



# A Comparative Analysis of Medicinal Plants Used by Folk Medicinal Healers in Three Districts of Bangladesh and Inquiry as to Mode of Selection of Medicinal Plants

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## Research

### Abstract

An ethnomedicinal survey conducted in two sub-districts (upazillas) each of three districts of Bangladesh revealed that there is both inter- and intra-district variation between the choices of medicinal plants selected by folk medicinal healers (**kavirajes**) to treat any specific ailment. The variations cannot be accounted for by differences in climate or plant availability for most of the plants used by the **kavirajes** are available in all six upazillas where the survey was conducted. Most **kavirajes** claimed that they obtained information on medicinal plants either from 'gurus' or from elderly members of their family. However, it was also revealed by the **kavirajes** that further modes for acquiring medicinal plant knowledge were through initial experiments conducted on animals and poultry, dreams, and a perceived similarity between plants or plant parts and human body features. It is concluded that such selections are, and were, primarily made through initial experiments by traditional healers on animals and birds. Dreams and perceived similarities between plant parts and human body parts may also play an important role in such selection.

### Introduction

Bangladesh is a small country with a total land area of about 144,000 km<sup>2</sup> and a population of more than 150 million. The overwhelming majority of the population speaks the same language (Bangla/Bengali) and functionally has the same culture. The majority of the population is rural-based with agriculture (including fisheries) and agriculture-related labor accounting for the major occupation. Since the country is a deltaic flood plain, the vegetation is not exceptionally different in the various regions except the coastal areas in the south, which have an abundance of mangrove species (i.e., salinity-tolerant plants). The whole country is divided into 64 districts, which are in turn

divided into 482 sub-districts or upazillas. Each upazilla is comprised of several unions. The upazillas are composed of 150 to 200 villages each; the population of any individual village runs from 1500 to 2000.

The health needs of the population are catered to by several sorts of practitioners. These include allopathic, homeopathic, ayurvedic, unani and folk medicinal practitioners (the last three groups being considered as practitioners of traditional medicine). Folk medicine is widely practiced in Bangladesh. Folk medicinal healers are known as **kavirajes** or  **vaidyas**. Two to three **kavirajes** on average practice in every village administering medicinal plant treatments, fulfilling the primary health-care needs of a large segment of both rural and urban populations. In fact, a survey report concluded that 39% of rural community members have knowledge about medicinal plants and 13% treat simple ailments with herbs (Khan & Chowdhury 2002). Bangladesh has about 5000 plant species out of which it has been conservatively estimated

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that 1000 are considered as medicinal plants by traditional medicinal healers.

We conducted a systematic ethnomedicinal survey of Bangladesh over 2008-2009. This survey included the various tribes as well as non-tribal folk medicinal practitioners, who are upazilla-based (Hossan *et al.* 2009, Nawaz *et al.* 2009). During the course of this survey, it was observed that the medicinal plants used by the **kavirajes** of adjoining upazillas, and often even adjoining villages, to treat any particular ailment differ widely. Even though the same medicinal plant is found in adjoining localities, for treatment, different plants are used. Alternately, the same medicinal plant may be used in adjoining areas to treat different ailments. Etkin (1993) has indicated that even within small and apparently undifferentiated groups, heterogeneity exists about perception of illness and mode of treatment. The same has been noted by Shepard (2004) who demonstrated that the ethnobotany of two neighboring Amazonian peoples varies considerably in the use of essentially the same environment. This raises the question as to how do the **kavirajes** of Bangladesh select medicinal plants for treatment of any ailment? This is an important ethnomedicinal question to which, to our knowledge no definitive answer is yet to be found. This question is further important from the view point that an understanding of how and why medicinal plants are selected by traditional medicinal healers can lead the way towards a better linking between traditional knowledge with biomedical science (Berlin & Berlin 1994, Browner *et al.* 1988). We conducted surveys among **kavirajes** of two upazillas each in three districts of Bangladesh (Bagerhat, Brahmanbaria, and Rajshahi (Figure 1) in order to address the above question.

## Material and Methods

### *Mode of information collection*

Interviews of the folk medicinal healers were conducted using a semi-structured questionnaire. In a preliminary survey, the **kavirajes** of the surveyed areas were asked about ailments they commonly treat. On the basis of their answers, we prepared a list of 54 ailments or disorders, which were most commonly treated. Inquiries were subsequently made about the plants, plant parts or plant combinations used to treat those ailments. The basic method followed was one of guided field work (Martin 1995, Maundu 1995). Healers were taken during daytime on field trips to areas from where they usually collected plants, while at the same time questions were asked and information noted. Information collected from the **kavirajes** consisted of medicinal plants or plant parts used, ailments treated, formulations, dosages and side-effects, if any. Information was also collected about whether combinations of plants were used to treat any particular ailment or if any single plant was used to treat multiple ailments.

The information was noted down during daytime interviews and later cross-checked with the same individuals in evening or night-time meetings. Evening or night-time meetings were usually conducted in the presence of the healers, village elders and any other interested local persons (usually 10-15 people altogether). Informed consent was obtained from every healer prior to the interview. No intellectual property right agreement with individual healers was signed; however, it was agreed that if ever any financial benefits were obtained by us as a result of this information, the benefits would be distributed among the healers. Interviews were conducted in the Bangla (Bengali) language, which apart from the tribal people is spoken throughout Bangladesh.

Plant specimens were photographed as well as collected, pressed and dried in the field. Local names of the plants were obtained from the informant and double-checked with other members of the community, who professed to know the plant names with accuracy (on average three persons). Plant specimens were identified at the Bangladesh National Herbarium, Dhaka (DACB), where voucher specimens were deposited.

### *Location of sites and selection of kavirajes or vaidyas*

Three districts were selected, Bagerhat, Brahmanbaria, and Rajshahi, on the basis of their locations in southwestern, east-central and north-western Bangladesh. It was felt that cumulatively, the locations of these three districts could give an overall picture ranging from the north to the south of the country. Two upazillas were selected in each district (Figure 1). Within each upazilla, the survey was conducted with **kavirajes** of the upazilla or union headquarter and/or adjoining villages: i.e., Bagerhat Sadar and adjoining areas of Bagerhat Sadar Upazilla; Rampal and adjoining areas of Rampal Upazilla; Shohagpur and Aabidpara villages (adjoining the upazilla headquarter Ashuganj) of Ashuganj Upazilla; Brahmanbaria Sadar and adjoining areas of Brahmanbaria Sadar Upazilla; Bagha and Puthia along with adjoining areas of Bagha and Putia Upazillas in Rajshahi district. It should be pointed out in this regard, that upazilla/union headquarters are basically villages with a few houses present (serving as various government offices) and can scarcely be identified as towns.

The total number of **kavirajes** selected in the six upazillas was 24. Four **kavirajes** were selected in Bagerhat Sadar and two in Rampal Upazilla. Two **kavirajes** were selected from Ashuganj Upazilla, and one from Brahmanbaria Sadar Upazilla. Seven **kavirajes** were selected in Bagha Upazilla, and eight in Puthia Upazilla. The selections were made on the basis of local assessment about the treatment offered by the **kavirajes**. Fifty to one hundred persons in each area were asked about which **kavirajes** they visited for treatment of ailments during the past six months



**Figure 1.** Survey areas in Bagerhat Sadar and Rampal in Bagerhat district, Ashuganj and Brahmanbaria Sadar in Brahmanbaria district, and Bagha and Puthia in Rajshahi district Bangladesh. A. Puthia Upazilla, Rajshahi district; B. Bagha Upazilla, Rajshahi district; C. Rampal Upazilla, Bagarhat district; D. Bagerhat Sadar Upazilla, Bagarhat district; E. Ashuganj Upazilla, Brahmanbaria district; F. Brahmanbaria Sadar Upazilla, Brahmanbaria district.

to a year. **Kavirajes** who received the highest ratings per patient satisfaction were chosen for the survey. Following selection of **kavirajes** of any particular upazilla, all of the selected **kavirajes** of that upazilla was interviewed as a group instead of one-on-one interviews.

