B I O D I V E R S I T A S
Volume 9, Nomor 1
Halaman: 59-63

ISSN: 1412-033X
Januari 2008

REVIEW: Research Ethnobotany in Indonesia and the Future Perspectives

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Received: 4th January 2008. Accepted: 31st January 2008.

ABSTRACT

Indonesia is not only rich in its biodiversity but it is also well known as a country with high diversity of ethnicities. Each ethnic group has extensive experienced in the utilization and conservation of biological and ecological diversity. This biocultural richness has provided ethnobotanical researchers with endless research opportunities. Ethnobotanical study has a long history in Indonesia and dates back to the early Dutch colonization period when Dutch explorers and naturalists recorded the uses of plants used by the natives for food, medicine, buildings materials, etc. Based on research on Java, Hasskarl (1845) recorded 900 species of plants used by Indonesian communities. Previously, Rumphius (1750) in his monumental book "Herbarium Amboinense", reported the uses of several hundreds plants from Ambon and its vicinity. Recently, Indonesian scientists from both government and non-government organizations have given more attention to the importance of ethnobotany as a means of elaborating traditional knowledge, especially for economically useful and scientifically undiscovered plants. The talk will focus on ethnobotanical research performed by LIPI scientists at the Research Center for Biology in Bogor and the Indonesia Botanic Gardens. During the last 20 years, since the Indonesia' Ethnobotanical Museum was established. Indonesian scientists have documented the importance of ethnobotany, ethnomedicine, ethnomycology, ethnoentomology, and ethnoecology for conservation of traditional knowledge in relation to the economic botany and to other applied sciences. The meaning and scope of ethnobotany and its status including the future prospects, its contribution to the exploitation and conservation will be discuses in this paper.

Key words: ethnobotany, ethnomedicine, ethnomycology, ethnoecology, traditional knowledge, use of plants, Indonesia.

INTRODUCTION

Ethnobotany has always been to some extent an interdisciplinary science. The ideal definition of ethnobotany is, in my view, very broad. The term in derived from "ethno" which means race, people, cultural group, nation, and from "botany" as the science of plants, thus the logical definition is becoming “the science of people's interaction with plants”. Their domain has special relation between man’s vision, cognition, and classification of his plant world, the cultural significance of plants, and the origin, uses and economic value of these plants.

The Indonesian archipelago consists of more than 17.000 islands, spread around the equator and between the Indian Ocean and the Pacific Ocean, with mountains up 3.000 meters altitude above sea level, giving opportunity of plant species growing to form rich and invaluable natural resources. The richness of Indonesia flora with more than 30.000 plant species is estimated to about 10% of the global flora. A very large number are native to the archipelago, and hence to Indonesia, and in a large proportion are endemic to Indonesia or to each island or to the group of island where they occur. An additional array of species is non-native exotics, having been introduced by design (as crops or ornamentals) or by accident, and have now been established in the wild, often to the detriment of the indigenous biota (Anonymous, 1993).

Within the thousand of islands that make up Indonesia, there are hundreds of ethnic groups. These ethnic groups occupy different areas, and each group has its own culture and traditions of which food, medicinal plants, and spices habits are a part. Each ethnic group has extensive experienced in the utilization and conservation of biological and ecological diversity. This biocultural richness has provided ethnobotanical researchers with endless research opportunities.

BEGINNING OF ETHNOBOTANICAL RESEARCH IN INDONESIA

Historically, the field of ethnobotany has belonged to the European explorers and adventures that observed and documented the uses of plants by the native peoples encountered on their travels. In the 17th and 18th centuries when the Dutch explorers and naturalists recorded the uses of plants used by the natives in the Indonesia region, the foundation of the botanical knowledge became more obvious and available through the colony-building activities of the European nations. Kalkman (1989) mentioned that Rumphius masterpiece "Herbarium Amboinense", was the first and the only great works of kind, in that period. This remarkable and beautifully illustrated flora of eastern Indonesia written between 1600 and 1650 has provided a comprehensive survey of the eastern Indo-Malayan economic flora in very early days of the colonial era. It was then followed by several numbers of explorers who also given a special attention to the Indonesian flora and documented the subject they have observed in form of

