Using Pattern, Depletion and Conservation Strategy of the *Triphala* Trees in the Village Groves of Chittagong Region of Bangladesh

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Abstract : *Triphala* is an important combination of three important forest fruits, i.e., *Emblica officinalis,
Terminalia chebula* and *Terminalia bellirica*. Chittagong region in Bangladesh was once rich in *triphala*
trees presently subject to the depletion. Thus, these forest resources are being threatened day by day. The
study was conducted to learn the present using pattern of the *triphala*, causes of its depletion and the
conservation strategies agreed by the villagers. Eight major uses of *triphala* trees were recognized. It was
revealed that 100% respondents used the *triphala* as fruit tree followed by 71-78% as fuelwood. The
present status of growing stock of *triphala* was found in depleted condition particularly in the Muslim
dominated area. It was found that unawareness was the major cause for depleting the *triphala* trees agreed
by the 87% respondents followed by depleting the village groves by 84%. Awareness creation (100%) and
induction of social forestry program (92%) were found major recommendations by the villagers to retard
depleting the *triphala* tree species in the Chittagong region of Bangladesh.

Key words : awareness, deforestation, fruit, medicine, myrobalans, social forestry

Introduction

Village groves in Bangladesh play an important role in conserving species and genetic diversities (Alam *et al.*, 1996). Homestead flora is comprised of both indigenous and exotic species. Most of the plants growing in the rural homesteads have multiple uses (Leuschner and Khaleque, 1987). Some are primarily used for medicinal purposes. Almost every plant has one or more medicinal properties (Singh *et al.*, 2004). However, there are over 100 homestead plant species that are recognized particularly for medicinal uses in Bangladesh (Alam and Mohiuddin, 1992). Hossain and Chatterjee (1999) states that 37% of the flora in Bangladesh has medicinal uses. Homestead medicinal flora includes herbs, shrubs and trees growing naturally or by artificial means. Bangladesh is a country reported as storehouse of plants. Most of the drugs, which have been used in curing most human diseases, are of plant origin (Singh *et al.*, 2004). Because of over exploitation and lack of proper management, these valuable resources are being degraded day by day in Bangladesh (Miah *et al.*, 2003). Also it has been realized

in Bangladesh that human interference is one of the main causes of depletion of plant resources and decline of genetic diversity. The necessity of proper management of this important wealth was not realized previously, as the plants were available. The major factors that have caused this problem are unscientific collection, improper management, over exploitation and destruction of natural forest (Hossain and Chatterjee, 1999).

Triphala is a combination of three important herbal forest fruits: Amloki- *Emblica officinalis* Gaertn., Bohera-*Terminalia bellirica* Roxb. and Horitaki-*Terminalia chebula* Retz. popularly known as myrobalan. It is an important combination of medicinal properties and is used extensively in *Ayurvedic* system of medicine (Sabu and Kuttan, 2002). It is said to remove toxins and various other undesirable accumulations from the body. It is said to improve digestion and assimilation and act as antioxidant (Scartezzini and Speroni, 2000). It is also beneficial in chronic lung and skin diseases, eye disorders and conditions with raised cholesterol levels (Hossain and Chatterjee, 1999). In the Chittagong region, *triphala* production was enormous before 15-20 years (*pers. commun.*). With the over extraction of forest resources, the growing stock of these *triphala* tree species is being degraded day by day. To understand the

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using pattern, causes of depletion and conservation strategy of these three species is an important research question for researchers and policy makers. The present status of the growing stock of the *triphala* and the causes of depletion of these resources, the agreed conservation strategies by the villagers, are the important information for the conservationist and policy maker. Thus, the study was conducted to ascertain the using pattern of *triphala* trees, causes of their depletion and the conservation strategies agreed by the villagers.

