GENDER RELATIONS AND THE ENERGY TRANSITION IN RURAL ASIA[1]

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Abstract

This study, drawn from research conducted in China and other parts of rural Asia, links women's and men's labour force participation and status to the adoption of new fuels and appliances in a number of countries. Low opportunity cost of women's labour limits the adoption of improved stoves and women's entry into income-earning activities would promote a fuel transition. While the severely negative health impacts of biomass fuels make public subsidy of alternatives desirable, this will not necessarily result in fuel switching by households so long as the value of women's labour remains low. This is shown in fieldwork from Yunnan, China and a number of other Asian countries. The critical area of intervention is likely to be in providing commercial fuels for women's income-earning activities.

Key words: Gender relations, energy, opportunity cost of labour, fuel transition

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Executive Summary

This study draws attention to the complex inter-relationship of energy and the socioeconomic position of women in rural Asia. The hypothesis is that where fuel is collected rather than purchased there is a sustained under-investment in labour-saving devices that would save women's labour time, and also save fuel. This is a function of the relatively low opportunity cost of women's labour time compared to that of men, and the systematic male bias in favour of their own power and time in preference to that of women, and not only a function of household income as is assumed in economic models of domestic energy use. In looking at the impact of energy on the empowerment of women it is apparent that energy policy and practice should be directed towards addressing gender relationships and increasing women's adequate participation in energy decisions and institutions. These, in turn, demand a gender-responsive energy policy establishing linkages between energy projects/programmes and the empowerment of women along with an increase in the productivity of women's labour.

In an earlier paper we had put forward the proposition that the low opportunity cost of women's labour limits the adoption of improved stoves and that women's entry into income-earning activities would promote fuel transition (Nathan and Kelkar, 1997). In this paper the analysis is carried forward with the following propositions:

- Women's overwork in rural developing countries is a result of their gendered responsibility for providing cooked food as a household public good.
- When the opportunity cost of men's labour is much lower than that of women it should promote the collection of unpurchased fuel by men rather than by women. This would indicate that gendered responsibilities, though generally rigid, are not completely fixed and can respond to changes in the comparative economic positions of women and men. However, this does not necessarily promote a fuel transition.
- A fuel transition to less-unhealthy fossil fuels is promoted by a situation in which the household purchases its fuel requirements, as a result of which fuelwood becomes an inferior commodity.
- The severely negative health effects of fuelwood and related biomass fuels (dung, crop residues) make it desirable for public subsidies to encourage household adoption of cleaner fossil fuels. While a policy of subsidising the equipment costs associated with cleaner fossil fuels is likely to encourage the use of such fuels by households that rely on purchased fuels, it is unlikely to change the choices of households that rely on non-purchased fuels.
- The critical area of policy intervention is in providing commercial fuels for women's income-earning activities. The resulting increase in the opportunity cost of women's labour, and the need to economise on women's (and household's) labour, will promote the household adoption of improved biomass technologies, the commercialisation of fuel and the switch to modern commercial fuels with their attendant health benefits. This is particularly important in areas where fuel is largely collected.

Policy Considerations: In order to promote a rural fuel transition there should be greater stress on investing public money in providing energy derived from fossil fuels or electricity to increase the productivity of women's labour, and less stress on public subsidy of domestic fuel consumption.

Energy policies should address gender asymmetries in capabilities, control and ownership of assets, and participation in community governance. Concerted attention is needed to strengthen rural women's involvement through learning new skills such as accounting, marketing, managing an enterprise and knowing about the various energy technologies and how to operate them. Thus, creating conditions where rural women have the ability to demand, manage and use energy services. A regular system of interactions with women's energy networks and other women's organisations

can be a powerful tool for generating self-confidence and increasing the social visibility of rural women.

To ensure that the rural poor have access to clean and efficient energy and to reduce the current inequitable situation of most women in Asian countries, concerted efforts need to be made to: 1) eliminate social and cultural limits to the opportunity costs of women's labour; 2) implement affirmative policies that strengthen women's capabilities, thus enabling them to articulate their needs and interests concerning health, technological education and future wellbeing; 3) promote end use of commercial energy that directly increases women's productivity in income-producing activities; and 4) substantially increase the representation of women in energy use and management bodies, as well as in all agencies and institutions that have an influence in the energy field.