## Results and Discussion

### *Number of plants and ailments or disorders treated by kavirajes of various upazillas*

232 species were identified from interviews in three districts and are listed in Table 1. The **kavirajes** of Bagerhat

Sadar (Bagerhat district) used a total of 49 plants to treat 29 ailments, while the **kavirajes** of Rampal (Bagerhat district) used 51 plants to treat 31 ailments, out of the list of 54 ailments on which the survey was conducted. Some plants were used to treat multiple ailments. At the same time, a variety of plants (but not in combination) were observed to be used to treat any specific ailment or disorder. In all cases the **kavirajes** were observed to use a single plant or its parts to treat any ailment and not a combination of plants. The medicinal plants used to treat the various ailments are shown in Table 2. It was observed that only six plants were commonly used by the **kavirajes** of

**Table 1.** Medicinal plants used in six communities of Bagerhat, Brahmanbaria and Rajshahi districts of Bangladesh.

Species	Bagerhat district		Brahmanbaria district		Rajshahi district	
	Bagerhat Sadar	Rampal	Ashuganj	Brahmanbaria Sadar	Bagha	Putia
<i>Abelmoschus esculentus</i> (L.) Moench				X		X
<i>Abelmoschus moschatus</i> Medik.				X		
<i>Abroma augusta</i> L.f.			X	X		X
<i>Abrus precatorius</i> L.					X	
<i>Abutilon indicum</i> (L.) Sweet	X	X		X	X	
<i>Acacia nilotica</i> (L.) Willd. ex Delile					X	
<i>Acalypha indica</i> L.		X				X
<i>Acanthus ilicifolius</i> L.		X				
<i>Achyranthes aspera</i> L.		X		X	X	X
<i>Acrostichum aureum</i> L.	X					
<i>Adenantha pavonina</i> L.			X			
<i>Adhatoda vasica</i> Nees		X			X	X
<i>Aegle marmelos</i> (L.) Corrêa					X	
<i>Ageratum conyzoides</i> L.				X		X
<i>Albizia procera</i> (Roxb.) Benth.						X
<i>Alisma gramineum</i> Lej.	X					
<i>Allium sativum</i> L.			X			
<i>Alocasia macrorrhizos</i> (L.) G. Don			X	X		
<i>Aloe vera</i> (L.) Burm.f.			X		X	
<i>Alstonia scholaris</i> (L.) R. Br.		X				
<i>Alternanthera sessilis</i> (L.) R. Br. ex DC.						X
<i>Amaranthus spinosus</i> L.			X	X		X
<i>Amaranthus viridis</i> L.			X			
<i>Amorphophallus campanulatus</i> Bl. ex Decne.						X
<i>Andrographis paniculata</i> (Burm. f.) Nees		X	X			
<i>Annona squamosa</i> L.				X		X
<i>Anthocephalus chinensis</i> (Lam.) Rich. ex Walp.				X		

Species	Bagerhat district		Brahmanbaria district		Rajshahi district	
	Bagerhat Sadar	Rampal	Ashuganj	Brahmanbaria Sadar	Bagha	Putia
<i>Anthocephalus indicus</i> A. Rich.			X			
<i>Anthurium andraeanum</i> Linden	X					
<i>Argyrea speciosa</i> (L. f.) Sweet	X					
<i>Aristolochia indica</i> L.	X				X	
<i>Artocarpus lakoocha</i> Wall. ex Roxb.			X			
<i>Averrhoa bilimbi</i> L.						X
<i>Averrhoa carambola</i> L.						X
<i>Axonopus compressus</i> (Sw.) P. Beauv.					X	
<i>Azadirachta indica</i> A. Juss.			X	X		X
<i>Bacopa monnieri</i> (L.) Wettst.						X
<i>Baliospermum axillare</i> Blume	X					
<i>Baliospermum montanum</i> (Willd.) Müll. Arg.	X					
<i>Bambusa arundinacea</i> (Retz.) Willd.						X
<i>Barleria lupulina</i> Lindl.					X	
<i>Barleria prionitis</i> L.	X					
<i>Barringtonia acutangula</i> (L.) Gaertn.			X			
<i>Barringtonia racemosa</i> (L.) Spreng.	X					
<i>Basella alba</i> L.						X
<i>Blumea lacera</i> (Burm. f.) DC.	X					X
<i>Boehmeria nivea</i> (L.) Gaudich.						X
<i>Boerhaavia diffusa</i> L.			X			
<i>Bombax ceiba</i> L.			X			
<i>Borassus flabellifer</i> L.				X		
<i>Caesalpinia bonduc</i> (L.) Roxb.	X	X				
<i>Cajanus cajan</i> (L.) Huth			X	X	X	
<i>Calotropis gigantea</i> (L.) W.T. Aiton		X			X	X
<i>Calotropis procera</i> (Aiton) W.T. Aiton			X			
<i>Camellia sinensis</i> (L.) Kuntze						X
<i>Canna indica</i> L.	X					
<i>Carica papaya</i> L.				X		
<i>Carissa carandas</i> L.					X	X
<i>Cassia angustifolia</i> Vahl		X				
<i>Cassia fistula</i> L.						X
<i>Cassia occidentalis</i> L.					X	X
<i>Cassia sophera</i> L.			X			
<i>Cassia tora</i> L.			X			
<i>Catharanthus roseus</i> (L.) G. Don		X	X			X
<i>Cayratia trifolia</i> (L.) Domin		X			X	
<i>Cedrus deodara</i> (Roxb. ex D. Don) G. Don						X
<i>Centella asiatica</i> (L.) Urb.			X		X	X
<i>Chenopodium album</i> L.	X					

Species	Bagerhat district		Brahmanbaria district		Rajshahi district	
	Bagerhat Sadar	Rampal	Ashuganj	Brahmanbaria Sadar	Bagha	Putia
<i>Chenopodium ambrosioides</i> L.		X				
<i>Chrysanthemum cinerariifolium</i> (Trevir.) Vis.						X
<i>Cinnamomum verum</i> J. Presl						
<i>Cissus quadrangularis</i> L.					X	
<i>Citrus acida</i> Pers.						X
<i>Citrus aurantium</i> L.						X
<i>Citrus grandis</i> (L.) Osbeck						X
<i>Cleome ruidosperma</i> DC.		X				
<i>Clerodendrum indicum</i> (L.) Kuntze				X	X	
<i>Clerodendrum viscosum</i> Vent.			X	X		X
<i>Coccinia cordifolia</i> (L.) Cogn.	X			X		X
<i>Coccinia grandis</i> (L.) Voigt			X			
<i>Cocos nucifera</i> L.						X
<i>Codiaeum variegatum</i> (L.) Rumph. ex A. Juss.						X
<i>Commelina benghalensis</i> L.			X	X	X	
<i>Costus speciosus</i> (J. König) Sm.						X
<i>Crataeva magna</i> (Lour.) DC.			X			
<i>Crateva religiosa</i> G. Forst.		X			X	
<i>Crinum asiaticum</i> L.	X					X
<i>Croton bonplandianus</i> Baill.		X	X			X
<i>Cryptocoryne ciliata</i> (Roxb.) Fisch. ex Wydl.	X	X				
<i>Curculigo orchioides</i> Gaertn.						X
<i>Curcuma longa</i> L.				X		
<i>Cuscuta reflexa</i> Roxb.		X	X	X		X
<i>Cynodon dactylon</i> (L.) Pers.			X	X	X	X
<i>Cyperus rotundus</i> L.	X					
<i>Datura stramonium</i> L.						X
<i>Delonix regia</i> (Bojer ex Hook.) Raf.						X
<i>Derris indica</i> (Lam.) Bennet		X				
<i>Derris trifoliata</i> Lour.	X	X				
<i>Desmodium gangeticum</i> (L.) DC.	X					
<i>Desmodium styracifolium</i> (Osbeck) Merr.	X					
<i>Desmodium triflorum</i> (L.) DC.			X			
<i>Dillenia indica</i> L.			X			X
<i>Dimocarpus longan</i> Lour.				X		
<i>Dioscorea bulbifera</i> L.		X				
<i>Diospyros peregrina</i> Gürke					X	X
<i>Drynaria quercifolia</i> (L.) J. Sm.	X	X				
<i>Eclipta alba</i> (L.) Hassk.	X	X				X

Species	Bagerhat district		Brahmanbaria district		Rajshahi district	
	Bagerhat Sadar	Rampal	Ashuganj	Brahmanbaria Sadar	Bagha	Putia
<i>Eclipta prostrata</i> (L.) L.			X			
<i>Enydra fluctuans</i> Lour.						X
<i>Ervatamia divaricata</i> (L.) Burkill						X
<i>Eryngium yuccifolium</i> Michx.	X					
<i>Erythrina variegata</i> L.				X		
<i>Euphorbia antiquorum</i> L.	X					
<i>Euphorbia hirta</i> L.					X	
<i>Euphorbia milii</i> Des Moul.						X
<i>Excoecaria agallocha</i> L.		X				
<i>Excoecaria indica</i> (Willd.) Müll. Arg.		X				
<i>Ficus benghalensis</i> L.						X
<i>Ficus hispida</i> L.f.						X
<i>Ficus racemosa</i> L.		X				X
<i>Ficus religiosa</i> L.			X			X
<i>Foeniculum vulgare</i> Mill.			X			
<i>Glinus oppositifolius</i> (L.) Aug. DC.			X			
<i>Glycosmis pentaphylla</i> (Retz.) DC.		X		X		
<i>Grewia subinaequalis</i> DC.						X
<i>Heliotropium indicum</i> L.			X	X	X	
<i>Hemidesmus indicus</i> (L.) R. Br. ex Schult.						X
<i>Heritiera fomes</i> Buch.-Ham.	X	X				
<i>Hibiscus rosa-sinensis</i> L.			X			X
<i>Hoya diversifolia</i> Blume	X					
<i>Hygrophila auriculata</i> Heine		X				
<i>Hyptis suaveolens</i> (L.) Poit.				X		
<i>Ipomoea batatas</i> (L.) Lam.				X		
<i>Ipomoea fistulosa</i> Mart. ex Choisy		X	X	X		X
<i>Ipomoea maxima</i> Don ex Sweet	X					
<i>Jasminum sambac</i> (L.) Aiton						X
<i>Jasminum sambac</i> (L.) Aiton						X
<i>Kalanchoe pinnata</i> (Lam.) Pers.		X	X	X		X
<i>Lagenaria vulgaris</i> Ser.		X				
<i>Lagerstroemia speciosa</i> (L.) Pers.						X
<i>Lannea grandis</i> (Dennst.) Engl.					X	
<i>Lasia spinosa</i> (L.) Thwaites	X					
<i>Leea macrophylla</i> Roxb. ex Hornem.					X	X
<i>Leonurus sibiricus</i> L.	X					
<i>Leucas aspera</i> (Willd.) Link	X	X	X	X	X	
<i>Ludwigia hyssopifolia</i> (G. Don) Exell				X		
<i>Luffa cylindrica</i> M. Roem.		X				

