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GENERATION, TRANSFER AND UTILIZATION OF INFORMATION ON NATURAL RUBBER: A FUNCTIONAL MODEL

Kurian K. Thomas
Rubber Research Institute of India, Kottayam – 686 009, Kerala, India
Email: rrii@vsnl.com

ABSTRACT

The components and sub-systems of an ideal natural rubber (NR) information transfer system by which innovations covering all relevant aspects of NR production, processing and marketing reach the users expeditiously using all communication channels with adequate feedback are presented. A new scientific extension-interaction linkage of agricultural service agencies and policy makers is observed among users. In the NR information system, four sub-systems of generation, documentation, extension and utilization are identified. International agencies like ANRPC, IRRDB, IRSG etc., Rubber Research Institutes like RRIM, RRISL, RRII, IRCA etc., Universities, public and private R&D institutions are among the NR information generation agencies. The generated information is processed, published, distributed, organized and controlled bibliographically in the documentation sub-system. The extension sub-system ensures the constant information flow in a readily comprehensible form to the growers through general extension workers and to manufacturers through technology consultants with regular feedback to the generating sub-system. In the utilization sub-system, the end users accept and adopt the information and their experience becomes the feedback input to the generation sub-system.

INTRODUCTION

The developments in production, processing technology and industrial application of natural rubber (NR) in the recent past are remarkable. The Para rubber tree, which is botanically known as *Hevea brasiliensis*, accounts for 90 per cent of world NR production. Contributions from concerted scientific research and adoption of modern technology since the genesis of the rubber plantation industry during the dawn of the 20th century have resulted in tremendous increase in productivity, total production of NR and total area under rubber cultivation.

On par with the developments in systematic research and technological boost, the world information on NR is also increasing. While the major rubber producing countries – Indonesia, Thailand, India, Malaysia and Sri Lanka – have an edge in the generation of information on biological aspects of NR, the highly industrialized European countries, USA and Japan are comparatively better equipped in generating information on industrial and technological applications and product manufacture.

A system of information transfer has been in operation for NR for a very long time. Literature search cannot find any attempt for identifying the various components of this information transfer process and a re-appraisal of the theory behind this communication process is long due.

The primary objective of the study is (1) to identify and classify the various sources of information on NR (2) to identify and categorize the users of NR information and assess their information needs and (3) to present a functional model for the generation, transfer and utilization of information on NR.

METHODOLOGY

Discussion of any information transfer system should be preceded by the identification of its components. The components of the NR information transfer system comprise of actual and potential users of information and the perfect matching of the users and their information needs (Deirng, 1973; Russ[illegible]l, 1983) with the sources of information on the subject and its related fields

For transfer of messages by various media between resource system and users (Havelock, 1969), different models of information transfer have been developed. The general model of Murdic and Liston (1967) looks appropriate as it links the users and sources of information. But in the general information model, very little emphasis is given for processing of scientific information. Lancaster (1979) has modified this model to suit information transfer among scientific community. Giving due importance for the documentation aspects, this model has been adapted for NR.

All the information sources on NR were categorized according to their nature and mode of publication (Craig, 1979; Lilley, 1981). The users of NR information were identified and categorized according to their level and quality of information needed (Haridasan and Pillai, 1988; Haridasan *et* al., 1974, 1984; Korah and Devarajan, 1991; Rajasekharan and Haridasan, 1992) and the linkages among various types of users were identified. The different linkages that exist among the users as studied, enumerated and the information seeking behaviour of users in different linkages were assessed (Lancaster, 1979; Thorpe, 1985). Finally, a functional model was proposed for the generation, transfer and utilization of NR information.

INFORMATION SOURCES

The world of NR information is established and developed by the synthesis of many branches of science ranging from agriculture to increase in production and productivity, chemistry, physics and technology to support and expand a growing range of applications and to economics for evaluation of performance in terms of cost, productivity and the marketing of NR. A detailed account of the subject divisions of NR information is presented in Figure 1.

Publications on biological and technological aspects of natural rubber (NR) constitute the core collection of information sources of the subject. Crag's (1979) mapping and Lilley's (1981) division of agricultural information sources suit NR sources too. These sources can be classified either on the basis of the quality of information sought (Fig. 2a) or on the type of publication (Fig. 2b).

Qualitative classification

The division of NR information sources as ephemeral, non-scientific, scientific primary and scientific secondary is helpful for a qualitative analysis. NR news items in local and national dailies, published package and practices, press releases of NR organizations and statutory bodies, price notification, market reviews etc. constitute the ephemeral type of sources. Non-scientific sources include government orders, policy statements, official publications (reports, reviews etc.) of NR organizations, popular articles and advisory publications like planting recommendations and project profiles. Periodical articles (both literature on NR and literature relevant for NR scientists), proceedings of conferences, thesis and dissertations pertaining to NR research at various universities, patents of specific NR products, standards on NR issued

