Ind. Jn. of Agri. Econ.
Vol.68, No.2, April-June 2013

ARTICLES

Economic Impact of Institutions on the Consumption of Forest Products in India

Kiran Kumar R. Patil, G.R. Manjunatha and M.G. Chandrakanth*

ABSTRACT

The paper analyses the impact of forest institutions and economic liberalisation of the 1990s on the consumption of forest products and in turn on forest conservation. It is hypothesised that the forest institutions (1) Forest Conservation Act of 1980, and (2) National Forest Policy of 1988, (3) the economic liberalisation and (4) real gross national product (GNP) have perceptible influence on the consumption of forest products and forest conservation. The time series data on apparent consumption of forest products (production plus imports minus exports) as detailed in the *FAO Yearbook of Forest Products* and the real GNP from 1971 to 2009 form the data base for this study. The transcendental and quadratic consumption functions are used to derive income elasticity of consumption for various forest products of India using time series data from 1971 to 2009. The results indicate that the impact of both forest and economic institutions has led to increase in the consumption of 14 forest products forming 67 per cent (of 21 forest products). For these products the imports are substantial and are the *prima facie* indicators of the role of economic institution such as liberalisation, which lead to substantial imports and reduced domestic supplies due to institution of forest conservation.

Keywords: Forest economy, Forest products, Raw material demand and supply, Economic liberalisation.

JEL: Q21, Q23, Q17, C22.

PREAMBLE

Institutions, technologies, markets and governance shape the forest economy of India. With about 99 per cent of India's forests being owned by the State, the transaction costs of governance in the wake of increasing demand for forest products are colossal. Rapid deforestation for purposes *inter alia* industry, agriculture, irrigation, infrastructure, including for fuel wood, threatened the availability of raw materials. In order to halt the rate of deforestation and the necessity to bring one-third of India's geographical area under forests, two crucial institutions namely (1) Forest Conservation Act (FCA) of 1980 and (2) the National Forest Policy (NFP) of 1988 provided for ban on green felling, clear felling, and empowered the State Forests to halt supply of forest raw materials such as roundwood, at concessional prices to forest based industries. Accordingly, these enabled the forest based industries to raise their own sources of raw materials (timber).

However, the forest based industries were still unable to meet their demand. The NFP liberalised imports, which enabled the forest based industries to import raw

*Ph.D Scholar, Department of Agricultural Economics, GKVK, University of Agricultural Sciences, Bangalore-560 065, Ph.D Scholar, Department of Agricultural Statistics, Bidan Chandra Krishi Vidyapeeth, Mohanpur (West Bengal), and Professor and University Head, Department of Agricultural Economics, University of Agricultural Sciences, Bangalore - 560 065 (Karnataka), respectively.

materials. But, it was the economic liberalisation (EL) of 1991, which gave a fillip to import of raw materials. While FCA and NFP were the institutions constraining/restricting the domestic supply of raw materials, the import demand was facilitated by the EL. In effect, FCA, NFP and EL are institutions regulating the demand and supply sides of forest raw materials. At present, about 30 per cent of the raw material demand is met by the public forests, 10 per cent from social forestry/public forests, and the balance 60 per cent is met by open market which includes imports.[1]

The consumption of forest products which reflects the effective demand is determined by the growth in national income, substitutes for forest products, technology, markets and institutions. In the Keynesian framework, the consumption is influenced by income. In the institutional framework, the consumption is influenced by institutions. This paper intends to estimate the joint contribution of economic liberalisation and forest institutions.

INSTITUTIONS

As mentioned earlier, in the 1980s, two crucial institutions in Indian forestry emerged: (1) The Forest Conservation Act of 1980 and (2) the National Forest Policy (NFP) of 1988.[2] The principle feature of these institutions is to protect the forests and environment of India through a ban on green felling and clear felling towards forest conservation as also promote domestic forest production. The States were offering forest raw materials at concessional prices to forest based industries to promote industrial development. However, the NFP examined this and withdrew such concessions. The forest institutions thus played their role in addressing the supply side; where in, extraction from forests were expected to reduce over time. The reduction in the availability of forest products was also expected to trigger technology of wood processing as well as the substitutes of forest products. These further resulted in improvement in the technology of wood processing and use as well as non-wood substitutes of forest products. Foster and Rosenzweig (2003) in their study revealed that the increasing demand for forest products associated with income growth leads to a rise in forests. They opine that the conservation-based measures such as reduction in the demand for forest products (e.g. checks on urbanisation) or restrictions on forest extraction will not save forests. The Government of India placed constraints on forest use such as ban on green felling. It also lowered tariffs on timber imports which relieved the subsequent rise in the price of wood products. However, these measures merely shifted the source of wood supply outside India and correspondingly led to increased forest growth outside India (such as Malaysia, Burma, Australia). Further reductions in barriers to trade in wood are likely to increase forests worldwide. In addition, there will be a reduction in the association between growth in domestic forest product demand and domestic forest growth**.**