Species	Bagerhat district		Brahmanbaria district		Rajshahi district	
	Bagerhat Sadar	Rampal	Ashuganj	Brahmanbaria Sadar	Bagha	Putia
<i>Lygodium flexuosum</i> (L.) Sw.				X	X	X
<i>Mangifera indica</i> L.				X	X	
<i>Manilkara zapota</i> (L.) P. Royen			X			X
<i>Marsilea crenata</i> C. Presl				X		X
<i>Marsilea quadrifolia</i> L.						X
<i>Melia azedarach</i> L.			X			X
<i>Mikania cordata</i> (Burm. f.) B.L. Rob.	X			X		
<i>Mimosa pudica</i> L.						X
<i>Mimusops elengi</i> L.					X	
<i>Momordica charantia</i> L.			X			
<i>Morinda citrifolia</i> L.		X			X	
<i>Moringa oleifera</i> Lam.		X	X	X		X
<i>Morus indica</i> L.			X			
<i>Mucuna pruriens</i> (L.) DC.	X					
<i>Murraya koenigii</i> (L.) Spreng.						X
<i>Musa acuminata</i> X <i>balbisiana</i> Colla				X	X	X
<i>Nypa fruticans</i> Wurm		X				
<i>Ocimum sanctum</i> L.		X	X			X
<i>Ocimum tenuiflorum</i> L.	X		X			
<i>Olea europaea</i> L.						X
<i>Opuntia dillenii</i> (Ker Gawl.) Haw.					X	
<i>Oroxylum indicum</i> (L.) Kurz	X	X				
<i>Oxalis lobata</i> Sims	X	X				
<i>Paederia foetida</i> L.					X	
<i>Pandanus odoratissimus</i> L.f.		X				
<i>Pedilanthus tithymaloides</i> (L.) Poit.						X
<i>Peperomia pellucida</i> (L.) Kunth		X				
<i>Phoenix sylvestris</i> (L.) Roxb.						X
<i>Phyllanthus acidus</i> (L.) Skeels			X			
<i>Phyllanthus emblica</i> L.			X		X	X
<i>Phyllanthus niruri</i> L.		X				
<i>Phyllanthus reticulatus</i> Poir.				X		X
<i>Physalis minima</i> L.					X	
<i>Piper longum</i> L.						X
<i>Plumbago indica</i> L.				X		
<i>Polygonum aviculare</i> L.	X					
<i>Polygonum hydropiper</i> L.			X			
<i>Polygonum minus</i> Huds.	X					
<i>Pongamia pinnata</i> (L.) Merr.	X					
<i>Psidium friedrichsthalianum</i> (O. Berg) Nied.			X			

Species	Bagerhat district		Brahmanbaria district		Rajshahi district	
	Bagerhat Sadar	Rampal	Ashuganj	Brahmanbaria Sadar	Bagha	Putia
<i>Pteridium aquilinum</i> (L.) Kuhn			X			
<i>Punica granatum</i> L.					X	X
<i>Randia dumetorum</i> (Retz.) Poir.	X			X		X
<i>Rauvolfia serpentina</i> (L.) Benth. ex Kurz		X			X	
<i>Rauvolfia tetraphylla</i> L.						X
<i>Ricinus communis</i> L.		X	X	X		X
<i>Rosa X damascena</i> Mill.						X
<i>Ruellia ciliosa</i> Pursh		X				
<i>Ruellia tuberosa</i> L.	X					
<i>Sansevieria trifasciata</i> Prain			X			
<i>Saraca indica</i> L.						X
<i>Scoparia dulcis</i> L.	X	X	X		X	X
<i>Sida diellii</i> A. Gray	X					
<i>Solanum americanum</i> Mill.						X
<i>Solanum indicum</i> L.	X					
<i>Solanum melongena</i> L.					X	X
<i>Solanum virginianum</i> L.						X
<i>Solanum torvum</i> Sw.		X	X			
<i>Sonneratia apetala</i> Buch.-Ham.	X					
<i>Spilanthes acmella</i> (L.) Murray				X		
<i>Stephania japonica</i> (Thunb.) Miers		X	X	X	X	
<i>Streblus asper</i> Lour.				X		
<i>Syzygium cumini</i> (L.) Skeels					X	
<i>Syzygium malaccense</i> (L.) Merr. & L.M. Perry						X
<i>Tagetes erecta</i> L.		X			X	X
<i>Tamarindus indica</i> L.		X	X			X
<i>Tectona grandis</i> L.f.						X
<i>Terminalia arjuna</i> (Roxb. ex DC.) Wight & Arn.				X	X	
<i>Terminalia belerica</i> Roxb.					X	
<i>Terminalia chebula</i> Retz.					X	X
<i>Terminalia elliptica</i> Willd.			X			
<i>Thevetia peruviana</i> (Pers.) K. Schum.	X					
<i>Thuja orientalis</i> L.						X
<i>Tragia involucrata</i> L.						X
<i>Trema orientalis</i> (L.) Bl.					X	
<i>Trewia nudiflora</i> var. <i>polycarpa</i> (Benth. & Hook. f.) Susila & N.P. Balakr.			X			
<i>Urena lobata</i> L.			X			
<i>Vernonia patula</i> (Dryand.) Merr.	X				X	

Species	Bagerhat district		Brahmanbaria district		Rajshahi district	
	Bagerhat Sadar	Rampal	Ashuganj	Brahmanbaria Sadar	Bagha	Putia
<i>Vitex negundo</i> L.				X		X
<i>Vitis vinifera</i> L.					X	
<i>Wedelia chinensis</i> (Osbeck) Merr.	X					X
<i>Xanthium italicum</i> Moretti		X				
<i>Xanthosoma sagittifolium</i> (L.) Schott	X			X		
<i>Zizyphus mauritiana</i> Lam.						X

**Table 2.** A comparative analysis of variation of medicinal plant use by **kavirajes** within two upazillas of Bagerhat district, Bangladesh. Plants used to treat the same ailment or disorder in both locations are highlighted in red.

Ailment/Disorder	Bagerhat Sadar	Rampal
Abortifacient		
Alopecia	Eclipta alba	
Anemia		
Anorexia		Andrographis paniculata, Oxalis lobata, Tamarindus indica
Antidote to poison	Derris trifoliata, Ipomoea maxima, Thevetia peruviana	Alstonia scholaris, Crataeva religiosa, Derris trifoliata, Excoecaria agallocha, Excoecaria indica, Ipomoea fistulosa, Morinda citrifolia
Anti-inflammatory	Barleria prionitis, Eryngium yuccifolium, Sonneratia apetala, Wedelia chinensis	Glycosmis pentaphylla
Astringent	Drynaria quercifolia, Polygonum aviculare	Acanthus ilicifolius, Croton bonplandianum, Ipomoea fistulosa, Tagetes erecta
Burns		
Cancer, tumor	Baliospermum axillare, Barleria prionitis, Eclipta alba, Randia dumetorum, Wedelia chinensis, Xanthosoma sagittifolium	Alstonia scholaris, Catharanthus roseus, Eclipta alba, Ocimum sanctum
Cardiovascular disorders	Baliospermum montanum, Lasia spinosa, Scoparia dulcis	
Chicken pox		
Diabetes		Drynaria quercifolia, Heritiera fomes, Morinda citrifolia, Tamarindus indica
Diuretic/Edema	Blumea lacera, Lasia spinosa	
Emetic		
Epilepsy		Oroxylum indicum
Eye diseases (including conjunctivitis, cataract, short-sightedness, night blindness)	Argyrea speciosa, Polygonum minus	Ipomoea fistulosa
Fever	Caesalpinia bonduc, Canna indica	Cassia angustifolia, Lagenaria vulgaris