1 Introduction

This study draws attention to the complex inter-relationship between energy and the socioeconomic position of women in rural Asia. The hypothesis is that where fuel is collected rather than purchased there is a sustained under-investment in labour-saving devices that would save women's labour time, and also save fuel. This is a function of the relatively low opportunity cost of women's labour time compared to that of men, and the systematic male bias in favour of their own power and time in preference to that of women rather than simply a function of household income, as is frequently assumed in economic models of domestic energy use. From looking at the impact of energy on the empowerment of women it appears necessary for energy policy and practice to be directed towards addressing gender relations and increasing women's participation in energy decisions and institutions. This, in turn, demands a gender-responsive energy policy establishing linkages between energy projects/programmes and the empowerment of women along with an increase in the productivity of women's labour.

In an earlier paper we put forward the proposition that the low opportunity cost of women's labour limits the adoption of improved stoves, and that women's entry into income-earning activities would promote fuel transition (Nathan and Kelkar, 1997). In this paper the analysis is carried forward with the following propositions:

- Women's overwork in rural developing countries is in part a result of their gendered responsibility for providing cooked food as a household public good.
- If the opportunity cost of men's labour would be much lower than that of women it would promote a substitution of men's for women's collection of non-purchased fuel. This would mean that gender responsibilities, although generally rigid, are not unchangeable and could respond to changes in the comparative economic positions of women and men. However, this would not necessarily promote a fuel transition.
- A fuel transition to less unhealthy fossil fuels is promoted by a situation in which the household purchases its fuel requirements, as a result of which fuelwood becomes an inferior commodity.
- The severely negative health effects of fuelwood and related biomass fuels (dung, crop residues) make public subsidies for the household adoption of cleaner fossil fuels desirable. While a policy of subsidising the equipment costs associated with fossil fuels is likely to result in continued use of fossil fuels by households that rely on purchased fuels, it is likely to be ignored by households that rely on non-purchased fuels.
- The critical area of policy intervention is in providing commercial fuels for women's income-earning activities. The resultant increase in the opportunity costs of women's labour and the need to reduce women's (and the household's) domestic labour will also promote household adoption of improved biomass technologies, the commercialisation of fuel and the switch to modern, commercial fuels with their attendant health benefits. This is particularly important in areas where fuel is largely collected.

These propositions resulted from our fieldwork in villages of the Mosuo and the Naxi communities in Yunnan, China. Since 1993, we have made regular visits to Lugu Lake and Lashih Lake in Yunnan related to our collaborative work with Chinese scholars (He Zhonghua, Yang Fuqnan, Yu Xiaogang and Xi Yuhua) on forest management, watershed ecosystems and gender relations in matrilineal Mosuo and patrilineal Naxi. This study is based on our fieldwork in three villages of Musuo people in Lugu Lake: Luoshih, Zhengbo and Zhashih; and two villages, Xinrong and Xihu, of Naxi people in Lashih Lake. The fieldwork was completed in June 2004 and our field assistant/interpreter was a young woman activist/scholar Yu Ying. Focus group discussions and individual interviews were the main methods of data collection, supplemented by local government data and our earlier work in Lao PDR, Vietnam and India. The one-to-two hour interviews were largely structured around questions designed to elicit information from women and men

respondents on matters related to energy developments in the area and changing gender relations in the household and community. The fieldwork findings and observations were discussed with Xi Yuhua and Yu Xiaogang, two senior scholars at the Gender and Culture Center in Lijiang, China.