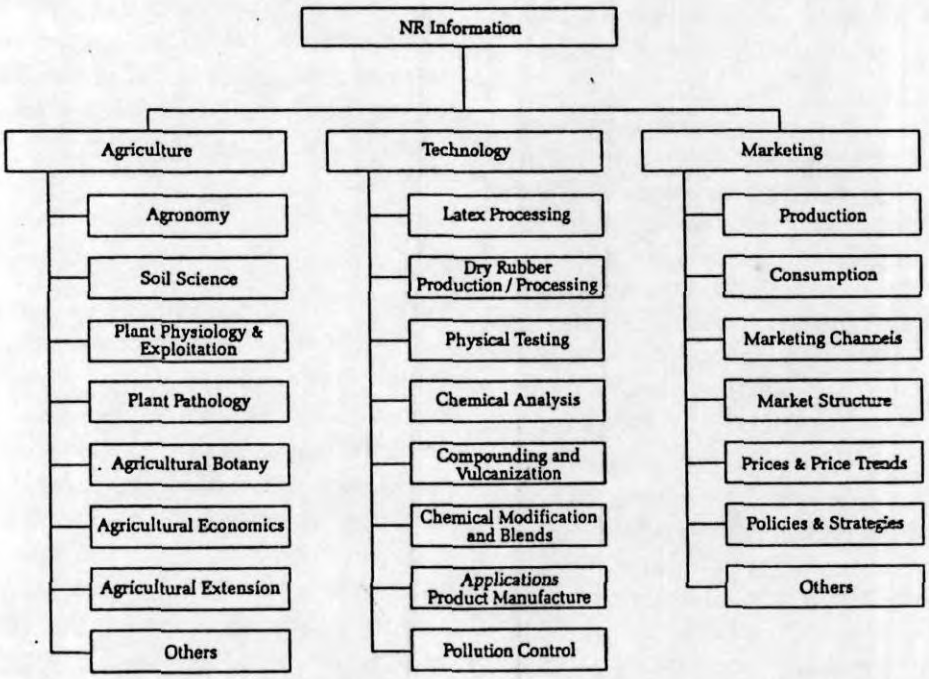

Fig. 1. Generation of NR information: A schematic representation

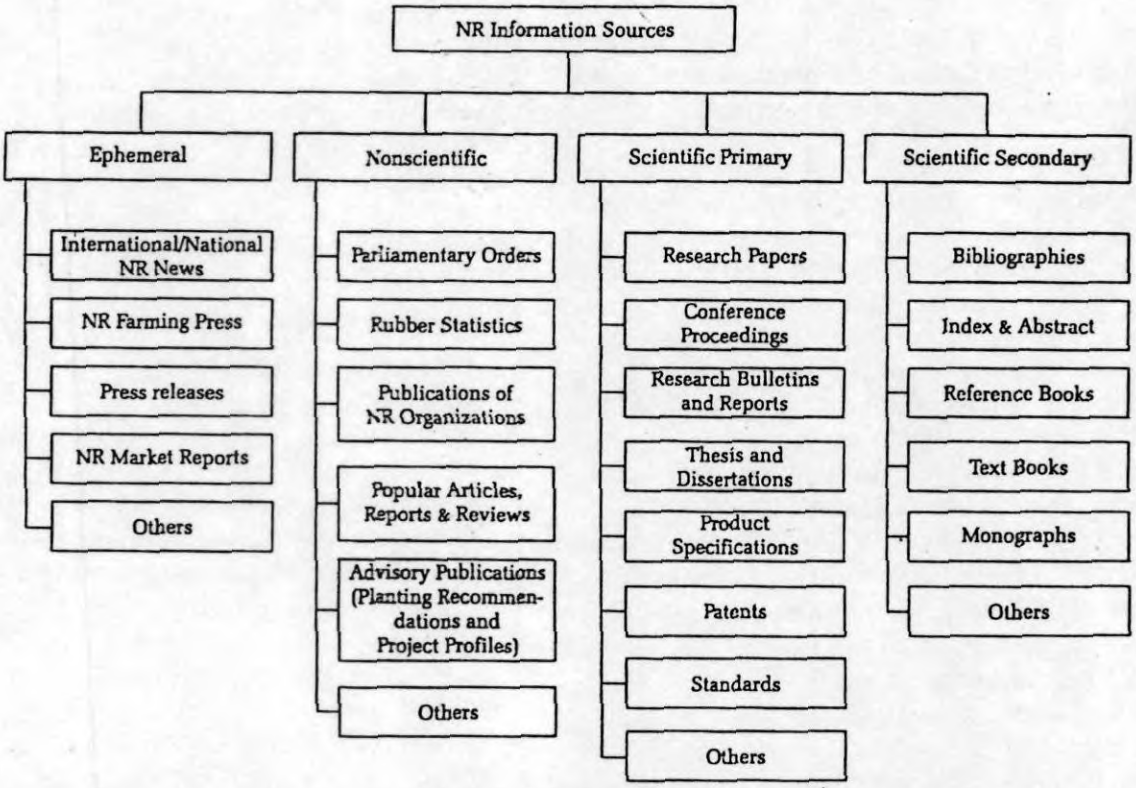

Fig. 2a. A qualitative classification of NR information sources

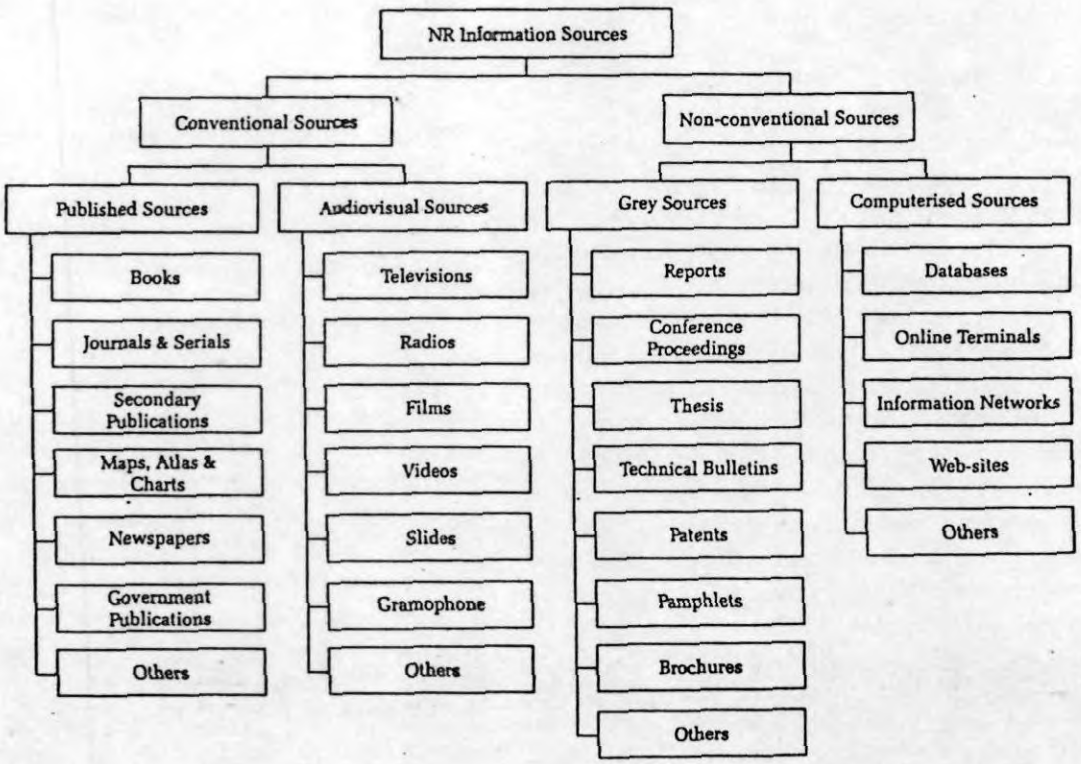

Fig. 2b. NR information sources by mode of publication

either by the ISO or by the respective national standards organizations etc. are some of the major primary sources of scientific information.

The secondary sources, though not concerned with reporting of original research, present synthesis of existing knowledge and provide bibliographic control of NR published literature. The main abstracting service for NR technology is the RAPRA Abstracts of the Rubber and Plastics Research Association, UK, the Chemical Abstracts of the American Chemical Society, USA. The Bibliography of Agriculture of the National Agricultural Library, USA, the Biological Abstracts of the BIOSIS, USA, the Agrindex of the AGRIS, USA, the 40 odd CAB abstracts of the Commonwealth Agricultural Bureau, UK, the Agriculture and Environment for Developing Regions, of the Tropical Agricultural Institute, Netherlands are the major secondary sources which provide most of the references on the agro-biological aspects of NR. NR bibliographies, rubber directories, dictionaries and encyclopedias are also included in the group of secondary sources.

Information sources by type

The division of NR information sources by types (Fig. 2b) as conventional and non-conventional is helpful for identifying the various sources in different media. The audiovisual sources are used mainly in the extension of NR information. The non-conventional grey sources include literature that cannot readily be acquired through normal book selling channels and are, therefore, difficult to identify and obtain (Chillang, 1982). Grey literature is often produced in limited quantity without any serious concern for its content or quality. Only a small portion of it is listed here as secondary sources. The variations in their layout and format make it difficult to control them bibliographically. This causes problems in their reading, storage and reproduction (Chillang, 1985).

From the early 1960s, the large secondary services began to use computers to help them compile their abstracting indexing journals and operate computer-based information services, which also form part of the non-conventional sources (Johnston, 1981). AGRICLOA, AGRIS, BIOSIS etc. have bibliographic databases with online access pertaining to agro-biological literature. Both CA Services and RAPRA Databases provide online access to NR technology literature. International Rubber Research and Development Board (IRRDB) in collaboration with CAB Database, provide computerized bibliographic services on NR.

Internet is a communication channel consists of large number of inter-connected computers. Like in many fields, internet provides e-mail and website services for NR information users and facilitates access to their resources. E-mail is the non-interactive communication of text, data and messages between a sender and recipient by utilizing telecommunication links. The *worldwide web or website is the portion of the* internet whose pages are inter-connected by hyper links. The information sources stored in web servers can be accessed and consulted from anywhere in the world at any time. Major e-mail facilities and websites on natural rubber are presented in Table 1.