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rough manuscripts. In the context of ethnobotany, Hasskarl (1845), of the Buitenzorg Botanic Garden (now, Bogor Botanic Garden), was the author of the paper on the use ascribed to some plants of Java by the native inhabitants. Heyne (1922, 1927, 1950), Ochse (1931a, 1931b), and Burkill (1935) were dealing with the exploration, evaluation, conservation, or utilization of plants with strong emphasize on ethnobotany. The information of plant species covered in those publications were linked to its scientific name, the uses of plants by the natives not only for ingredient in food but also as an medicine, magic potions, breath sweeteners, perfumery, and buildings materials.

ETHNOBOTANICAL RESEARCH PERFORMED BY LIPI SCIENTISTS

As one of government institutions, the Research Center for Biology (Pusat Penelitian Biologi, LIPI) and the Center for Plant Conservation, Bogor Botanic Garden (Pusat Konservasi Tumbuhan, Kebun Raya Bogor) strategic planning have been focused to undertake the exploration and inventory of the biological resources, to study the living processes, to evaluate the utilization of the resources and to provide information as required by the scientific communities, the education sectors, and the general public. With the above considerations, the research programs of the institute aim for the exploration of biological resources to support agriculture, industry, and health simultaneously with the ethnobotanical idea that is concerned with reciprocal influence between people and plants in their environments. These general research activities can be described as ethnobotany, ethnomedicine, ethnomycology, ethnoentomology, and ethnoecology.

Historically, the role of Indonesian Botanic Gardens and Herbarium Bogoriense were strongly directed towards ethnobotany. The Indonesian Botanic Gardens (Kebun Raya Indonesia) has initially supports the conservation of traditional plant knowledge in its policy and practice. The staff undertakes research on conserving traditional knowledge follows by the collection and propagation of the germplasm of plant species utilized. While Herbarium Bogoriense, now is under Botany Division, Research Center for Biology, Indonesian Institute of Science (LIPI), has contributed a vast number of finding about the Malesian flora. From the labels on the specimens, some very incidental information about local name and local uses can be extracted, which very useful for supporting the ethnobotanical research. Data from the collections are now being collated into a database, linked to database of the zoological collections of the Museum Zoologicum Bogoriense at Cibinong-Bogor. The combined database represents a significant tool for biodiversity management of which to be expected to play an important role in the future, including for the research in ethnobotany and ethnozoology. In connection to ethnobotanical research, the exploration of local perception of plant has also been conducted in many places with references of ethnic groups. An example of this interconnecting study is a catalogue of ethnophytomedica by Sangat *et al.* (2000) which has provided much useful information on medicinal plants used by 45 ethnic groups in Indonesia.

The National Ethnobotanical seminars were held in Bogor, Yogyakarta, and Bali, organized by Botany Division, Research Center for Biology, LIPI. At these seminars, more than 150 papers was presented and published on the Proceedings of Ethnobotanical Seminars (1992, 1995, and 1998).

Indonesian Botanic Garden scientists and their interest of ethnobotanical research

From 1977 to the late 1999, the Indonesian Botanic Gardens and the Parks and Wildlife Commission of the Northern Territory, Australia have conducted the joint research. The funding assistance was provided by the Australian Center for International Agricultural Research (ACIAR). This research has focused on ethnobotany and has resulted in the publication of books relating to plant use in West Java (1994), Bali (2000), and Sumba (2001). It has also resulted in the publication of a number of research papers in journals and the presentation of research results in conferences in Australia and Indonesia. First publication was resulted is the Sundanese ethnobotany traditional plant knowledge from Ciamis and Tasikmalaya, West Java. A set of information compiled from the local informants of 86 vascular plant species are provided, including the use of medicine, food and timber (Wightman *et al.,* 1994).