2 Emerging perspectives

Attention to women and energy only really began in the early 1980s with pioneering work by Elizabeth Cecelski (1992). An important aspect of this involved looking at women's work and its significance for total production, a perspective that raised the question of renewable energy sources, including the energy expenditure of women's own labour. It has also led to a broader shift in thinking about energy with linkages to women's gendered position and the reduction of poverty including economic and political linkages ranging from inappropriate pricing policies and subsidies for fuel and electricity to inadequate land tenure.
In these emerging perspectives it was noted that, from the perspective of the rural third-world woman, the energy crisis was a fuelwood crisis; the dependence of large sections of the world's population on hitherto unexamined forms of biomass energy was highlighted, and it was noted that, for many, deforestation had meant that in some cases it was 'more difficult to cook the food than to grow it' (Omvedt and Kelkar, 1995; Agarwal, 1985). The human energy crisis was also seen as important. Many rural women in Asia and Africa have to spend long hours collecting fuel and fetching water, using their own bodies to carry heavy loads over long distances. Furthermore, the energy used in agricultural activities (with increasing recognition that women are often the primary farmers), 'is essentially human labour and animal power - in other words, sweat energy' (Romani, 2003, p.16). The disproportionate amount of this sweated energy spent by women and girls in gathering wood fuels and water for the household could be better used for income-producing activities.

In spite of these emerging perspectives, as Cecelski notes, the dominant paradigm continues to see energy as 'large-scale, capital intensive technological projects run by professional experts' and so ignores the actual definition of energy as 'the capacity for doing work and overcoming resistance' (1992, pp.3-4).

As part of the preparations for the 1997 General Assembly special session reviewing sustainable energy, UNDP's project on Energy and Women (UNDP, 2001) emphasised key assumptions highlighting that women and girls in developing countries are the primary providers and users of traditional fuels such as wood, dung and charcoal. Their greater access to modern, cleaner energy services (such as for lighting and cooking) could have significant effects on women's levels of literacy, health, nutrition, economic opportunities and participation in community management. These, in turn, can provide wider social and economic benefits.

The World Bank-sponsored EnPoGen studies (http://www.worldbank.org/astae) in 1999-2001 recognised the problematic inter-linkages among energy, poverty and gender. Despite such concerns about the complexity of the inter-relationships and acknowledging the need for inclusion of women's interests and needs in energy policies and programmes, a great deal of the research that has concentrated on energy-related problems has excluded gender analyses from the methodology, and been limited by a techno-economic focus. There has been little attempt made to focus on small-scale, management-intensive activities done by women, through the participation of women in programmes, and a lack of sensitivity to the significance of indigenous knowledge and practices in energy use. In commenting on some of these studies (China and Cambodia in particular), our major questions were:

- To what extent can the introduction of energy-intensive, low cost production be a useful starting point for meeting rural poor and indigenous women's and men's priorities through such energy projects?
- Does the inclusion of women in decision-making on energy projects and in the community make a difference, for instance, in the ways that matters concerning women's drudgery are addressed?
- Can women's decision-making roles in energy projects implicitly or otherwise question and change the social subordination of women? An energy project in Midu County of Yunnan, China, implemented by the local branch of the Women's Federation shows that it can. It made a difference, through addressing women's needs, in reducing drudgery and improving their position in the family and community.

Changing the type of energy that households use is an important aspect of energy policy. The negative health and drudgery effects of traditional biofuels (wood, animal dung and crop residues) are well known. There are two important aspects of the use of wood and other biomass fuels in traditional stoves. The first is that they are inefficient in terms of the conversion of biomass into useful energy. The second is that they are harmful to the health of women (and those children who stay near the mother) who inhale fumes that are harmful to the respiratory system. As a result of cooking for long hours over poorly ventilated indoor fires, women and their young children are exposed to pollutants (such as carbon monoxide, benzene and formaldehyde) and suffer from respiratory problems, lung diseases, eye infections and cancer. 'Worldwide, close to two million premature deaths per year are attributable to indoor air pollution from cooking fires.' (UNDP 2001, p.9). In India, Jyoti Parikh and Vijay Laxmi (1999, 2003) have pointed out the adverse health effects on rural women and children from burning biofuels.

As the pioneering research of Pandey (1984, 1992) showed, women in Nepal who cook with fuelwood have an incidence of chronic respiratory ailments (CRAs) equal to that of men who smoke four packets of cigarettes a day[2]. CRA should be viewed as an occupational disease of women who cook with wood in traditional stoves, particularly in hill/mountain climates where space-heating considerations keep stoves burning beyond cooking requirements. Another health hazard for women comes from collecting fuelwood. It leads to back problems from carrying heavy loads on the head[3], and sprains and fractures of the legs resulting from the steep slopes that have to be negotiated with these loads.

