WOOD ENERGY NEWS

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Wood Energy in China

Contents

Editorial

This is the first time an issue of Wood Energy News has focused on a single country. RWEDP feels this is appropriate in the case of China because the country is a new member of the regional programme and it is also the largest member. We have observed that many people in other countries are very interested to learn more about wood energy in China.

It has been claimed that energy development in China will have a relatively large impact on the global environment due to the sheer size of the population. However, international interest in China is not only due to the size of the country. Quite a few institutions, methods and technologies have been developed inside China which are successful and which differ from those elsewhere. Moreover, substantial changes have taken place in China in recent years which are of great interest, but at the same time, language barriers have often hampered the communication of these changes.

As far as wood and other biomass energy is concerned, there are many interesting developments from China: from the institutionalization of rural energy at central, provincial and county levels to the implementation of fuelwood forests, and stove and gasification technologies. Gender-related issues are also of particular interest.

It seems that few people, if any, are in a position to overview the Chinese biomass energy scene, or even the wood energy scene in the country.

The present issue of Wood Energy News does not pretend to provide a complete overview of Chinese situation. However, it may help to bring some relevant aspects to the attention of a wider audience. In translating and interpreting original sources from the Chinese language, we have experienced problems of definition and terminology, which have not been satisfactorily resolved. Probably, more work needs to be done in order to interpret primary sources, analyse policies and their effects, and resolve data conflicts. Closer linkages between experts from different countries will benefit wood energy development, and energy development at large.

Front painting: Fire of Life, by Mr. Weiguo Wang, Xian Institute of Traditional Chinese Painting, Shanxi, China.

Colophon

Programme Information

The Regional Wood Energy Development Programme in Asia (RWEDP) aims to assist 16 developing countries in establishing and strengthening their capabilities to assess wood energy situations, plan wood energy development strategies and implement wood energy supply and utilization programmes. The programme promotes the integration of wood energy in the planning and implementation of national energy and forestry programmes.

Wood Energy News

The programme's newsletter, *Wood Energy News*, which is published on a regular basis, addresses a wide variety of wood energy issues, such as woodfuel resources, woodfuel flows, wood energy planning and policies and wood energy technologies. Its purpose is to share information on wood energy with its subscribers. Suggestions, reactions or contributions are more than welcome, and don't forget to share your own experiences.

Those wishing to obtain *Wood Energy News* can write to the RWEDP secretariat at:

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Programme Focal Points

- Bangladesh: Chief Conservator of Forests, Forest Dept, Min. of Environment and Forest; Industry and Energy Dev., Planning Commission, Min. of Planning.
- Bhutan: Dir, Dept of Power, Min. of Trade; Joint Secretary, Forest Services Division, Min. of Agriculture.
- Cambodia: Dep. Dir., Dept. of Forests and Wildlife; Secretary of State, Min. of Industry, Mines and Energy.
- China: Asst. Professor, Institute of Forestry, Chinese Academy of Forestry; Dep. Dir, IEEP, Chinese Academy of Agricultural Engineering Research and Planning.
- India: Inspector General of Forests, Min. of Environment and Forests; Secr., Min. of Non-Conventional Energy Sources.
- Indonesia: DG of Electricity and Energy Devt; Dir of Regreening and Social Forestry, Min. of Forestry.
- Laos: DG, Dept of Forestry, Min. of Agriculture and Forestry.
- Malaysia: DG, Forest Research Institute; DG, Economic Planning Unit, PM's Dept.
- Maldives: Dep. Director, Agricultural Services, Min. of Fisheries and Agriculture
- Myanmar: DG, Forest Dept; DG, Energy Planning Dept, Min. of Energy
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- Pakistan: Inspector General of Forests, Min. of Env., Local Govt and Rural Devt.; Chairman, Pakistan Council of Appropriate Tech.; Chief, Energy Wing, Planning and Devt. Divison
- Philippines: Secretary, Dept of Energy; Secretary, Dept of Environment and Natural Res.
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Biomass Energy Consumption in China

Zheng Luo

Biomass energy constituted 23% of the total energy consumed in China in 1995 (IEA, 1994/5). It plays an important role in the rural energy system which directly concerns the livelihood of 70% of China's inhabitants. In 1993, biomass accounted for 43% of the total energy consumed in rural China. The share of biomass energy used in total rural energy consumption has declined from 86% in 1979 to 40% in 1992, according to Feng Liu, 1993. However, since there is a lack of reliable time-series data and large variations between different data sources on biomass use, it is very difficult to give a detailed report, especially concerning the recent trend. Data from EDP-Asia indicate that biomass energy consumption declined during 1987-1992. However, it slightly increased thereafter. IEA data show that biomass use increased by 8% during 1993-1995.

Table 1. Biomass energy consumption in China

Year	Biomass Consumption in PJ		Share in Total Energy Consumption	
	IEA	EDP-Asia	IEA	EDP-Asia
1987		7,934		25%
1990		7,845		22%
1992		7,338		20%
1993	7,772	7,361	31%	19%
1994	7,837	7,390	23%	18%
1995	8,431		23%	

The decline of biomass use could be related to two factors. The first is the Chinese National Improved Stove Programme, which started in the early 80's. It is reported that approximately 142.56 million farm households, i.e. 70 % of the total rural households, had adopted fuel-saving stoves by the end of 1991. As a result, 1,740 PJ in the form of woodfuel and coal are saved annually. The second factor is the increasing use of commercial energy, especially coal.

Table 2. Fuelwood consumption in China

Year	Fuelwood Consump-tion	Share in Total Biomass Consumption	Share in Total Energy Consumption
1987	3,967	50%	12%
1990	3,907	50%	11%
1992	3,281	45%	9%
1994	3,290	45%	8%

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Table 3. Rural energy consumption structure in China

Year	Commercial Fuels				Biomass Fuels				Others	Total Consum.
	Coal	Oil	Electri.	Sub-total	Crop stalks	Fuel wood	Manure	Sub-total		
1979	957	44	90	1,091	3,306	3,016	174	6,496		7,587
1987	1,728	55	207	1,990	3,770	3,845	94	7,709		9,699
1990	6,206	803	980	7,989	3,828	3,811		7,639		15,628
1992	6,915	939	1,543	9,397	3,930	3,199		7,129		16,526
1993	7,207	1,073	1,760	10,040	4,544	3,515		8,059	815	18,914
% of the sub-total										
1979	88%	4%	8%	100%	51%	46%	3%	100%		
1987	87%	3%	10%	100%	49%	50%	1%	100%		
1990	78%	10%	12%	100%	50%	50%		100%		
1992	74%	10%	16%	100%	55%	45%		100%		
1993	72%	11%	17%	100%	56%	44%		100%		
% in the total rural energy Consumption										
1979	12%	0.6%	1%	14%	44%	40%	2%	86%		100%
1987	18%	0.7%	0.2%	21%	39%	40%	0.8%	79%		100%
1990	40%	5%	6%	51%	25%	25%		49%		100%
1992	42%	6%	9%	57%	24%	19%		43%		100%
1993	38%	5%	9%	53%	24%	19%		43%	4%	100%

Fuelwood and crop stalks are the main types of biomass used in China. About 50% of biomass energy is derived from wood. The fuelwood consumption followed the same trend as biomass energy in total and similar explanations can be applied. The share of fuelwood in total biomass energy consumption has also declined. However, this is determined by the shortage of fuelwood supply, so people have to use the relatively abundant crop stalks instead.

Table 4. Fuelwood Consumption in rural China

Year	Fuelwood Consumption in PJ					
	Rural Households		Industrial sector		Total	
	CED	Other sources	CED	Other sources	CED	Other sources
1979	3,016				3,016	
1980		2,987				2,987
1985		2,813				2,813
1987	3,857	4,466			3,857	4,466
1990	3,799				3,799	
1992	2,712		488		3,200	
1993		3,045		467		3,512

The consumption of wood and other biomass fuels outside the rural household sector is not considered in most data collection and analysis. The use of biomass energy in most urban cities has quickly declined over the years. However, based on an investigation conducted by the Ministry of Forestry in 1993 (Zhida Zhang *et al*, 1996), urban fuelwood consumption represented 8.8% of the total fuelwood consumed. The figure varies from 56.7% to 1.7% among different provinces. In Inner Mongolia and Jinlin province, urban fuelwood consumption accounted for more than half of the provincial total fuelwood consumption. In the 20 provinces investigated, nine provinces showed that the urban fuelwood consumption presented more than 10% of the provincial total fuelwood consumption, while in another nine provinces, the shares were less than 10%. Data from various sources indicate the increasing use of biomass fuel in the industrial sector. According to the above mentioned investigation, fuelwood consumption in the industrial sector accounted for 7.2% of the total fuelwood consumption of the 20 provinces in 1993.

Biomass Energy Supply in China

Zheng Luo

Biomass is the most widely accessible energy source in the rural areas of China. Crops from various agricultural plants, and wood from forest and non-forest land are the main types of biomass used in China. In 1987, the total amount of potential biomass energy was 13,079 PJ (table 5). The potential crop residues amounted to 590 million tons, i.e. 8,120 PJ, of which 34% was used as fuel in rural households. A certain amount of these residues should be returned to the farm land in order to maintain the carbon balance and the ecosystem of the agriculture land. Since there are no data available regarding the use of agriculture residues, it is difficult to estimate the potential sustainable supply of crops as an energy resource. It was estimated that, due to the limited land area and productivity of agricultural crops, there would be no large increase in the output of agriculture residues. In general, government research indicates that the use of agriculture residues should be maintained at the present level or even cut down (Zhida Zhang *et al,* 1996). At the same time, the utilisation of manure as fuel is rather underdeveloped and has a large potential in husbandry focused regions. From the 180 million tonnes per year of manure supply, less than 1% is used to produce biogas or burned as fuel.

Table 5. Biomass energy supply in China

Year	Crops		Fuelwood		Manure		Total
	Physical amount	In PJ	Physical amount	In PJ	Physical amount	In PJ	In PJ
1979	232	3,277	90	1,508	213	3,219	8,004
1987	594	8,120	141	2,349	179	2,610	13,079
1993			143	2,364			

Based on the results of the Fourth National Forestry Inventory Survey, the forest area in China is 133.7 million ha, of which fuelwood forests represent approximately 4.4 million ha (3.3%). Of the fuelwood forest area, 92% is mainly located in 14 provinces /regions. In China, "fuelwood forest" is one of the 5 types of forest officially classified in China (Huang Yi *et al*, 1998), but is not the only source of fuelwood. Shown in table 6, the theoretical fuelwood production was 143 million tonnes in 1993, of which timber forests had the biggest share, approximately 39%, followed by fuelwood forests and "four-sides" trees accounting for 20.4% and 12.7% of the total, respectively. Because many timber forests, particularly the natural ones, are located in remote areas with very poor transportation facilities, it is not profitable to transport the fuelwood (dead branches, cutting residues, etc.) produced in these forests. According to estimates, this inaccessible fuelwood accounts for more than 50% of the fuelwood production from timber forests, which means out of 143 million tonnes of fuelwood, only 115 million tonnes are actually available as fuelwood sources annually (Zhida Zhang *et al*, 1996).

Surveys on rural energy from the Ministry of Forestry showed that the actual fuelwood consumption in 1993 was 213.4 million tonnes, which has greatly exceeded the sustainable supply as stated above. For many years, fuelwood supply has failed to meet the demand in China. Despite the country's five-year plans to increase annual plantations, the fuelwood forest plantation area has declined in recent years and reached its lowest point with only 150 thousand ha in 1995. Recently, the Chinese government emphasised that establishing fuelwood plantations is the most important strategy with an irreplaceable role in rural energy development. Thus, continuous efforts should be devoted to promote integrated rural energy programmes and plans to seek sustainable development including environmental, economic and social benefits. Various objectives and targets have been set for the next decade, of which some are listed as follows (Zhida Zhang *et al*, 1996):

- Expanding the forest area by the year 2000 (the current total forest area is 133.2 million ha):
  expanding the timber forest area to 99.9 million ha with a net growth of 11.9 million ha; and,
  expanding the fuelwood forest area to 6 million ha with a net growth of 1.6 million ha.
- By the year 2010, net growth of wood land will be 29 million ha.
- Fuelwood production will have a net growth of 29.9 million tonnes by the year 2000 and 43.5 million tonnes by the year 2010, which sum up to 173.2 million tonnes and 216.6 million tonnes in total, respectively.