In an earlier work on consumption of forest products in India, using the Keynesian framework, the forest products were classified as inferior, normal,

superior goods using historical data from 1961 to 1976 (Chandrakanth *et al.,* 1979). Apparently earlier to 1980, India did not have strong forest and economic institutions and accordingly did not face the heat of conservation and economic liberalisation.

This paper analyses the impact of forest institutions and economic liberalisation of the 1990s on the consumption of forest products and in turn on forest conservation. It is hypothesised that the forest institutions (1) Forest Conservation Act of 1980, and (2) National Forest Policy of 1988, (3) the economic liberalisation and (4) real gross national product (GNP) have perceptible influence on the consumption of forest products and forest conservation. The time series data on apparent consumption of forest products (production plus imports minus exports) as detailed in the *FAO Yearbook of Forest Products* and the real GNP from 1971 to 2009 form the data base for this study.

OBJECTIVES

The specific objectives of the study are: (1) To determine the relationship between consumption of forest products and real national income and to derive income elasticity of consumption of forest products and (2) To determine the impact of institutions on consumption, conservation and trade of forest products.

DATA AND METHODOLOGY

In order to estimate the impact of forest institutions and economic liberalisation on consumption and trade of forest products in India, time series data on the apparent consumption of forest products and real national income from the year 1971 to 2009 are used. According to the *FAO Yearbook of Forest Products* (2009), apparent consumption of a forest product refers to production of forest product plus import of forest product minus export of the forest product. This procedure is resorted since the actual data on consumption of forest products is not available. Accordingly, the data on consumption of forest products[3] was used for the analysis. The definitions of forest products and components are according to FAO Yearbook. The data on real national income was obtained from the *Handbook of Statistics on Indian Economy (2010) by RBI*.[4]

The conceptual framework is the relationship between the use or consumption of forest products and the real national income. From this relationship, income elasticity of consumption (IEC) along with the marginal propensity to consume (MPC) are derived. The transcendental function form (1) (Chandrakanth *et al.,* 1979) is used for modelling consumption of all but one forest product, treating IEC and MPC as variables. Quadratic consumption function (2) was used to assess the relationship for 'paper and paper boards' as the transcendental form did not offer adequate explanation. The time series data on consumption of forest products and of real national income is obtained from 1971 to 2009, thus t =1,...,39 years.

Transcendental consumption function: $c_{it} = \alpha Y_t^{\beta} e^{\gamma Y_t}$ ....(1)

Quadratic consumption function: $C_{it} = \alpha Y_t^2 + \gamma$ ....(2)

Here c_{it} = Apparent consumption of the i-th forest product (i = 1, 2, ..., 21 forest products) in the j-th year (t = 1,2,…,39). Apparent consumption is total production plus imports minus exports measured in physical units, such as tonnes/cubic meters, Y_t = Real National Income in year t, in million rupees measured at 2004-05 constant prices. α, β, and γ are regression coefficients.

The estimated form of the transcendental consumption function is

$$Lnc_{it} = Ln\alpha + \beta LnY_t + \gamma Y_t \quad ....(3)$$

From Equation 3, the marginal propensity to consume (MPC) is derived for the i-th forest product in the j-th year as,

$$\frac{dc_{it}}{dY_t} = MPC = \frac{\beta}{Y_t} c_{it} + \gamma c_{it} \quad ....(4)$$