USERS' LIKAGES AND THEIR INFORMATION NEEDS

Farmers, estate managers, technologists, extension workers, marketing agencies like rubber dealers, co-operative marketing societies, rubber producing societies etc., policy makers, researchers and students constitute the user community of natural rubber (NR) information.

Linkages among NR users

The types of linkages exist among the NR user community are presented in Figure 3. Both the scientific and extension channels have already been identified in the transfer process (Thorpe, 1985). As Lancaster (1979) observes, the scientific linkage includes the research and education institutions, and library and information centres. The extension linkage covers farmers, extension workers, rubber producers' societies (RPSs), manufacturers and traders. A scientific-extension interaction linkage also can be observed. Agricultural service agencies and policy makers are in the interaction linkage having interaction with both the scientific and extension channels.

Table 1. Major national and international websites and e-mail on natural rubber

Organization	Website	E-mail
National		
Automotive Tyre Manufactuers Association, Mumbai	www.atmaindina.com	atma@vsnl.in
CAPEXIL, Mumbai	www.capexil.com	embindia@biopond.com
Rubber Technology Centre, IIT, Kharagpur	www.iitkgp.ernet.in	golokb@rtc.iitkgp.ernet.in
Indian Rubber Manufacturers Research Association, Mumbai	www.irmra.org	rubberin@bom7.vsnl.net.in
Rubber Board, Kottayam	www.rubberboard.org.in	rbedp@vsnl.net.in
International		
International Rubber Research and Development Board, Malaysia	www.irrdb.org	irrdb@the.net.my
International Rubber Study Group London, UK	www.rubberstudy.com	irsg@compuserve.com
Rubber Division, American Chemical Society	www.rubber.org	lblazef@uakron.edu
Rubber Manufacturers Association London, UK	www.rma.org	dbshea@intmail.att.net
Rubber Network, Atlanta, USA	www.rubbernetwork.com	pr@rubbernetwork.com
Rubber Research Institute of Thailand	www.rrit.go.th	rrit@lmethan.co.th
Rubber World, USA	www.rubberworld.com	
Tun Abdul Razak Research Centre, London, UK	www.tarrc.co.uk	general@tarrc.co.uk

Scientific linkage

The scientific channel has two segments; the research segment and the academic segment, both well supported by library and information centres. As Tidbury (1974) pointed out, Scientific community has two kinds of information needs (a) information on current developments in research, and (b) archival information. Both are well served, mainly by traditional library and modern information services.

The institutions all over the world which undertook biological and technological research constitute the research segment of this information transfer process. Teaching staff and students constitute the academic segment. Publishers, distributors, librarians and information scientists, who retrieve and disseminate the information, form the middle users in the scientific linkage. The information centres also belong to this group and perform the dissemination function by a variety of services.

Extension linkage

The rubber growers of estates and smallholdings, manufacturers and traders, represent the beginning and the end of the information transfer chain as they are the ultimate beneficiaries. There are also the extension workers, the RPS and the technology consultants, who are the middle users in the transfer process.