Ailment/Disorder	Bagerhat Sadar	Rampal
Gastrointestinal disorders (including dysentery, diarrhea, indigestion, colic, acidity, constipation, bloating, lack of appetite, stomachache)	Abutilon indicum, Alisma gramineum, Argyreia speciosa, Baliospermum axillare, Blumea lacera, Cyperus rotundus, Desmodium gangeticum, Drynaria quercifolia, <i>Eclipta alba</i> , Heritiera fomes, Ipomoea maxima, Lasia spinosa, <i>Leucas aspera</i> , Oroxylum indicum, Oxalis lobata, Polygonum minus, Randia dumetorum, Solanum indicum, Sonneratia apetala, Wedelia chinensis	Acalypha indica, Andrographis paniculata, Caesalpinia bonduc, Cassia angustifolia, Cuscuta reflexa, Dioscorea bulbifera, <i>Eclipta alba</i> , Hygrophila auriculata, Kalanchoe pinnata, <i>Leucas aspera</i> , Oroxylum indicum, Peperomia pellucida, Ruellia ciliosa, Scoparia dulcis, Tagetes erecta, Tamarindus indica, Xanthium italicum
Heatstroke		Lagenaria vulgaris
Helminthiasis	<i>Caesalpinia bonduc</i> , Scoparia dulcis	<i>Caesalpinia bonduc</i>
Hepatic disorders (including jaundice, hepatitis)	Chenopodium album, Desmodium stracyfolium, <i>Eclipta alba</i> , Leonurus sibiricus, <i>Leucas aspera</i> , Ocimum tenuiflorum, Wedelia chinensis	Alstonia scholaris, Andrographis paniculata, Catharanthus roseus, Heritiera fomes, Lagenaria vulgaris, <i>Leucas aspera</i> , Phyllanthus niruri
Hernia	Crinum asiaticum	
Hypertension		Drynaria quercifolia, Rauwolfia serpentina
Insanity		
Insomnia		
Insect repellent	Alisma gramineum, Baliospermum montanum, Barringtonia racemosa, Canna indica, Polygonum minus, Randia dumetorum	Heritiera fomes
Kidney problems		
Kidney, gall bladder stones		Kalanchoe pinnata
Leprosy	Pongamia pinnata	
Malaria	Drynaria quercifolia, Polygonum aviculare	Adhatoda vasica, Alstonia scholaris, Andrographis paniculata, Caesalpinia bonduc, Cayratia trifolia
Measles		
Menstrual problems		
Obesity		
Oral infections/ lesions (mouth, tooth, tongue)		
Pain (including headache, toothache, muscle pain)	Barringtonia racemosa, Coccinia cordifolia, Desmodium gangeticum, Hoya diversifolia	Caesalpinia bonduc, Calotropis gigantea, Cleome ruidosperma, Croton bonplandianum, Derris indica, Glycosmis pentaphylla, Pandanus odoratissimus, Peperomia pellucida, Xanthium italicum
Paralysis		Solanum torvum
Piles		Calotropis gigantea, Excoecaria agallocha, Xanthium italicum
Rabies		Achyranthes aspera

Ailment/Disorder	Bagerhat Sadar	Rampal
Respiratory tract disorders (including asthma, bronchitis, pneumonia, cold, cough, mucus, influenza, tonsillitis, sore throat)	<i>Abutilon indicum</i> , <i>Baliospermum axillare</i> , <i>Blumea lacera</i> , <i>Canna indica</i> , <i>Ocimum tenuiflorum</i> , <i>Oroxylum indicum</i> , <i>Mikania cordata</i> , <i>Polygonum aviculare</i> , <i>Sida diellii</i> , <i>Solanum indicum</i> , <i>Vernonia patula</i>	<i>Abutilon indicum</i> , <i>Acalypha indica</i> , <i>Adhatoda vasica</i> , <i>Crataeva religiosa</i> , <i>Lagenaria vulgaris</i> , <i>Ocimum sanctum</i> , <i>Oroxylum indicum</i> , <i>Peperomia pellucida</i> , <i>Solanum torvum</i> , <i>Tamarindus indica</i>
Rheumatism, arthritis, rheumatoid arthritis	<i>Cyperus rotundus</i> , <i>Ocimum tenuiflorum</i> , <i>Oroxylum indicum</i> , <i>Sida diellii</i>	<i>Calotropis gigantea</i> , <i>Derris indica</i> , <i>Excoecaria agallocha</i> , <i>Ricinus communis</i>
Sedative	<i>Anthurium andraeanum</i> , <i>Derris trifoliata</i> , <i>Polygonum minus</i> , <i>Pongamia pinnata</i> , <i>Ruellia tuberosa</i>	<i>Ricinus communis</i> , <i>Ruellia ciliosa</i> , <i>Solanum torvum</i> , <i>Tagetes erecta</i>
Sex stimulant, impotency, spermatorrhea, premature ejaculation, aphrodisiac	<i>Abutilon indicum</i> , <i>Euphorbia antiquorum</i> , <i>Leonurus sibiricus</i> , <i>Mucuna pruriens</i> , <i>Polygonum aviculare</i> , <i>Scoparia dulcis</i> , <i>Thevetia peruviana</i> , <i>Vernonia patula</i>	<i>Abutilon indicum</i> , <i>Acanthus ilicifolius</i> , <i>Dioscorea bulbifera</i> , <i>Leucas aspera</i> , <i>Scoparia dulcis</i>
Sexually transmitted diseases – STD (including syphilis, gonorrhoea)	<i>Argyrea speciosa</i> , <i>Ruellia tuberosa</i>	<i>Solanum torvum</i>
Skin diseases (including eczema, abscess, acne, boils, scabies, itch, infections, dermatitis, rash, sores, scar, warts)	<i>Acrostichum aureum</i> , <i>Alisma gramineum</i> , <i>Aristolochia indica</i> , <i>Baliospermum axillare</i> , <i>Chenopodium album</i> , <i>Cryptocoryne ciliata</i> , <i>Eclipta alba</i> , <i>Eryngium yuccifolium</i> , <i>Hoya diversifolia</i> , <i>Lasia spinosa</i> , <i>Leonurus sibiricus</i> , <i>Ocimum tenuiflorum</i> , <i>Oroxylum indicum</i> , <i>Polygonum aviculare</i> , <i>Pongamia pinnata</i> , <i>Scoparia dulcis</i> , <i>Xanthosoma sagittifolium</i>	<i>Alstonia scholaris</i> , <i>Calotropis gigantea</i> , <i>Crataeva religiosa</i> , <i>Excoecaria agallocha</i> , <i>Exocaria indica</i> , <i>Heritiera fomes</i> , <i>Luffa cylindrica</i> , <i>Ocimum sanctum</i> , <i>Peperomia pellucida</i> , <i>Ricinus communis</i> , <i>Scoparia dulcis</i> , <i>Solanum torvum</i> , <i>Stephania japonica</i> , <i>Tagetes erecta</i> , <i>Xanthium italicum</i>
Snake, insect, animal bites	<i>Aristolochia indica</i> , <i>Chenopodium album</i> , <i>Cryptocoryne ciliata</i> , <i>Eryngium yuccifolium</i> , <i>Mucuna pruriens</i> , <i>Pongamia pinnata</i>	<i>Achyranthes aspera</i> , <i>Chenopodium ambrosioides</i> , <i>Cryptocoryne ciliata</i> , <i>Rauwolfia serpentina</i>
Spasms		
Sprain, fracture, joint displacement	<i>Pongamia pinnata</i>	<i>Achyranthes aspera</i> , <i>Glycosmis pentaphylla</i> , <i>Stephania japonica</i>
Stimulant, tonic (for debility)	<i>Acrostichum aureum</i> , <i>Anthurium andraeanum</i> , <i>Chenopodium album</i> , <i>Crinum asiaticum</i> , <i>Desmodium stracyfolium</i> , <i>Drynaria quercifolia</i> , <i>Euphorbia antiquorum</i> , <i>Leucas aspera</i> , <i>Mikania cordata</i> , <i>Sida diellii</i> , <i>Wedelia chinensis</i>	<i>Cassia angustifolia</i> , <i>Cayratia trifolia</i> , <i>Cryptocoryne ciliata</i> , <i>Eclipta alba</i> , <i>Kalanchoe pinnata</i> , <i>Moringa oleifera</i> , <i>Nypa fruticans</i> , <i>Rauwolfia serpentina</i>
Stimulant, tonic (for brain, nerves)		
Tetanus		
Tuberculosis	<i>Ocimum tenuiflorum</i>	
Typhoid		

Ailment/Disorder	Bagerhat Sadar	Rampal
Urinary tract infections and genital disorders (including leukorrhea, pus or semen or blood in urine, infrequent urination)	Randia dumetorum, Scoparia dulcis	Acalypha indica, Scoparia dulcis
Wounds, cuts, bruises (to stop bleeding, infections)	Alisma gramineum, Argyreia speciosa	

both upazillas in Bagerhat district to treat the same ailment or disorder.

A comparison of medicinal plants used by the **kavirajes** of the two upazillas of Brahmanbaria district shows that the **kavirajes** of Ashuganj Upazilla used 61 plants for treat-

ment of 24 ailments and those of Brahmanbaria Sadar used 47 plants to treat 17 ailments (Table 3). Of the plants used by the **kavirajes** in the two upazillas of Brahmanbaria, only 9 instances with 6 species were found to be common, i.e. the same species were used to treat the same ailment or disorder.

**Table 3.** A comparative analysis of variation of medicinal plant use by **kavirajes** within two upazillas of Brahmanbaria district, Bangladesh. Plants used to treat the same ailment or disorder in both locations are highlighted in red.