As the MPC is a function of consumption of forest products and real national income, the MPC is calculated at the geometric mean level η of income and consumption. Similarly the average propensity to consume (APC) is calculated by taking the ratio of consumption of forest products and real national income at their geometric mean level. The expression for the income elasticity of consumption of the i-th forest product denoted as η_i becomes,

$$\eta_i = \frac{MPC_i}{APC_i} = \beta + \gamma Y_t \quad ....(5)$$

The η_i is enumerated at the geometric mean level of real national income. From the estimated equation (2), expression for MPC is obtained as:

$$\frac{dc_{it}}{dY_t} = MPC = 2\alpha Y_t + \beta \quad ....(6)$$

As the MPC is a function of real national income, it is calculated at its arithmetic mean level. Similarly the APC is obtained as the ratio of consumption of forest products and real national income at their arithmetic mean level. The expression for the income elasticity of consumption of the i-th forest product denoted as η_i becomes,

$$\eta_i = \frac{MPC_i}{APC_i} = \frac{(2\alpha Y_t + \beta) x Y_t}{c_{it}} \quad ....(7)$$

From economic theory, for $\eta > 1$, the product in question is a luxury; for, $0 < \eta > 1$, the product is a necessity and for $\eta > 0$, the product is called an inferior good. The classification of forest products is based on increasing or decreasing elasticity of

consumption obtained as quinquennial average income elasticity of consumption over time. In order to estimate the impact of forest institutions and economic liberalisation on consumption of forest products, the institutional consumption function is estimated using real GNP, intercept dummy (to represent influence of economic liberalisation and forest institutions) and slope dummy to represent the rate of change of real national income. The functional form is:

$$c_{it} = \alpha + \beta Y_t + \delta D + \lambda DY_t \quad \text{....(8)}$$

Here c_{it} and Y_t are defined as earlier D = dummy variable to represent economic liberalisation and forest institutions (0 is assigned for pre-economic liberalisation and forest institutions (where t represents the years 1971-1990) and 1 for post-economic liberalisation and forest institutions (where t represents 1991-2009). It is hypothesised that the effect of FCA, NFP and EL all significantly began from 1991. DY_t represents slope dummy variable. α, β, λ and γ are regression coefficients.

RESULTS

The estimated consumption functions using transcendental framework have significant adjusted coefficient of multiple determination for all the 21 forest products considered in the study (Appendix 1). The forest products are arranged according to the pattern of behaviour of elasticity of consumption with respect to real income (Table 1). While a few of the forest products experienced falling income elasticity, a few others are exhibiting increasing elasticity. Among the products with falling elasticity, two groups are identified;

The first group of products are other industrial round wood, Industrial round wood onto round wood, where the income elasticity is negative. These products by 2009 are rendered inferior goods. The products namely other paper + paper board, printing + writing paper, newsprint, paper + paper board are exhibiting income inelastic consumption. The extent of use of internet, computerisation and 'soft copies' has its effect on the consumption of these products related to paper. Among the products with positive but falling income elasticity of demand, wrapping + packing paper + board exhibits income elastic consumption of 1.45, indicating that it is a luxury product.

Among the forest products with increasing income elasticity of consumption, there are five, namely fibre board, plywood, mechanical wood pulp, paper + paper board (NES) and wood based panels which are luxury wood products with more than unitary income elasticity of consumption. Since their income elasticity is increasing over time, these five products will continue to be consumed in larger quantities over time with increase in real incomes. Normal goods comprises both necessities ($\eta<1$) and luxury goods ($\eta>1$). To meet the demand for such necessities, the domestic capacity of the country has to be strengthened by providing incentives to the farmers in practicing agroforesty with the species, which serve as raw materials such as