The analysis of these programmes shows not only that the fuelwood supply and demand gap will decrease from 70 million to 60 million tonnes in the next decade, but also that a gross profit of 3 billion *yuan*/year and many ecological and social benefits will be obtained.

Data sources for table 1-6:

Daxiong Qiu et al, Planning and Implementation of Integrated Rural Energy Development,1991

Feng Liu, Energy Use and Conservation in China's Residential and Commercial Sectors,1993

J. E. Sinton et al, China Energy Databook (CED)

Zhida Zhang et al, Fuelwood Forest Development Strategy in China,1996

Table 6. Fuelwood yield in various forests in China *(unit: million tonnnes)*

Practical Total	Theoretical total	Timber	Protection	Fuelwood	Special purpose	Non-timber					Others
						Cash	Bamboo	Brush	Sparse	Four sides	
143.2	115.2	55.9	3.8	29.1	0.7	10.9	2.6	10.8	10.6	18.3	0.5

Classification of Fuelwood Forests in China

To guide the development of rural energy, a study on the “Classification and Technical Policy of Fuelwood Forests in China” was launched in 1986. The study was carried out in 26 provinces (regions) and a number of studies on fuelwood supply, utilisation and consumption were conducted. One of the major outcomes was a classification of fuelwood forests. The main criteria for such a classification were:

a. the satisfactory level of energy
b. the ratio of fuelwood resources to regional energy resources
c. the ratio of fuelwood in total regional energy consumption
d. the insufficiency of fuelwood supply
e. characteristics of regional resources.

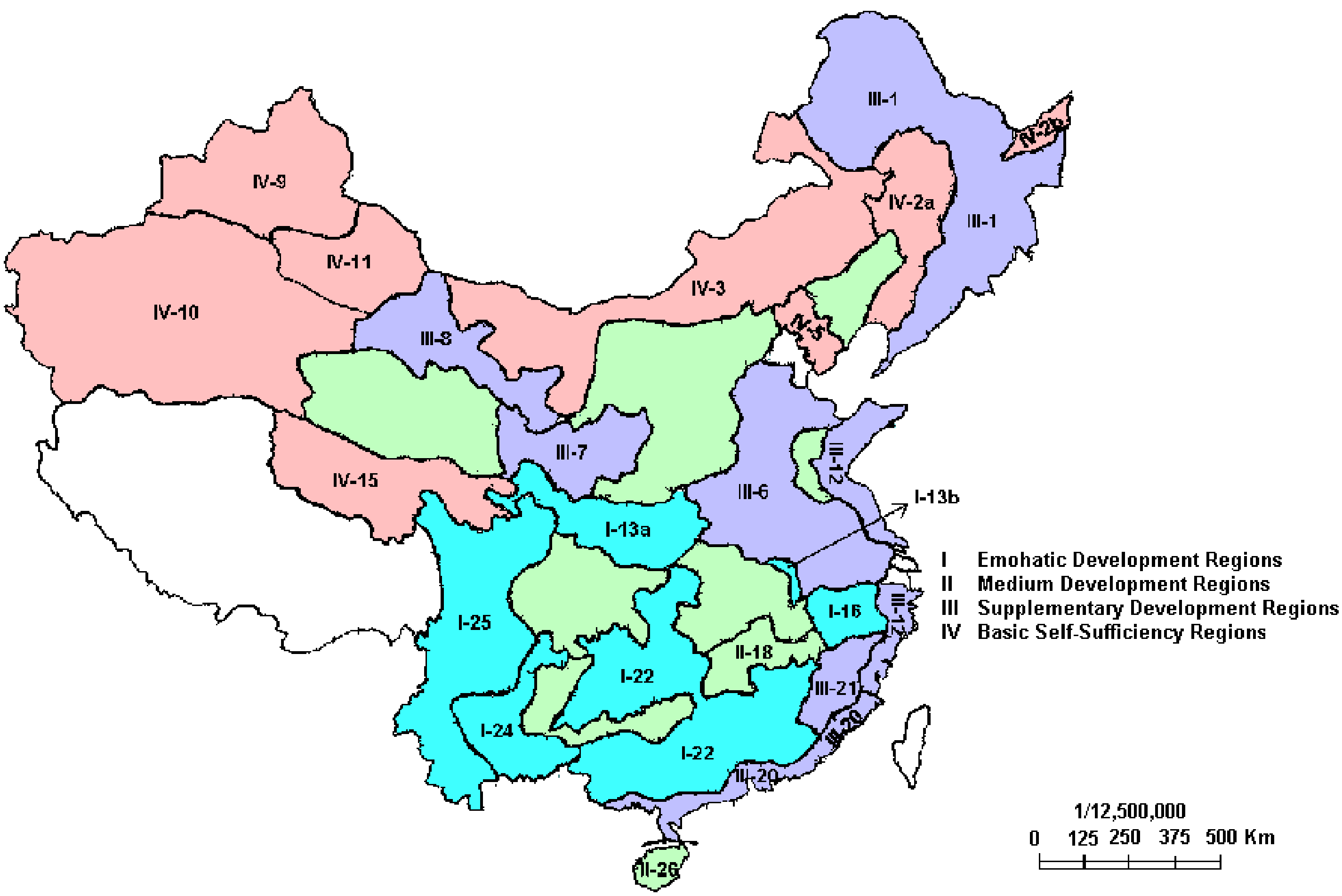
Thus, China’s fuelwood forests, except those in Beijing, Tianjing, Shanghai, Tibet and Taiwan, are divided into 26 regions, which are illustrated in the map. The main characteristics of each region are described in the table. Thereafter, for the rational management of fuelwood forests, these regions are grouped into 4 types according to the estimates and the characteristic value of the insufficiency of fuelwood supply in each district:

I. the regions in need of emphatic development of woodfuel forests

Fuelwood resources are rich in most of these regions and the natural conditions are also suitable for many fuelwood species. However, the regions of this type have a high demand for fuelwood and because of the difficulty in transportation, the high population density and the low stove efficiency, fuelwood shortages are severe. The average fuelwood shortage per capita in the year 2000 will amount to more than 200kgce, the highest among the four types. Thus, the regions of type I have been given the highest priority for fuelwood forestry development.

II. the regions in need of medium development of fuelwood forests

Shown in the rural energy structure, the percentage of fuelwood consumption of these regions is lower than that of the type I regions. In the regions II-4 and II-23, coal is the major energy source, and in region II-14, dung provides more than 60% of the energy consumed. Despite the availability of various energy sources and the relatively rich fuelwood supply in most of these regions, the average shortage of woodfuel will still be approximately 60 kgce per person. Thus woodfuel forests



are still an important factor for the regions' overall energy development.

III. the regions in need of supplementary development of fuelwood forests

Two regions (III-20 and III-12) in this group are located along the east coast, which has the fastest economic growth in China. With their increasing accessibility to fuels higher on the energy ladder, the dependency on woodfuel will become less intensive. Region III-1 hosts one of the largest forest areas in China. In regions III-6, 7 and 8, fuelwood resources account for less than 10% of the total available energy resources. In general, the shortage of fuelwood in the regions of type III will be less than 30kgce per person by the year 2000.

IV. the regions of basic self-sufficiency of fuelwood

In these regions, fuelwood supply is higher than fuelwood consumption. There will be no shortage in the coming years.

This paper was summarised by RWEDP from Reseach on Forest Energy, Shangwu Gao and Wenyuan Ma, 1991

Fuelwood Forests Development in China

Fuelwood forest management has a long history in China. However, rural energy and fuelwood resources have been in short supply for several decades in the country. Since the implementation of the reform and opening policy, the Party's Central Committee and the State Council have issued a series of instructions and policies to resolve the fuel problems in urban and rural areas. It is stated that, "in areas with fuel supply difficulties, fuelwood forest development should be regarded as the first task of tree plantation". To implement such a policy, the Forestry Ministry of China included fuelwood forest development in the national afforestation programme for the Sixth Five-Year Plan period. In the Seventh Five-Year Plan period, pilot projects of fuelwood forest development were implemented in 50 counties nationwide. In the Eighth Five-Year Plan period, even though there was a budget shortage, 50 more counties were added to the project, bringing the total number of fuelwood forest development pilot projects up to 100 countries covering 29 provinces of the country. Thus, fuelwood forest development can be approximately divided into three periods: starting in the Sixth Five-Year Plan period, rapidly developing in the Seventh Five-Year Plan period, and solidifying and improving in the Eighth Five-Year Plan period.

According to official statistics, during 1981-1985, the accumulated fuelwood forest plantation area reached 5 million ha, with 8 provinces reaching 10-100 thousand ha, 14 provinces reaching 100-300 thousand ha, and 5 provinces reaching more than 300 thousand ha. Rapid fuel-wood forest development was found in the provinces of Heilongjiang, Liaoning, Guangdong, Henan, Beijing, Shaanxi, Gansu, Fujian, Sichuan, and Zhejiang.

Achievements

a. Alleviation of the rural energy and fuelwood supply shortage: According to official estimates, the annual biomass output of newly developed fuelwood forests reached 20-25 million tonnes in 1990, about 11.4-14.3 million tce. Hence, the severe shortage of fuelwood, specially in remote and poor areas, has been greatly alleviated.

b. Improvement of the forest structure and protection of forest resources and vegetation: In most cases, broad-leaved brush and tall tree species are chosen for fuelwood forest plantation. This not only improves the forest structure, but also effectively restrains the occurrence and spread of insects and diseases and fire risk. Increased forest quality protected the ground cover and maximised the multiple benefits of forest resources. Because of the use of fuelwood forests, the destruction of other types of forest decreased and the pressure on forest resources has been alleviated. This in turn effectively protected the timber forests, the protective forests and forests for other purposes.

Due to the use of the Chinese language and variations in translation, the forestry terms used may cause some confusion. Some explanations of the terms used in this Wood Energy News are given below:

According to the Forestry Law of China, promulgated in 1984, forests are classified, according to use and functions, into 5 types:

1. **ecological protection forest;**
2. **timber production forest;**
3. **non-timber forest, including bamboo forest, cash forest (the type of forest uses plant leaves, seeds, extracts, etc. as main products, and usually has relatively high economic value. Thus, it is also called economic forest), four-side trees (trees planted around the crop fields, roads and houses), etc.;**
4. **fuelwood forest, of which there are two types: Wood energy forest (Xintan Lin) is defined as a plantation forest of selected fast-growing/high yielding tree species, under intensive management practice from the forestry establishment to harvest; Wood fuel forest means mainly local tree species traditionally used as fuelwood, growing mainly under natural conditions with little management practice. The term fuelwood forest as used in this issue refers to both types;**
5. **forest for other specific uses.**

c. *Promotion of rational use of denuded lands with poor conditions*: Lands with poor conditions and infertile soil are not suitable for timber and cash forests, but many are suitable for the growth of some fuelwood tree species. In China, this has resulted in conservation of soil and water and the acceleration of the process of "greening the land".

d. Enhancement of integrated benefits in improving rural living conditions: From the ecological point of view, the measure of combining multiple species has been adopted in fuelwood forest plantations, which forms a relatively steady eco-system. Fuelwood forests have thick layers of fallen leaves covering the ground, which is good for soil conservation. As leguminous tree species were planted for fuelwood in many places, the quality of soil has been improved and fertilised. Regarding the economic benefit, the development of fuelwood forests in areas with poor land conditions not only solves the fuelwood problem, but also brings about advances in agriculture, animal husbandry, and supplementary industry for the rural economy. Some varieties of tree species such as locust, scabuck-thorn, Prunus armeniaca var. ansu Maxim, Chinese tamarisk, brush willow, shrub lespedeza, and eucalyptus, may serve as honey sources, may be used for eucalyptus oil extraction, for wicker weaving, and for the manufacture of wooden handles to increase local people's incomes.

