production.

Microbiology of forest soils (Credit hours 2+1)

Microbial population of forest soils with emphasis on rhizosphere interaction and mycorrhizae. Nitrogen fixation. Decomposition of organic matter.

Soil and water management (Credit hours 2+1)

Causes and types of soil erosion. Universal soil loss equation; techniques of monitoring soil erosion and water,

flow. Soil and water conservation methods. Role of perennial vegetation in soil and water conservation. History, problems, programmes and achievements of soil and water conservation in India.

II YEAR III TRIMESTER

Silviculture - III: important species and systems (Credit hours 2+1)

Productivity of important tree species as function of silvicultural manipulation. Silviculture of important tree species including N-fixing and multi-purpose trees both indigenous and exotics. Study of Silvicultural Systems and their application. Choice of System, methods of conversion and evaluation of Silvicultural Systems.

Forest entomology (Credit hours 2+1)

Fundamentals of entomology; the impact, biology and management of insect pests of trees and other economic plants and wood products. Nature of damage and the stages of the insects responsible. Estimation of the damage and the economics of control. Diagnosis and ecological interpretation of pest succession in forest stand development. Pest population - forest stand dynamics. Long-range pest management and decision making.

Harvesting (Credit hours 2+1)

The technical.and economic aspects of harvesting wood; factors to be taken into account in harvesting - the choice of appropriate machinery (operational capacity and output), and the design of harvesting systems. Felling, conversion, extraction and transportation. Pit sawing, mobile saw mills, chipping.

Forest utilisation (Credit hours 2+1)

Products and services available from forests. Primary conversion (sawing, veneering and chipping). Seasoning, including kiln design and operation. Wood preservation (equipment, Chemicals and processes). Wood panels (manufacture and uses). Pulp and paper (processes and uses). Wood working (equipment, wood structures, joinery, cabinet making). Chemicals and energy from wood, including charcoal, minor forest products. Utilisation of waste, wood and residues.

Anatomy and properties of wood (Credit hours 2+1)

Developmental anatomy of wood; processes of wood formation, differentiation and maturation; cell and tissue types and functions. Variation in structural properties within and between trees and taxa. Manipulation of structural features through breeding, silviculture and environmental modification. Relation between anatomy and taxonomy; wood use and processing.

Wood science and technology (Credit hours 2+1)

Wood anatomy, chemical, physical and mechanical properties of wood and factors determining them. Defects and abnormalities Drying characteristics of wood (effects on properties). Agencies of deterioration, durability and amenability to preservative treatment, wood preservation materials and processes; glueing, finishing and improvement of wood. Grading and standardization.

III YEAR I TRIMESTER

Forest genetics (Credit hours 2+1)

Nucleus and cytoplasm in heredity and differentiation; chromosome chemistry and mechanics; natural and experimental mutation; quantitative variation; the physiology of gene action. Evolution: ecological, geographical and population genetics; natural and artificial selection; origin of species and evolution of genetic systems.

Economic entomology (Credit hours 1+1)

Sericulture: morphology and anatomy of the mulberry silk worm. Rearing techniques of mulberry and non-mulberry silk worms. Apiculture, Lac-culture; study of other beneficial insects - parasites, predators, pollinators, weed killers and scavengers.

Forest mensuration (Credit hours 2+1)

Methods of measuring trees and stands. Measurement and computation of volumes and weights of felled trees and logs. Form factors. Construction of volume and weight tables; determination of age of trees. Assessment of increment and yield.

Statistical methods (Credit hours 2+1)

Theory and methods of sampling, standard error; theory of probability and statistical inference. Experimental designs; analysis of variance, single and multiple comparisons; response curves; linear regression. Multiple regression analysis and curve fitting.

Watershed management (Credit hours 2+1)

Interaction of climate, vegetation and soils. The influence of various land-use practices/vegetation on the quantity and quality of water yield, emphasizing the importance of interception losses. Manipulation of vegetation for soil and water conservation - effects on river flow.

Forest production (Credit hour 0+1)

Students will work in the field or nursery, and manage the area assigned to them. They will keep a record of the work done and record observations on the crop managed by them.

Study tour - I (Credit hour 0+1)

The students of third year class will undertake study tour for about a fortnight during the trimester break. They will visit forest areas, plantations, industries and other institutions in the state and get acquainted with the work and developmental activities in which the student will maintain the record book on the information of the study tour and will submit it to the tour leader.