Materials and Methods

The study involves a social survey on the present status of the *triphala* tree species, in different areas of Raozan upazila (subdistrict) of Chittagong district. The conscious people of different levels of these areas including farmers, Union council members, imams (religious leader), village leaders, traders, schoolteachers, students and housewives were interviewed using pre-tested semi-structured questionnaires.
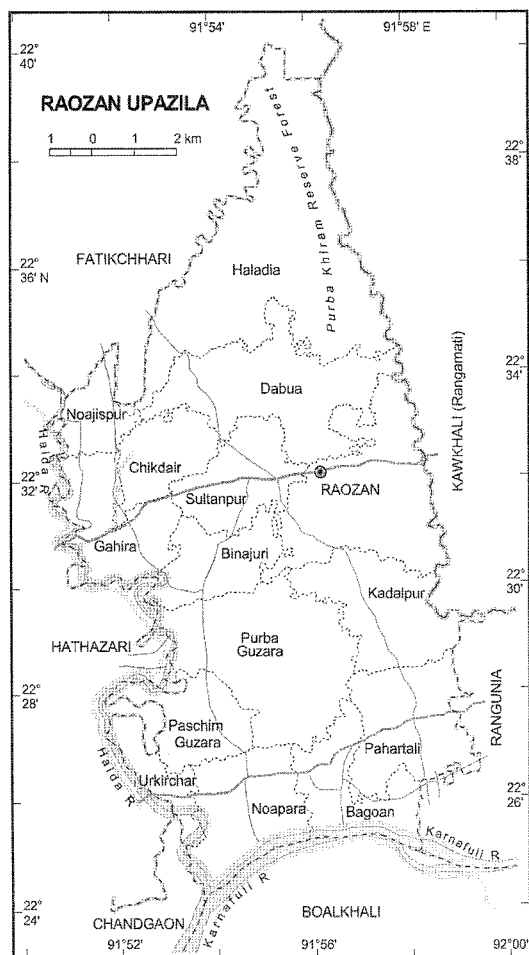
1. Description of the study site

Raozan upazila of Chittagong district was chosen purposively for this study because it is an area rich in vegetation and floral diversity compared to most of the other localities of Chittagong region. Raozan, an upazila of Chittagong district occupies an area of 246.58 km^2 including 2.33 km^2 river area and 61.22 km^2 forest area. It is located between 22° 25' and 22° 10' north latitudes and between 91° 51' and 91° 59' east longitudes (Anonymous, 2006a). The study site is shown in the figure 1. It consists of three types of topographies. The eastern and northeastern part consists of hills, eastern and some portion of northern part consists of Pahartali alluvial land, southern and southwestern part consists of tidal alluvial land (Khan, 1979). The study region has a tropical monsoon climate with yearly average rainfall of 2390 mm. Most of the rainfall occurs between April to October (Figure 2). Mean maximum temperature of the region is 31°C and mean minimum temperature is 22°C with the mean temperature as 26°C. Mean relative humidity is 83% (Anonymous, 2006b). A climate diagram of the Chittagong region is shown in the figure 2. Soil pH varies from 5.5 to 7.3 (Khan, 1979). The population of the area is 53,817 with the density, 5,398 per km^2. The sex ratio of the upazila is 102 males per 100

Figure 1. Specific study site in the Chittagong region of Bangladesh (Anonymous, 2006a).
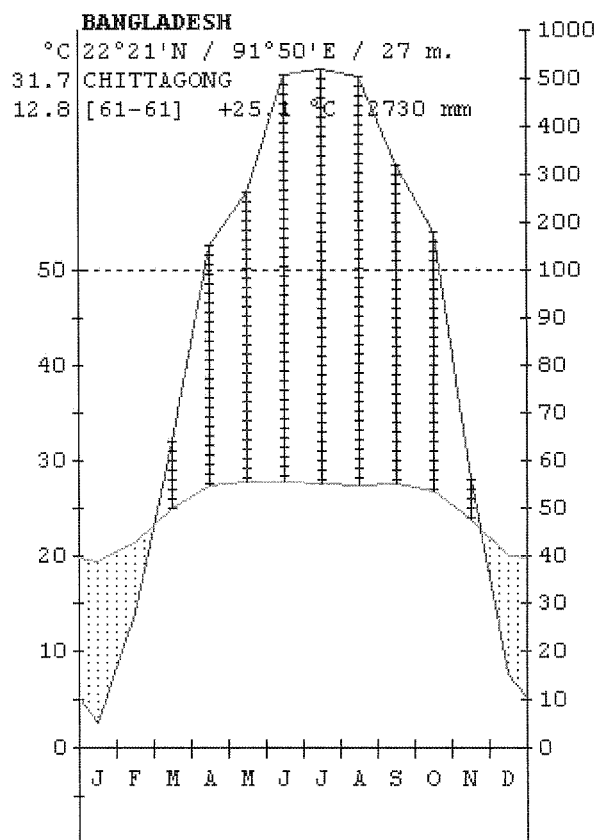