Experiences

Full awareness and effective organisation: There is considerable awareness of the importance of fuelwood forest development as a basic strategy for sustainable rural development.

Establishment of forest models: During the process of development of fuelwood forests, many typical cases have been used to guide development efforts. The effective technical measures and management experiences from these cases have laid a good foundation for fuelwood forest development in the country.

Combination of fuelwood forest development with key national ecological projects: Since 1978, China has launched several protective forest projects in regions where vegetation has been seriously destroyed and with severe soil erosion and deteriorated ecological environments. Rural energy shortages and destructive forest cutting are, among others, very important causes of these problems. Thus, multiple forest types and tree species, including a certain amount of fuelwood forests, were considered in the protective forest systems. As part of these projects subsidies were provided to facilitate the establishment of fuelwood forest plantations.

Application of various means according to local conditions: Instead of simply planting dedicated fuelwood forests as in the past, other means have also been employed such as closing hillsides for afforestation, improving the forest quality, and changing the original purpose of the plantations, which makes them more suitable to local environmental and economical conditions.

Current Problems

The planned fuelwood forest land area declined in the Eighth Five-Year Plan period. In the Seventh Five-Year Plan period, the minimum annual plantation of fuelwood forest was 340 thousand ha and the maximum 392 thousand ha. While in the first four years of the Eighth Five-Year Plan period, the maximum figure was 312 thousand ha in 1991, this declined every year till the figure was only 101 thousand ha in 1994. Compared with the first four years in the Seventh Five-Year Plan period, the fuelwood forest plantation area decreased 826 thousand ha, about 54.2%. The major reasons for this situation are considered to be the following:

Poor economic benefit: With the reform of the national economic system and the transition to a market economy, fuelwood forest development is facing a new problem. Fuelwood forests could easily be ignored in a market economy because they have a much lower financial benefit compared to timber and cash forests. According to the results of an investigation of a fuelwood forest pilot site in Guangxi, the annually net income of the traditional fuelwood forest was 500 yuan/ha. Even with integrated management, this figure would only reach 1300 yuan/ha. At the same time, 3000-4000/ha can be expected for timber forests, and as high as 7500-15000 yuan/ha for cash forests. Generally, the ratio of net annual income for fuelwood forests, timber forests and cash forests would be 1:2.6:8.5, from which it can be seen that fuelwood forests bring relatively low financial benefits. This directly affects the farmers' fuelwood forest development initiatives.

Lack of investment: In the Eighth Five-Year Plan period, only 950 thousand yuan was forthcoming from the central government to support fuelwood forest development. This is not much even when the local government supplement is added on. Many counties are both poor and inadequate in fuelwood supply. For instance in Guizhou Province, of the 47 counties suffering fuelwood supply shortage, 37 counties, or 78.75%, are on the poor county list.

Lack of awareness of characteristics and functions of fuelwood forests: It is generally believed that fuelwood forests only provide fuelwood. The characteristics of and the ecological and social benefits from fuelwood forests have not been fully recognised. Some people think that the present energy consumption pattern in rural China is just like the situation in many developing countries, and that the users will climb up the fuel ladder as in developed countries which depend on oil, electricity and coal. Actually, it should be realised that developing fuelwood forests is determined by the specific conditions of the country. China has a large population, a vast territory and a large number of rural areas with still weak economic foundations. Coal, oil and electricity resources are unevenly distributed in the country and the transportation system is not well developed. So, it is not realistic to rely only on fossil fuels. Some people think there will be fuelwood available if there are forests, no matter what type of forests there are. This also seriously impedes the development of fuelwood forests. When wood residues fail to meet the demand, farmers will cut trees, and destroy the forests and their vegetation, and cause soil erosion and environmental deterioration.

This paper was summarised by RWEDP from Fuelwood Development Strategy in China, by Zhida Zhang et al, 1996.

Village Biomass Gas Supply System

Li Sun and Zhenzhao Gu

Several demonstration biomass gasification systems were designed, built, tested and put into use in order to develop a new way of producing cooking gas from crop straw and stalks for villages. A type of crop straw gasification unit composed of a down draft gasifier and gas cleaning equipment was also developed. The gas produced from crop straw and stalks was piped to each farmer's house by a distribution network on a scale of 100 to 1000 households.

System

The village biomass gas supply system is shown in Figure 1. Biomass materials such as corn stalks and wheat straw with moisture content below 20% are, after breaking the pellet at a length of 10 to 15 mm, fed into a downdraft gasifier by the screw feeder. The gas produced by the gasifier is filtered to remove the tar and ash dust by being passed through a cyclone, cooler and filter, and its temperature drops to ambient from about 450°C. Afterwards the gas is sent to the gas holder by a fan. The gas holder functions as a balance for the pulsation of consumption and as a manostat with its pressure maintained at a specific value (2000 to 4000 Pa) to overcome the delivery resistance of the network and to provide a steady pressure for the combustion of stoves. The gas from the gas holder is sent into the network of pipelines to be distributed to every household for cooking.

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Crop straw gasification unit

Research, experiments and improvements have been conducted to overcome the disadvantages of the straw and stalks in terms of their physical properties. Two models of crop straw gasification units named XFF-1000 (energy capacity equal to 1000 MJ/h) and XFF-2000 (2000 MJ/h) have been developed. Each unit comprises a downdraft gasifier, a set of gas cleaning equipment (cyclone, cooler, filter, etc.), and a fan. The gasifier is operated under weak negative pressure, that is, a suction operation with the fan placed at the rear of the gasifier. The units produce a low-Btu product gas with the tar and dust content below 100 mg / m^3. The experimental data of the units using four kinds of feed are shown in tables 1 & 2.

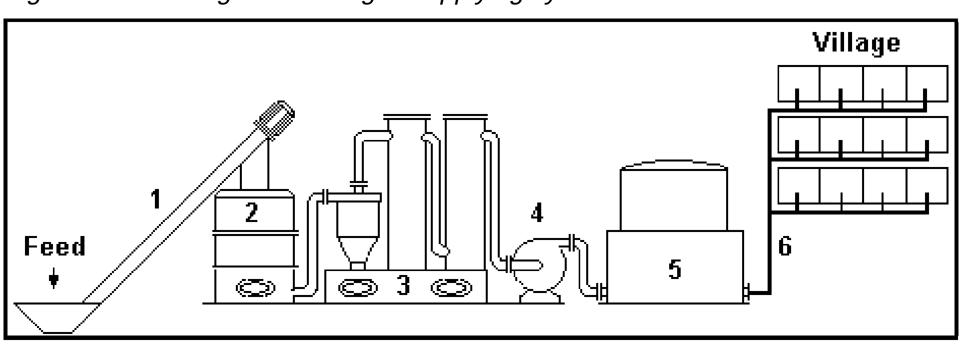
Table 1. Main gas composition and low heat value

Feed	Gas composition, %					Low heat value
	CO_2	O_2	CO	H_2	CH_4	kJ / m^3
Corncob	12.5	1.4	22.5	12.3	2.32	5302.8
Cotton straw	11.6	1.5	22.7	11.5	1.92	5585.2
Corn straw	13.0	1.65	21.4	12.2	1.87	5327.7
Wheat straw	14.0	1.7	17.6	8.5	1.36	3663.5

Table 2. Properties of the nodel-XFF gasification units

	XFF-1000	XFF-2000
Gas output, m^3 / h	200	400
Gas low heat Value, KJ / m^3	5200	5200
Energy output, MJ / h	1000	2000
Conversion efficiency, %	73.92	73.10

Figure 1. The village biomass gas supplying system



1. screw feeder 2. gasifier 3. gas cleaner 4. fan 5. gas holder 6. gas users

Demonstration systems

The first system supplying gas for 94 households was built in October 1994 in Huantai County, Shandong Province. Now over 70 demonstration systems have been built and put into use. Most of the systems are located in the northern provinces of China.

In general, an average family size in the rural area of Shandong Province is 3.82 persons. According to the data derived from the running and testing of the systems, each family consumes about 6 m^3 of the gas with a low heat value of 5.2 MJ/m^3 per day. The efficiency of the gasifier is over 70%, and that of the gas stove is over 50%. So total energy efficiency of the demonstration system is over 35% when using the biomass gas as cooking fuel. That means a family consumes only 3kg of straw for one-day's cooking.

The development prospect

In China's rural areas the largest biomass resource available for energy is composed of all kinds of agricultural residues, especially the crop straws and stalks, the so-called "soft firewood". Approximately 600 million tons of straws and stalks are produced annually. At each harvesting season, the farmers burn the excessive straws in the field directly. This not only wastes the resource but also leads to air pollution. In contrast to this, the supply of commercial energy in rural areas such as liquefied gas is in short supply and expensive.

As a consequence of the rapid development of China's agricultural economy and increases in farmers' incomes, the living and housing conditions in rural areas have improved greatly. Getting rid of the strenuous, time-consuming and smoky cooking method traditionally used for many years is high on farmers' agendas. There are over 100 million villages in China. The renewability of biomass resources and the strong desire of farmers to improve their way of cooking indicate excellent prospects for this biomass gasification technology.

Fuel-saving Stoves in China

Mengjie Wang and Yi Ding

Background

The thousand-year-old tree exhumed from the upper reaches of the Yellow River demonstrates that the river did not contain the huge amount of sand in ancient times, as it contains today. The Yangtze River, unfortunately, is turning yellow as a result of the deforestation in its upper reaches. The 1998 flood in China was not only a natural disaster but also a natural punishment for destroying the ecological environment. Forest resources are a source of the wealth that nature endows to human beings. However, unplanned logging and over-utilisation for fuel dramatically diminish the resources and results in disaster.

In China, the development of fuel-saving stoves plays an important role in the rational exploitation and utilisation of wood energy resources, and has made a great contribution to the conservation of forest resources..

Government Policy

In the rural areas of China, the shortage of fuelwood is serious. Since the 1980s, the government has paid much attention to rural energy construction by adopting the following principle: "To work according to local conditions; to supplement different kind of energy with each other; to use an integrated energy system; to seek the maximum benefits". Many kinds of technologies have been applied and many problems have been solved. Up to now, however, rural people still face energy supply shortages. According to the 1992 statistics, the total energy consumption in the rural areas was 560 million tce, in which 230 million tce was from such biomass energy resources as firewood and straw. It is obvious that wood energy still plays a major role in energy consumption.

The Chinese government initiated its rural energy program around 1980. At that time, equal attention was given to exploitation and energy saving, with energy saving as the starting point. In rural areas, the dissemination of fuel-saving stoves was systematically carried out, including planning, administration, financing, manufacturing technology and extension. Over the past four decades the State Council has issued numerous Orders and decisions which have significantly promoted the conservation of rural energy resources and the development of the forestry industry. Moreover, a series of the State Council and ministerial documents, has emphasised the significance of exploitation and protection of forest resources and the dissemination of fuel-saving stoves. State leaders have also given important speeches encouraging the protection of forest resources and the dissemination of fuel-saving stoves. They have pointed out that: 1. Forest resources should be rationally exploited and strictly conserved. 2. An overall scientific plan should be applied in the exploitation of forest resources. 3. Forest resources should be rigorously managed; unplanned logging should be forbidden. 4. Saving should be emphasised in wood utilisation and dissemination of fuel-saving stoves should be stepped up. Under the instructions of the central government, the local governments at different levels have actively implemented the fuel-saving stoves program.

On the basis of the State Energy Saving Law, the State Council issued the Provisional Regulations on Energy Saving in 1986 and an energy saving program was included in the National Economic Development Plan. Relevant government departments provided special funds which meant an administrative and financial guarantee for the dissemination of fuel-saving stoves.