III YEAR II TRIMESTER

Tree breeding (Credit hours 2+1)

Methods of plant breeding; principles and practices of tree breeding; selection-practice, progeny testing, provenance

trials, vegetative and clonal propagation. Breeding trees or higher production and quality wood, resistant to pests, diseases and environmental stresses; special problems of design and analysis in tree breeding. Breeding strategy.

Forest pathology (Credit hours 2+1)

The basic principles of forest pathology; life histories, classification, prevention and control of bacteria, fungi and viruses that cause tree diseases and wood deterioration. Impact of air pollutants; climatic and environmental damage on trees; physiological disorders, quarantine measures. Disease epidemiology, genetics and physiology of disease resistance. Pathology of amenity trees.

Photo interpretation and Remote Sensing (Credit hours 2+1)

Photogrammetry: aerial photography, geometry of air photos and stereo models, applications in measurement and mapping; photo-interpretation, identification of tree species, stand delineation, interpretation of land forms and soils; Remote Sensing, large-scale photos in forest inventory; regeneration mapping; terrain analysis and site selection; imagery and image analysis - video, thermal satellite, computer and radar.

Forest inventory and yield prediction (Credit hours 1+2)

Scope and objectives; basic techniques of estimating growth and yield of trees and stands. Forest sampling methods. Planning inventory; recurrent inventory; permanent sample plots; sample size and allocation; double sampling; data processing; techniques for predicting the growth and yield of stands by various methods; use of growth models.

Livestock husbandry (Credit hour 2+1)

The biology, husbandry and management of domestic animals (cattle, goats and sheep, poultry, pigs, rabbits and fish).

Forest production - II (Credit hour 0+1)

Students will continue and complete the work started under Forest production - I, and write a brief report.

III YEAR III TRIMESTER

Forest seed technology (Credit hours 2+1)

Seed biology, seed production, processing, testing, certification and storage. Seed banks and seed orchards.

Forest protection (Credit hours 2+1)

Impacts of destructive agents upon forests. Prevention and protection against damage caused by shifting cultivation, mismanagement, domestic and wild animals, injurious plants. Climatic hazards and environmental stress. Predicting hazard. Basic principles and technology of forest fire management. Decision making and tile application of techniques in forest fire management.

Forest industries (Credit hours 2+1)

Wood as an industrial raw material. The resource base and its future. Present and projected future demand. The

role of forest industries in the economy, their interrelationships with each other and production forest enterprises. Organisation structure of the major forest industries including trade associations (sawmilling, panels, pulp and paper, wood working, particle, fibre and chip board, plywood and match, etc.); construction timber; marketing of wood products. Rural and Cottage industries using wood. Pollution control; recycling.

Wildlife and range management (Credit hours 2+1)

Wildlife ecology and management. Techniques of study and management; comparison of natural and plantation forests in terms of ecology and requirements of wildlife. Management strategies to integrate forestry and wildlife conservation. Wildlife parks. Range management. Importance of range management in soil and water conservation; The ecology and physiology of plants in relation to grazing; Animal nutrition in relation to range management; range surveying and management planning; range conservation and range development; range economics; Administration and management of range lands.

Ergonomics (Credit hour 1+0)

Physical work load, psychological problems (often connected with technical development and work organisation); work and the working environment, including medical and technical work hygiene; pertinent legislation; housing, nutrition, clothing, etc. Labour safety and work improvements.

Arboriculture (Credit hour 1+0)

Selection of landscape trees, shrubs and vines; plant growth and form; planting site- soil and climate; management: site preparation, planting, transplanting large plants, special planting situation, fertilization, irrigation, soil management, pruning, chemical control of plants, preventive maintenance and repair, diagnosing plant problems, pest management, non-infectious disorders; legal rights and responsibilities.

Cropping scheme and crop planning (Credit hours 1+1)

Cropping scheme, factors considered in preparation of cropping schemes suitable for different tracts, selection of crops, crop rotation and mixtures. Preparation of alternate cropping plans for use of individual farmer. Working out seed, manure, insecticide, fungicide, water and labour requirements, short-time and long-time crop planning in utilizing available farm resources fully.