TABLE 1. QUINQUENNIAL AVERAGE OF ELASTICITY OF CONSUMPTION OF FOREST PRODUCTS IN INDIA - 1971 TO 2009

Forest products	1971-2009	1971-75	1976-80	1981-85	1986-90	1991-95	1996-2000	2001-05	2006-09
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
I. Forest products with decreasing income elasticity of consumption (inferior good)									
Other industrial roundwood ('000M^3)	-0.77	0.27	0.10	-0.11	-0.44	-0.87	-1.57	-2.78	-5.27
Industrial round wood ('000M^3)	0.39	0.60	0.56	0.52	0.45	0.36	0.21	-0.13	-0.6
Particle board ('000M^3)	1.33	1.75	1.69	1.6	1.46	1.29	1.01	0.51	-0.5
Chemical woodpulp ('000 tonnes)	1.38	1.80	1.73	1.64	1.51	1.34	1.05	0.57	-0.44
Dissolving woodpulp ('000 tonnes)	0.72	0.96	0.92	0.87	0.79	0.69	0.53	0.25	-0.34
Wood pulp ('000 tonnes)	1.25	1.62	1.56	1.48	1.37	1.22	0.98	0.56	-0.3
Sawlogs + veener logs('000M^3)	0.43	0.59	0.57	0.53	0.48	0.41	0.3	0.12	-0.27
Fuel wood + charcoal ('000M^3)	0.36	0.49	0.47	0.44	0.40	0.34	0.25	0.07	-0.2
Round wood ('000M^3)	0.37	0.50	0.48	0.45	0.41	0.35	0.26	0.11	-0.2
II. Forest products with decreasing income elasticity of consumption with inelastic consumption (normal good)									
Other paper + paper board ('000 tonnes)	1.21	1.46	1.42	1.37	1.29	1.19	1.02	0.73	0.13
Printing + writing paper ('000 tonnes)	0.83	0.95	0.93	0.91	0.87	0.82	0.74	0.61	0.32
Newsprint ('000 tonnes)	1.16	1.36	1.32	1.28	1.22	1.15	1.01	0.79	0.33
Paper + paper board ('000 tonnes)	1.04	1.17	1.15	1.12	1.08	1.02	0.93	0.77	0.44
III. Forest products with decreasing income elasticity of consumption with elastic consumption (luxury good)									
Wrapping + packing paper + board ('000 tonnes)	3.19	3.59	3.53	3.44	3.32	3.15	2.88	2.41	1.45
IV. Forest products with increasing income elasticity of consumption (luxury good)									
Fibre board ('000M^3)	1.04	0.95	0.97	0.99	1.03	1.07	1.14	1.36	1.53
Plywood ('000M^3)	1.10	0.84	0.88	0.94	1.02	1.13	1.33	1.91	2.4
Mechanical woodpulp ('000 tonnes)	1.77	1.55	1.58	1.63	1.71	1.81	1.97	2.26	2.88
Paper + paper board (NES) ('000 tonnes)	0.17	0.12	0.22	0.27	1.88	1.59	1.54	2.2	3.1
Wood-based panels ('000M^3)	1.09	0.58	0.66	0.77	0.96	1.19	1.53	2.27	3.35
V. Forest products with erratic income elasticity of consumption									
Sawnwood + Sciages ('000M^3)	0.87	1.34	1.25	1.13	0.96	0.73	0.19	-1.6	-
Household + sanitary paper('000 tonnes)	1.06	1.71	1.50	1.23	0.84	-0.21	-1.21	-	-

different fast growing species of pulpwood. The Government can offer these subsidies as they are recommended under the Green Box provisions of the WTO. This demand can also be met through liberalised imports.

Two products, namely, sawnwood + sciages and household + sanitary paper have exhibited erratic income elasticities of consumption since they have inelastic, elastic and negatively inelastic and negatively elastic consumption with respect to income. Hence these products are difficult to be grouped among other categories. In this model, the emphasis is largely on income elasticity of consumption of forest products. Quinquinnial geometric mean of consumption of various forest products used in computation of income elasticity of consumption are given in Appendix 2.

For all the 21 forest products, all the regression coefficients including intercept are significant at 5 per cent except those which have been marked as NS (Not significant) (Appendix 3). The estimated linear consumptions of forest products where consumption is a function of real income, forest and economic institutions (intercept dummy) and the rate of change of consumption due to real income (slope dummy), are statistically significant for all the 21 forest products considered in this study.

The role of forest institutions such as FCA of 1980, NFP of 1988 and the role of economic institutions such as economic liberalisation which began in 1991, is highlighted by the coefficient of intercept dummy variable (Appendix 3). With the exception of four products such as Particle board, fuel wood + charcoal, Fibre board and Mechanical wood pulp, the role of institutions in consumption of all the forest products is economically significant. Among these four products, intercept is significant for Fuel wood + charcoal, which implies that consumption of fuelwood + charcoal is independent of not only real income but also of forest and economic institutions. The size of the autonomous consumption being 216216000 M^3, forms a substantial portion (97 per cent) of the total consumption of fuelwood + charcoal. Since fuelwood + charcoal are a basic necessity for the rural masses of India, as they use as energy for cooking and domestic purpose, its consumption is independent of real income as well as institutions. For the other three products particle board, fibre board and mechanical wood pulp, neither the intercept nor the slope coefficients are significant, indicating that the consumption of these products is independent of real income and institutions and the autonomous consumption forms an insignificant portion of total consumption. The slope dummy variable is negative for most forest products excepting for six. The slope dummy coefficient is statistically significant for 12 products out of 21, indicating that the rate of increase in consumption of forest products is significantly influenced by the enactment of forest institutions as well as economic liberalisation.