Figure 2. Climate diagram of Chittagong region, Bangladesh (Lieth *et al.*, 1999).

females (Anonymous, 2006a). The upazila consists of 1 municipality, 15 union Parishads, 64 Mouzas and 76 Villages.

2. Methods

Four villages were selected based on stratified random sampling technique. Idilpur and Binajuri were selected from tidal alluvial land and those two villages were NonMuslim dominated areas. Purba Raozan and Paschim Raozan were selected from hilly areas and those two were Muslim dominated areas. Religion wise distribution of households shows there are 210 households in Idilpur. Of them 165 households were Buddhists, 45 Hindus. In Binajuri the total household number was 800. Of them 530 households were Hindus, 240 Buddhists and 30 Muslims. In Purba Raozan, the total household number was 864. Of them 762 households were Muslims, 85 Hindus and 17 Buddhists. In Paschim Raozan the total household number was 1,223. Of them 1,058 households were Muslims, 120 Hindus and 45 Buddhists (*pers. commun.*).

3. Data collection and analysis

A thorough survey was conducted in those selected areas to know the using pattern of *triphala* trees, causes of their depletion, and conservation strategy through interview of the stakeholders of different social strata. The data was collected by a rapid appraisal method through November 2003 to January 2004. A semi-structured questionnaire was prepared well ahead based on the above parameters. The growing stock parameters, such as height class distribution, DBH (Diameter at Breast Height) class distribution, crown-diameter class distribution, mode of regeneration, etc., were determined by personal effort by using the instruments directly as the background study. From each village, socio-cultural data was collected from 25 meetings practicing tree use matrix. Thus 100 meetings were encountered into this study. To show the differences of the villagers among the use, villages, species, causes and conservation strategies, One-way ANOVA was performed with the post hoc test. The data were analyzed with SPSS 13.00. The letters a, b, c, d, e, f, g, and h in the figure and tables are used to show the significant ($p < 0.05$) difference. Bars in the graph and rows in the tables by the same letters are not significantly different. Error bars in the figure represent the standard deviation.

4. Background study of *triphala* trees

Most of the trees were present in 10-20 m height classes. The results of diameter class distribution shows that maximum number of individuals of myrobalan was in 20-30 cm classes. It was further observed that, the percentage of individual trees decreased with increasing height and diameter. Most of the individuals were found in 5-10 m crown-diameter class. Artificial regeneration was found dominant in all areas while most of the natural regenerations were found in hilly areas of Purba and Paschim Raozan. Density of individuals was found higher in nonMuslim dominated areas.

It was observed that, the number of individuals of higher diameter classes had been decreased severely. Because of excessive population growth, poverty, increased wood requirement for household construction, fuel and furniture, local people were selling those trees and harvesting to meet their requirements. Moreover, village people were then more interested to plant high valued timber and fruit species instead of medicinal tree species in their homesteads (Alamgir *et al.*, 2004). They wanted to use their limited land resources for maximum economic benefit. Financial benefits were gaining priority over other benefits.

All the three tree species are light demander and have the tendency to spread their crown. But this expansion is related to density of trees within a location. In the surveyed areas, most of the myrobalan individuals occurred in association with other species in close contact. That was why; they got limited space for lateral expansion of crown. Despite this, some myrobalan individuals were age-old and occurred in the upper crown strata. Moreover, some individuals were situated in open spaces like school ground, playground and roadsides. Those trees got more opportunity for lateral expansion of crown. But their numbers were few.