IV YEAR I TRIMESTER

Landscaping, national parks and forest recreation (Credit hours 2+1)

Landscaping. landscape analysis; principles of landscaping; designing, planning and management of landscapes; techniques of landscaping. landscape of the multi-purpose forest - conservation and landscape; landscape and recreation. National parks; concepts, principles and policies, influencing the development and management of National Parks, nature reserves, wildlife management; parks and people.

Forest recreation, outdoor recreation; planning for recreation. Demand and supply of forest recreation resources to forest uses; recreational use of forested areas; recreation resource policy and implementation of plans.

Environmental forestry (Credit hours 2+0)

Nature of natural resources, the biotic regions land, its characteristics, uses and problems; management of soil and water resources, environmental pollution; conservation of environments and resources; problems of population and conservation. The environmental impact of forest practices; the study of environmental, law and policy related to forestry. Integrated resource or land-use planning.

Forest planning (Credit hours 2+0)

Competing demands for land - nature, evaluation and allocation; alternatives; planning for the use of land on sustained basis; fanning criteria and techniques; planning situations; project planning.

Forest management (Credit hours 2+0)

Principles of management and functions of managers; planning, organising, staffing, directing and controlling. Management in the forestry sector, public and private including social industrial and ecological aspects.

Management plan (Credit hours 1+2)

Preparation of management plan with defined objectives for a particular forest area.

Work study (Credit hour 1+0)

Method study, method training, work measurement; techniques and application to output and performance; project planning; critical path analysis and resource levelling. A study visit to a work situation to carry out method study and work measurement.

Study tour - II (Credit hour 0+1)

The students of final year class will undertake a study tour for about three weeks during the trimester break. They will visit a few important institutes, forest areas and plantations in the country and get acquainted with the agro-climatic and socio-economic conditions and the work and developmental activities in progress. Each student will maintain the record book on the information gathered on study tour and will submit it to the tour leader.

IV YEAR II TRIMESTER

Agroforestry (Credit hours 2+1)

Definition and scope, potentials and constraints; agroforestry practices; the systems perspective; ecological aspects of agroforestry; role of agroforestry in soil and water conservation; socio-economics of agroforestry; concepts and techniques of agroforestry research and planning. Diagnosis and design methodology.

Computers in forestry (Credit hours 2+1)

Introduction to computers; mainframe to micro; characteristics and use of computers especially in forestry; practical introduction to programming, business software, data bases, simulation models.

Forest policy and law (Credit hours 2+0)

Forest policy: Definition, scope, range and foundation of a stable forest policy; forest policy in relation to.land use policy. National forest policy, the history of forest policy and programme development; the policy making process.

Successful forest policies of the different countries in the world.

Forest law: Legal definitions, application of criminal procedure code and Indian Penal code; law of evidence; object of Social Forest law; legal organization of the forest service.

Forest research methods - I (Credit hours 1+1)

Elementary principles of the philosophy and methods of science; limitations of research techniques; structure of research organisations, research planning; students need to plan, lay-out and conduct a field experiment. Maintenance of experimental records, recording of observations, sampling technique, tabulation, analysis and interpretation of result. Preparation of data for a scientific paper. Essential features for success in field experiments.

Forest stay (Credit hour 0+1)

Students will stay in a forest area for about ten days and engage in the relevant professional work. They will keep the record of work done and submit a report after completing the stay.

Major field of specialisation (Credit hours 2+1)

IV YEAR III TRIMESTER

Forestry extension (Credit hours 2+1)

Extension education, information and behavioural change, communication, extension tools and methods, extension programme planning and evaluation.

Social forestry (Credit hours 2+1)

Socio-economics: Policies - land use, economic, energy policies, etc., land tenure and application, tax, incentives, rural sociology, project identification, preparation, appraisal, monitoring, farm and community forestry, planning for large areas, labour, seed and plant supplies.

Forest research methods - II (Credit hour 0+1)

Communication of research findings; preparation, oral presentation and submission of the research report based on the field experiment conducted during previous course (Forest Research Method - I). Practical application of experimental results.

Philosophy and professional ethics (Credit hour 1+0)

Religion, culture and the environment. General, moral and political philosophy; philosophy of the social sciences; philosophy of mind; logic; moral principles to guide foresters in the exercise of their profession.

Global forestry (Credit hours 2+0)

Forest geography of the world forest resources and practices in different regions of the world; regional development of wood based industries and trade patterns in forest raw materials and finished products.