Enabling a transition to household use of modern, commercial fuels, chiefly electricity or liquid petroleum gas (LPG), is an important goal of rural development. This energy transition would meet three objectives: (1) it would eliminate or reduce the negative effects on women's health of traditionally burned biomass fuels; (2) it would reduce women's drudgery; and (3) it would promote an increase in the productivity of rural labour by making nonhuman, nonanimal energy available for household production.

In discussions on energy policy it is often assumed that the critical factor in bringing about a rural energy transition (i.e. the shift from traditional, biomass fuels to modern, commercial fuels) is that of household income. Models of household energy use put household income as the key factor in

[2] What led Dr Pandey, an eminent cardiologist in Nepal, and cardiologist to the King, to study this problem was the puzzling to him high incidence of CRA among hill women who came to him for treatment in Kathmandu. Going back to their homes and measuring the smoke etc., he came to the conclusion, since corroborated by various other studies around the world, that women inhale so much smoke while cooking that they have an incidence of CRA equal to that of men smoking four packets of cigarettes a day (personal communication, Dr Pandey).

[3] Hani/Akha women in China and Thailand have a particular problem due to their carrying wood in a basket with a sling that goes round the forehead – this results in a receding hairline, which they cover up by a headdress.

promoting the energy transition. Demand projections for fuelwood and substitute fuels are made on the basis of 'changes in consumption patterns as a result of increase in income and improvements in standards of living (Best, 1993, p.161). Similarly, in Munasinghe and Meier (1993), the demand for fuelwood is taken to be a function of household income and the price of fuelwood, with negative elasticities for both factors. In Heaps et al. 'The transition away from reliance on collected wood as a fuel and toward increased purchase of commercial (often fossil) fuels tends to occur as people's standards of living improve' (1993, p.249). More recently, a study of gender and energy also argued that, 'Income represents the factor that influences the choice of a carrier' (Piana, 2003, p.20).

The paper 'Energy and Gender Issues' by Grazia Piana (2003, p.9) discussed two factors as they emerged on the road from Johannesburg: (1) reorientation of energy policies from their traditional technical focus and supply concerns to a broader range of issues, including globalisation and a sustainable environment; and (2) the evolution of gender concerns in the energy paradigms and their increasing affirmation at policy level forums. In establishing links between energy, gender and poverty, Piana argues successfully that energy should be viewed as an 'essential component of economic as well as social development at the same time as a prerequisite for an improved quality of life'.

Our key question is whether rural household energy use really depends mainly on household income, or are there gender factors that need to be taken into account in understanding the nature of household fuel use?

Household fuel consumption decisions are the result of a combination of two sets of factors. One is the fuel supply system. Fuel supply is a combination of public sector or government systems, typically that of grid electricity supply, and market-based supply. Some parts of both may not be the result of pure public or private sector systems, but of some public-private combination. Kerosene in India, for instance, is both supplied through the public distribution system (PDS) and through legal or extra-legal market systems. Electricity is also often supplied through both public and private (illegal) connections in informal settlements.

Given the different types of fuel that are supplied, a household has to choose the kind of fuel system that it will use. Supply does not necessarily determine fuel consumption, nor does it necessarily create demand. Naturally, making a particular fuel cheaper is likely to promote its greater use. However, the household always has to choose among the range of fuels available. Even if it is only between wood and crop residues, a choice still has to be made.

While there are gender factors in the supply side of the equation, it is more crucially in the household decision system, on the demand side, that gender factors enter the decision-making process. For instance, when villages or even households are connected to the electric grid there is still a matter of what will be done with the electric connections. Will the available connection be used with equipment such as electric grinders and corn millers, or to run a music system or TV? The use of electricity for lighting is ubiquitous. Almost the first thing a household does with electricity is to install light bulbs. Even here there is a choice to be made about where to install the light fixture - in the kitchen or living room, in the bathroom or in front of the house? Such decisions reflect choices between production, domestic and entertainment uses. Gender factors enter into these choices. This paper is essentially concerned with those gender factors that influence the household decision-making process over choice of energy systems and their end uses.