In Bali the research of traditional plant usage was conducted in four villages of Bali Aga, i.e. Tenganan, Sepang, Tigawasa, and Sembiran. The most important result of the research is some species of flora in these four villages have become locally rare. In general, the harvesting of ceremonial plants is becoming a problem due to its extensive used in cultural ceremony as is in Aga people with its strong ceremonial lives. In Tenganan, the serious problem on over-harvesting of various *Lygodium* fern species occurs because the stem of this fern is used extensively for handicraft. In Sepang and Sembiran there are a shortage of timber of the species such as *Dysoxylum caulostachyum, Dysoxylum* sp. and *Garcinia celebica.* Various species of bamboo are harvested frequently in Tigawasa for used in handicraft production, and the natural stands are being eroded. Due to the problems above, the research on the cultivation of these over harvested species are carried out by the Indonesian Botanic Garden (Astuti *et al.,* 2000).

East Sumba was also chosen as a study site due to the cultural strength of the indigenous people of the region, and their desire to be involved, together with the paucity of previous research undertaken in the area. Hidayat *et al.* (2001), reported the number of plant species used by the Luku Melolo community. He reported of 81 species of plants used for traditional medicines, 29 species in construction, 5 species for firewood, 4 species for forage, 6 species for fencing, 7 species for rope, 16 species for vegetables, and 6 species for dye.

All the findings on the management and conservation of plant species by the botanic garden staff have also been presented during the National Ethnobotanical Seminar held in Bogor, Yogyakarta, and Bali.

Herbarium Bogoriense scientists in the context of ethnobotany research

Herbarium Bogoriense is a focal point of professional botanists in Indonesia. In general, researchers of Herbarium Bogoriense conduct researches in the taxonomy of a wide range of plant families in the country as well as the researches in ecology, ethnobotany, plant physiology, morphogenetic, and phytochemistry. The researchers also concern with reciprocal influence between people and their environments, thus they are very active in documenting the importance of ethnobotany, ethnomedicine, ethnomycology, and ethnoecology for conservation of traditional knowledge relating to economic botany and other applied sciences, especially to promote a social, botanical and ecological approach.

Research on ethnoecology

Ethnoecologist has been involved with the people and their environment and has been worked with local people in a wide range of projects related to the conservation of both plant resources and its linked traditional ecological knowledge. In line with Man and Biosphere (MAB) Program that is officially established in 1974 the most relevant to the research ethnoecology is the interaction between human activities and the structure and the dynamic of tropical and subtropical forest ecosystems. The theme of the research is "The Impact of Development on Interactions between Peoples and Forest in East Kalimantan" and it was reported by Kartawinata *et. al.* (1982). In 1976 the Indonesian MAB National Committee, where the herbarium researchers has been participated, a study of the environmental and social effects of human activities in the primary forest areas was launched, with three primary themes, i.e. (i) the environmental effects of different kind of land use; (ii) the effect of timber camps on the economic activities of villagers; and (iii) the comparative studies of cultivators in up-river home-lands and down-river resettlement areas (Kartawinata *et al.,* 1981).

In reality, forest resources management by local people in Indonesia shows a great diversity. Apart from being skilled managers of forest resources in wild, using a great variety of the extraction systems, the smallholder farmers are also performing as the main actors in the production and domestication of the resources. Local forest production system including its cyclic forest production such as benzoin gardens integrated in forest successions dynamics was reported by Walujo and Purwanto (2002) and for the evolution of *Cinnamon* garden management was reported by Purwanto *et al.* (2003).

In relation with ethnoecological study, Walujo (2002, 2004) presented the spatial environmental organization and the life of the Dawan people in Timor, Indonesia. In the study the author recognized 8 types of natural, succession as well as man-made ecosystem based on the physiognomy or the vegetation covers of the habitat. This knowledge is derived from their long interactions with their environment, especially because their way of life is entirely dependent on their surrounding natural resources.

Research on ethnomedicine

Most of the ethnomedicinal research in Indonesia has been focused mainly on the utilization of plant diversity as traditional medicine. The topic of the study of ethnomedicinal becomes very broad (interdisciplinary), e.g. the society concept and perception on the body condition (health and illness), plant diversity, kind of diseases, social cultural aspect, technological aspect concerning traditional medicine practice, phytochemistry, and all aspects of those related with ecological acid society health aspects (Purwanto, 2002). From 119 papers presented on 2nd National Seminar in Asian Pacific Information Network on Medicinal and Aromatic Plants (APINMAP) held in Bogor, 22 topics were contributed on ethnomedicinal plants used in different ethnic groups. Herbarium researchers presented these 22 research topics.