Tribal ethnology (Credit hour 1+0)

Linkages of forestry and tribal development; constitutional provisions for development of scheduled tribes and forests; symbiotic relationship between tribals and forests; concept of tribal development; tribal co-operative societies; socio-economic aspects of shifting cultivation; tribal development programmes; tribal land and tenurial systems.

Major field of specialization (Credit hours 2+1)

Appendix V

Lead institutions and human resources in selected Asian countries in the field of wood science

BANGLADESH		
Institution	**Thrust Areas**	**Areas and Resource Persons**
Bangladesh Forest Research Institute P.O. Box 273, **Chittagong**-4000		**Wood Technology** Tel: +880-31-681577 Fax: +880-31-681566 Email: bfri@spnet.ctg.com
Chittagong University, Institute of Forestry Chittagong 4331		Gias Uddin Ahmed Tel: +880-31-210132-49
CHINA		
Bamboo Research and Development Center (BRDC), Chinese Academy of Forestry Hangzhou http://www.forestry.ac.cn/zzzx/bamboo	1. Scientific research and technical development on cultivation, utilization and development of bamboo 2. BRDC has technical and economic exchange programmes both domestically and abroad. 3. Conducts technical training on bamboo for China and other countries.	
International Network for Bamboo and Rattan (INBAR) Anyuan Building No.10, Anhui Beili, Asian Games Village, Chaoyang District, **Beijing** 100101-80 URL: http://www.inbar.org.	1. Through a growing Network of participating organizations and individuals from all continents of the world, INBAR develops and assists in the transfer of appropriate technologies and solutions to benefit the peoples of the world and their environment.	Tel: +86-10-64956961/82 Fax: +86-10-64956983 Email: info@inbar.int

Research Institute of Wood Industry **Chinese Academy of Forestry** **Beijing** Post No:100091	1. Wood property 2. Wood drying 3. Wood protection 4. Wood-based Panels 5. Wood Adhesives and Panel Surface finishing 6. Machinery and Automation, 7. Civil engineering designing	**Wan Shou Shan** Tel: 010-62889410 Fax: 010-62881937 Email: office.mg@wood.forestry.ac.cn Units: National Quality Monitoring and Testing Center for Wood-based Panels
Research Institute of Chemical Processing and Utilization of Forest Products No. 16, Suojin Wucun, **Nanjing**, 210042, P. R. China	1. Pulping and Paper-making from wood and non-wood fibers. 2. Chemical utilization of Oleoresin. 3. Chemical utilization of forest resources. 4. Activated carbon and wood-based energy 5. Adhesives. 6. Manufacture of Furfural and Furfuryl Alcohol by hydrolysis of plant cellulose materials, and Chemical modification of cellulose.	**Director- Shen Zhaobang** Tel: +86 25 5412131 Fax: +86 25 5413445 E-mail: ricpufp@public1.ptt.js.cn
Shanghai Wood Industry Research Institute 667 Zhongshan Road (West), **Shanghai** 200051		Director: Ma Xin Tel: 0086-21-2412200/2412266 Fax: 0086-21-2412266
INDIA		
Forest Research Institute (FRI), Dehra Dun, Deemed University http://envfor.nic.in/icfre.html	1. Ph.D. programmes for postgraduates students. 2. Specialized courses-Postgraduate Diploma courses in Pulp and Paper Technology, Wood Technology and Plantation Technology. 3. Networking with other training institutions involved in the field of forestry education.	

Indian Plywood Industries Research and Training Institute (IPIRTI), Bangalore (URL: http://envfor.nic.in/ipirti.html),	1. Finger-jointed and glulam structures from plantation grown timbers and bamboo mat boards from bamboos. 2. Training in mechanical wood industries and processing small diameter logs 3. Developed new products like bamboo mat boards and application in various uses for housing	DIRECTOR Tel: +91-80-8394231 Fax: +91-80-8396361
Institute of Forest Genetics and Tree Breeding (IFGTB) URL: http://envfor.nic.in/ifgtb.html	1. Provenance trials of Teak, Casuarina, Acacia nilotica, Albizia lebbek, Neem and Bamboos. 2. Socio-economic survey and studies on productivity in agroforestry systems. 3. In situ and ex situ conservation studies on biodiversity of forest genetic resources	**Wood properties of Acacia/Eucalypts -** **Dr. Mohan Varghese**
Institute of Wood Science and Technology (IWST), Bangalore-560 003 URL: http://envfor.nic.in/icfre.html	1. Processing / utilization of lesser known timber of plantation species. 2. Development of indigenous substitutes for imported raw material in perfumery industries. 3. Utilization of alternative timbers for catamarans, the traditional craft of poor coastal fishermen of A.P.	**Wood anatomy/ identification/ properties -** **Dr. R. V. Rao** Tel: +91-80-3341731 Fax: +91-80-3341731 **Wood Treatment for catamarans -** **Dr. K. S. Rao** Tel: +91-80-3341731 Fax: +91-80-3341731