The forest products are arranged according to the descending order of magnitude of the IEC (Table 2). For 14 forest products forming 67 per cent (of 21), namely other industrial roundwood onto wrapping + packing paper + board, the effect of forest institutions and economic institutions is to increase the domestic consumption.

TABLE 2. INCOME ELASTICITY OF CONSUMPTION AND INFLUENCE OF REAL INCOME AND INSTITUTIONS ON CONSUMPTION OF FOREST PRODUCTS IN INDIA - 1971 TO 2009

Sr.No.	Forest products	Income elasticity of consumption	*Change in consumption due to institutional factors other than real income	**Change in consumption due to increase in real income	Effect of: Real income on consumption of forest products	Effect of: Economic and forest institutions on consumption of forest products
(1)	(2)	(3)	(4)	(5)	(6)	(7)
I. Forest products with decreasing income elasticity of consumption (inferior good)						
1.	Other industrial roundwood ('000M^3)	-0.77	6704	-0.0018	Decrease	
2.	Industrial Round wood ('000M^3)	0.39	24932	0.0004	Increase	
3.	Particle board ('000M^3)	1.33	49	0.0000	No effect	
4.	Chemical wood pulp ('000 tonnes)	1.38	504	0.0003	Increase	
5.	Dissolving wood pulp ('000 tonnes)	0.72	242	0.0000	No effect	Increase
6.	Wood pulp ('000 tonnes)	1.25	763	0.0005	Increase	
7.	Sawlogs + veener logs ('000M^3)	0.43	16804	0.0015	Increase	
8.	Fuel wood + Charcoal ('000M^3)	0.36	252308	0.0154	Increase	
9.	Round wood ('000M^3)	0.37	277240	0.0159	Increase	
II. Forest products with decreasing income elasticity of consumption with inelastic consumption (normal good)						
10.	Other Paper + paper board ('000 tonnes)	1.21	527	0.0007	Increase	
11.	Printing + writing paper ('000 tonnes)	0.83	612	0.0004	Increase	Increase
12.	Newsprint ('000 tonnes)	1.16	219	0.0003	Increase	
13.	Paper + paper board ('000 tonnes)	1.04	1172	0.0015	Increase	
III. Forest products with decreasing income elasticity of consumption with elastic consumption (luxury good)						
14.	Wrapping + packing paper + board ('000 tonnes)	3.19	569	0.0005	Increase	Increase
IV. Forest products with increasing income elasticity of consumption (luxury good)						
15.	Fibre board ('000M^3)	1.04	-17	0.0001	Increase	
16.	Plywood ('000M^3)	1.1	-749	0.0008	Increase	Decrease
17.	Mechanical wood pulp ('000 tonnes)	1.77	-2382	0.0018	Increase	
18.	Paper + paper board (NES) ('000M^3)	0.17	-67	0.0002	Increase	
19.	Wood-based panels ('000M^3)	1.09	-853	0.0009	Increase	
V. Forest products with erratic income elasticity of consumption						
20.	Sawnwood + Sciages ('000M^3)	0.87	16291	-0.0007	Decrease	Difficulty in forecasting due to erratic income elasticity
21.	Household + sanitary paper ('000 tonnes)	1.06	25	0.0001	Increase	

*change in consumption due to institutional factors other than real income = Intercept (α) + coefficient of intercept dummy (δ). **change in consumption due to real income= regression coefficient of real income (β) + coefficient of slope dummy for real income (λ).

Accordingly, the proportion of imports of products to India for chemical wood pulp (>100 per cent imported), wrapping + packing paper + board (>100 per cent), industrial roundwood (87 per cent), wood pulp (93 per cent), dissolving woodpulp (85 per cent), other paper and paper board (61 per cent), roundwood (61 per cent), newsprint (52 per cent), the imports are substantial and are the *prima facie* indicators of the role of economic institution of liberalisation, which lead to substantial imports, due to institution of forest conservation.

For the five forest products from (Sl. No. 15 to 19) Fibre board, to wood based panels, the effect of forest and economic institutions is to decrease the consumption of forest products. For these products, there are substitutes for forest products due to new technologies. Here, the rate of change in consumption due to real income is positive, while forest institutions and economic liberalisation have reduced the consumption of these products. Accordingly, substantial reduction in imports was noticed for mechanical wood pulp, paper + paper board (NES), plywood.