3 Some critical concepts

- **Gender division of labour:** While the gendered division of labour affects household decisions on energy use, the gendered division of labour itself is not something that is completely static. What are the factors that affect the gendered division of labour and energy-use decisions with women being allotted responsibility for the majority of the non-income earning activities? To what extent is there a movement between the non-income earning labour of women and of men? What factors affect the substitution of men's labour for women's labour?

- **The opportunity cost of women's labour:** What is the opportunity cost of collecting and using non-purchased fuels? Not just the opportunity cost of women's labour, but also the comparative opportunity costs of women's and men's labour. If the marginal income from women's labour is much higher than the marginal income from men's labour, then there is a greater likelihood of change in the household division of labour; with men taking up additional domestic responsibilities. There is a limit to the extent to which men take up domestic work - is this linked with their own ideas of what it is to be a man? That a man who does most of the domestic work is 'not masculine'.

- **Increase in women's income earning activities:** An increase in a woman's income-earning activities does not necessarily lead to a change in either the division of labour or the use of labour-saving methods/devices. We often see that there is a lag between the two - but why is there a lag? Is this related to women's control over the disposition of household income, or of her own income?

- **Energy, leisure and everyday practices:** Given the fact that women routinely work a few hours more per day that men in most regions of the world, we would point to the importance of increasing women's leisure time. Critically, leisure is not a function of enjoyment but a function of self-development, and thus also a function of production and empowerment. However, then the factor of the gendered control of household income comes into the picture. The key decision maker in the household tends not treat the leisure or labour time of all its members equally. The leisure time of the men and boys is frequently viewed more favourably than the leisure time of women and girls. In a Hani village in Yunnan, we noticed that money was spent on acquiring cassette players (with which men could listen to music in their substantial leisure time) rather than on getting piped water or improved stoves, both of which would have reduced women's working hours. Similar occurrences are seen in Indian villages in Punjab.

  What this means is that in any process of empowerment, the anticipation of leisure time and the expectation of enjoyment on the part of women have to be continually cultivated. As discussed in the recent inception meeting of Collaborative Research Group on Gender and Energy (19-22 April 2004) in Cape Town, South Africa, women's perceptions of time gain and leisure is an indicator of empowerment.

- **Purchased and non-purchased fuels:** In line with the distinction between income-earning and non-income-earning activities, should we distinguish between 'purchased' and 'non-purchased' fuels? Is this a more relevant economic concept than, say, traditional and non-traditional fuels?

- **Fuel transition**: the substitution of traditional (biomass) fuels by non-traditional fuels, such as electricity and LPG. This is usually stated as the movement from non-commercial to commercial fuels. However, there can be a transition to commercial fuels without there

being a shift away from traditional, biomass fuels. Traditional fuels may themselves be commercialised.

4 Case study findings

A large part of the rural developing world depends on wood, in particular, and other biomass fuels for their household needs. These are, in the main, non-commercial fuels. The collectors and users of wood fuels are primarily women. This situation is common to both developing countries of Asia (i.e. countries of South Asia, some of South-east Asia including Vietnam, Laos and Cambodia, and parts of China) and Africa. 'From an energy point of view rural Asia shares the energy profile of Africa. The largest portion of the energy supply is provided through individual or private effort at very low or even zero costs' (Piana, 2003, p.27). Does this picture change with an increase in income? Does higher household income lead to a shift to fossil or other commercial fuels?

Case studies, summarised in the Annex 1, show that:

1. There was a household energy transition in the tourism-intensive village of Luoshui, Lugu Lake. Between 1993 (our first visit to the area) and 2004 there was a more than five-fold increase in income, and both women and men were intensively involved in income-earning labour associated with tourism. In 1997, the villagers were no longer collecting wood but buying it. By 2004, the village was no longer using wood for household cooking: LPG and rice cookers had taken over in household cooking.
2. In the Lao villages in North Sayaboury Province on the Lao-Thai border, there was a shift from women alone collecting fuelwood to men performing some of this labour, and wood no longer just collected – it was also bought.
3. In the Naxi villages in Lijiang, where women were mainly involved in agriculture and animal raising, there was not so much of a fuel transition. About half of the households used rice cookers, but traditional stoves still accounted for the bulk of cooking. Further, some of the wood collection and cooking was carried out by old men, who were not involved in income-earning activities.
4. Improved wood stoves have been much more diffused in rural China than in rural India, even though in the latter case these labour-saving devices are subsidised. By 1991, about 150 million farm households in China, i.e. about 70% of the total farm households, had adopted improved stoves. These improved stoves were sold at commercial prices. In comparison, in India, by 1992, about 12 million stoves had been distributed, i.e. to about 15% of farm households. Unlike in China, partial or full subsidies were provided for the stoves.