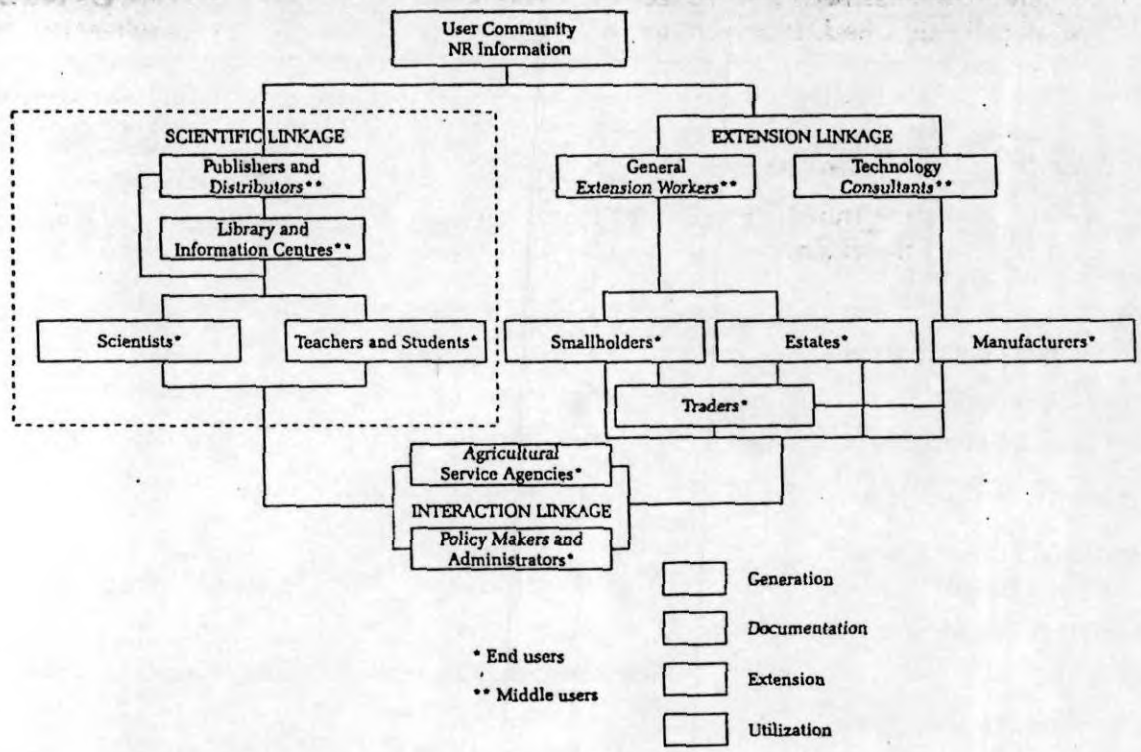

Fig. 3. Linkages of users of NR information

The intermediaries in between the producers and manufacturers are the marketing agencies such as dealers and other agencies like co-operative and Rubber Producers' Societies. There are brokers who are also rubber dealers with different nature of operation.

The middle users in the extension channel, the general extension workers and the technology consultants, act as a linkage between the scientific channel and the end user by translating the scientific innovations in a readily adaptable form for the growers and at the same time manufacturers.

Interaction linkage

Agricultural service agencies, policy makers and administrators constitute this segment. They gather NR information from all available sources and have a two-way interaction with both the scientific and extension linkages. Banks, agrochemical suppliers, rubber brokers, farm consultants etc. constitute the group of agricultural service agents.

Information needs

Research publications, text books, reviews, conference proceedings, farm publications etc. form their key sources of information of scientific and academic segment. Essential figures of production, revenue and expenditure together with agronomic, factory and infrastructure information are collected and analyzed for improving the efficiency for obtaining a higher profit. However, escalating cost and shift to other sources of information limit their role.

The information needs of estates are well served either by their own R&D establishments or through extension. Traditionally, all the smallholders depend on other farmers, extension workers, co-operative societies and to some extent the local press for their information needs (Haridasan *et al.*, 1974; 1984).

As the price is the most sensitive factor in a commodity market and it is highly essential that the market price is to be correctly compiled, monitored and published regularly so as to avoid exploitation of growers. A well-organized system

of market information has been evolved for NR with regular collection and dissemination of information on rubber price. This information is vital not only for the scientists in formulating future research strategies but also provides the basic feedback for the policy makers.

The success of the transfer process rests with the efficiency of the extension system and hence it should be properly strengthened (Russel, 1983). The general extension workers and RPS have more consistent interaction with the rubber growers, especially with the smallholders. For their needs of actual information on various aspects of NR production like rubber fertilizers, disease identification etc., farmers depend on personal contacts, group discussions, published farming recommendations, reviews and trade publications with a minimum use of scientific literature.

The successes of extension agents in motivating small growers to adopt modern technologies depend to a large extend on proper identification and exploitation of the preferred source of information. Earlier studies on the use pattern of information sources by Indian small growers reveals that 99 per cent of the growers in the area studied read newspaper by direct subscription or from other sources (Haridasan *et al.*, 1974; Rajasekharan and Haridasan, 1992). Seventy four per cent of the growers possessed television sets. The sizeable percentage of viewers of agricultural programmes in television indicates the potentialities of this medium in dissemination of information (Rajasekharan and Haridasan, 1992).

The impact of various channels of information diffusion on the information needs of Indian rubber small growers can be assessed by reviewing the farmers' ranking of information sources on NR (Table 3). The percentage of small growers depending on other growers for their information need ranged from 22 to 35 for various technical aspects. This is in conformity with an earlier study by Haridasan and Pillai (1988). The highest percentage of growers depends on other growers for information pertaining to selection of planting materials and disease management. The role of Rubber Board officials was mainly limited to decisions relating to manuring and planting materials. The performance of RPSs, which are intended to be the nodal agency for extension, is very poor and are to be strengthened to take up this task.

The primary information needs of the technology consultants centre around the knowledge of new developments in NR technology especially in product manufacture. In order to acquire relevant information in any

Table 2. Contributions of NR research institutions

Name of the R&D Institution	Year of establishment	No. of staff (2000)			No. of research articles (yearly average)
		Research	Supporting	Total	
Rubber Research Institute of Malaysia (RRIM)	1926	197	1897	2094	63
Rubber Research Institute of India (RRII)	1955	133	257	388	76
Institute de Recharche Cauchaque (IRCA)	1956	—	—	—	47
Rubber Research Institute of Sri Lanka (RRISL)	1923	42	232	274	49
Rubber Research Institute of Indonesia	1912	55	240	295	19

- Information not available

specialized NR area, they monitor a wide spectrum of scientific literature to product specifications, standards, patents, manuals, reference books, technical notes, trade journals and even directories.

The agriculture service agencies need information on production and marketing of NR, problems and prospects of NR-based industries, research and development activities, government policies and planting practices. Policy makers and administrators gather information on various aspects like production, consumption, market outlook, resource mobilization and performance monitoring from the local, national and international perspectives. The specific characteristics of their information needs include its transitory and dispersed nature, the need to draw data together in summary from many sources, the minor role of formal literature and the urgency for quick access.

The NR information user community, as it is evident, comprises highly complex groups ranging from the specialized scientific elites to tradition-bound smallholders with diverse and heterogeneous information needs.