For dissolving wood pulp and particle board, the rate of increase in consumption due to increase in real income is virtually zero, signifying that for these two products, the rate of change of consumption is influenced largely by forest and economic institutions rather than by real income. However, for other industrial roundwood and sawn wood + sciages, the rate of change of consumption is negative with respect to real income, and is largely influenced by forest and economic institutions.

For products such as industrial roundwood, chemical wood pulp, wood pulp, saw logs + veneers, round wood, other paper and paper board, printing and writing paper, newsprint, paper and paper board, wrapping + packing paper + board, fuel wood + charcoal and household + sanitary paper, the role of forest institutions and economic liberalisation is profound, in addition to the influence by rise in real national income (Table 2).

DISCUSSION

Prior to 1990s, India's pristine tropical forests rich in biodiversity were plundered. Smuggling and uncontrolled logging were unabated in pristine forest areas, not for all timber, but for specific types of timber.[5] Thus, even with FCA and NFP, poaching exists; since the exclusion is expensive and rent seeking/rent sharing are substantial. Thus, the role of economic liberalisation which has allowed for liberalised imports is decisive in conservation of forests rather than FCA and NFP. Currently, there is relatively free trade of forest raw materials for forest based industries to India from different countries for meeting the both the domestic and international demand for forest or wood based products.[6]

There is also a relatively free flow of finished products (including flow of door frames, window frames, furniture sets from abroad), since this meets the demand of a few affluent who would always buy them, due to Snob, Veblen and Bandwagon effects.[7] There is an apparent increase in forest cover (according to Forest Survey of

India), though there is still a debate whether this is happening with respect to desirable local species or with exotic species such as eucalyptus, silver oak. There is also a dependence on wood substitutes such as aluminium/iron/plastic/particle boards/forest products made from biological/agricultural 'waste'. Transfer of technology in wood use is apparent as for instance rubber wood after felling rubber trees, was more used as firewood or fuel wood. However, rubber wood is now used for making furniture, with Malaysian technology, which is a wise use of wood.[8] Thus, there is conservation of tropical forests rich in biodiversity with ecological, environmental and wildlife impacts due to reduced pressure on domestic forests, reducing the cost of local governance required for supervision of forests.

There is increase in forest cover by 5 per cent (1997- 2007) as a sink to absorb 50 million tonnes of carbon dioxide per year offsetting 6 per cent of annual emissions due to forest institutions.[9] There is economic growth of forest based industries due to liberalised imports and exports of wood and wood products including transfer of technology, income and employment. In addition, the emergence of wood substitutes and efficient wood processing industries is keeping a tab on the prices increasing overall wood supplies. There is also an increase in forest cover in countries exporting forest raw material/s to India utilising India's economic advantage due to liberalisation. While it is difficult to conclude that the force of economic liberalisation as an institution is greater than forest institutions resulting in overall welfare, this will be a suggestion for future research work. Governance efforts could also be on non-timber flow of services such as conservation of wild life, medicinal plants, which otherwise would have gone towards conserving timber (the product with higher use value).

CONCLUSIONS

The transcendental and quadratic consumption functions are used to derive income elasticity of consumption for various forest products of India using time series data from 1971 to 2009. Based on the quinquinnial income elasticity of consumption derived the forest products are classified into those with decreasing income elasticity and with increasing income elasticity of consumption. Further, based on the magnitude and sign of the income elasticity of consumption, forest products are categorised into inferior, normal and luxury goods. The impact of institutions on consumption was captured through linear consumption functions with real GNP, intercept dummy representing institutions and slope dummy for rate of change in income. The results revealed that the impact of both forest and economic institutions has led to increase in the consumption of 14 forest products forming 67 per cent (of 21 forest products). For these products the imports are substantial and are the *prima facie* indicators of the role of economic institution such as liberalisation, which lead to substantial imports and reduced domestic supplies due to institution of forest conservation. The following forest products, other paper + paper board, printing + writing paper, newsprint, paper + paper board have experienced inelastic

demand with respect to income, indicating that they are necessities. Accordingly their domestic capacities need to be increased by offering subsidies and incentives to farmers to cultivate pulpwood, by way of Green Box provisions of WTO. It is also noticed that forest and economic institutions decreased the consumption of five forest products forming 24 per cent (of 21 forest products). Thus, economic liberalisation facilitated liberalised imports while conservation of forests through forest institutions of FCA and NCP reduced domestic supplies. The relative role of forest and economic institutions in promoting consumption of forest products is a subject matter of future research.