Technical Process

Special administrative offices were set up at every level from the central government to county government to manage the fuel-saving affairs. Even at

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the village level, technical service groups are normally established. Technological exchange meetings on the dissemination of fuel-saving stoves were held at every level in the country. During the 5th conference of the Fifth People's Congress in 1982, the task of fuel-saving stoves dissemination was explicitly put forward in the 6th National Economic Development Plan, which aimed to disseminate such stoves to 25 million households during the five-year plan period. By reaching the goal, 1/7 of the total rural households would be able to use fuel-saving stoves. In 1984, a conference on the dissemination of fuel-saving stoves in rural area was held in Beijing, and the Premier attended and gave a speech. The conference summarised the experience drawn from the 79 demonstration counties for dissemination of fuel-saving stoves that were established in 1983, and it was decided to add 100 demonstration counties per year. The national conference on fuel saving experience exchange was jointly held by the State Planning Commission, the Agriculture Commission, the Ministry of Agriculture, the Ministry of Commerce, during which high-efficiency fuel-saving stoves were exhibited and tested.

The government provided special funds to support and organise research institutes to design efficient and applicable advanced fuel-saving stoves. The many colleges and research institutes, which participated with the Chinese Academy of Agricultural Engineering as the major force, provided more than thirty types of fuel-saving stoves suitable for different regions, different fuel types and different social customs. The institutes compiled drawings and technical materials for stoves as technical service. Besides, many fuel-saving stove manufacturers were established under the technological instruction of the institutes. Thus, fuel-saving stove products were standardised and commercialised. The performance of the commercial fuel-saving stove is good, with a thermal efficiency of 25%-30%. The key technology for stove modification is the scientific design of the combustion chamber. The accessories, such as the grate, door, chimney must be compatible with the design of the combustion chamber, and rational heating of the cooker must also be considered. The goal of design is to achieve the maximum comprehensive effectiveness.

To meet the required stove quality, a quality guarantee system was established. The Ministry of Agriculture set up a national centre for quality supervision and testing of fuel-saving stoves, the State Technology Supervision Bureau issued the Test Standards and Test Methods, such as the national standard: GB4363-84 (GB: Chinese National Standard) and the test methods for thermal performance of household firewood stoves: GB5186-85. The test method for the thermal value of biomass fuel was implemented, replacing the traditional "three-ten" method: 10 jin (5 kg) of water heated by 10 liang (0.5 kg) of firewood for 10 minutes.

To assist the dissemination, technical training courses, itinerant technical services and itinerant inspections were organised at state, province and county. To promote and educate on the dissemination of fuel-saving stoves, exhibitions and appraisals of fuel-saving stoves were held, and newspaper articles were published.

Achievements

In the 6th National Economic Development Plan, the state identified the goal of disseminating of 25 million fuel-saving stoves in 5 years. The accompanying table shows the healthy development of the dissemination. However, the situation of stove replacement is not acknowledged.

Dissemination of fuel-saving stoves in rural China (unit: million household)

Year	Incremental	At the end of the year
1985		40.00
986	18.40	65.88
1987	18.03	83.73
1988	17.49	99.16
1989	17.00	114.00
1990	17.18	128.90
1991	15.10	138.50
1992	14.50	14900
1993	13.00	157.00
1995		170.00
1997		180.00

By the end of 1997, there were 180 million rural households who were using or had used fuel-saving stoves. The dissemination of fuel-saving stoves has developed into a commercial venture. At present the dissemination of fuel-saving stoves is focusing on remote and poor rural areas.

Because of the nationwide effort of firewood saving and energy saving in rural areas, the shortage of forest resources for household energy consumption in rural areas was mitigated. Meanwhile, a large amount of agricultural residues was saved, which could lead to the problem of burning straw on the fields becoming very serious. China is now seeking scientific and rational means to resolve the problem of agricultural residues. We hope to carry out extensive international cooperation in this field.

For many years, FAO, ESCAP, UNDP, World Bank and many countries have had close cooperation with China. It is clear that the international organisations and countries along with China will obtain significant benefits from the research on and the dissemination of fuel-saving stoves and from the exploitation and utilisation of biomass energy resources.

Gender and Wood Energy in Yunnan Province

In Yunnan Province, strategies and programmes on rural energy, which include wood/biomass energy at the provincial and county level, have been assigned to engineering-based units, which do not specialise on socio-cultural aspects. At the same time, extensive knowledge of ethnic minorities and the gender aspects of household energy is available from systematic research. Such knowledge would be most relevant for rural energy strategies and programmes. However, this source of expertise has not yet being fully tapped by the provincial energy authorities.

Kunming workshop

As part of RWEDP's effort to address gender issues and as a follow-up of the Regional Expert Consultation on "Gender and Wood Energy in Asia", a national workshop took place on 27-29 April 1998. It was organised by the Institute of Ethnology of the Yunan Academy of Social Sciences, with financial and technical assistance from RWEDP. The workshop focused on wood energy and gender issues in Southwest China. The participants were delegates from different provinces and regions and various ethnic groups, as well as local experts who have been working with energy programmes for years in Yunnan Province. Through this workshop, RWEDP brought relevant engineering and social science experts together, and explored their interest in benefiting from each other's work and co-operating in wood energy development.

There were 11 papers presented during the workshop regarding the general situation of wood energy in Southwest China, minority women's involvement in rural energy development and gender impact in energy transitions, etc. A field trip to Tuanji Township, Xishan District of Kunming was a welcome experience for participants. The township was "famous" for its poverty. Through planting trees and introducing 300 micro bio-gas plants, they not only rehabilitated the damaged ecosystem, but also improved their energy situation and reduced the work load of women.

Summary of some main points

Wood energy and women: Traditional energy, specially firewood, is the main energy source in this part of the world. In some areas, people have to fully depend on firewood every day for lighting, cooking, heating, etc. Thus, it is no surprise that firewood is placed first on the household list. In Yunnan province alone, the annual consumption of forest products is about 49 million cubic meters, among which firewood for rural households accounts for more than 54%. Firewood collection is mainly done by women while men, in some cases, will contribute by cutting wood. A man guiding a horse followed by a woman carrying firewood on her back is a scene often seen in these areas. With the population growth, the forest resources are decreasing and women are forced to spend more time and travel longer distance for gathering firewood. Meanwhile, there are health problems caused by low stove efficiency. Moreover, with the development of a market economy, many men go outside their villages for better paid work. Hence, besides all the house work, most farming activities have also fallen upon women.

It was because of the above circumstances, and the willingness to improve their own lives and social positions, women in these regions initiated various actions and programmes in tree plantation and energy utilisation.

Means adopted for energy development and achievements: a. establishment of firewood forest; b. promotion of fuel saving stoves; c. promotion of the method of raising pigs with raw feed; d. promotion of small and portable fire places; e. multiple use of heating; f. utilisation of biogas; g. utilisation of solar energy.

In most areas, the stove efficiency has improved from 10% to 25%, which reduces firewood consumption by 50%. A five-person family could save 40 days in firewood collection due to local forest recovery and reduced firewood demand. Besides the significant economic benefits, this has also brought tremendous social benefits to women. They are not only being released from heavy work and gaining more free time, but also have contributed and realised their political value in the development of their own society.

RWEDP

Women in Energy Reform - A Midu County Case Study

The total land area of Midu county is about 1523 km sq. The valley area accounts for 8.66%, and the remaining 91.34% is mountainous area. 98% of the total population, which was 295,095 in 1995, live in rural areas, and agriculture production accounts for 93.9% of total production value (1996). The eco-system is suitable for agricultural production in terms of climate, temperature, moisture, light and soil fertility condition.

In the 1980s, natural disasters frequently visited the county. A huge flood in 1986 destroyed 51% of rice fields, and a great deal of infrastructure. Direct loss amounted to 33.6 million *yuan* RMB and Midu county joined the forty counties classified as "poor".

Deforestation is the main cause of the degradation of the ecological system. The forest cover in the early 1950s was 51%. This reduced to 19.7% in 1978. The main causes of deforestation are the conversion of forest land to agricultural land, logging, and firewood consumption. Firewood consumption accounts for over 70% of the total amount of forest consumption in the county. The total consumption of firewood is about 423,400 tonnes/year. This means that 7056 ha of forest is burned each year which is five times the area afforested each year in the county. The county government's policy is to recover the forest by closing it and banning any kind of forest use. However, the policy can not stop the rural people, especially the poor, using the forest for their livelihood purposes.

Women and energy

In Midu, women are traditional housewives. Women have to work longer and harder than men to fulfil all of their domestic responsibilities as well as to contribute to agricultural production. Over-extracting wood fuel resources has resulted in harder and harder work for women. Women often have to travel some 10-20 km to collect one bundle of firewood that can only meet the need of one or two days. Many girls have stopped schooling to help their mothers collect fuel. The local stove is also called the ‘tiger stove’, which indicates that it is not only always “hungrily” consuming firewood, but also consuming the time, energy and health of the women.

After the great flood, the director of Midu Women’s Federation (MWF), Ms. Hou Zhaofang, decided to change the fate of Midu women as well as the fate of the forest. She made a request to the county government that the newly established county’s Rural Energy Office (REO) should be under the MWF’s control and the MWF would take the responsibility for the energy reform programme. After her request was approved, Ms. Hou considered the problems of Midu county in terms of three basic points: 1. Midu is an agricultural county, which depends on a sound ecological system. Therefore the forest must be rehabilitated. 2. Midu women make up half of the population and undertake 70% of the agricultural production tasks. As a main-force in economic development they must change their traditional lifestyle and free themselves from some of their domestic burdens. 3. Midu is rich in coal resources, which can be developed for local consumption. The coal energy resource and energy efficient stove should be employed along with the afforestation programmes to help the rehabilitation of the forests.

The first thing Ms. Hou thought of was to set up a pilot project with only 1500 *yuan* funding. The mountainous Mizhi district was chosen as a pilot area because it is an important water catchment area of a big reservoir which can irrigate 80% of the rice fields in the county. Mizhi is also rich in coal resources which have not been developed yet for household consumption. Ms. Hou and staff of MWF and REO together with an experienced technician visited villages and set up a number of energy saving stoves for demonstration in the houses of village heads, the houses of women committee members and some volunteer demonstration households. Villager’s assemblies and women’s group meetings were organised in each village to introduce the benefits of using energy saving stoves with practical demonstrations. To access new energy technology, to change their traditional life style and to be free from the drudgery of firewood collection have been women’s wishes for a long time. The majority of village women therefore became actively involved in the energy reform program. By the end of the first year, the MWF achieved great success: 70% of households in Mizhi district began to use energy saving stoves. At the same time a new method of pig feeding was also introduced to villagers. The old time-consuming method of cooking pig feed was changed to a no cooking or short time cooking. The improved stoves and new pig feeding method reduced firewood consumption of each household by about 50%.

After the first year’s success, in 1989, the MWF decided to promote the energy saving stove on a county-wide scale. The MWF formulated policies and planned a programme for the whole county’s energy reform. Several documents on promotion policies and regulations were issued. These documents also obtained the county government’s approval and were distributed as official government documents to be implemented. Due to their previous success, MWF gained support and funds from various groups. Within a year, the MWF teams visited 88 Administration Villages (sub-districts), covered about 600 villages, and held 358 training classes. 100,241 people or 1/3 of the population, mostly women, participated in the training courses. This is the first time in the county’s history that so many people participated in such a project. By the end of the second year, the energy saving stoves had been installed in 80% of households in the county. In the following years, the MWF signed an agreement with the Environment Protection and Energy Department of the Ministry of Agriculture to make the county a National Wood and Coal Energy Saving Pilot County. The Agreement set high requirements and standards for rural energy reform.

In 1994, the county witnessed rainfall greater than it experienced in 1986, but no serious damages were reported. The forestry survey showed that the forest cover reached 41% and the forest ecosystem was significantly improved. The MWF has also realised that the multiple and sustainable use of various resources will be the basis of energy development in the future. After the forest is rehabilitated, the sustainable use of wood fuel and other biomass may replace some of the coal energy. Biogas is also one of the best solutions for rural households for many reasons. Micro-hydropower will be developed. Solar energy water heating devices will be introduced to rural families. In 1995, an agreement with provincial government was signed to promote biogas in rural households.