Ailment/Disorder	Ashuganj	Brahmanbaria Sadar
Abortifacient		<i>Carica papaya</i>
Alopecia		
Anemia		
Anorexia		
Antidote to poison		
Anti-inflammatory		<i>Streblus asper</i>
Astringent	<i>Ipomoea fistulosa</i>	
Burns		
Cancer, tumor	<i>Terminalia alata</i>	
Cardiovascular disorders	<i>Terminalia alata</i>	<i>Stephania japonica</i>
Chicken pox		
Diabetes	<i>Catharanthus roseus</i>	
Diuretic/Edema	<i>Alocasia macrorrhizos</i> , <i>Boerhaavia diffusa</i>	<i>Streblus asper</i>
Emetic		
Epilepsy		
Eye diseases (including conjunctivitis, cataract, short-sightedness, night blindness)	<i>Centella asiatica</i> , <i>Commelina benghalensis</i>	<i>Heliotropium indicum</i> , <i>Ricinus communis</i> , <i>Xanthosoma sagittifolium</i>
Fever	<i>Heliotropium indicum</i>	

Ailment/Disorder	Ashuganj	Brahmanbaria Sadar
Gastrointestinal disorders (including dysentery, diarrhea, indigestion, colic, acidity, constipation, bloating, lack of appetite, stomachache)	<i>Alocasia macrorrhizos</i> , <i>Aloe vera</i> , <i>Andrographis paniculata</i> , <i>Artocarpus lakoocha</i> , <i>Cassia tora</i> , <i>Centella asiatica</i> , <i>Cinnamomum verum</i> , <i>Crataeva magna</i> , <i>Dillenia indica</i> , <i>Embllica officinalis</i> , <i>Foeniculum vulgare</i> , <i>Glinus oppositifolius</i> , <i>Momordica charantia</i> , <i>Morus indica</i> , <i>Polygonum hydropiper</i> , <i>Pteridium aquilinum</i> , <i>Scoparia dulcis</i> , <i>Solanum torvum</i> , <i>Urena lobata</i>	<i>Annona squamosa</i> , <i>Coccinia cordifolia</i> , <i>Cuscuta reflexa</i> , <i>Erythrina variegata</i> , <i>Hyptis suaveolens</i> , <i>Ipomoea batatas</i> , <i>Kalanchoe pinnata</i> , <i>Lygodium flexuosum</i> , <i>Moringa oleifera</i> , <i>Vitex negundo</i>
Heatstroke	<i>Abroma augusta</i>	
Helminthiasis	<i>Croton bonplandianum</i> , <i>Polygonum hydropiper</i>	<i>Clerodendrum viscosum</i> , <i>Glycosmis pentaphylla</i>
Hepatic disorders (including jaundice, hepatitis)	<i>Alocasia macrorrhizos</i> , <i>Amaranthus spinosus</i> , <i>Cajanus cajan</i> , <i>Coccinia grandis</i> , <i>Cuscuta reflexa</i> , <i>Eclipta prostrata</i> , <i>Hibiscus rosa-sinensis</i> , <i>Manilkara zapota</i> , <i>Scoparia dulcis</i>	<i>Achyranthes aspera</i> , <i>Ageratum conyzoides</i> , <i>Cajanus cajan</i> , <i>Clerodendrum indicum</i> , <i>Ludwigia hyssopifolia</i> , <i>Mangifera indica</i> , <i>Marsilea crenata</i> , <i>Mikania cordata</i> , <i>Terminalia arjuna</i>
Hernia		
Hypertension	<i>Allium sativum</i>	
Insanity	<i>Barringtonia acutangula</i> , <i>Ficus religiosa</i>	
Insomnia		
Insect repellent		
Kidney problems	<i>Aloe vera</i>	
Kidney, gall bladder stones		<i>Kalanchoe pinnata</i>
Leprosy		
Malaria		
Measles		
Menstrual problems	<i>Cynodon dactylon</i>	
Obesity		
Oral infections/ lesions (mouth, tooth, tongue)		<i>Alocasia macrorrhizos</i> , <i>Anthocephalus chinensis</i> , <i>Phyllanthus reticulatus</i>
Pain (including headache, toothache, muscle pain)	<i>Azadirachta indica</i> , <i>Calotropis procera</i> , <i>Centella asiatica</i> , <i>Clerodendrum viscosum</i> , <i>Ficus racemosa</i> , <i>Phyllanthus acidus</i> , <i>Phyllanthus emblica</i> , <i>Psidium friedrichsthalianum</i> , <i>Sansevieria trifasciata</i>	<i>Azadirachta indica</i> , <i>Borassus flabellifer</i> , <i>Clerodendrum viscosum</i> , <i>Commelina benghalensis</i> , <i>Nephelium longana</i> , <i>Randia dumetorum</i> , <i>Spilanthes acmella</i>
Paralysis	<i>Anthocephalus indicus</i>	
Piles		
Rabies		
Respiratory tract disorders (including asthma, bronchitis, pneumonia, cold, cough, mucus, influenza, tonsillitis, sore throat)	<i>Calotropis procera</i> , <i>Desmodium triflorum</i> , <i>Leucas aspera</i> , <i>Ocimum sanctum</i> , <i>Ocimum tenuiflorum</i>	<i>Hibiscus esculentus</i> , <i>Leucas aspera</i>

Ailment/Disorder	Ashuganj	Brahmanbaria Sadar
Rheumatism, arthritis, rheumatoid arthritis	<i>Ficus racemosa</i> , <i>Ricinus communis</i> , <i>Stephania japonica</i>	
Sedative		
Sex stimulant, impotency, spermatorrhea, premature ejaculation, aphrodisiac	<i>Bombax ceiba</i> , <i>Kalanchoe pinnata</i> , <i>Scoparia dulcis</i>	<i>Abelmoschus moschatus</i> , <i>Abroma augusta</i> , <i>Abutilon indicum</i> , <i>Terminalia arjuna</i>
Sexually transmitted diseases – STD (including syphilis, gonorrhoea)		
Skin diseases (including eczema, abscess, acne, boils, scabies, itch, infections, dermatitis, rash, sores, scar, warts)	<i>Adenantha pavonina</i> , <i>Azadirachta indica</i> , <i>Calotropis procera</i> , <i>Cicca acida</i> , <i>Commelina benghalensis</i> , <i>Heliotropium indicum</i> , <i>Melia azedarach</i> , <i>Scoparia dulcis</i> , <i>Tamarindus indicus</i> , <i>Trewia nudiflora</i> var. <i>polycarpa</i>	<i>Amaranthus spinosus</i> , <i>Clerodendrum indicum</i>
Snake, insect, animal bites		
Spasms		
Sprain, fracture, joint displacement	<i>Stephania japonica</i>	<i>Clerodendrum viscosum</i> , <i>Musa acuminata</i> X <i>balbisiana</i> , <i>Nephelium longana</i>
Stimulant, tonic (for debility)	<i>Amaranthus viridis</i> , <i>Moringa oleifera</i>	<i>Carica papaya</i> , <i>Plumbago indica</i>
Stimulant, tonic (for brain, nerves)		
Tetanus		
Tuberculosis		
Typhoid		
Urinary tract infections and genital disorders (including leukorrhoea, pus or semen or blood in urine, infrequent urination)		
Wounds, cuts, bruises (to stop bleeding, infections)	<i>Cassia sophera</i> , <i>Ipomoea fistulosa</i>	<i>Curcuma longa</i> , <i>Cynodon dactylon</i> , <i>Ipomoea fistulosa</i>

A comparison of medicinal plant use in the two upazillas of Rajshahi district (Table 4) shows that the **kavirajes** of Bagha Upazilla used 49 plants for treatment of 26 ailments, while in Puthia Upazilla 99 plants were used to treat 39 ailments. Of the plants used, only 4 plants were observed to be common between the two upazillas of Rajshahi district.

As in the case of the two upazillas of Bagerhat district, the **kavirajes** of two upazillas each of Brahmanbaria and Rajshahi districts also used the same plant to treat multiple ailments as well as used a variety of plants (but not in combination) to treat the same ailment. There were however, instances, where only a single plant was used to treat a single ailment. Examples of such use are *Eclip-*

**Table 4.** A comparative analysis of variation of medicinal plant use by **kavirajes** within two upazillas of Rajshahi district, Bangladesh. Plants used to treat the same ailment or disorder in both locations are highlighted in red.