Received February 2013. *Accepted April 2013.*

NOTES

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APPENDIX 1

ESTIMATED KEYNESIAN TRANSCENDENTAL FUNCTION FOR CONSUMPTION OF FOREST PRODUCTS OF INDIA (1971 TO 2009)

Sr.No.	Forest products	Lnα	B	□	R2
(1)	(2)	(3)	(4)	(5)	(6)
1.	Other paper + paper board ('000 tonnes)	-15.55	1.65	-3.80E-07	0.96
2.	Industrial round wood ('000M^3)	-0.13 ^{NS}	0.76	-3.30E-07	0.87
3.	Particle board ('000M^3)	-24.47	2.08	-6.50E-07	0.83
4.	Chemical wood pulp ('000 tonnes)	-22.21	2.12	-6.40E-07	0.95
5.	Dissolving wood pulp ('000 tonnes)	-10.03	1.15	-3.70E-07	0.82
6.	Wood pulp ('000 tonnes)	-18.63	1.89	-5.50E-07	0.95
7.	Sawlogs + veener logs ('000M^3)	0.12 ^{NS}	0.71	-2.50E-07	0.86
8.	Fuel wood + Charcoal ('000M^3)	4.5	0.58	-1.90E-07	0.98
9.	Round wood ('000M^3)	4.41	0.6	-2.00E-07	0.98
10.	Other industrial roundwood ('000M^3)	-5.09 ^{NS}	1.06 ^{NS}	-1.60E-06	0.6
11.	Printing + writing paper ('000 tonnes)	-7.35	1.04	-1.80E-07	0.95
12.	Newsprint ('000 tonnes)	-14.3	1.5	-2.90E-07	0.96
13.	Paper + paper board ('000 tonnes)	-9.77	1.28	-2.10E-07	0.97
14.	Wrapping + packing paper + board ('000 tonnes)	-48.69 ^{NS}	3.9 ^{NS}	-6.10E-07 ^{NS}	0.34
15.	Fiber board ('000M^3)	-8.5	0.88	1.50E-07 ^{NS}	0.84
16.	Plywood ('000M^3)	-3.58 ^{NS}	0.63 ^{NS}	4.10E-07	0.84
17.	Mechanical wood pulp ('000 tonnes)	-14.42	1.37	3.60E-07 ^{NS}	0.84
18.	Paper + paper board (NES) ('000M^3)*	169.65	-0.000096	4.00E-11	0.76
19.	Wood-based panels ('000M^3)	2.15 ^{NS}	0.21 ^{NS}	7.60E-07	0.78
20.	Sawnwood + Sciages ('000M^3)	-13.75	1.75	-8.40E-07	0.81
21.	Household + sanitary paper ('000 tonnes)	-29.2	2.38	-8.40E-07	0.97

(NS indicates the Non-Significant @5 per cent level of significance).