INFORMATION TRANSFER MODEL

The process of information generation, transfer and dissemination is continuous, cyclic and never ending. A perfect communication system should facilitate free flow of processed information from the generating agency to the user community directly and through the extension workers with a constant feedback to the generating segment. The NR information transfer process is schematically illustrated in Figure 4.

In this transfer process, four activities *viz.*, generation, documentation, extension and utilization take place. The scientists, teachers and research scholars are the authors and they generate information. Publishers, distributors and library and information scientists contribute documentation process. The extension segment consists of general extension workers and technology consultants. Rubber growers, manufacturers, agricultural service agencies, policy makers and administrators are involved in the utilization process. Feedback information is generated in the utilization segment, which is used for planning future strategies for scientists and policy makers.

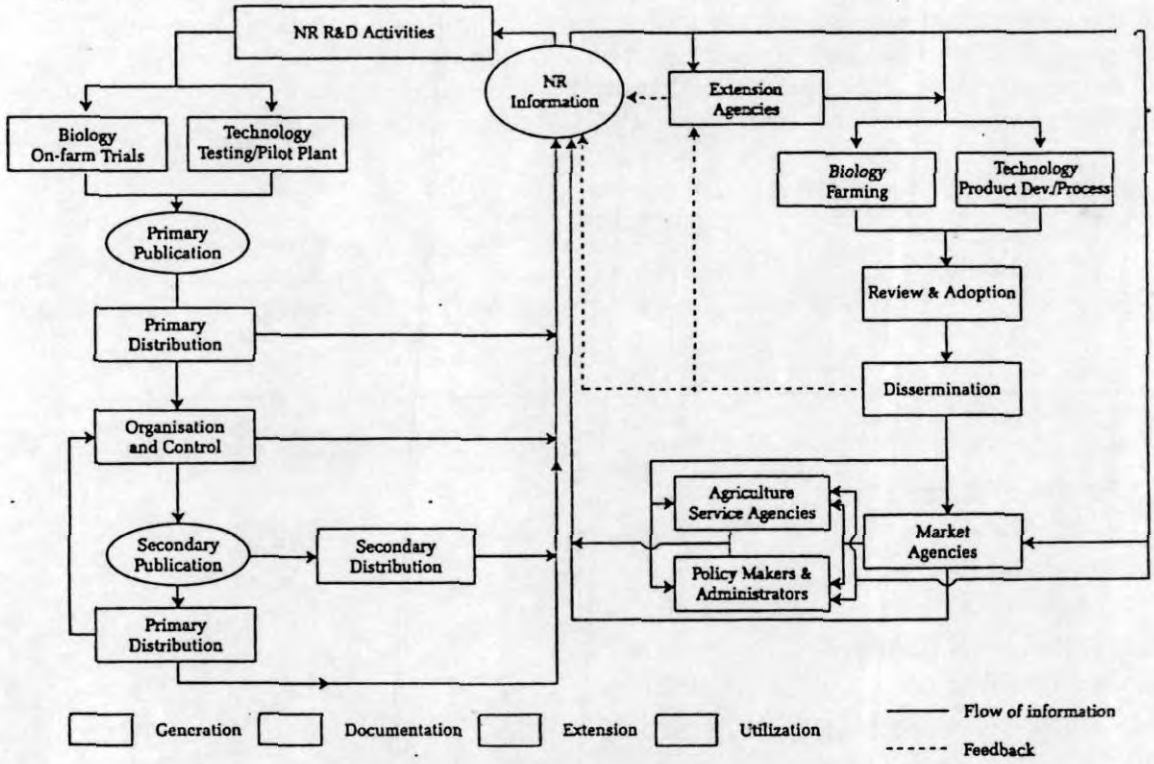

Fig. 4. Generation, Transfer and utilization of information on natural rubber

Generation process

All the components of the scientific channel in the user community form the main generators of NR information also. The international, national and regional institutions generate and utilize the bulk of world's NR information and a comprehensive list of is provided by Yescombe (1976). The directory published by RRII in 2002 also provides information on world NR institutions (Jose and Korah, 2002).

As a trade product of big business both in the agricultural and industrial sectors, the NR industry has a number of international organizations to support its interests and chart its future course of action in the spheres of production, marketing and trade. Formed in 1970, the Association of Natural Rubber Producing Countries (ANRPC) is an inter-governmental organization of seven countries, which account for 90 per cent of the world NR production. The IRRDB is an association of government rubber research institutions. The close contacts between these institutions ensure rapid dissemination and utilization of technical information.

The International Rubber Study Group (IRSG) is made up of important producer and consumer countries of both natural and synthetic rubbers. The IRSG periodically review the global situation of elastomer production and consumption and add to NR information. Though not a rubber body, International Standards Organization (ISO) with the active involvements of national standards institutions of ANRPC develops rubber specifications. The United Nations Industrial Development Organization (UNIDO) has been publishing polymer information for developing countries, providing not only advices, contacts and training facilities but also experts, fellowships and equipment for demonstrations.