Gender impact

- Improving the working, cooking and health conditions of women
- Challenging traditional patriarchal ideology and raising women’s social position
- Improving women’s environmental awareness, technological skills and resource utilisation
- Changing the traditional gender division of labour. Thus women can now spend more time on productive work and income generation activities
- Gaining women’s participation and empowering them in decision making
- Realising women’s significance in achieving economic and ecological benefits for the whole society.

This paper was summarised by RWEDP from Women in Energy Reform Programme - A Midu County Case Study, by Xiaogang Yu and Zhaofang Hou.

Wood Energy Planning in China - A Case Study

Conrado S. Heruela

China is the first country in which RWEDP is assisting a multi-level case study on wood energy planning. The case study for China includes a national-level study for the country, a provincial-level study for Yunnan province and a county-level study for Chengjiang County of the province. At the national level, the case study is looking into the integration of wood energy to national level rural energy planning exercises being conducted by the Ministry of Agriculture (MOA) through its Institute of Energy and Environmental Protection (IEEP). At the provincial level, the case study is looking into the integration of wood energy to provincial rural energy planning exercises conducted by the Provincial Rural Energy Office under the supervision of IEEP. Finally, county-level area-based wood energy planning exercises are being conducted by the Provincial Rural Energy Office in cooperation with the County-Level Rural Energy Office and under the technical guidance of IEEP.

The activities of the case study can be divided into four overlapping phases as follows: (1) collection and compilation of data needed for the case study; (2) processing and analysis of data using the LEAP model; (3) application of the LEAP model to conduct wood energy planning exercises and to analyse and formulate programs, strategies and policies for wood energy development; and (4) identification of follow-up activities to strengthen national capabilities in wood energy planning, including building of institutional capacities.

The case study started in February 1998 when a tutorial on the application of LEAP was conducted for the case study team members. Since then the study team, led by IEEP has:

1. established a technical network and working groups at the national, provincial and county levels;
2. conducted the collection and analysis of data on the supply and demand for wood energy using mainly secondary data collection techniques but also including selected primary data collection methods (Data collection and analysis were done at the national, provincial and county levels);
3. generated practical experiences in the application of the LEAP planning model, particularly in the analysis and projection of energy demand focusing on wood energy, the analysis of wood energy conversion and transformation processes, and the analysis and projection of wood and biomass energy supply.

China has accumulated substantial information, obtained valuable experiences and achieved significant progress in rural energy planning. Despite this, the initial results of the case study indicate that appropriate wood energy information to allow proper wood energy planning is still inadequate. As such, the case study on wood energy planning is providing IEEP key inputs on how wood energy planning can be further strengthened as part of the country's overall rural energy planning process.

The case study is targeted for completion by the middle of 1999. Hopefully, the case study will provide the formulation and implementation of a strategic program for the sustainable supply and use of wood energy in China, so as to contribute to fueling China's efforts towards development and the modernization of its economy.

Wood Energy and the Global Environment in China

Zheng Luo

China doubled its energy consumption during the period 1980-1994 (J.E. Sinton et al, 1996). It is expected that with the current economic growth energy consumption will continuously increase despite the improvement in energy efficiency. An increasing amount of research has contributed to the analysis of emissions from energy use in China, their environmental impacts, and various projections for emission reduction. However, few studies have integrated wood energy, which represents about 8% of the country's total energy consumption and nearly 20% of the total rural energy consumption. This paper highlights the potential of wood energy use in terms of CO_2, SO_2, etc. emission abatement in China, and aims to promote interest in further research and analysis of policy options.

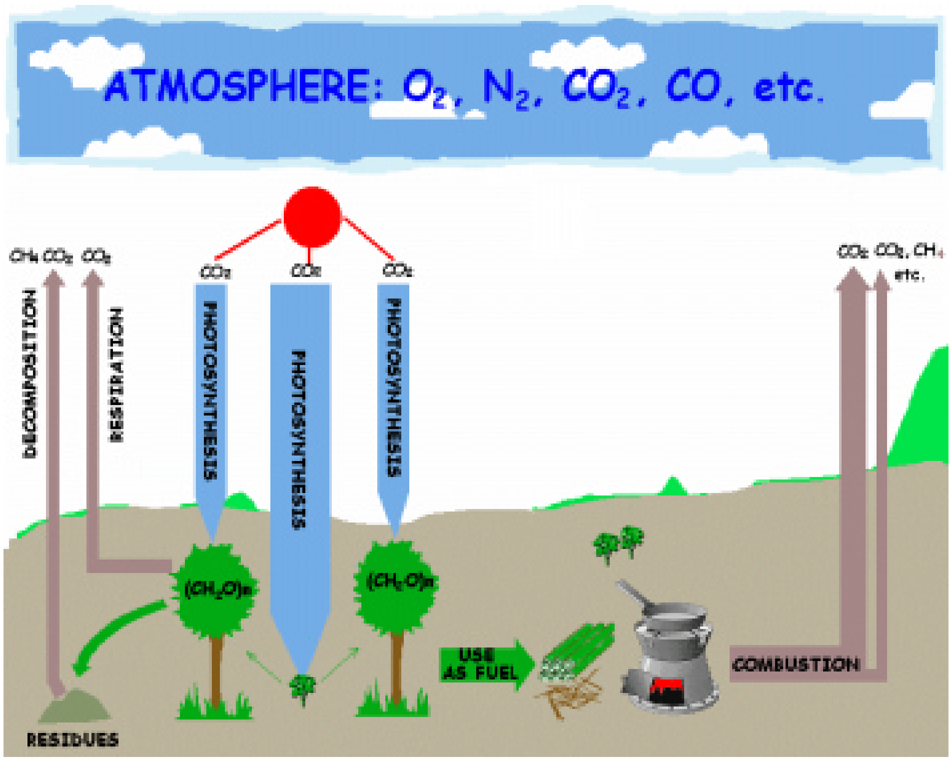
Table 1. Estimated carbon dioxide emission in China, 1990-2015 (Unit: million tonnes of carbon)

Year	Coal	Oil	Natural gas	China total	World total
1990	527	100	8	635	6165
1993	598	134	8	741	6071
2005	957	256	30	1222	7854
2015	1400	354	46	1807	9503

Source: DOE/EIA and OECD data tables, http://www.geocities.com/~combusem

Emissions from fossil fuels

Worldwide, fossil fuel are the main source of emissions, such as CO_2 and SO_2. In China, the heavy reliance on coal and the low energy efficiency aggravate these emissions. It is reported that in 1993 China's CO_2 emission carried 741 million tonnes of carbon, approximately 12% of the world total. (EIA, 1993) The breakdown of carbon emission, presented in table 1, shows that 81% of the emission originated from coal while oil and natural



gas represent 18% and 1% respectively. Historical data, given by various sources, indicate that CO_2 emission has increased by 67% since 1980. It is expected that such emission will continuously increase, and by the year 2015 China will be responsible for 19% of the total CO_2 emission in the world. Fossil fuel use, especially coal, also emits a large amount of SO_2 and particulates, which have been the major air pollutants and causes of various diseases in China for decades. In 1993, the SO_2 emission was 18 million tonnes, which was an increase of about 13% compared to 1980 (J.E. Sinton et al, 1996).

Although the current adoption of modern technologies has contributed greatly to reducing these emissions, the use of fossil fuels still causes various problems, such as resource depletion and air pollution. China's coal and oil reserves are mostly concentrated in the northern part of the country. The transportation of coal has heavily occupied the railway system in China and is demanding large investment in infrastructure to cope with the economic growth.

Emissions from fuelwood

Photosynthesis of trees is the most natural way to store solar energy, and planting trees is one of the few truly effective ways of mitigating climate change, including the greenhouse effect. In order to analyse the GHG emission from woodfuels, a simplified carbon cycle of trees is illustrated in the accompanying figure. By their nature, trees absorb CO_2 and store it as $(CH_2O)_n$. In its early life, a tree has greater capability to absorb CO_2, which helps it to grow. For an adult tree, the absorption of carbon is roughly equal to the total release of carbon via respiration and residue decomposition. The eventual decomposition of tree residues emits not only CO_2, but also other chemicals containing carbon, such as CH_4.

When trees are used as fuel, the combustion produces carbon emissions, but as long as trees are planted or naturally reproduce at the same rate as they are burnt, the carbon level, in principle, is kept in balance assuming that combustion is complete. Incomplete combustion of woodfuel, like all other type of fuels, does not only result in emission of CO_2, but also other GHGs, such as CH_4, N_2O, CO and other Non-Methane Hydrocarbons (NMHC), which can not be absorbed by trees. If a wood stove with 90% nominal combustion efficiency (30% of overall efficiency) is used, about 450g carbon/kg of dry woodfuel is emitted as CO_2 and 50 g of carbon is emitted as CH_4, NMHC, etc (dry woodfuel mostly contains 50% carbon). CH_4, NMHC, etc. have a much greater potential to contribute to global warming than CO_2. Although their warming effect will reduce over time, the potential can still be significant even in 100 years. Thus, when low efficiency stoves are used, the non-CO_2 emissions become the main concern for global warming in the case of woodfuel.

Reference data A - emission factors from IPCC

	CO2	CH4	CO
Woodfuel	30,000 kg C/TJ	300 kg/TJ i.e. 233 kg C/TJ	5000 kg/TJ i.e. 2,333 (kg C/TJ)
Coal	25,500 kg C/TJ	300 kg/TJ i.e. 233 kg C/TJ	2000 kg/TJ i.e. 933 (kg C/TJ)

Reference data B - emission factors from Zhang, Smith, et al, 1997

	CO2	CH4	CO	TNMHC
Improved fire wood brick stove with a flue	446g C /kg dry fuel i.e. 30,000 kg C /TJ	2.6g C /kg dry fuel i.e. 173 kg C /TJ	30g C /kg dry fuel i.e. 2000 kg C /TJ	5g C /kg dry fuel i.e. 333 kg C /TJ
Washed coal metal stove with a flue	624g C /kg dry fuel i.e. 30,400 kg C /TJ	10g C /kg dry fuel i.e. 490 kg C /TJ	37g C /kg dry fuel i.e. 1800 kg C /TJ	2g C /kg dry fuel i.e. 97 kg C /TJ

Woodfuel and CO_2 abatement

The carbon cycle indicates that even if fuelwood is harvested under sustainable conditions, woodfuel use will still have a net warming effect due to the low combustion efficiency of the most widely used stoves in China. This raises two main questions: Will woodfuel use actually benefit net carbon emission reduction? What is the saving potential of fuelwood? There is not enough data to give a detailed analysis for China. From the available literature, two data sources are used for the following analysis which aims to quantify the answers to these questions.

The first data used are derived from *IPCC Guidelines for National Greenhouse Gas Inventories,* which presents a systematic model to estimate all energy related emissions. Because of the variation in fuel emission factors for different end-uses, the analysis presented will only focus on the residential sector. Furthermore, the calculation has been largely simplified by using default emission factors and neglecting all other influences (and assuming that fuelwood use is sustainable):

EMISSIONc = total consumption X
(c: coal) emission factor
EMISSIONw = total consumption X
(w: woodfuel) emission factor
- CO_2 emission

The other data used is based on a research report, *Greenhouse Gases from Cookstoves in Developing Countries: Preliminary Emission Factors*. (Zhang, Smith, et al, 1997) Two type of stoves, one using fuelwood and the other one using coal as fuel, were selected for the analysis in this paper. Other general data used:

- Net calorific values of hard coal for China: 20.5 TJ/ktonne
- Net calorific values of wood: 15 TJ/ktonne

The global warming potential (GWP) in comparison with CO_2 in 20 years:

1 g C of CH_4 = 22 g C of CO_2
1 g C of CO = 4.5 g C of CO_2
1 g C of TNMHC = 12 g C of CO_2

Thus, if woodfuel is used under sustainable conditions, and fugitive emissions from coal mining and production are not taken into account, the emissions can be calculated as:
for data A:

net EMISSIONw, CO_2 equivalent =15.6 tonne C/TJ
net EMISSIONc, CO_2 equivalent = 34.8 tonne C /TJ

which means, 1 TJ of energy from woodfuel emits 19 tonnes less carbon then from coal in China.
for data B:

net EMISSIONw, CO_2 equivalent = 16.8 tonne C /TJ
net EMISSIONc, CO_2 equivalent = 50.5 tonne C /TJ

which indicates that the woodfuel stove generates 34 tonnes less carbon emission then the coal stove in delivering 1 TJ of energy.