The observation on the women of Malays tribe in Singkep Island concluded that various plants species were used in health care, e.g. acne, lactation, painkiller during menstrual period, abortion (pregnancy), to stop bleeding, etc. (Siagian, 2002). Indigenous knowledge to use plants as Sepa and Nuaulu ethnic groups in South of Seram have practiced medicine since long time ago. More than 57 species of plants recorded as medicine for asthma, after childbirth, and as aphrodisiac (Wardah, 2002). Furthermore, a kind of diseases and other aspects related to medicinal remedy and ecological aspect of 72 plants species used by Sasak tribe at Lombok Island was reported by Rahayu *et al.* (2002).

Research on ethnomycology

Recent publications concerning to the Indonesian ethnomycology are rather poor especially in term of bibliography and references. An example of the diversity in Indonesia fungal species traditionally used as food or employed in food production is presented by Rifai (2004) in the 3rd Nasional Scientific Forum, October 1-3, 2004. In his presentation on Indonesian fungi as a nutritional food source, Rifai explained the edible plant pathogen, the woody vegetables, the delicious termite-nest agarics, the nourishing "tempeh" as well as other less known local fermented foods, and a number of further useful tropical fungal curiosities.

Further studies on various species of moulds and yeast in the different fermented foodstuffs, particularly the traditionally product in West Java was presented in the highlights of Lembaga Biologi Nasional (now, Research Center for Biology) since 1974. In "ragi", this organism included 8 species of yeasts *(Candida* sp., *C. gulliermondii, C. humicola, C. intermedia, C. japonica, C. parapsilosis, C. pellicola, C. solani),* and 5 species of mould *(Fussarium* sp. *Mucor circinelloides, M. rouxii, Rhizophus oryzae).* In "tape ketela", included 9 species of yeasts *(Candida* sp., *C. gulliermondii, C. intermedia, C. japonica, C. mycoderma, C. parapsilosis, C. parapsilosis* var. *intermedia, C. pelliculosa, C. solani)* and 2 species of moulds *M. circinelloides* and *M. javanicus),* however, the black "tape ketan" comprises only 2 species of yeasts (*Candida* sp. and *C. pelliculosa).* Six species of yeasts and 4 species of moulds were isolated from black "oncom", meanwhile in red "oncom" 10 species of yeasts and 5 species of moulds were found. In addition to the yeasts and moulds, most of the products also contained different kinds of bacteria. Subowo (1992) in his work in Habema of Papua, reported that from 30 species of wood fungi, 17 species has been known by the Dani people as wild edible mushrooms *(Amanita spisa, Auricularia auricula, Boletus edulis, Cantharellus cibareus, Clavaria inaequalis, Collybia dryophila, Coprinus atramentarius, C. micaceus, Crepidotus mollis, Hineola auricula-yudae, Laccaria proxima, Oudmansiella mucida, Panus chonantus, Poliporus botulinus, Pseudohidnum gelatinosum, Suillus cavipes, Tricholoma columbetta).*

Research on ethnobotany

During the last 20 years, since the Indonesia Ethnobotanical Museum was established, herbarium scientists have documented the importance of ethnobotany, ethnomedicine, ethnomycology, and ethnoecology for conservation of traditional knowledge relating to economic botany and other applied sciences. The earliest reason for human to look for the usefulness of any plant species is because of its value as food source such as in major Indonesian root crops as taro *(Colocasia esculenta* var. *esculenta)* and yam *(Dioscorea* spp.). In the case of the yams, the propagation and its production are not as fast and as high as cassava. Thus, cassava *(Manihot utilisima)* continues to replace yams, not because it is a better food, but because it is a species that is easy to grow and productive (Martin, 1975).