Division of Wood Science **Kerala Forest Research Institute** **Peechi** 680 653, **kerala** URL: http://www.kfri.org	1. Wood and Non-wood (bamboo/rattan) anatomy, identify-cation, properties 2. Economic schedule for preservative treatment of rubber wood 3. Utilization of wood from wilt-diseased coconut palms 4. Pulpwood quality of Clonal eucalypts from short rotation plantation 5. Protection of pulpwood in storage 6. Rural technology for rattan (cane) curing 7. Grading rules for rattan (cane) 8. Harvesting tool for reed bamboo 9. Preservative treatment and storage of reed bamboo 10. Local tools, equipments and technologies for processing bamboo and rattan 11. Wood quality of fast grown teak, eucalypts, acacia,	**Wood/rattan anatomy and identification, wood quality of tropical woods -** **Dr. K. M. Bhat** Tel: +91-487-282037 Fax: +91-487-282249 Email: kmbhat@kfri.org or maksbhat@vsnl.com (home) **Wood/ bamboo anatomy, Bamboo-reed harvesting -** **Dr. K. V. Bhat** Tel: +91-487-282037 Fax: +91-487-282249 Email: kvbhat@kfri.org **Rubber wood, coconut stem, bamboo Preservation -** **Dr. R. Gnanaharan,** Tel: +91-487-282037 Fax: +91-487-282249 Email: gnana@kfri.org **Rubber wood, coconut stem, Preservation, Acacia -** **Dr. T. K. Dhamodaran** Tel: +91-487-282037 Fax: +91-487-282249 Email: tkd@kfri.org **Rubber wood bio-degradation -** **Dr. E. J. Maria Florence** Tel: +91-487-282037 Fax: +91-487-282249 Email: flory@kfri.org

INDONESIA		
Centre for Research and Development of Isotopes and Radiation Technology, National Nuclear Energy Agency (P3TIR-BATAN) Jl. Cienere Ps. Jumat, Kotak Post 7002 JKLS **Jakarta** 12070	1. Modification rubber latex for wood adhesives 2. Development of lingo-cellulosic plastic composites (wood, rattan, bamboo) by radiation polymerization technique	**Radiation polymerization technique for wood plastic and rattan/bamboo composites -** **Marga UTAMA** Tel: +62-21-7690709 Fax: +62-21-7691607 Email: marga@batan.go.id **Sugiarto DANU** Tel: +62-21-7690709 Fax: +62-21-7691607
Department of Forest Products Technology, Faculty of Forestry, Bogor Agricultural University Kampus IPB Darmaga P.O. Box 168, **Bogor** 16001	1. Wood extractives and pulping chemistry 2. Chemical modification, wood-polymer composites, 3. Bio-deterioration and preservation 4. Wood physics and mechanics 5. Wood machining 6. Growth stresses and wood quality 7. Wood anatomy/ proeprties	**Pulping and wood Chemistry -** **Prof. Wasrin SFAII** Tel: +62-251-621285 Fax: +62-251-621256 Email: wasrinsy@indo.net.id **Dadeb sarip NAWAWI** Tel: +62-251-621285 Fax: +62-251-621256 Email: jthh-ipb@indo.net.id **Chemical modification / composites -** **Prof. Yusuf Sudo HADI** Tel: +62-251-621677 Fax: +62-251-621256 Email: yshadi@indo.net.id **Wood physics/ Engineering -** **Sucahydo SADIYO** Tel: +62-251-621285 Fax: +62-251-621256 Email: jthh-jpb@indo.net.id **Naresworo NUGROHO** Tel: +62-251-621285 Fax: +62-251-621256 Email: jthh-jpb@indo.net.id