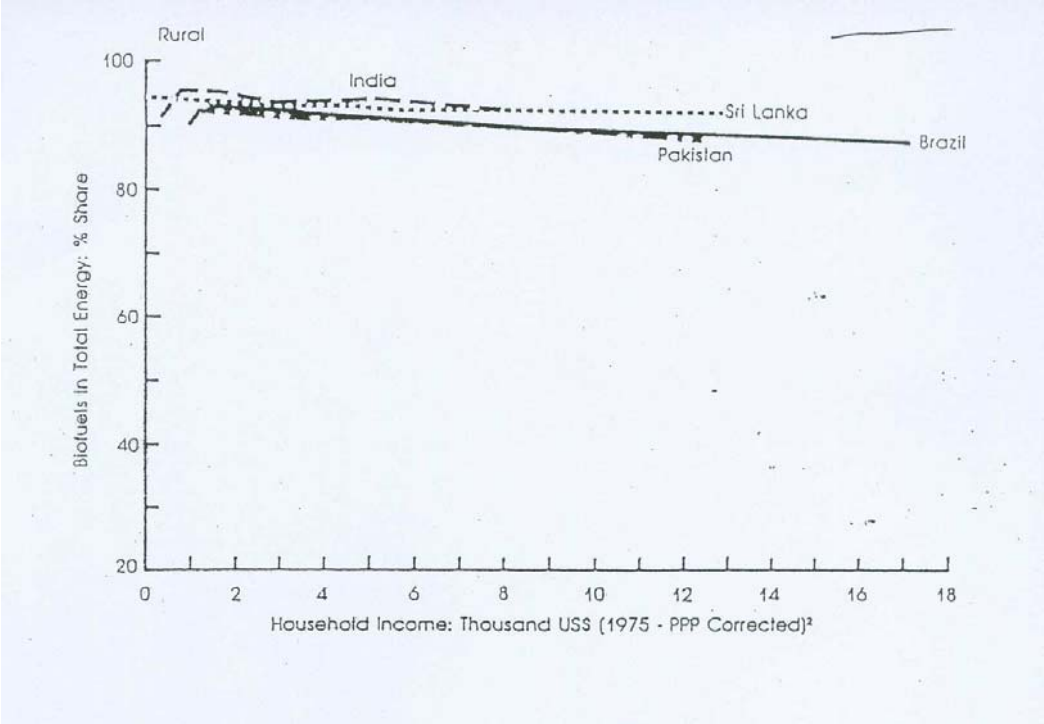
5 Rural/urban fuel use differences

Kirk Smith et al. (1992) consider that it is China's relatively high real incomes that mainly accounts for the difference between China and India in success rates – as household income increases there is a change in fuel consumption pattern, with a shift to improved stoves and to substitutes, such as commercial fuels. To put it in other words, fuelwood is an inferior good, whose consumption decreases as income goes up. This intuitively looks correct – as income goes up one of the things we observe is that households move up the fuel ladder to more efficient and cleaner fuels, from wood to kerosene to gas or electricity.