In the NR producing countries, R&D is centred at the rubber research institute in each country. Systematic research on NR was initiated during the end of the 19th century. Although H.N. Ridley is regarded as the father of NR research for his work at the Singapore Botanic Gardens around 1880-1900 on a system of extracting latex from the tree, it was the Dutch in Begor, Java in 1912 and at Medan, Sumatra in 1917 who opened research institutes, which included rubber as a major crop for study (Templeton, 1978). The world's first research institute (now RRISL) solely devoted to rubber was founded in Ceylon (now Sri Lanka) in 1923 and the Malayan (now Malaysia) Rubber Research Institute (now RRIM) started as a private institution in 1926. The contributions of important rubber research institutions are listed in Table 2. The other national centres include Estates Crops Research Institute at Medan, Indonesia, Rubber Research Centre of Thailand, Rubber Research Institutes of Nigeria and Vietnam and National Centre of Rubber Research, Brazil.

Universities, private R&D establishments, estates etc. constitute the NR information generating agencies at the regional level. In addition to usual R&D activities, they undertake costing / management studies of rubber estates for improving their performance.

Documentation process

An average of 500 articles on NR are being published annually. This needs processing, storing and dissemination. The work of an NR scientist has little or no impact either on the NR information transfer system or on the ultimate user, ie. The grower, until it has been reproduced in multiple copies and distributed in a formal manner. Scatter and Lancaster (1984) have categorically identified renewed role for the information scientists in the process of agricultural information transfer as the agricultural information being more fugitive than many other scientific fields.

The primary publication such as books, journals, patents or dissertations on NR are distributed for use either directly to the users or indirectly through information centres. The information centres organize and control the information through cataloguing, classification, indexing and through an array of information services. The publishing of locally prepared current awareness abstracting periodicals, conducting literature search of almost all leading secondary sources and the providing SDI services and current contents are some of the documentation services provided. The information centres provide bibliographic service such as compilation and supply of bibliographies

on specific aspects of NR. To help in overcoming the language barrier, they also provide translations of articles from one language to another. They also provide referral service by locating information on related subjects and interests at various NR and other institutions. They also try to extend the news items on NR prices, production, development etc. for the use of smallholders and policy makers. The secondary sources help the synthesis of existing knowledge and provide bibliographic control of the published literature. A majority of NR secondary sources reach the R&D institutions and some may go directly to the user community as evident from Figure 4.

Extension process

NR research findings will have to go hand in hand with agro-technology transfer. The philosophy and methodology of the extension process is to expose, teach and motivate the rubber growers and manufacturers and then transfer the appropriate and promising research findings to them (Abdul Aziz bin S A Kadir, 1988). The extension channel provides the package of available information to end-users. Although the available innovations to be transferred are similar, the method and approaches are different for the different beneficiaries, namely estates, smallholdings and manufacturers.

The ideal extension streamlines the research finding to the estates and smallholdings in the form of guidance and technical assistance on all aspects of rubber planting, production and maintenance with systematic feedback to the research system. Major functions of the sub-system for the estates include supply of relevant information and advise for crop management through field visits, group discussions, demonstrations, classes etc., carrying out ad-hoc trials on specific problems observed in estates, collecting feedback information on introduced planting recommendations and passing it on to research sub-system.

The smallholders also need the latest planting and production techniques. The new NR information generated through research on aspects such as intercropping, cover crops, utilities of rubber wood, pests, diseases and its control, exploitation techniques etc. are to be monitored in such a way to suit the local farming system. Popular articles, pamphlets, regular newspaper columns etc. can be used as extension means (Table 3). Evaluation of the implemented planting practices is also important. The appropriate technologies can be identified through meetings, visits and consultations.

Farmers, traders and manufacturers are the marketing agencies and they also constitute the

Table 3. Farmers ranking of NR information sources

Source	Planting materials	Manuring	Tapping	Processing	Diseases
Other growers	1 (35)	1 (28)	2 (26)	2 (22)	1 (32)
Rubber Board officials	2 (19)	2 (20)	4 (8)	5 (7)	5 (7)
Newspaper	3 (18)	4 (10)	5 (7)	4 (9)	3 (15)
Rubber Board publications	4 (17)	3 (14)	3 (15)	3 (14)	2 (21)
Other sources	5 (3)	5 (6)	1 (33)	1 (36)	5 (7)
Seminar	5 (3)	5 (6)	6 (6)	6 (6)	4 (10)
Radio	5 (3)	7 (2)	8 (1)	8 (1)	7 (2)
Co-operative societies	6 (1)	4 (10)	9 (0)	9 (0)	9 (1)
Rubber Board's training	6 (1)	8 (1)	8 (1)	8 (1)	8 (1)
Rubber Producers' Societies	7 (0)	6 (3)	7 (3)	7 (4)	6 (4)

Figures in parentheses indicate the percentage of growers
Source : Rajasekharan and Haridasan (1992).

user community of NR information. The prices of rubber and field coagulum, published daily and twice a week respectively, is largely responsible for the awareness and bargaining power of the small growers against possible exploitation by brokers. This information also provides the basic feedback for scientists, policy makers and agricultural service agencies formulating their respective strategies for the future.