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Wood anatomy/properties of tropical woods -
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Wood-based panels / composites from wood /agricultural residues -
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Forest Products Research Centre Jl. Gunung Batu No.5, **Bogor** 16610	1. Wood anatomy, identification and wood properties 2. Wood preservation 3. Plywood and composite boards from Indonesian woody species	**Plywood, particleboard and composite boards -** **I.M. SULASTINGSIH** Tel: +62-251-326378 Fax: +62-251-313613 Email: titin@usim.or.id **Wood preservation , thermal treatment -** **Pipin PERMADI** Tel: +62-251-326378 Fax: +62-251-313613 Email: permadi@indo.net.id **Properties of wood/ lingo-cellulosic materials -** **Nurwati HADJIB** Tel: +62-251-326378 Fax: +62-251-313613 Email: usim@indo.net.id **Wood suitability for pulping and bio-pulping by enzymatic and fungal lignin degradation -** **Ridwan Achmad PASARIBU** Tel: +62-251-326378 Fax: +62-251-313613 Email: slitbang@bogor.indo.net **Rene M. SIAGIAN** Tel: +62-251-326378 Fax: +62-251-313613 Email: slitbang@bogor.indo.net **Wood, rattan, bamboo properties, drying and permeability -** **Efrida BASRI** Tel: +62-251-326378 Fax: +62-251-313613 Email: efrida@usim.or.id **Wood biodeteriration -** **Paimin SUKARTANA** Tel: +62-251-326378 Fax: +62-251-313613 Email: paimins@usim.or.id

Institute for Research and Development of Cellulose Industry Bandung Jl. Raya Dayeuhkolot No. 132, **Bandung** 40258	1. Cellulolse, lignin, pulp and paper, bleaching, etc 2. Utilisation of NWFPs as raw material for pulping	**Cellulose derivatives, lignin and waste-water treatment of pulp and paper mill -** **Nursyamsu Bahar TOBING** Tel: +62-22-5202980 Fax: +62-22-5202871 Email: bbsindag@melsa.net.id **Pulping and bleaching technology -** Tel: +62-22-5202980 Fax: +62-22-5202871 Email: bbsindag@melsa.net.id **Susi SUGESTY** Tel: +62-22-5202980 Fax: +62-22-5202871 Email: bbsindag@melsa.net.id
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Research and Development Centre for Biology (Botany division), Indonesian Institute of Sciences Jl.Ir. H. Juanda 22, **Bogor** 16002	1. Wood and bamboo anatomy 2. DNA moelcualr study and phylogenetic analysis	**Bamboo anatomy/ molecular marking and classification -** **Elisabeth A. WIDJAJA** Tel: +62-251-322035 Fax: +62-251-325854 Email: ewidjaja@indo.net.id **Wood anatomy/tree mutiplication -** **Ninik SETYOWATI** Tel: +62-251-322859 Fax: +62-251-370934 Email: prosea@indo.net.id

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Division of International Environmental and Agricultural Science, Graduate School of Agriculture, Tokyo University of Agriculture and Technology Saiwai, Fuchu, **Tokyo** 183-8509 (URL: http://samia.ab.a.u-tokyo.ac.jp/aeb/) Tel: +81-42-367-5655 Fax: +81-42-360-8830	1. Mechanical wood processing, industrial safety, etc.	**Mechanical wood processing -** **Prof. Shigeru KITAYAMA** **Sawmilling and laser processing -** **Prof. Nobuaki HATTORI**
Faculty of Agriculture, Gifu University **Yanagido, Gifu** 501-1193 Tel: +81-58-293-2833 Fax: +81-58-293-2840	1. Biochemistry and effective use of plant constituents 2. Enzymatic ligninolysis and biologically active phenolics	**Biochemistry and use of plant constituents -** **Prof. Hideo OHASHI** **Enzymatic ligninolysis and biologically active phenolics -** **Prof. Shingo KAWAI**
Faculty of Agriculture, Iwate University **Morioka, Iwate** 020-8550 Tel: +81-19-621-6103 Fax: +81-19-621-6107	1. Wood-based panels	**Wood-based panels -** **Prof. Noboru SEKINO**