The Sundanese, population in West Java, have food preferences that are specific to their own area. These

preferences are characterized by the eating of a lot of leafy vegetables (Sastrapradja and Kartawinata, 1975). More than 25 species was recorded from the area. Some of these are grown wild. Dyes to the people preference to eat European vegetables, the native leafy vegetables are not longer recognized by the younger generations.

For some unknown reasons, for the centuries the beauty of orchid failed to trigger the interest of the locals. The Indonesian first found other uses for a few species of orchids. The ornamental purposes of orchids were more recently introduced. Rifai (1975) in his article on the extraordinary uses of orchids in Indonesia noted about 26 species of orchids used for food, medicine, and perfumes. As a food source, the young leaf of *Phalaenopsis amabilis* and *Ceratostylis latifolia* has been used as vegetable. The Javanese consumed the pseudo bulb of *Hebenaria multipartita*, or "uwi-uwi". In herb medicine, *Acriopsis javanica,* has been applied to the forehead during the fever. The roots of *Calanthe rubens* and C. *triplicata* were chewed together with pinang *(Areca catechu)* and nutmeg *(Myristica fragrans)* and ginger to cure the chronic diarrhea.

The lingkage of PROSEA data with developing research of ethnobotany in Indonesia

PROSEA is long term project scheduled to last 10 years to evaluating the existing knowledge on thousands of plant species making it available for education, extension, research, and commercial production. Numerous reports have been produced. Kadarsan *et al.* (1989) in accordance with the PROSEA publication reported that 1,528 records have been obtained by screening 82 journals and serials, and 13 proceedings of scientific meetings. The basic unit of PROSEA handbook is the species, the family and the classification by commodity group. At present, PROSEA distinguishes 21 commodity groups (Table 1), covering the fields of agriculture, horticulture, forestry and botany are the most relevant to ethnobotany. Jansen *et al.* (1993) distinguished 39 different commodity groups in their list encompassing 5,952 species of the "PROSEA region" of which comprising Brunei Darussalam, Indonesia, Malaysia, Papua New Guinea, the Philippines, and Singapore. According to Erdelen *et al.* (2000), the majorities of species (1,462) are categories as timber commodity; followed by the medicinal plants (1,135 species) as the second highest category.

NGOs and their research in relevant to ethnobotany

The Indonesia non governmental organizations (NGOs) have played an active role in stimulating public interest in biodiversity, urging government to strengthen conservation and environmental issues in national legislation, policy documents and development activities. More than 400 NGOs throughout the country working with local communities to resist and counter destruction and simplifying habitats. FORRESASIA has closed link with other projects such as ICRAF based project in Krui Community Forest Management Program sponsored by the Ford Foundation and the Policy Research for Sustainable Upland Systems supported by ADB, and CIFOR project on Sustainable Development and Management of Non Timber Forest Products. WWF studied briefly about Medicinal Plant of Siberut. The knowledge of medicine is mastered through a learning process in which the case of the Kerei's is surrounded by complex ritual. Some medicines are received through dreams. Others are obtained by buying and/or exchanging. The trial and error method is also still applied. According to Ave and Sunito (1990), in general, the traditional herbal medicines in North Siberut are more complex. The composition often comprising 5 to 15 or in certain cases up to 40 different plants for each remedy, while in South Siberut usually 2 to 5 sometimes up to 10 different plants are utilized. Herbal medicines are taken internally as concoction or decoction and/or applied externally as herb-bath or as massage.

Table 1. The number of species in each commodity groups published by PROSEA.

	Commodity group	Number*
A	Cereals	76
B	Starch/sugar/alcohol/acid-producing plants	176
C	Pulses	96
D	Vegetables oils and fats	135
E	Edible fruits and nuts	287
F	Vegetables	199
G	Spices and condiments	138
H	Essential oil plants	51
I	Plants for beverages/chewing/smoking	105
J	Medicinal/narcotic/poisonous plants	251
K	Timber trees	234
L	Fiber plants used for packing thatching wickerwork	111
M	Feed plants	70
N	Dye and tannin-producing plants	69
O	Rattans	34
P	Bamboos	27
Q	Plants producing exudates/aromatic woods	10
R	Auxiliary plants in agriculture	124
S	Ornamental/hedges/wayside trees	179
T	Fuel plants	26
U	Lower plants	53
V	Other plants	17
	Total	2,564

Annotation: * Number of time a commodity group is referred to PROSEA publications.