The Pakistan Household Energy Study (HESS) undertaken in 1991 showed that 'income plays an important role only in urban areas…. In rural areas, where about 84 per cent of the fuelwood is consumed, the level of consumption, after correcting for the household size effect, was not found to

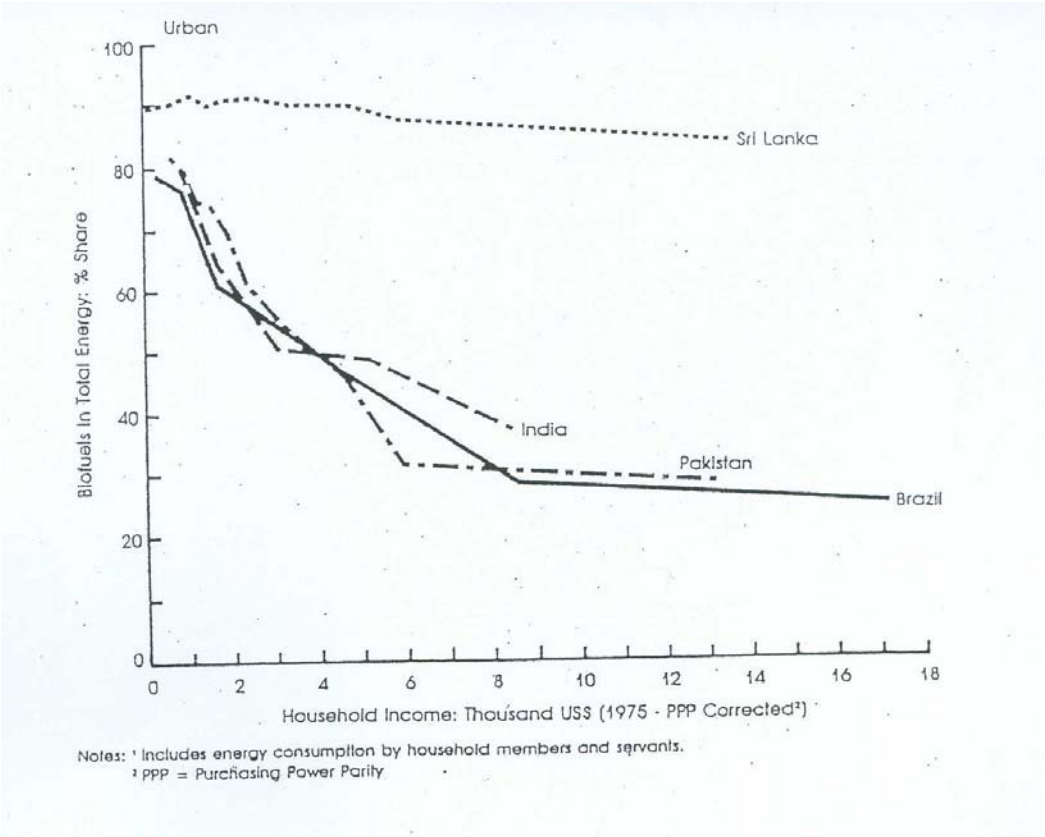
be sensitive to the level of income' (Ouerghi, 1993, pp.69-70). According to Census of India 2001 and Central Electricity Authority data, electricity is available to only 43.5% of rural households and 84% of villages (2001, Tables on Houses, Household Amenities and Assets). Taking biomass fuels as a whole, a number of earlier studies for India, Pakistan, Sri Lanka and Brazil all make the same point - that there is no shift away from biomass fuels irrespective of income level in rural areas, while there is such a shift in urban areas (see Figures 1 and 2 below, taken from Leach and Gowen, 1987, pp.42-43). The only exception to this urban pattern of a substitution for biomass by fossil fuels with a rise in income was in Sri Lanka. The reasons for this are the availability of fuel from women's own gardens (30% of domestic fuelwood) and the large-scale availability of coconut trunks (Leach and Gowen, 1987). Together, these result in a low fuelwood price compared to kerosene and LPG.

Figure 1: Rural fuel use pattern, 1979-82



Source: Leach and Gowen, 1987

Figure 2: Urban Fuel Use Pattern, 1979-82



Source: Leach and Gowen ,1987

Between the late 1970s and the early 1980s, when the above studies were undertaken, and the present, there have certainly been changes in the participation of women in the labour force in rural areas. This, if our hypothesis is correct, should have resulted in a fuel transition.