Faculty of Agriculture, **Kyoto University** Sakyo-ku, **Kyoto** 606-8224 URL: http://mirror.xanet.edu.cn/www.kyoto-u.ac.jp/index-e.html Tel: +81-75-753-7531 Fax: +81-75-753-6020	1. Wood and heartwood formation in fast growing tropical hardwoods 2. Anatomy of palms, bamboo, monocotyledons, etc. 3. Genetic engineering of bamboo 4. Anatomy, ultra-structure, quality of tropical woods and biomass utilization 5. Lignin, cellulose, enzyme studies	**Heartwood formation in tropical hardwoods -** **Prof. Tadashi NOBUCHI** **Genetic engineering of bamboo -** **Prof. Jun-ichi AZUMA** **Quantitative wood anatomy and X-ray diffraction -** **Prof. Minoru FUGITA** **Ultra-structure and lignifications -** **Prof. Keiji TAKABE** **Biodegradable plastics from cellulosic and other biomass -** **Prof. Mariko YOSHIOKA**
Wood Research Institute (WRI), **Kyoto University,** **Uji City, Kyoto** 612-0011 URL: http://mirror.xanet.edu.cn/www.kyoto-u.ac.jp/index-e.html Tel: +81-774-38-3601 Fax: +81-774-38-3600	6. Fundamental methodology, machines and systems for producing the high-performance of wood composites and their characteristic functions. 7. The development of wood carbon materials with new functions by thermal conversion and the technology for bio-energy. 8. The development for improving fire-resistant performance of wood composites. 9. studies on gene expression in woody plants to elucidate function of target genes.	

Faculty of Agriculture, **Kyoto Prefectural University** Sakyo-ku, **Kyoto** 606-8522 Tel: +81-75-703-5186 Fax: +81-75-703-5149	1. Wood extractives, chemical modification of wood and wood-based materials 2. Vibration properties of wood 3. Wood permeability and sap-flow	**Chemical modification of wood -** **Prof. Kazuya MINATO**
Faculty of Agriculture, **Kyushu University** Higashi-ku, **Fusuoka** 812-8581 URL: http://www.bcasj.or.jp/jb/3erarotx.html Tel: +81-92-642-2111 Fax: +81-92-642-2804	1. Phenolic resin adhesives & chemical modification 2. Biotechnology and gene mapping	**Adhesives and chemical modification of wood -** **Prof. Mitsuo HIGUCHI** **Bio-synthesis of wood components -** **Prof. Kokki SAKAI** **Prof. Koki FUGITA** **Prof. Ryuichiro KONDO** **Prof. Mitsuhiro MORITA** **DNA-Gene mapping -** **Prof. Susumu SHIRAISHI**
Faculty of Agriculture, **Shizuoka University** Suruga-ku, **Shizuoka** 422-8529 Tel: +81-54-237-1111 Fax: +81-54-237-3028	1. Wood adhesion, bond quality, wood composites 2. Utilization of Bamboo in panels and MDF. 3. Recycling of wood resources	**Wood adhesion, bond quality and composites -** **Prof. Kinji TAKI** **Utilization of Bamboo in panels and MDF -** **Prof. Hiroaki YOSHIDA** **Wood composites and recycling -** **Prof. Shigehiko SUZUKI**
Faculty of Agriculture, Tottori University **Koyama, Tottori** 680-8553 Tel: +81-857-31-5343 Fax: +81-857-31-5347	1. Wood gluing and durability of glued structures in exposed conditions 2. Board manufacture from agro-residues 3. Wood quality variation of tropical/arid zone trees	**Wood gluing and durability of glued structures -** **Prof. Tomoyasu SAKUNO** **Wood quality variation of tropical/arid zone trees -** **Prof. Ikuo FURUKAWA**
Faculty of Agriculture, Yamagata University **Tsuruoka, Yamagata** 997-8555 Tel: +81-235-28-2805 Fax: +81-235-28-2812	1. Chemical characterization of forest products	**Chemical characterization -** **Prof. Koichi OGIYAMA**