In 1993, fuelwood consumption in Chinese households was approximately 3500 PJ, which is 9% of the total energy consumption (Zhida Zhang, 1996). According to the above analysis, and assuming that woodfuel use is sustainable in China, then 66 million tonnes carbon has been avoided, which was 9% of the year's total emission. If the share of woodfuel is kept at 9% of the total energy consumption in the year 2000, when the total energy consumption is estimated to be 41,600PJ (3% annual increase from 33,800PJ in 1993, IEA, 1993-4), the avoided carbon emission will be 71 million tonnes. (If the woodfuel share increases to 12%, the level of 1987, the avoided carbon emission will be 87 million tonnes from woodfuel in the year 2000.) If 50% of China's households coal use, i.e. 3200 PJ in 1993, will be replaced by woodfuel using the stoves described in the analysis in the year 2000, 54 million tonnes of carbon emission can be avoided.

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Health and Wealth, No Regrets

Zheng Luo

Several countries have recognised the importance of woodfuel and have integrated woodfuel into their energy planning. However, due to the lack of quantitative information, the actual economic, social and environmental benefits of woodfuel have not yet been fully taken into account in policy making. By reviewing current research, this paper aims to highlight the importance of woodfuel in sustainable energy development for policy makers and planners.

Woodfuel for millions

Woodfuel accounts for an average 30% of the energy consumed in RWEDP member-countries (in China, woodfuel accounts for 20% of the rural energy consumption), and the consumption is

Developing poor and arid land

into green hills and clean water

increasing by 1.6% per annum. Millions of people in these countries depend on biomass and woodfuel for their daily cooking and heating.

Woodfuel shortages are common and are often. Degraded landscapes, and scenes like arid land with few trees, and women and children cooking their meal in a smoky hut, etc. have often been associated with woodfuel. However, the causes of poor and arid land are always more complicated than just over-exploitation for fuelwood .

In many of these areas, the only feasible and affordable fuel source is wood. Sustainable management and utilisation of woodfuel resources has proven to be the key. Programmes for improved stoves and planting more trees have been undertaken, and great benefits in easing fuel shortages and reducing indoor air pollution have been achieved. Furthermore, long-term benefits from woodfuel development have also been gradually realised.

Woodfuel for health and environment

The smoke from fuel burning is the main source of indoor air pollution, which is an important risk factor for various respiratory diseases, cancer, adverse pregnancy outcomes, etc. Not even mentioning the human suffering, it is very difficult to quantify the cost of these diseases, and even more difficult to estimate the benefits which can be gained from using improved stoves in medical and economic terms. The Chinese programme on improved cookstoves, which has reached about 150 million households, claimed 100 million tonnes woodfuel equivalent savings annually. It also has avoided health hazardous emissions from woodfuel, e.g. Non-Methane Hydro-carbons (NMHC) and Respirable Suspended Particulates (RSP), by saving 16% of rural household woodfuel and coal use each year. This probably is the most effective way in the battle against indoor air pollution.

Improved Biomass Stoves (IBS):
a story from Huangpi County, Hubei, China

Before:

- **Only 24,000 ha of trees left of 68,7000 ha planted because of biofuel gathering and poor management**
- **Nicshu River accumulated much silt due to erosion, partly caused by farmers digging tree roots and cutting grass stubs.**
- **Because crop residues were burned, soil degraded such that 35% of the arable land had less than 2% organic matter in 1983.**

After (IBS started in 1983):

- **Rate of ophthalmological and respiratory diseases reduced by more than 30% and 20% respectively**
- **County forest cover increased from 14.7% to 17.6%**
- **Average organic content of soil increased by 1.16%**
- **Saved crop residues used to create 100,000 yuan of woven products in 103 households**
- **Saved crop residues used to start mushroom production and increase value in other agricultural products. Part of the "courtyard economy"**

- K. Smith, et. al , 1993

Besides NMHC and RSP, woodfuel combustion emits CO_2, CH_4 and CO. Although the mechanism is not yet fully understood, it is believed that these emissions have a global warming effect and consequently, among others, have adverse health impact on human beings. While reducing the indoor air pollutants by promoting improved stoves, GHGs emissions can also be decreased (see Woodfuel and the Global Environment in China). Moreover, woodfuel combustion, in comparison with coal, has little SOx emission, which is one of the main causes of acid rain. By reducing acid rain, the benefits of woodfuel can be broadened in terms of ecological balance and biodiversity.

Trees are essential in the natural environment. They prevent soil erosion and floods, fertilise soil, etc. Forests play a crucial role in the carbon cycle and planting trees is one of the effective ways against climate change. In the every day life of millions of people in Asia, woodfuel is needed, no matter if the tree is replanted or not. Thus, forest plantation and utilisation will not only provide fuel, but also improve an arid landscape.

Woodfuel for wealth

It has been wrongly said that woodfuel has no value and thus no business. In fact the total value of woodfuel in RWEDP countries amounts to US$30 billion per annum. Numerous people make their living out of woodfuel. Even more people in small businesses and farms depend on wood as a fuel for their business. For them, woodfuel brings income and wealth.

Through agroforestry, energy and agriculture can be integrated. In China, this has proved to be a fruitful approach which provides not only local energy but also an increased agricultural harvest. People need not to go miles away to collect fuelwood, so time can be saved and heavy work can be avoided, specially for women. They can now spend more time working in the field and producing local handcrafts for sale, and some can even find jobs in the local factories. As a result family incomes can be increased.

By improving stove efficiency, unpleasant smoke is reduced in the home, thus people will have a better living environment. By planting trees, the land becomes greener and richer, which probably is the greatest wealth.

From the facts stated above, it is obvious that woodfuel development will not only benefit the energy and forestry sectors, but also play an important role in health, the environment and overall sustainable development. This implies that, for example, policies on health improvement can adopt stove programmes as one of the measures against indoor air pollution. As mentioned before, there is not enough data to quantify the benefits from woodfuel, as many social and environmental benefits are difficult to value. However, studies and research have convincingly shown that sustainable woodfuel development is economic, and in the long-term significantly contributes to the well-being of people and nature, which will be valued for generations.

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Integrated Rural Energy Development at County Level in China

Xiangjun Yao

China has the largest population in the world. More than 917 million people live in 230 million households in rural areas, which accounts for 76.2% of the total national population. Therefore, rural energy development impacts not only the development of the rural economy and the improvement of rural people's life, but also the national macro economic development. In order to alleviate the energy supply shortage, to improve energy use efficiency in rural areas, and to reduce the environmental impact of excessive energy consumption, a "Hundred County" Integrated Rural Energy Development Program (IRED) was started in the early 80's and was extended rapidly to cover most of the nation in the early 90's. Up till now, over 300 counties have been involved in the program.

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The aims of Integrated rural energy development at county level are to comprehensively develop various energy resources available locally and to solve the energy problem in the whole county to achieve the harmonious development of economy, environment and society. The planning and implementation of IRED at county level is based on an evaluation of

Figure 1. Rural energy development structure

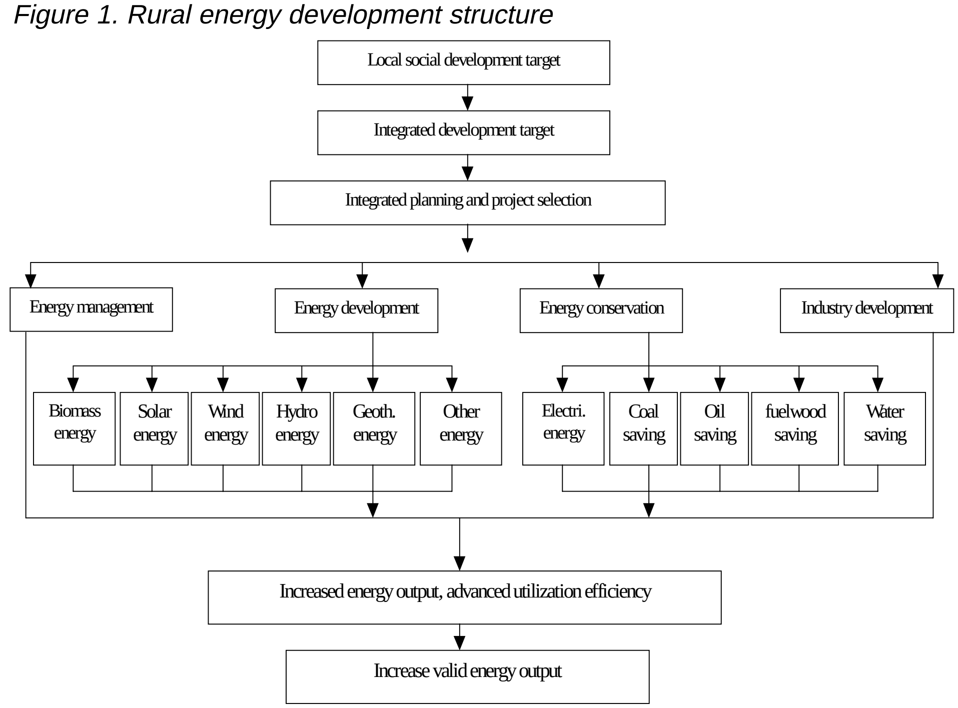


Table 1. Changes of rural energy consumption (Unit: million TCE)

Year	Sector	Fuelwood	Straw	Coal	Oil product	Electricity	Total
1979	Total	103.77	113.69	58.15	14.27	16.58	306.46
	Household	103.77	113.69	32.58	1.51	3.10	254.65
	Production			25.57	12.76	13.48	51.81
1995	Total	115.70	150.92	252.96	42.21	85.62	647.41
	Household	100.13	150.92	86.11	2.56	41.92	381.64
	Production	15.57		166.85	39.65	43.70	265.77

technology, economy, environment, and social benefits to select energy resources, varieties, and techniques; and then choosing the best technology assembly to form an optimised development scenario. Figure 1 shows the technological structure of IRED. IRED pays attention not only to renewable energy development but also to energy conservation; not only to system management but also to market fostering; not only to a single technology application but also to an array of technologies. Its objective stresses both an increased effective energy supply and improved sustainable capability development.

In the last 15 years, through the "one hundred county" IRED Program and nationwide expansion of renewable energy exploitation and commercial energy conservation projects, the imbalance between energy supply and demand has been greatly alleviated. Rural energy development has promoted the development of agricultural production and the rural economy. The rational use of various energy resources also improves the ecological environment. The annual rural energy exploitation and conservation has reached over 80 million tce. The total energy consumption in rural areas increased from 300 million tce in 1979 to 650 million tce in 1995 (see Table 1).

In addition, the structure of rural energy consumption has been shifted from a heavy dependence on traditional energy resources such as fuelwood and crop residue to high-grade energy resources like electricity and gas, even though the total amount of biomass consumed has kept stable over almost the last twenty years. Figure 2 and figure 3 shows the shift of rural energy consumption structure from 1979 to 1995.

The IRED program has many different features due to its nationwide distribution of projects. One of its most special characteristics is the popular dissemination of efficient stoves. By the end of 1995, efficient fuelwood/coal stoves had been disseminated to 172 million households, over 70% of the total rural households. Their benefits in terms of energy saving, pollution reduction, and health improvement of rural residents, especially the women in households have been significant and easily observed. For rural industries, technologies like efficient tea stoves, tobacco-drying houses, and brick kilns are popularly disseminated as well. In addition, some new techniques such as a village-scale centralised gas supply system from the conversion of crop residues have been put into use after scientific research in the laboratory. Their successful commercial operation will show a prospective way for rural energy development in China when facing new challenges of rapid rural economic development and a growing demand for high grade energy resources.