Remark and the future research ethnobotany in Indonesia

On the basis of what has been illustrated and described in the previous sections in this paper it is summarized that botanical research undertaken in the region has been laid the importance foundation in the increasing knowledge on ethnobotany. The series of botanical publications such as Flora Malesiana Bulletin, PROSEA, other journals and serials, as well as proceedings are contained a vast amount of data and information available for ethnobotanists.

Since the last decades, the number of researcher who extensively involve in the ethnobotanical research in Indonesia has been increased. It is reflected through the recent papers written by Rifai (1975), on an extraordinary uses of orchid in Indonesia and Rifai (2004) on Indonesian fungi as a nutritional food source (ethnobotany), by Kartawinata et al. (1981, 1982), on the impact of man on a tropical forest in Indonesia, by Walujo (2002, 2004) and Purwanto *et al.* (2003) on ethnoecology. These are only a few examples of references that work on the same interest and have been given in the preceding sections. However, the increasing number in the ethnobotanical research in Indonesia has not yet represented the overall coverage on the area and on the ethnical groups (Figure 1).

ANKNOWLEDGEMENT

I would like to express my gratitude to Dr. Jeanine Pfeiffer and Prof. Mien A. Rifai for their critical comments to the manuscript. An extended appreciation goes to other reviewers that also contributed positive comments to this article.

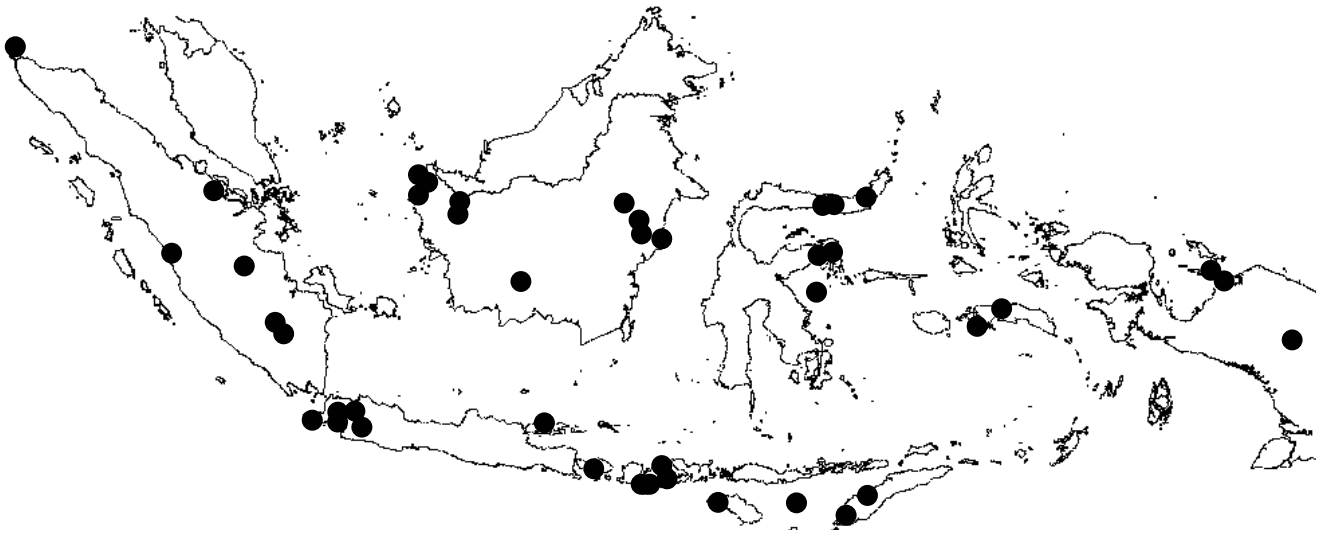

Figure 1. Map showing the number of ethnobotanical research conducted by the researchers at LIPI in different sites throughout Indonesia (black dotted).

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