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Faculty of Science and Engineering, Shimane University, Matsue, Shimane, 690-8504 URL: http://susc3002.riko.shimane-u.ac.jp/index-e.html Tel: +81-852-32-6492 Fax: +81-852-32-6499	1. Automation of wood processing machinery 2. Developing Reinforced wood - based panels 3. Anatomy and identification of tropical woods other wood-based materials 4. Chemical modification of low quality wood for higher performance	**Wood-working machinery -** **Prof. Chiaki TANAKA** **Wood anatomy/ identification and wood quality modification -** **Prof. Takeshi FURUNO**
Graduate School of Agricultural and life sciences, University of Tokyo Yayoi, Bunkyoku, **Tokyo** 113-8657 URL: http://www.a.u-tokyo.ac.jp/english/ Tel: +81-3-3812-2111 Fax: +81-3-5841-5023	1. Utilization of agricultural residues like rice straw, pulping, recycling of wood resources 2. Bio-polymer chemistry, bleaching and lignin chemistry	**Lignin derivatives, pulping -** **Prof. Gyosuke MESHITSUKA** **Wood physics, engineering and recycling -** **Prof. Takanori ARIMA** **Bio-polymers and cellulose chemistry -** **Prof. Shigenori KUGA**
School of Agriculture, Ehime University **Matsuyama** 790-8566 URL: http://ugas-eu.agr.ehime-u.ac.jp/index.htm Tel: +81-89-946-9803 Fax: +81-89-977-4364	1. Wood physics, drying, permeability, charcoal 2. Tissue culture and biotechnology, pulping 3. Non-destructive testing 4. Bio-mechanical pulping	**Wood physics, charcoal -** **Prof. Kazuo HAYASHI** **Biotechnology/tissue culture -** **Prof. Sanro TACHIBANA** **Non-destructive wood testing -** **Prof. Masatoshi SUGIMORI** **Prof. Sanro TACHIBANA** **Bio-mechanical pulping -** **Prof. Kazutaka ITOH**

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編集後記

『農学国際協力』本号は、農学国際教育協力研究センター（以下、「農国センター」という。）が海外から客員教授・客員研究員として招へいした４名の研究者の方々が農国センターの教員と共同研究した成果の報告を掲載した。本招へい事業が開始された2000年度から翌年度に招へいした４名の研究者である。

中国社会科学院農村発展研究所元所長の陳吉元氏は、2001年12月の世界貿易機関（WTO）加盟を控え、市場経済体制に全面的に転換する時を迎えて、農業支援戦略を“農業が工業を育てる”時代から“工業が逆に農業を育てる”時代へ転換する必要性を強調している。さらに、条件の整っている地域から徐々に実現し、最後に全面的転換に発展させる道筋を提示されている。2003年７月に病気で他界された陳氏のご冥福を改めてお祈りします。

カンボジア王立農業大学学長補佐Visalsok Touch氏は、カンボジアの農業教育制度の現状と問題点を分析し、食料安全保障と貧困削減のためにも、農業教育制度の充実のために投資し、農業普及、国民の教育や研究並びに政策担当等まで国家の様々な機関で貢献できるような人材の育成の必要性と緊急性を強調されている。

東南アジア文部大臣機構農業高等教育研究地域センター（SEAMEO SEARCA）大学院教育・組織開発部長Editha Calienta-Cedicol氏は、1966年の設立以来35年以上になるSEARCAの経験をもとに、農業高等教育の強化のためには、SEAMEO傘下の個々の機関レベル、国レベル、地域レベル、アジア農科系大学連合（AAACU）などの様々なレベルでのパートナーシップの確立およびそれに基づく相互の協力がとりわけ重要であることを強調されている。

インド・ケララ州森林科学研究所木材科学部長Kanthila M. Bhat氏は、アジア諸国、特にインドの林学教育の現状と問題点を分析し、木材科学分野の研究から現場で働く技術者まで広くカバーできるような人材育成のための研修プログラムを論じている。

以上４編の中には、本誌刊行が遅れたこともあって、やや時宜を得ていない感を否めない報告もあるが、それはひとえに当農国センターの責任であって、各論文ともそれぞれ貴重な論考であることに間違いはない。読者の参考になれば幸いである。

本招へい事業は、日本人の研究者・技術者・専門家の方々を客員教授として招へいする事業とともに現在も実施している。農国センターの教員等との共同研究の成果を刊行し、農学国際協力の理論と方法に関わる新たな学問創出に資すると同時に、読者の参考に供することが我々の責務であると理解しており、今後も引き続き刊行を継続していくつもりである。

最後に、本誌の編集には、前農国センター教授・北川勝弘先生のご支援をいただいた。ここに記して謝意を表します。

（浅沼　修一）

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