Meanwhile, biogas technologies have been further extended. In 1995, there were 5.7 million households using biogas in rural China, producing 1.47 billion cubic meter of biogas; more than 600 large and medium scale biogas plants and 540 intensive biogas stations provided biogas for 840,000 households. Comprehensive utilisation of digested liquid and solid residues from biogas plants promotes the local agricultural production. For example, by adopting a rural energy ecological model which consists of a family size biogas digester, one pigpen, and one 1-ha. greenhouse, and one toilet in one system, each household can get an extra 4,000 RMB *yuan* in a year.

In addition, the establishment of fuelwood forests has been dramatic. In the last 13 years, China planted 4.72 million ha of fuel forest, and the total area of fuelwood forest increased to 5.40 million ha. The plantation and protection of forest resources has been stressed throughout the country, especially after the recent terrible flooding which occurred along the Yangtze River and in Northern China in the past summer,

The experience shows that IRED is an effective and environmental friendly way of increasing the rural energy supply in developing countries like China. The Chinese government will continue to allocate its efforts to IRED, for it benefits not only the huge rural population in China, but also the whole nation as well as the global environment.

Figure 2. Energy consumption structure in 1979

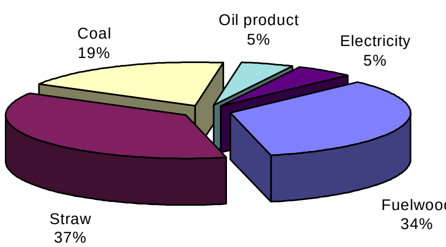
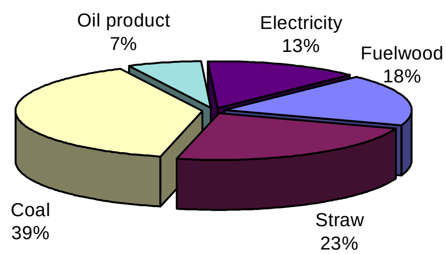


Figure 3. Energy consumption structure in 1995



Wood Energy in Forestry Education in China

In June, 1998, RWEDP organised a expert consultation on the "*Integration of Wood Energy into the Training Curricula of Forestry Education Institutions*". This consultation was the first of its kind in Asia designed exclusively for addressing the training needs of the wood energy sector. Experts from RWEDP member countries reviewed the extent of the coverage of wood energy aspects currently addressed in the region and discussed the potential of integrating these aspects into the formal forestry education curricula. Mr. Wu Xiaofu from the Central South Forestry University in Zhuzhou, China attended the consultation and presented the situation in China as well as some suggestions for improvement. A summary based on the country report on China is presented in this article.

In China, the curricula covering topics of wood energy are mainly included in either forestry or agriculture institutions. There are 11 forestry universities/ colleges, 22 agricultural universities/ colleges that possess forestry departments/faculties, and 179 forestry technical schools including adult education and training.

The major subjects in forestry and agricultural specialities that cover aspects of wood energy are summarised in the table below, which also shows the related wood energy topics not covered in China's current education system.

In both forestry and agriculture institutions there is no specific course dealing with wood energy as an integrated subject and as a consequence the limited existing knowledge is scattered. Moreover, the existing knowledge concerning this subject is insufficient and somewhat out-of-date. There are almost no training programs regularly designed for local workers and farmers and very few popular reading materials concerning wood energy issues are available.

Based on the current situation, a few suggestions were given in the report:

1. Include Management and Utilization of Wood fuel Forest as a prerequisite course in the forestry education curricula at bachelor level and higher;
2. Introduce a whole chapter covering the major aspects of wood energy in silviculture at certificate educational level and lower;
3. Reorganize and compile new materials for short-period training programs as well as for adult education;
4. Promote the transformation of knowledge and techniques on production and utilization of wood energy in rural areas.

This paper was summarised by RWEDP from the country report on China, by Huang Yi and Xiaofu Wu, presented at the Expert Consultation on the Integration of Wood Energy into the Training Curricula of Forestry Education Institutions.

	Current situation			Main topics not covered
	Curricula subject		Wood energy related issues	
WE resources	Forestry	Silviculture	- production and management of forests, including fuelwood forest; - afforestation species, including selection of fuelwood species; - forest land division	- Wood waste and by-products from forest industries; - Recovered wood from old construction; - Drift wood and others.
		Forestry economic and management	- WE forest distribution	
		Forestry general system and engineering	- fire damp - community forest	
	Agriculture	Agroforestry	- multiple purpose trees in farming systems	
		Agroecology	- role of WE forest	
WE flow	Forestry	Forestry utilisation	- charcoal making	- fuelwood harvesting/ collecting and preparation/ bundling; - transportation /distribution/ marketing;
		Microbiology	- methane generation	
	Agriculture	Application of agriculture technique	- fire dump pool - proper utilisation of biogas	

Other WE issues not covered		
WE planning: - data collection and analysis - Sectoral WE demand - assessment of WE resource/ supply potential - emerging trend in WE consumption and transformation	**WE conversion/utilisation:** - traditional applications/ technologies; - charcoal end-use technologies; - briquetting/densification of loose biomass residues; - modern applications gasification, co-generation, dendro-thermal power.	**WE and environment:** - green house gas - employment, poverty, etc.; - soil/water conservation; - impact on gender and health

Publication Review

Fuel Forestry Development Strategy in China

China's fuel forest plantation programme has made significant achievements in the last few decades. According to official statistics, from 1981-1995 the fuel forest plantations have accumulated to a million ha. However woodfuel supply can still not meet the demand. In recent years, fuel forest land has increased more slowly due to the low economic benefits derived from woodfuel. Based on the fuelwood supply situation and the country's rural energy development policy, a new Forest Energy Project was proposed, with the target of 18 million ha of fuel forest plantations in about 20 years (starting from 1996). With the aim to contribute to this project, this book presents data, methodologies, detailed analysis and suggestions for the development of fuel forests in China.

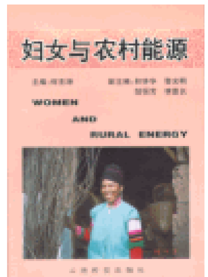
The authors first present the historical and the current situation regarding woodfuel use in China, and then argue the necessity of and potential for fuel forest plantations and the strategies for their development. In the second part of this book, detailed information and discussions are given on 4 major regions with respect to the economic and ecological benefits of fuel forests.

This book was written in Chinese published by the Forestry Press of China. RWEDP has translated it into English, and a limited number of copies are available in due course.

Author: Zhida Zhang *et al*
ISBN7-5038-1766-6/S 1020

Women and Rural Energy

With the financial assistance of the Ford Foundation of the USA, a study of "the Status and Role of Women in the Rural Energy Development in Yunan Province" was conducted. During the two years research period, a large amount of information and data was collected through interviews, field investigations and literature studies. For many years women have been contributing to fuel forest establishment, improved stove promotion, biogas development, etc. often unacknowledged and unrecognised. This book fully unveils and recognises the importance of women in rural development



Author: Peikun He *et al.*
ISBN7-5416-0953-6/Z 163

Notes on Fireplace Culture

A fireplace centred life style can be seen in many cultures and countries. In China, especially among the South-west ethnic groups, this life style has been maintained and gradually fostered to become a so-called Fireplace Culture which is rich in content and fascinating to see.

Based on many studies of the life and customs of many ethnic groups, mainly in Yunan province, the authors of this book present a detailed analysis of the important position and symbolic functions of the fireplace in the social and religious life of these ethnic groups. The book is the first of its kind to study the secret fireplace culture which has hitherto remained unknown to most of the world.

Author: Fuquan Yang & Xiaoyun Zheng
ISBN7-222-00870-5/G 80

Woodfuel Resources Management in Kumpur, Nepal: A Gender Perspective

Biomass is the main source of energy in rural households of Nepal where woodfuel forms a major part. But in broader perspective, energy policy and planning has mostly focused on the development of commercial fuels that hardly cater to the needs of rural people. Consequently, gender aspects of household energy management have received little attention in energy development.

The primary role of women in fuelwood collection, carrying, processing and utilisation is evident in most of the developing countries. In the case of Nepal, for instance, it is girls and women who together collect 84 per cent of woodfuel used for household consumption.

This study, conducted in Kumpur Village Development Committee of Dhading District in the central hilly region of Nepal, revealed the fact of women's prime involvement (exclusively 64.7 per cent) in woodfuel collection and transport. In Kumpur, forests are the major source of woodfuel and 97 per cent of households use woodfuel mainly for cooking and heating purposes (the remaining three per cent use kerosene and biogas in addition to woodfuel). The massive deforestation in the area over the last decade has had a deep impact on the lives of women. It has increased their drudgery in terms of time and labour inputs to procure woodfuel. Although, the community forestry program has moved the conservation of forests into the hands of local communities, it has not been very effective, for control still rests with the men in users group committees. Women face several sociocultural constraints and are less mobile and have little time off from household responsibilities. The undervaluation of women's opinions and their lower social position has resulted in the lower rate of women's participation in decision making. Thus, women's concerns are rarely heard, while they continue to have little access to forest products and to better quality wood.

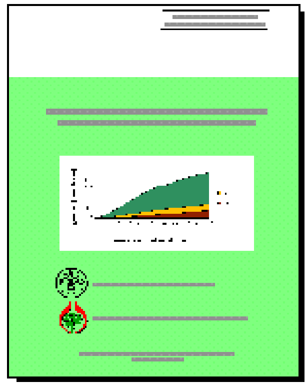
The burden of accessing woodfuel has had a direct bearing on women's health. Major causes of concern among women include prolapse of the uterus and chronic bronchitis. A possible relation has been seen between uterus prolapse and carrying woodfuel. 23 per cent of women in the study noted prolapse of the uterus a few days after delivery, when they resumed the usual work of carrying fuelwood without proper rest.

Exposure to woodfuel smoke led to chronic bronchitis among some of the women studied. Women's longer exposure to the smoke in ill-ventilated kitchens and the use of inferior wood were found to be factors in the disease. The crude 8 per cent prevalence of disease with increasing prevalence in relation to exposure hours per day has indicated women's high vulnerability to respiratory diseases.

The situation calls for including a gender dimension in national energy policy, sustainable management of the woodfuel resources, finding alternative fuels and technological interventions whilst considering the sociocultural and economic factors related to adoption of the technology.

Author: Suman Subba, AIT

Carbon Dioxide Offset Investment in the Asia-Pacific Forestry Sector: Opportunities and Constraints



Author: REWDP (FD 52)

Growing concern about the effects of climate change has led to increasing research, policy initiatives, and the development of innovative programs and projects around the world designed to reduce human-induced greenhouse gas (GHG) emissions (i.e., CO_2, CH_4, N_2O and chlorofluorocarbons [CFCs]).

Storing carbon in trees and forests is one option for offsetting the gases released by fossil fuel burning, and for mitigating the potential effects of global warming. Under the Kyoto Protocol negotiated in December 1997, recognition is given to this option. Countries that have agreed to specific greenhouse gas emission limits will be eligible to receive credit for certain domestic forestry and land-use activities that increase the storage of carbon in sinks. Moreover, under the Kyoto Protocol, countries will be able to earn emission reduction credits by carrying out collaborative carbon-storage activities in other countries. These credits, in turn, can be used to offset greenhouse gas emissions in their home countries to partially meet emission reduction commitments. In this report carbon offset project activities are referred to as certified Emission Reduction Credits (ERC).

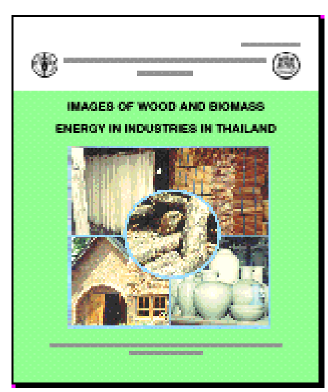
Numerous issues related to the new international negotiations and agreements remain unclear, however. Many questions remain over the economics, politics, and mechanisms under which the new agreements will be implemented. Nonetheless, it is apparent that forestry could play a significant role in the global strategy for mitigating the threat of global climate change. This report discusses opportunities and constraints in forest sector ERC projects in the Asia-Pacific Region.