Both natural and artificial regeneration were found for all the three species in all the surveyed areas. But most of the individuals of myrobalan species were found artificially regenerated. But the area is still productive to support natural regeneration if the habitats are not disturbed by men and grazing animals. Natural regeneration found in the hilly areas of Purba and Paschim Raozan showed that fact.

There was a higher density of myrobalan trees in the nonMuslim dominated areas of Idilpur and Binajuri compared to Muslim dominated areas of Purba Raozan and Paschim Raozan. Religions played an important role, because in nonMuslim localities, medicinal and religious uses of these trees were found. But the overall density status was poor in all the areas.

Results and Discussion

1. Using pattern of *triphala* trees

Eight major uses of *triphala* trees were recognized. It was revealed that 100% respondents used the *triphala* as fruit tree followed by 71-78% as fuelwood (Figure 3).
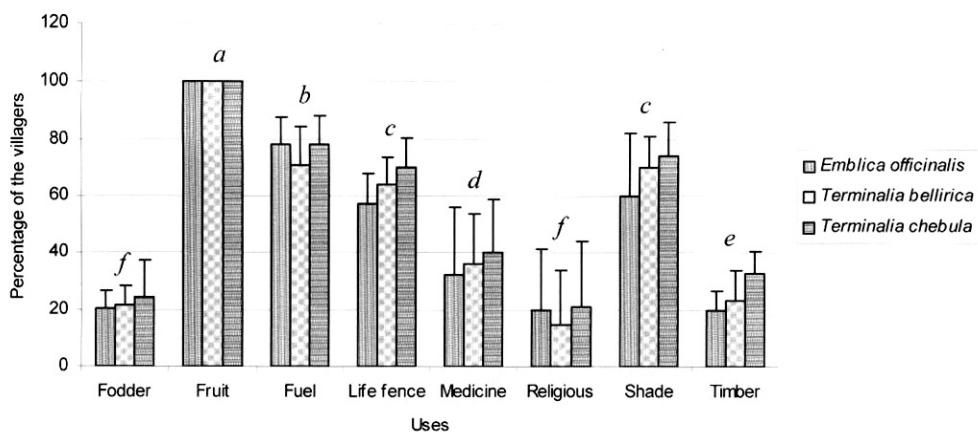
Figure 3. Using pattern of *triphala* trees in the villages of Chittaong region of Bangladesh.

Table 1. Using pattern of *triphala* trees by the villagers in the Chittagong region of Bangladesh.

Uses	Villagers (%)											
	NonMuslim dominated						Muslim dominated					
	Idilpur			Binajuri			Purba Raozan			Paschim Raozan		
	Eo	Tb	Tc	Eo	Tb	Tc	Eo	Tb	Tc	Eo	Tb	Tc
Fodder	20(6.78)*	20(6.43)	20(5.83)	20(5.82)	24(6.60)	16(7.64)	20(6.62)	20(6.80)	20(7.99)	20(6.60)	24(5.71)	40(13.17)
Fruit	100(0.00)	100(0.00)	100(0.00)	100(0.00)	100(0.00)	100(0.00)	100(0.00)	100(0.00)	100(0.00)	100(0.00)	100(0.00)	100(0.00)
Fuel	80(10.99)	72(9.46)	72(8.54)	80(9.53)	72(8.65)	72(12.08)	72(7.91)	84(6.88)	84(6.34)	80(8.58)	56(10.18)	84(7.19)
Life fence	60(9.60)	60(6.31)	72(10.04)	60(10.38)	72(7.98)	72(9.43)	56(12.79)	60(13.45)	64(10.99)	52(9.57)	64(4.58)	72(9.92)
Medicine	36(8.24)	52(9.72)	52(8.24)	68(7.88)	52(9.40)	59(9.58)	12(2.62)	20(7.86)	32(6.55)	12(4.06)	20(5.88)	16(5.49)
Religious	40(11.57)	16(5.31)	32(8.93)	40(10.50)	44(9.81)	52(9.46)	00(0.00)	00(0.00)	00(0.00)	00(0.00)	00(0.00)	00(0.00)
Shade	32(6.77)	60(7.39)	64(9.27)	88(7.37)	72(9.32)	76(12.82)	60(12.77)	72(9.57)	76(8.49)	60(10.75)	76(10.30)	80(9.55)
Timber	20(5.73)	24(8.48)	32(9.68)	20(5.21)	16(7.31)	32(8.24)	24(7.79)	36(8.72)	36(7.09)	16(4.84)	16(6.54)	32(5.43)