Ailment/Disorder	Bagha	Puthia
Abortifacient		<i>Annona squamosa, Hibiscus rosa-sinensis</i>
Alopecia		
Anemia		<i>Phyllanthus emblica</i>
Anorexia		<i>Carissa carandas, Citrus acida, Dillenia indica, Diospyros peregrina, Grewia subinaequalis</i>
Antidote to poison		<i>Ageratum conyzoides, Albizia procera, Amorphophallus campanulatus, bambusa arundinacea, Chrysanthemum cinerariifolium, Ipomoea fistulosa, Rauvolfia tetraphylla, Scoparia dulcis, Solanum surattense</i>
Anti-inflammatory		<i>Marsilea quadrifolia, Terminalia chebula</i>
Astringent		<i>Cynodon dactylon, Leea macrophylla, Manilkara zapota, Vitex negundo</i>
Burns	<i>Musa acuminata X balbisiana</i>	<i>Thuja orientalis</i>
Cancer, tumor	<i>Euphorbia hirta</i>	<i>Azadirachta indica, Camellia sinensis, Catharanthus roseus, Citrus aurantium, Ficus benghalensis, Jatropha gossypifolia, Melia azedarach, Olea europaea, Solanum surattense</i>
Cardiovascular disorders		<i>Olea europaea</i>
Chicken pox		
Diabetes		<i>Abroma augusta, Cassia occidentalis, Clerodendrum viscosum, Coccinia cordifolia, Ficus racemosa, Lagerstroemia speciosa, Tamarindus indica</i>
Diuretic/Edema	<i>Physalis minima, Vitis vinifera</i>	<i>Achyranthes aspera, Amorphophallus campanulatus, Cedrus deodara, Centella asiatica, Cocos nucifera, Euphorbia milii, Kalanchoe pinnata, Pedilanthus tithymaloides, Tagetes erecta</i>
Emetic		<i>Melia azedarach, Moringa oleifera</i>
Epilepsy		<i>Cassia fistula, Citrus grandis</i>
Eye diseases (including conjunctivitis, cataract, short-sightedness, night blindness)	<i>Cayratia trifolia, Centella asiatica</i>	<i>Catharanthus roseus, Jasminum sambac, Solanum nigrum</i>

Ailment/Disorder	Bagha	Puthia
Fever	<i>Adhatoda vasica</i> , <i>Paederia foetida</i>	<i>Adhatoda vasica</i> , <i>Ageratum conyzoides</i> , <i>Alternanthera sessilis</i> , <i>Bacopa monnieri</i> , <i>Citrus acida</i> , <i>Clerodendrum viscosum</i> , <i>Coccinia cordifolia</i> , <i>Delonix regia</i> , <i>Dillenia indica</i> , <i>Ficus benghalensis</i> , <i>Ficus racemosa</i> , <i>Kalanchoe pinnata</i> , <i>Manilkara zapota</i> , <i>Ocimum sanctum</i> , <i>Phyllanthus emblica</i> , <i>Ricinus communis</i> , <i>Solanum melongena</i> , <i>Solanum surattense</i> , <i>Syzygium malaccense</i> , <i>Tamarindus indica</i> , <i>Trewia nudiflora</i> var. <i>polycarpa</i> , <i>Zizyphus mauritiana</i>
Gastrointestinal disorders (including dysentery, diarrhea, indigestion, colic, acidity, constipation, bloating, lack of appetite, stomachache)	<i>Abrus precatorius</i> , <i>Aegle marmelos</i> , <i>Calotropis gigantea</i> , <i>Carissa carandas</i> , <i>Cassia occidentalis</i> , <i>Crataeva religiosa</i> , <i>Lannea grandis</i> , <i>Opuntia dillenii</i> , <i>Punica granatum</i> , <i>Rauvolfia serpentina</i> , <i>Syzygium cumini</i> , <i>Terminalia arjuna</i>	<i>Abelmoschus esculentus</i> , <i>Achyranthes aspera</i> , <i>Acorus calamus</i> , <i>Amaranthus spinosus</i> , <i>Annona squamosa</i> , <i>Basella alba</i> , <i>Boehmeria nivea</i> , <i>Calotropis gigantea</i> , <i>Cassia fistula</i> , <i>Centella asiatica</i> , <i>Citrus grandis</i> , <i>Diospyros peregrina</i> , <i>Ficus racemosa</i> , <i>Ficus religiosa</i> , <i>Jatropha gossypifolia</i> , <i>Lagerstroemia speciosa</i> , <i>Marsilea quadrifolia</i> , <i>Moringa oleifera</i> , <i>Murraya koenigii</i> , <i>Musa acuminata</i> X <i>balbisiana</i> , <i>Punica granatum</i> , <i>Ricinus communis</i> , <i>Syzygium malaccense</i> , <i>Tectona grandis</i> , <i>Zizyphus mauritiana</i>
Heatstroke	<i>Aloe vera</i> , <i>Heliotropium indicum</i>	<i>Cocos nucifera</i> , <i>Codiaeum variegatum</i> , <i>Hemidesmus indicus</i> , <i>Hibiscus rosa-sinensis</i> , <i>Phoenix sylvestris</i> , <i>Phyllanthus reticulatus</i>
Helminthiasis		<i>Acalypha indica</i> , <i>Phoenix sylvestris</i> , <i>Phyllanthus reticulatus</i>
Hepatic disorders (including jaundice, hepatitis)	<i>Cajanus cajan</i> , <i>Stephania japonica</i> , <i>Vitis vinifera</i>	<i>Cocos nucifera</i> , <i>Eclipta alba</i> , <i>Enydra fluctuans</i>
Hernia		
Hypertension		<i>Solanum americanum</i> , <i>Solanum melongena</i>
Insanity		<i>Carissa carandas</i> , <i>Datura stramonium</i>
Insomnia		<i>Bacopa monnieri</i> , <i>Datura stramonium</i> , <i>Jasminum sambac</i> , <i>Mimosa pudica</i>
Insect repellent	<i>Solanum melongena</i>	<i>Acorus calamus</i> , <i>Azadirachta indica</i> , <i>Blumea lacera</i>
Kidney problems		<i>Murraya koenigii</i> , <i>Tagetes erecta</i>
Kidney, gall bladder stones		
Leprosy	<i>Terminalia belerica</i>	
Malaria		<i>Tectona grandis</i> , <i>Vitex negundo</i>
Measles	<i>Clerodendrum indicum</i>	
Menstrual problems		<i>Saraca indica</i>
Obesity		<i>Musa acuminata</i> X <i>balbisiana</i>

Ailment/Disorder	Bagha	Puthia
Oral infections/ lesions (mouth, tooth, tongue)	<i>Cynodon dactylon</i> , <i>Vernonia patula</i>	
Pain (including headache, toothache, muscle pain)	<i>Achyranthes aspera</i> , <i>Barleria lupulina</i> , <i>Calotropis gigantea</i> , <i>Crataeva religiosa</i> , <i>Leea macrophylla</i> , <i>Morinda citrifolia</i>	<i>Cedrus deodara</i> , <i>Citrus aurantium</i> , <i>Crinum asiaticum</i> , <i>Ervatamia divaricata</i> , <i>Ficus benghalensis</i> , <i>Phyllanthus emblica</i> , <i>Ricinus communis</i> , <i>Tragia involucrata</i> , <i>Trewia nudiflora</i> var. <i>polycarpa</i>
Paralysis	<i>Morinda citrifolia</i>	<i>Piper longum</i>
Piles		<i>Averrhoa bilimbi</i> , <i>Averrhoa carambola</i> , <i>Curculigo orchioides</i> , <i>Ficus religiosa</i> , <i>Punica granatum</i> , <i>Zizyphus mauritiana</i>
Rabies		
Respiratory tract disorders (including asthma, bronchitis, pneumonia, cold, cough, mucus, influenza, tonsillitis, sore throat)	<i>Commelina benghalensis</i> , <i>Paederia foetida</i>	<i>Adhatoda vasica</i> , <i>Calotropis gigantea</i> , <i>Costus speciosus</i> , <i>Crinum asiaticum</i> , <i>Datura stramonium</i> , <i>Dillenia indica</i> , <i>Eclipta alba</i> , <i>Euphorbia milii</i> , <i>Ficus benghalensis</i> , <i>Kalanchoe pinnata</i> , <i>Ocimum sanctum</i> , <i>Pedilanthus tithymaloides</i> , <i>Piper longum</i> , <i>Randia dumetorum</i> , <i>Scoparia dulcis</i> , <i>Solanum melongena</i> , <i>Syzygium malaccense</i>
Rheumatism, arthritis, rheumatoid arthritis	<i>Leea macrophylla</i> , <i>Leucas aspera</i>	<i>Annona squamosa</i> , <i>Ricinus communis</i>
Sedative		
Sex stimulant, impotency, spermatorrhea, premature ejaculation, aphrodisiac	<i>Abutilon indicum</i> , <i>Acacia nilotica</i> , <i>Aloe vera</i> , <i>Centella asiatica</i> , <i>Diospyros peregrina</i> , <i>Mangifera indica</i> , <i>Phyllanthus emblica</i> , <i>Terminalia arjuna</i> , <i>Terminalia belerica</i> , <i>Terminalia chebula</i> , <i>Vernonia patula</i>	<i>Cereus grandiflorus</i> , <i>Cuscuta reflexa</i> , <i>Randia dumetorum</i> , <i>Scoparia dulcis</i>
Sexually transmitted diseases – STD (including syphilis, gonorrhea)	<i>Lansea grandis</i> ,	<i>Abelmoschus esculentus</i> , <i>Codiaeum variegatum</i> , <i>Costus speciosus</i>
Skin diseases (including eczema, abscess, acne, boils, scabies, itch, infections, dermatitis, rash, sores, scar, warts)	<i>Axonopus compressus</i> , <i>Mimusops elengi</i> , <i>Morinda citrifolia</i> , <i>Stephania japonica</i> , <i>Tagetes erecta</i> , <i>Trema orientalis</i>	<i>Abroma augusta</i> , <i>Cassia occidentalis</i> , <i>Croton bonplandianum</i> , <i>Curculigo orchioides</i> , <i>Cuscuta reflexa</i> , <i>Enydra fluctuans</i> , <i>Ficus hispida</i> , <i>Hibiscus rosa sinensis</i> , <i>Jatropha gossypifolia</i> , <i>Lygodium flexuosum</i> , <i>Melia azedarach</i> , <i>Scoparia dulcis</i> , <i>Solanum melongena</i> , <i>Solanum nigrum</i> , <i>Wedelia chinensis</i>
Snake, insect, animal bites	<i>Aristolochia indica</i> , <i>Cassia occidentalis</i> , <i>Solanum melongena</i>	
Spasms		
Sprain, fracture, joint displacement	<i>Cissus quadrangularis</i>	
Stimulant, tonic (for debility)	<i>Abutilon indicum</i> , <i>Lansea grandis</i> , <i>Mangifera indica</i> , <i>Phyllanthus emblica</i> , <i>Terminalia chebula</i>	<i>Camellia sinensis</i> , <i>Citrus acida</i> , <i>Grewia subinaequalis</i> , <i>Terminalia chebula</i> , <i>Thuja orientalis</i>