This report, a joint publication of RWEDP and FAO's Regional Office for Asia and the Pacific, discusses wood energy development as one of the options for ERCs. In fact, the global climate will benefit twice if the investments are directed to plantations that supply wood energy. First, by initial carbon sequestration when the trees are growing, and second, by avoiding emissions when the trees are used as a source of wood energy on a sustainable basis. The second effect reflects common practice in Asia.

Images of Wood and Biomass Energy in Industries in Thailand

In Thailand as in other countries, numerous industries use wood or other biomass as their main fuel. Many of these industries are small scale, are located in rural or urban environments, and employ traditional production processes. Some of these industries avail of modern technology to make efficient use of wood and biomass fuels in a local, cost-effective way.

Some years ago, Thailand, within the framework of the Thai Forestry Sector Masterplan, implemented a nationwide survey of rural industrial wood consumption. This generated a wealth of data on types and characteristics of industries utilising fuelwood. As this type of information will be of interest to many people, RWEDP in close co-operation with staff from the Royal Forest Department decided to compile the information in the form of a photo-illustrated publication. This publication gives an overview of the main wood/biomass-fuel based industries in Thailand, such as agro-processing, food-processing, metal processing, forest products, mineral based industries and textile. It also provides some information about production, technologies, fuel characteristics and enter-preneurial aspects. This type of information will be relevant for strategies, policies and programmes not only in the energy and forestry sectors, but also with respect to industrial development, employment generation, technology development, regional development, and others.



Author: RWEDP (FD 53)

National Training Course on the Integration of Woodfuel Production and Marketing, Hyderabad, Pakistan, 20-22 October 1998

The training course was sponsored by RWEDP at the special request of the Secretary, Forest & Wildlife Department, Government of Sindh Pakistan. It was a second national follow-up activity of the sub-regional training workshop, "Integrating Woodfuel Production into the Implementation of Agriculture, Forestry and Rural Extension Programs in South Asia", which was held in October 1995, in Dhaka, Bangladesh.

The course was attended by 30 senior and middle level participants from Sindh, mostly from forestry and wood energy related disciplines. The advisor to the Chief Minister of Sindh inaugurated the course which the Secretary and other higher dignitaries attended. Altogether 19 technical papers covering different aspects of wood energy in Sindh and Pakistan were presented.

The field visit part of the course covered the production, marketing and utilization of woodfuel in Sindh. Plantations of *Acacia nilotica* under the traditional *Hurry* system and *Eucalyptus camaldulensis* in blocks and linear rows in private lands were observed. And to familiarise participants with the local system of woodfuel procurement, processing and trade two woodfuel depots were visited.

The national training course was designed to address the prevailing issues of woodfuel production and marketing in Sindh. Recommendations made by the participants are expected to enhance further production and marketing in the coming years. The recommendations, inter alia, suggest that the government pursue the Social Forestry Development Programme of Sindh for the sustainable development of wood energy. They call for the simplification of rules and regulations, the provision of information, research and development support, etc.

RWEDP Expert Consultation on "Sustainable Wood |Energy Programmes in Asia: Policy and Institutional Issues", Hua Hin, Thailand, 29-31 July 1998.

Sustainability of wood energy has essential links with various policy areas, e.g. energy, forestry, agriculture, environment, economics, trade, labour, health, education, gender and overall development. Wood energy is also subject to routine activities in government sectors like interior, finance, statistics and others. It is a tremendous task to review and analyse the numerous relevant inter-actions in different member countries. RWEDP made an effort through this Expert Consultation, jointly with experts and delegates from obvious sectors, to identify and clarify the main linkages.

Overall the experts took the view that wood energy is of significant social, economic and environmental importance in Asia, and that the benefits can and should be further enhanced by dedicated efforts. Such efforts are to be supported by measures in related policy areas.

LEAP Training and Wood Energy Planning Case Studies

In the remaining years of RWEDP, the thrust of the project is to conduct more national capacity building activities for wood energy data and planning. The strategy to accomplish this is to conduct a series of training activities in the member countries that include the following:

- a national seminar-workshop on wood energy planning;
- a tutorial on the LEAP application for energy modelling studies;
- an on-the-job case study of wood energy planning; and
- the preparation of a national guidebook on wood energy planning.

The national seminar-workshops aim to introduce participants working in areas related to wood energy planning to wood energy data collection and analysis, and wood energy planning. The LEAP tutorials are aimed towards a smaller group of local experts with whom RWEDP plans to work with in conducting of case studies and preparing the national guidebooks. RWEDP 's aim is to help the participating local experts profoundly develop their capacities in wood energy data and planning. RWEDP proposes to conduct case studies at three levels: national level, provincial/state level, and county/district level.

Up till now, seven national courses have been completed in the Philippines, China, Sri Lanka, Vietnam, Thailand, Laos and Cambodia. LEAP tutorials and follow-up case studies are now being initiated in these countries.

National Workshop on Woodfuel Trade, Dhulikhel, Nepal, 25-28 August

The workshop was sponsored by RWEDP and hosted jointly by the Department of Forests (FD) and the Water and Energy Commission Secretariat (WECS), Nepal. The workshop was designed to bring together key actors in the area of woodfuel production and trade and to discuss the prevailing problems of commercial woodfuel flows. It was hoped to identify measures to promote private and community participation in non-forest land based wood energy development. The opening session of the workshop was attended and addressed by many high dignitaries, including the Mayor of Dhulikhel Town, Secretary of Forest and Soil Conservation, FAO Representative in Nepal, Chief Conservator of Forests, and other senior officers from the central and local agencies.

The workshop recognised Nepal's heavy reliance on traditional fuels for energy and endorsed the view that its importance is not expected to decline within the foreseeable future. One point clearly stated/raised in the workshop was that the country's diverse topography and limited infrastructure, its differential accessibility and affordability of alternative fuels all determine the pattern of the local level energy mix.

Since the present workshop was the first national level activity of RWEDP in Nepal, it has enhanced the participants' knowledge of the woodfuel supply system and the issues of production, distribution and marketing, from both private and public supply sources. The workshop successfully conveyed the message to participants that sustainable production and open trade in woodfuel could contribute significantly to socio-economic development and should be supported by the relevant sectors in Nepal.

Centre for Energy and Environment (CEE)

The CEE was established in December 1997 under His Majesty's Government of Nepal as an NGO. The main objective of this centre is to assist the rural people to uplift their socio-economic status through initiating community actions for productive utilisation of local skills and resources.

Events

Event, description (info)	Venue, date
Green Power '99 - An international Conference Cum Exibition on Investment Opportunities in Renewables (CIITRFD)	New Delhi, India. 15-16 Febuary,1999
World Renewable Energy Congres 1999 (UKM)	Kuala Lumpur, Malaysia. 7-11 June, 1999
Training Programme for Karnataka State Forestry Offices on Wood Fuel Production & Utilisation (TERI) This training course is sponsored by Karnataka State Forest Department.	TERI Board Room, New Delhi, India. 5-9 January, 1999

CEE	P.O Box 3628, Tripureswar, Kathmandu, Nepal. ☎ +977-1-256819; 🖹 +977-1257922; 💻crt@wlink.com.np
CIITRFD	Ms. Shefail CHatuvedi Mande, Deputy Director, Confederation of India Industry Trade Fair Division, Gate No. 31Noryh \block, J. L. N. Stadium, New Delhi-110 003, India. 🖹 +91-11-462627; 4647844. 💻shefail@ sai.cii.ernet.in.
UKM	Prof. Mohd. Yusof Hj. Othman, Conference Scretary, Deputy Dean, Department of Physics, University Kebangsaan Malaysia, 43600 Bangi, Selangor, Malaysia.
TERI	Dr. SP Banerjee, TERI Board Room, Tata Energy Research Institute, Darbari Seth Block, Habitat Place, Lodhi Road, New Delhi - 11, 0003 INDIA. 💻benerjee@ teri.res.in.

CD-ROM from RWEDP

RWEDP is preparing a CD-ROM, which will contain the same information as the RWEDP web site. In this way the information on the RWEDP web site will also be available to those who don't have access to the Internet (or have difficulties in gaining access to it).

The RWEDP web site has been operational since March 1998 and is well appreciated by users. It contains extensive information about various issues in the field of wood energy. Apart from this a selection of RWEDP publications as well as all the newsletters can be viewed.

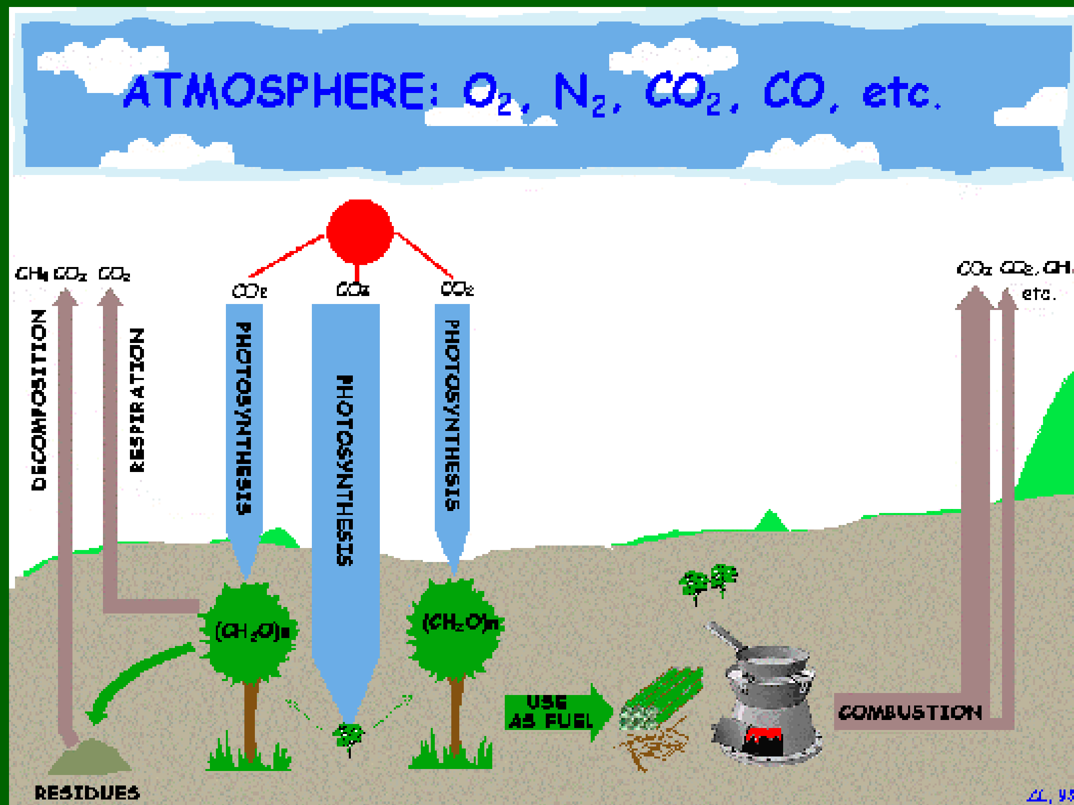
For using the CD-ROM one needs a suitable computer system. The system requirements are a computer system with a 80486 SX processor or higher, and a Windows NT, Windows 95 or higher operating system and a CD-ROM drive. If you have any questions about these system requirements you can contact RWEDP.

The first RWEDP CD-ROM will be released around April 1999. You can request the RWEDP CD-ROM by contacting RWEDP (address on page 2).

Trees, Woodfuel and the Carbon Cycle

Adult trees emit CO_2 through respiration

All the carbon stored during a tree's life time will be released as CO_2, CH_4, etc. when the trees die and decompose.



Sustainable use of fuel-wood under complete combustion means no net carbon emission.

When low efficiency stoves are used, incomplete combustion will result in emissions of CO, CH_4, etc.