Notes: Eo= *Emblica officinalis*; Tb= *Terminalia bellirica*; Tc= *Terminalia chebula*
*Figure in the parenthesis indicates standard deviation

The other two important uses were fuel, 56-84% and shade, 32-88%. The two less important uses of all *triphala* trees were fodder and religious. Medicinal and religious uses were mostly found in the nonMuslim dominated areas (Table 1). It was further found that, most of the people ignored the diversified uses of these *triphala* species. The use, fruit was significantly different from the other uses at α = 0.05 level irrespective of the villages (Figure 3). There was no significant difference between life fence and shade; and fodder and religious. For all of those, it was shown the villagers using the *triphala* trees in the Muslim dominated areas were significantly different from the nonMuslim dominated areas at α = 0.05 level. The villagers using the *triphala* were not significantly different among the species.

Medicinal and religious uses were mostly found in the nonMuslim areas. It revealed the cultural heritage of the people of those areas compared to those in the Muslim areas. The Hindus and the Buddhists were observed to be informed and dependent on herbal medicine as well as main consumers of those kinds of medicines. Timber and fodder from the *triphala* were the two minor uses because villagers mainly want to depend on the traditionally recognized timber and fodder trees for their requirements.

2. Causes of depletion of *triphala* trees

The present status of growing stock of *triphala* trees was found in depleted condition particularly in the Muslim dominated areas. Several causes were found acting behind the depletion. Most of the people in those areas were dependent for their livelihood on jobs, business and agriculture. They were not directly dependent on trees for their livelihood. Therefore, they were unaware of the tree resources surrounding them. It was found that unawareness was the major cause for depleting the *triphala* trees agreed by the 87% respondents followed by depleting the village groves by 84% while the lowest was diseases agreed by the 13% villagers (Table 2). The causes between 'Unawareness' and 'Depletion of the village groves' were not significantly different. But they were significantly different from the other causes at α = 0.05 level. The 'Nonavailability of nursery seedling' as

Table 2. Causes of depletion of *triphala* trees in the village groves of Chittagong region of Bangladesh.

Causes	Agreed by the villagers (%)				Average
	NonMuslim dominated		Muslim dominated		
	Idilpur	Binajuri	Purba Raozan	Paschim Raozan	
Diseases	12(3.38)*	12(4.97)	16(4.50)	12(4.05)	13[h] (4.50)
Availability of allopathic medicine	48(9.44)	40(8.95)	40(10.21)	40(9.16)	42[e] (9.99)
Competition by high yielding trees	28(9.19)	48(10.18)	40(10.30)	48(14.11)	41[e] (13.61)
Cutting for domestic fuel wood & for other requirements	20(9.18)	16(7.99)	20(8.38)	20(7.87)	19[g] (8.51)
Depletion of the village groves	76(9.18)	84(7.56)	92(5.67)	84(10.60)	84[a] (10.10)
Introduction of exotic species	32(8.50)	24(9.98)	52(6.76)	50(8.91)	40[e] (14.74)
Lack of funds	60(8.51)	52(6.39)	92(5.63)	92(5.14)	74[c] (19.65)
Land management	20(5.64)	24(7.16)	24(5.04)	20(5.45)	22[g] (6.20)
Nonavailability of nursery seedling	80(9.72)	80(8.95)	84(8.78)	76(11.66)	80[b] (10.11)
Overgrazing	32(9.69)	28(9.35)	36(9.47)	40(11.00)	34[f] (10.80)
Overpopulation	60(9.62)	60(13.04)	48(8.09)	40(9.14)	52[d] (13.08)
Regeneration problem	48(8.58)	56(12.31)	56(11.57)	52(8.70)	53[d] (10.79)
Religious taboos	60(11.24)	64(10.61)	56(9.96)	52(9.88)	58[d] (11.15)
Unawareness	80(7.51)	84(5.56)	92(5.53)	92(5.34)	87[a] (8.00)
Using timber by brick fields	00(0.00)	00(0.00)	92(6.80)	92(4.53)	46[e] (46.44)