Ailment/Disorder	Bagha	Puthia
Stimulant, tonic (for brain, nerves)		<i>Bacopa monnieri</i> , <i>Leea macrophylla</i> , <i>Rosa X damascena</i>
Tetanus	<i>Cynodon dactylon</i>	
Tuberculosis		
Typhoid	<i>Paederia foetida</i>	
Urinary tract infections and genital disorders (including leukorrhea, pus or semen or blood in urine, infrequent urination)	<i>Centella asiatica</i> , <i>Lygodium flexuosum</i> , <i>Mangifera indica</i>	<i>Hemidesmus indicus</i> , <i>Scoparia dulcis</i>
Wounds, cuts, bruises (to stop bleeding, infections)	<i>Tagetes erecta</i>	<i>Ageratum conyzoides</i> , <i>Boehmeria nivea</i> , <i>Calotropis gigantea</i> , <i>Cynodon dactylon</i> , <i>Lygodium flexuosum</i> , <i>Tagetes erecta</i>

*ta alba* (L.) Hassk. to treat alopecia (Bagerhat Sadar), *Oroxylum indicum* (L.) Kurz to treat epilepsy (Rampal Upazilla), *Catharanthus roseus* (L.) G. Don to treat diabetes (Ashuganj Upazilla), *Streblus asper* Lour. to treat inflammation (Brahmanbaria Sadar), *Musa acuminata X balbisiana* Colla to treat burns (Bagha Upazilla), and *Phyllanthus emblica* L. to treat anemia (Puthia Upazilla). The mean  $\pm$  standard deviation (SD) of the number of ailments treated per upazilla was  $27.6 \pm 7.4$ , while the mean  $\pm$  SD of the number of medicinal plants used per upazilla was  $59.3 \pm 20.1$ . Of the six upazillas surveyed, only one upazilla, namely Puthia in Rajshahi district showed a higher use of medicinal plants and a higher number of ailments treated as compared to the other five upazillas.

Not all **kavirajes** of the surveyed areas treated all of the listed 54 ailments or disorders. It is also to be mentioned that the **kavirajes** were reluctant to provide complete information about formulations, dosages, and side-effects; however, they freely informed us about plants or plant parts used, mode of administration (decoction, maceration, powder, pill) and ailment(s) treated.

## Discussion

### *Intra-district variation of plants used by the kavirajes to treat common ailments or disorders*

Tables 2-4 point out the inter-district variations in medicinal plant usage in each of the two upazillas surveyed per district. Table 5 demonstrates the intra-district varia-

**Table 5.** Intra-district variation in plants used to treat various ailments in Bagerhat, Brahmanbaria and Rajshahi districts, Bangladesh.

Ailment/Symptom	Bagerhat district total number of plants	Brahmanbaria district total number of plants	Rajshahi district total number of plants
Abortifacient		1	2
Alopecia	1		
Anemia			1
Anorexia	3		5
Antidote to poison	7		9
Anti-inflammatory	5	1	2
Astringent	6	1	4
Burns			2
Cancer, tumor	9	1	10
Cardiovascular disorders	3	2	1
Chicken pox	1		

Ailment/Symptom	Bagerhat district total number of plants	Brahmanbaria district total number of plants	Rajshahi district total number of plants
Diabetes	4	1	7
Diuretic/Edema	2	3	11
Emetic			2
Epilepsy	1		2
Eye diseases (including conjunctivitis, cataract, short-sightedness, night blindness)	3	5	5
Fever	3	1	23
Gastrointestinal disorders (including dysentery, diarrhea, indigestion, colic, acidity, constipation, bloating, lack of appetite, stomachache)	34	29	36
Heatstroke	2	1	8
Helminthiasis	2	4	3
Hepatic disorders (including jaundice, hepatitis)	13	17	6
Hernia	1		
Hypertension	2	1	2
Insanity		2	2
Insomnia			4
Insect repellent	8		4
Kidney problems		1	1
Kidney, gall bladder stones	1	1	
Leprosy	1		1
Malaria	7		2
Measles			1
Menstrual problems		1	1
Obesity			1
Oral infections/lesions (mouth, tooth, tongue)	3	3	2
Pain (including headache, toothache, muscle pain)	13	14	15
Paralysis	1	1	2
Piles	3		6
Rabies	1		
Respiratory tract disorders (including asthma, bronchitis, pneumonia, cold, cough, mucus, influenza, tonsillitis, sore throat)	19	6	19
Rheumatism, arthritis, rheumatoid arthritis	8	3	4
Sedative	9		
Sex stimulant, impotency, spermatorrhea, premature ejaculation, aphrodisiac	11	7	15
Sexually transmitted diseases – STD (including syphilis, gonorrhoea)	3		4
Skin diseases (including eczema, abscess, acne, boils, scabies, itch, infections, dermatitis, rash, sores, scar, warts)	32	12	19
Snake, insect, animal bites	9		3
Spasms			1

Ailment/Symptom	Bagerhat district total number of plants	Brahmanbaria district total number of plants	Rajshahi district total number of plants
Sprain, fracture, joint displacement	4	4	1
Stimulant, tonic (for debility)	19	4	10
Stimulant, tonic (for brain, nerves)			3
Tetanus			1
Tuberculosis	1		
Typhoid			1
Urinary tract infections and genital disorders (including leucorrhoea, pus or semen or blood in urine, infrequent urination)	3		5
Wounds, cuts, bruises (to stop bleeding, infections)	2	4	6

tion between uses of medicinal plants. Only 15 instances were observed of the use of same plant to treat same ailment or disorder between **kavirajes** of Bagerhat versus Brahmanbaria districts; 10 instances between **kavirajes** of Brahmanbaria versus Rajshahi, and 13 instances between **kavirajes** of Bagerhat versus Rajshahi. As can be seen from Figure 1 and Table 5 in combination, distance between districts was not a contributing factor between the variations. Thus, although Brahmanbaria district is close to Rajshahi district in terms of distance, there were only 10 instances of same plant use versus 13 instances of same plant usage between Bagerhat and Rajshahi districts, which two districts are at a greater distance from each other. Overall, the survey showed greater variations in the use of medicinal plants than the **kavirajes** selecting the same plant to treat the same ailment or disorder.

Several conclusions can be drawn from the above observations. The first is that there is a wide variation in the use of medicinal plants for treatment of ailments/disorders among the **kavirajes**. The second conclusion is that this variation is not confined to **kavirajes** outside any given area (district), but is occurring within the **kavirajes** of the same district but different upazillas. The third conclusion is that this variation cannot be explained away by intra-district variation or availability of medicinal plants, for the variations are occurring on an inter-district basis as well, where the availability of medicinal plants can be regarded to be the same throughout the district.