An extension of NR information on technologies and expertise on rubber-based industries also takes place in the transfer process. Suitable formulations and product testing facilities, developed and provided by the research sub-systems, are to be extended to the manufacturers. The NR technology package is processed, released and extended through extension means such as trainings, advertisements, demonstrations, exhibitions etc. (Ahmed *et al.*, 1988).

Utilization process

The entire spectrum of NR information transfer process is indented for the smallholders, estates, product manufacturers and to a lesser extent market agencies. They are the actual users of latest innovations and technologies for maximizing the rubber production, marketing and product manufacture.

In the transfer of NR information technology, the last stage is the acceptance and adoption of the technologies and products by the manufacturers. Studies are to be conducted to assess the acceptance of technology against a set of criteria through published materials, seminars, advisory and consultancy services. The findings will become the feedback input to the NR information transfer process.

Feedback

The feedback information generated from the smallholdings and estates can be used in reviewing the priorities of R&D in the field of NR. The regular advisory visits, consultancy services and the follow-up visits will result in better feedback for assessing the utility of the recommendations.

Valuable feedback aspects of organization and management of estates are obtained from the findings of the management studies. Thus the performance of rubber estates in terms of production costs, revenue, profitability and management practices can be evaluated. Further, this information can be better utilized for planning and budgeting by those who wish to invest in rubber estate sector. As in the case of estate sector, influx of information to the fields and an uninterrupted feedback to the research sub-system should be ensured to the smallholders also.

Informal communication

All the above discussions are on formal channels of NR information transfer. But in scientific and academic communities, information is transferred through both formal and informal channels, which are complementary. As Lancaster (1979) observed, when a scientist emerges as a key figure in his subject through his contributions in scientific journals and professional conferences, he tends to become integrated in a communication network and gets familiar with other scientists working in the same or related areas.

The people in such group are usually in touch with others who contribute materially to the research in his subject not merely on a national scale but including all other countries in which that speciality is strong (Price and Beaver, 1966). They are distinguished as a core group of scientists who attracted a disproportionately large number of contacts and who are distinguished by their level of productivity (Crowford, 1971).

Such networks can be distinguished among both biology and technology scientists of NR. Core groups have already developed in areas such as tapping panel dryness, South American leaf blight (SALB), tissue culture propagation, liquid natural rubber and epoxidised natural rubber. Such core groups can be observed in other fields of NR research as well. Such informal communication networks existing in any field are referred to as 'invisible colleges' (Crane 1992) and that of technology and industry as 'technological gatekeepers' (Cooney and Allen, 1974).

Informal communication plays a major role in the diffusion of new developments in all the sub-systems of NR information transfer except in the documentation sub-system, where almost all the NR information is transferred through formal channels.

SHORT-FALL AND ITS REASONS

In an ideal NR information transfer system, innovations covering all aspects of rubber cultivation, production, processing and marketing should reach the end users rapidly and effectively, making use of all channels. Yet there is likely to have an adoption gap between the generation of NR information and the achievable limits of proven clonal yields, raising serious reservations about the efficacy of the information transfer process particularly about the amount and quality of NR information reaching the rubber growers and still 22-35% of farmers are depending on other farmers for information on various crop management operations. Only 7-20% of farmers are depending on extension agencies for their information needs, which raises serious reservations about the efficacy of the present information transfer process (Rajasekharan and Haridasan, 1992). Even in 1999, the functioning of 30 per cent of RPS is not satisfactorily (Krishnakumar and Nair, 1999).

The reasons for this pessimistic appraisal may stem from the high ratio of growers to extension staff; too many diffuse set of responsibilities like disbursement and accounting of subsidies entrusted to extension staff; credibility gap between government publicity and the actual experience of rubber farmers, the difficulties in transmitting modern scientific knowledge to the tradition bound farmers who are entirely alien to it; and above all, the possibility of tending the transfer process to be one way with little scope for feedback and interaction between the different sub-systems.

SUGGESTIONS FOR IMPROVEMENT

From the experience, it is clear that bridging the adoption gap is within reach. It warrants intensified efforts towards effective transfer mechanism with greater emphasis for feedback information. More emphasis shall be given for applied research, which has relevance to NR industry and top-most priority shall be given to farmers' needs in identifying research problems. In the extension activities, more stress shall be given for motivating the farmers and providing them appropriate technology. RPS also shall be strengthened as the nodal agency in the information transfer process (Krishnakumar and Dhanakumar, 2000; Usha Rani, 2002).

CONCLUSIONS

A new scientific-extension interaction linkage of agricultural service agencies and policy makers is observed among NR users and a functional model for the NR information transfer is presented. Four sub-systems of generation, documentation, extension and utilization are identified in this transfer process. The information generated at international, national and regional levels is published, distributed, organized and controlled bibliographically in the documentation sub-system. The extension sub-system ensures the constant information flow in a readily comprehensible form to the farm and to the factory with regular feedback to the generating sub-system. In the utilization sub-system the end users accept and adopt the information and their experience become the feedback input to the system.

The present information transfer model can be further evaluated and the strength and weakness of various components in the transfer process can be assessed for further improvement. This model cannot only be used as the basis for developing the national information system on NR but also for an effective information system for the plantation crops in general.

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