*Figure in the parenthesis indicates standard deviation

the second most important cause was significantly different from the other causes at $\alpha = 0.05$ level. The minor cause, 'Diseases' was also significantly different from the other causes at $\alpha = 0.05$ level.

Excessive population growth was another major cause of depletion. In the last two decades, the population of the area has been doubled (*pers. commun.*). Because of the excessive population growth, households required more spaces for housing, more fuel wood for cooking; consequently the habitats of *triphala* trees around the households were being constricted and degraded. Akhter *et al.* (1997) and Misbahuzzaman (1993) found the degradation in the village groves in Chittagong region. The scenario was almost same in all the parts of the country (ADB, 1993). Uncontrolled grazing of cattle and goats was found particularly in the hilly areas. Because of overgrazing, regeneration problem was occurring frequent, which was another major cause of depletion. Brickfields became one of the major causes of depletion of growing stock of homestead flora (SEHD, 1998). To meet the fuel requirements, those brickfields were employing several agents in the rural areas who were trumpeting the rural people to sell their household trees. Those agents with other tree traders were exploiting the poverty and unawareness of the rural poor, which made the *triphala* trees threatened to endanger in those areas. Nonavailability of nursery seedlings was another important cause of depletion of *triphala* trees. In the nonMuslim dominated areas, some people were found interested in rearing medicinal plants but they were suffering from

unavailable land. In the nonMuslim areas, people were conscious about conservation of those medicinal plants for their religious use. However, those people were interested in herbal medicine compared to those in Muslim dominated areas. That trend helped in conservation of the gene pool of *triphala*s. Because of financial problem and high demand of timber species, most of the rural people were interested in high yielding timber and fruit trees (Abedin *et al.*, 1988; Leuschner and Khaleque, 1987). As a result, they wanted to utilize their limited land resources in producing high yielding timber trees like Teak (*Tectona grandis*), Mehogoni (*Swietenia mahagoni*), Gamar (*Gmelina arborea*), Koroi (*Albizia spp.*) etc. compared to low yielding medicinal trees (Alamgir *et al.*, 2004). Availability of alternative medicine (allopathic) was also an important cause in reducing the significance of herbal medicine.

Moreover, the rural people being poor want direct benefit from their landuse but these medicinal trees are not providing such impact. They are considering high yielding timber trees and fruit trees, which are financially more feasible. Although brickfields are destroying homestead flora to a large extent and polluting environment, there is an absence of implementation of Government rules and regulations to protect this hazardous process.

3. Conservation strategy for *triphala* tree species

All the respondents (100%) in all areas agreed with 'Awareness creation' for conserving *triphala* trees which was significantly different from the other conservation

Table 3. Conservation strategies for *triphala* tree species agreed by the villagers in Chittagong region of Bangladesh.