#### **Analysis of inter- and intra-district variation in the use of medicinal plants**

We next analyzed whether the use of any particular medicinal plants was totally unique to each upazilla or district or whether the same medicinal plant is used in different upazillas or districts but for the treatment of a different ailment or disorder. Table 5 shows a comparative list of medicinal plant usage in the different upazillas. The total number of medicinal plants used to treat the 54 ailments surveyed in the six upazillas (distributed in three districts)

was 232. Out of this number 79 plants (33.6%) were used in multiple upazillas. Approximately, two-thirds of the 232 plants (i.e., 156 plants or 66.4%) were specifically used only in any particular upazillas. Although about one-third of the plants were used in multiple upazillas, in most instances, the same plant was used not to treat the same ailment but a very different one. For example, *Achyranthes aspera* L. was used in 4 different upazillas. In Rampal Upazilla, the plant was used to treat sprains, fractures or joint displacements; in Brahmanbaria Sadar, the plant was used to treat hepatic disorders; in Bagha, it was used to treat pain, and in Puthia, it was used to treat edema. Tables 2-4 also highlight that in most instances (two-thirds of all plants used), a new set of plants are used by the **kavirajes** in different upazillas to treat various ailments. Thus the type of medicinal plant(s) used by the **kavirajes** are at the very least upazilla-based. This variation in use cannot be explained away by differences in inter- or intra-district vegetation. To cite only a few instances (of plants used in one upazilla only), plants like *Bambusa arundinacea* (Retz.) Willd. and *Cocos nucifera* L. (used in Puthia), *Borrassus flabellifer* L. and *Carica papaya* L. (used in Brahmanbaria Sadar), *Cassia sophera* L. and *Cassia tora* L. (used in Ashuganj), *Allium sativum* L. (used in Ashuganj), and *Mangifera indica* L. and *Paederia foetida* L. (used in Bagha) are commonly found throughout Bangladesh. It was beyond the scope of the present study, but obviously the next question which remains to be addressed is whether the use of medicinal plants varies between **kavirajes** up to village level or even differs between **kaviraj** to **kaviraj**.

#### **Mode of medicinal plant selection by the kavirajes to treat various ailments or disorders**

To analyze the reasons behind this inter- and intra-district variation of medicinal plant usage by the **kavirajes**, we next questioned them about what made them select any particular medicinal plant(s) to treat a specific ailment or disorder. Of the 24 **kavirajes** interviewed, 2 declined to give any answer. The other 22 **kavirajes** cited any one or

more of seven causes behind their selection of medicinal plants (a total of 30 explanations altogether). They said that knowledge about the medicinal plants were derived from either one or more of these sources:

- (i) medicinal plant knowledge was passed from generation to generation within the family,
- (ii) such knowledge was obtained from teachers, who are called by them 'gurus',
- (iii) this knowledge was obtained from reading available folk medicinal books,
- (iv) the knowledge was garnered by experimenting initially with animals or poultry and later applied to human beings,
- (v) knowledge was obtained in dreams,
- (vii) selection of medicinal plants to treat any particular ailment of the human body was made on any perceived similarity between plant or plant parts and the particular part of the human body suffering from the ailment.

With the exception of three **kavirajes**, 19 **kavirajes** gave only one reason behind their selection of plants to treat ailments. Two **kavirajes** gave three reasons each, and one **kaviraj** gave four reasons. The maximum number of **kavirajes** (11) claimed that the medicinal plant knowledge came from their 'gurus', followed by 8 **kavirajes**, who claimed that the medicinal knowledge has been preserved within the immediate family for generations and passed from one generation to another. Four **kavirajes** said that in addition to other reasons, they also dreamed of selected medicinal plants, and an equal number claimed to have acquired the knowledge from reading books. Two **kavirajes** based at least part of their selections through initial experiments on animals (cats, dogs and cattle) and poultry, and one **kaviraj** based at least part of his selection by what he claimed as similarity between plant or plant parts and human body parts.

If generational knowledge is combined with knowledge obtained from 'gurus' and knowledge obtained from folk medicinal books, it follows that out of the total of 30 explanations given by 22 **kavirajes**, 23 have to deal with some teacher in the form of a 'guru' (11), elder family member(s) (8) or author(s) of folk medicinal books (4). Thus the question still remains as to what formed the original basis of selection of any particular medicinal plant by these teachers to treat any specific ailment. Since these teachers cannot be questioned any more (they being long dead), we are left with the three remaining modes of selection, that is these teachers in their times in some distant or immediate past experimented with medicinal plants on animals and poultry, or dreamed of those plants, or perceived some sort of similarity between plant, plant parts and human structural features.

Similar forms of learning about traditional remedies have been reported from elsewhere in the world. The Kamba and Luo tribal traditional medicinal practitioners of Kenya have been reported as owing their healing skills to training

by knowledgeable kin, spirit inspiration (with which they converse through dreams), or buying such knowledge from a non-relative specialist (Owuor & Kisangau 2006). The Iroquois Indians have been reported to be more prone to use plants, which appear to them totally or partially of human form (Moerman 2007).

Our observation of the inter- and intra-district diversity of medicinal plants to treat ailments by the **kavirajes** of three districts of Bangladesh would run contrary to common thinking or logic. It cannot be claimed that the observed differences of medicinal plant use in the present study are emic (i.e., culture-specific) for the cultural pattern is quite homogenous within the population of the various upazillas and certainly more so among adjoining upazillas of any given district. One would assume that even if there had been any emic differences, cross-cultural and cross-border linkages might have provided for rapid communication of the efficacy of any medicinal plant and thus a consensus would be quickly achieved and the same plant (provided it serves the purpose) would be used to treat any specific ailment. On the contrary, our results show that the **kavirajes** of Bangladesh are more noted for their diversity of use. The answer to this diversity of use remains unknown, but one possible answer may be that each individual **kaviraj** or **kavirajes** of a particular area (i.e., a number of **kavirajes** acting as a group and who may be disciples of the same 'guru') tend to keep the medicinal knowledge as much as possible to themselves. A second point to consider is that quite obviously the selection of any medicinal plant is always an ongoing process (Caniano & Siebert 1998, Garro 1986, Trotter & Logan 1986). In the present survey it was mentioned by two **kavirajes** that experiments are conducted by them involving plants and human, cattle or poultry subjects. Thus if any **kaviraj** finds out the efficacy of any particular plant, the tendency would be to keep the knowledge to himself so that he can have a better "edge" over other **kavirajes** in the area.

Plant taste, for example bitterness, has been proposed to be a common factor behind choice of plants by traditional medicinal healers in various continents (Johns 1990). Bitter plants are usually richer in alkaloids and so have the potential to have considerable medicinal value (Johns 1990, Rodrigues *et al.* 1976, Schmeda-Hirschmann & Bordas 1990). Among the folk medicinal healers of Bangladesh, there is certainly a tendency to use bitter tasting plants or plant parts, but they are used primarily to treat diabetes (M. Rahmatullah, unpublished observations). The ayurvedic system of traditional medicine in Bangladesh and India utilizes plants based on its pungent, bitter, sour, sweet or astringent taste, but this system is not followed by the folk medicinal healers of Bangladesh. Another factor to be considered is whether a plant is perceived to be hot or cold. Such a system is followed by the unani traditional medicinal system of Bangladesh, India and Pakistan, but once again not by the folk medicinal healers of Bangladesh. If it had been followed then it would have re-

sulted in greater consensus among the **kavirajes** for using the same plant species, which was not what has been observed in the present survey.

Notwithstanding the diversity of medicinal plants used in the various upazillas surveyed, one thing was common in all upazillas, namely the more frequent use of plants, which can be classified as weeds. Bangladesh is highly deforested, which has led to secondary growth in the deforested regions. Particularly roadsides in village areas, open lands containing secondary growth, and uncultivated fields are rich sources of these plants (small plants and shrubs, commonly classified as weeds by the farmers). For instance, *Scoparia dulcis* L. can even be found growing by the roadsides of urban areas. Plants like *Adhatoda vasica* Nees, *Alocasia macrorrhizos* (L.) G. Don, *Amaranthus spinosus* L., *Calotropis procera* (Aiton) W.T. Aiton, *Ricinus communis* L. are common occurrences by the side of rural roads or uncultivated places. This preference by traditional medicinal healers of weeds has also been noted in other communities of the world. For example, Voeks (1996) found that healers along the Atlantic coastal tropical forest of Brazil overwhelmingly preferred secondary forest and disturbed habitats (which had a preponderance for weeds). Similar results had been reported by Posey (1984) with the Kayapó in the Brazilian Amazon, and by Stepp and Moerman (2001) for the Highland Mayas in Chiapas, Mexico. Although weeds forms one of the principal repertoire of **kavirajes** in Bangladesh, the diversity of weed use in various upazillas suggest that other factors are in play behind choice of weeds by different upazilla **kavirajes**, for the same weeds can be observed growing in adjoining upazillas.

## Conclusion

Taken together, our results indicate that a primary factor behind the diversity of medicinal plant use by the **kavirajes** of different upazillas may be the result of by-gone or on-going experimentation by the **kavirajes** of any particular medicinal plant's efficacy. Once an efficacious plant is found, the **kaviraj** tends to keep the knowledge within the immediate family or disciples. This has led over time to a greater diversification of medicinal plant selection between **kavirajes** of adjoining upazillas than would be dictated by simple logic of cross-border linkages and dissemination of information. A similar explanation has been hypothesized by Vandebroek *et al.* (2003) in their studies of traditional healers' medicinal plant knowledge in the Bolivian Andes and Amazon. The authors hypothesized that a background of extensive family in traditional medicine play an important role in transmission and survival of knowledge on medicinal plants.

Further surveys are being conducted by us at present in more areas of Bangladesh to determine the cause(s) of selection by a **kaviraj** of any particular plant for treatment

of a given ailment. Since this is a first-time study of its kind in Bangladesh (to our knowledge), we believe that any answers found can greatly advance our knowledge of ethnopharmacological practices of the region.

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