APPENDIX 2

QUINQUINNEAL GEOMETRIC MEAN OF CONSUMPTION OF FOREST PRODUCT

Forest products (1)	1971-75 (2)	1976-80 (3)	1981-85 (4)	1986-90 (5)	1991-95 (6)	1996-2000 (7)	2001-05 (8)	2006-09 (9)
Other industrial roundwood ('000M^3)	2335.81	2641.62	3633.91	4657.09	5133.44	2770.51	177.4	178
Industrial Round wood ('000M^3)	14840.51	18396.58	21691.56	25093.02	25159.67	25837.79	27086.02	25706.45
Particle board ('000M^3)	12.01	15.64	23.04	30.26	35.79	79.45	86.54	92.04
Chemical wood pulp ('000 tonnes)	162.35	280.81	388.76	610.77	790.02	1147.22	1265.32	1777.18
Dissolving wood pulp ('000 tonnes)	100.74	175.8	200.55	206.07	275.18	307.58	331.37	378.82
Wood pulp ('000 tonnes)	298.73	506.32	734.08	1066.82	1323.43	1731.57	2036.46	2865.59
Sawlogs + veener logs ('000M^3)	10503.93	13249.01	16258.11	18350	18350	18350	22314.29	22390
Fuel wood + Charcoal ('000M^3)	175503.5	196623.38	219777.67	244352.07	263716.61	285451.81	306169.7	307815.42
Round wood ('000M^3)	188045.82	211126.5	236411.07	264575.56	286644.07	302875.31	332398.8	333548.78
Other Paper + paper board ('000 tonnes)	355.45	426.44	571.72	874.5	1245.26	1710.43	1982.84	2888.17
Printing + writing paper ('000 tonnes)	468.79	550.11	741.45	841.76	1103.74	1419.51	1617	2271.65
Newsprint ('000 tonnes)	187.82	234.12	331.38	479.58	528.32	894.41	1088.55	1589.82
Paper + paper board ('000 tonnes)	1015.98	1214.63	1509.76	1969.45	2646.62	4028.1	4703.42	6799.37
Wrapping + packing paper + board ('000 tonnes)	149.22	245.46	355.91	809.47	1148.26	1533.64	1722.91	2443.22
Fiber board ('000M^3)	23.21	26.36	38.92	45.2	39.73	92.71	218.36	212
Plywood ('000M^3)	117.61	147.47	256.15	359.56	317.97	270.89	1923.28	2162.49
Mechanical wood pulp ('000 tonnes)	31.37	34.51	90.86	247.77	223.78	231.88	422.57	3765.05
Paper + paper board (NES) ('000M^3) **	162	128.8	158	37.8	73.6	141.2	218	406.25
Wood-based panels ('000M^3)	157.13	195.6	319.91	435.98	384.01	404.39	1890.21	2737
Sawnwood + Sciages ('000M3)	5662.21	9054.7	13722.79	17481.56	17457.2	16899.45	14867.64	-
Household + sanitary paper ('000 tonnes)	12.74	20.04	27.79	39.67	42.17	39.99	-	-
Real GNP**	498413.56	603910.48	739620.36	947870.05	1215331	1680509.3	2726490	4154437.6

** indicates arithmetic mean.

APPENDIX 3

ESTIMATED LINEAR CONSUMPTION FUNCTION

Sr. No. (1)	Forest products (2)	A (3)	B (4)	δ1 intercept dummy (5)	δ2 slope dummy (6)	□2 (7)
1.	Other industrial roundwood ('000M^3)	-355^{NS}	0.00528	7059	-0.0071	0.59
2.	Industrial Round wood ('000M^3)	5034	0.02146	19898	-0.0211	0.90
3.	Particle board ('000M^3)	-7^{NS}	0.00004^{NS}	57^{NS}	-0.00003^{NS}	0.51
4.	Chemical wood pulp ('000 tonnes)	-290	0.00094	794	-0.0006	0.96
5.	Dissolving wood pulp ('000 tonnes)	34^{NS}	0.0002	208	-0.0002	0.85
6.	Wood pulp ('000 tonnes)	-466	0.00161	1229	-0.0011	0.98
7.	Sawlogs + veener logs ('000M^3)	3081	0.01651	13723	-0.015	0.91
8.	Fuel wood + Charcoal ('000M^3)	216216	0.01274^{NS}	36092^{NS}	0.0027^{NS}	0.17
9.	Round wood ('000M^3)	110806	0.16356	166434	-0.1477	0.96
10.	Other Paper + paper board ('000 tonnes)	-241^{NS}	0.00115	768	-0.0005^{NS}	0.88
11.	Printing + writing paper ('000 tonnes)	65^{NS}	0.00084	547	-0.0004^{NS}	0.88
12.	Newsprint ('000 tonnes)	-127^{NS}	0.00063	346	-0.0003	0.95
13.	Paper + paper board ('000 tonnes)	-7^{NS}	0.00206	1180	-0.0006^{NS}	0.92
14.	Wrapping + packing paper + board ('000 tonnes)	-596	0.00142	1165	-0.0009	0.87
15.	Fiber board ('000M^3)	-52^{NS}	0.00016^{NS}	35^{NS}	-0.0001^{NS}	0.33
16.	Plywood ('000M^3)	-158^{NS}	0.00055^{NS}	-591	0.0002^{NS}	0.86
17.	Mechanical wood pulp ('000 tonnes)	-222^{NS}	0.00047^{NS}	-2160^{NS}	0.0013^{NS}	0.48
18.	Paper + paper board (NES) ('000M^3)	285	-0.00023	-352	0.0004	0.83
19.	Wood-based panels ('000M^3)	-208^{NS}	0.00073	-644	0.0002^{NS}	0.89
20.	Sawnwood + Sciages ('000M3)	-6059	0.02522	22349	-0.0259	0.63
21.	Household + sanitary paper ('000 tonnes)	68	-0.00005	-43	0.0001	0.18

NS indicates the Non-Significant @5 per cent level of significance.