Strategies	Agreed by the villagers (%)				
	NonMuslim dominated		Muslim dominated		Average
	Idilpur	Binajuri	Purba Raozan	Paschim Raozan	
Availability of planting material	80(8.93)*	80(8.46)	80(11.42)	76(11.42)	79^c (10.14)
Awareness creation	100(0.00)	100(0.00)	100(0.00)	100(0.00)	100^a (0.00)
Formulation of law	32(8.83)	40(10.42)	24(9.59)	24(8.38)	30^g (11.47)
Gene pool conservation	64(9.41)	72(11.69)	72(11.65)	60(8.57)	67^d (11.53)
Identifying various uses	12(2.16)	24(10.77)	20(7.84)	20(5.87)	19^h (8.49)
Incentive and buy-back guarantees	72(11.32)	72(12.38)	76(11.53)	64(8.55)	71^d (11.77)
Maintenance of naturally regenerated seedlings	80(8.09)	84(9.03)	84(11.02)	80(8.46)	82^c (9.27)
Periodic inventory and survey	48(9.80)	40(8.51)	40(7.55)	52(8.07)	45^f (10.02)
Political will or commitment	52(8.25)	56(10.83)	52(9.75)	56(9.05)	54^e (9.58)
Prevention of invasive exotic species	40(6.35)	48(10.82)	48(9.37)	40(6.49)	44^f (9.32)
Providing undisturbed habitat	52(5.94)	56(7.53)	52(7.81)	52(8.46)	53^e (7.60)
Regulation of brick field	00(0.00)	00(0.00)	64(8.59)	76(8.46)	35^g (35.85)
Social forestry program	92(4.08)	92(6.31)	92(4.28)	92(6.77)	92^b (5.42)
Women's participation	60(7.11)	64(9.55)	32(8.91)	37(6.95)	48^{ef} (16.22)

*Figure in the parenthesis indicates standard deviation

strategies at α = 0.05 level. 'Social forestry program' came as second choice (92%) as conservation strategy. About 82% villagers stressed on 'Maintenance of naturally regenerated seedlings' and 79% on 'Availability of planting material' (Table 3). The conservation strategies 'Incentive and buy-back guarantees' (71%), 'Gene pool conservation' (67%), 'Political will or commitment' (54%), etc. also gained support of the villagers. The minor conservation strategy as recognized was 'Identifying various uses' (19%), which was significantly different from the other strategies at α = 0.05 level. The conservation strategies between 'Maintenance of naturally regenerated seedlings' and 'Availability of planting material'; 'Incentive and buy-back guarantees' and 'Gene pool conservation'; 'Political will or commitment', 'Providing undisturbed habitat' and 'Women's participation'; 'Periodic inventory and survey' and 'Prevention of invasive exotic species'; and 'Regulation of brick field' and 'Formulation of law', were not significantly different.

Among the suggested conservation strategies, some gained more public support and some gained less support. Awareness creation was considered best strategy because most of the local people were reported unaware. Supplying available planting materials and maintenance of naturally regenerated seedlings were supported because planting materials were not available in those areas. Kala (2005) also suggested this measure for the Indian Himalayan region. Extension program was considered effective, as there is a chance to directly interact with extension agent and to get technical advice. Incentive and buy-back guarantee was considered favorable if Government is willing to buy the *triphala* fruits at local market price.

Women's participation was considered necessary, as they make up half of the population. The people of Purba Raozan and Paschim Raozan stressed on regulating brickfield because they were the worst sufferers of the brickfields.

Conclusion

Using pattern of *triphala* trees showed that those were traditionally accepted as the fruit tree species rather than medicinal trees in the Chittagong region of Bangladesh. But the religious and medicinal uses of *triphala* were stressed in the nonMuslim dominated area connecting the subreligious factors. The comparative higher density of *triphala* trees in the nonMuslim dominated areas shows that nonMuslim subcultures are favorable for conserving *triphala* trees. Unawareness was pointed out as the major cause for depleting *triphala* trees. It points out that medicinal properties of *triphala* have not been fully addressed. The recent tendency to plant more timber yielding tree species in the village groves is also posing the weights of depletion scenario of *triphala* trees. The conservation strategies agreed by the villagers shows that creation of awareness on the utility of *triphala* trees should be done first. Extension practice through social forestry program can be important to make the people aware and conserve the *triphala* trees. In this case Government and nongovernment organization (NGOs) can take an active part. The known medicinal effects of *triphala* products should be extended in the study area. More research should be carried out on the medicinal effects of *triphala* products to make the *triphala* more

sustainable and popular. Furthermore, proper marketing may encourage the villagers to grow the *triphalas*. The results of this study may be useful for promoting *triphala* trees and their products as well as the rural development of Bangladesh.

Acknowledgement

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