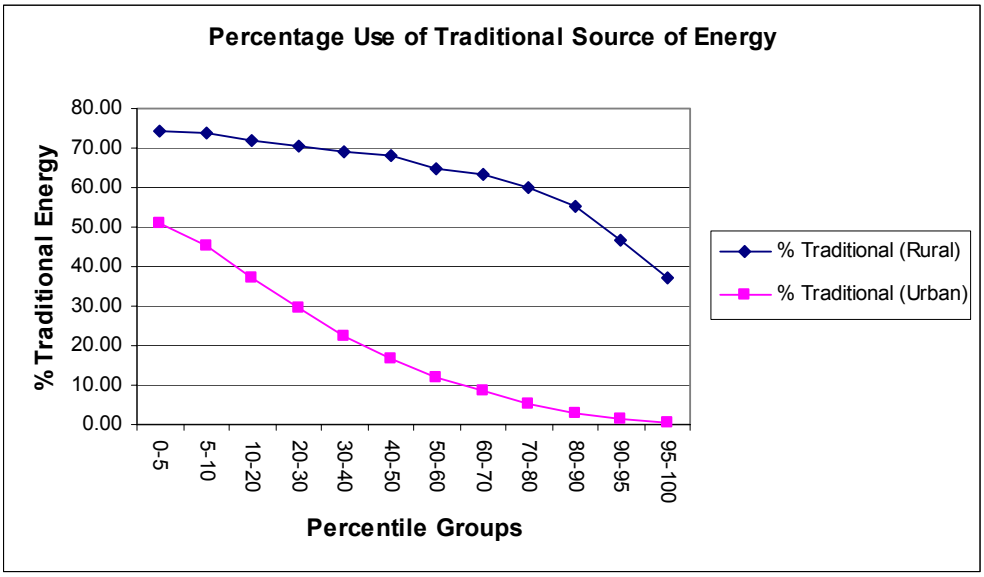
The latest Indian National Sample Survey (NSS) of 1999-2000 shows that the consumption of fuelwood (combined here with other biomass fuels) in rural situations does not fall with an increase in income as much as it does in urban areas. Further, there is little reduction in the proportion of wood and dung fuel consumed until about the sixth consumption percentile, i.e. it is only among the top 40% of the rural population that there is significant fuel substitution (see Figure 3). What these NSS figures suggest is that fuelwood is still not seen as an inferior commodity by much of rural India; only at the highest consumption levels does this become the case.

However, the NSS figures are for the country as a whole, which is made up of disparate regions with varying levels of women's labour force participation. There are large differences in the labour force participation rates among states, ranging from less than 20% in Punjab, Assam, West Bengal and Haryana to 60% or more in Tamil Nadu, Madhya Pradesh, Andhra Pradesh and Maharashtra. (NSSO, 1999-2000)

Further investigation is needed to understand the relative influence of women's labour force participation and household income on rural fuel use. A distinction also needs to be made between

areas where rural food supply is largely commercialised and those where rural fuel is collected using household labour.

Figure 3: Rural Fuel Use Pattern, India, 1999-2000



Source: NSSO, 1999-2000, Household Consumption Survey as calculated by the Institute for Human Development, New Delhi.

What these studies show is that there are differences between urban and rural patterns of fuelwood use: in the urban situation, fuelwood is an inferior good - its consumption falls as incomes rise; but in the rural situation, fuelwood is not an inferior good, and its consumption does not show much variation with income level.

In urban areas, fuelwood is a commodity, sold and purchased on the market. There is very little collection of wood for self-use with the possible exception of Sri Lanka as noted above. Consequently, in urban areas, wood as a fuel is compared to other fuels and its sale and purchase are subject to the same supply and demand forces as other fuels. Fuelwood then becomes an inferior good, one whose consumption falls as income increases.

In the rural situation, on the other hand, wood is not produced as a fuel commodity; i.e. it is not produced for sale. A Pakistan study (Ouerghi, 1993, p.71) showed that 69% of all fuelwood is collected and therefore considered 'financially free'. While, in India, an older 1979 study (Leach and Gowen, 1987) showed that 80% of rural fuelwood consumption was collected and not purchased. Naturally, there are regional variations depending on the type of agro-ecological zone. In irrigated areas, landless labourers tend to buy a large portion of their fuel, which may be fuelwood, rather than collect it since there are no public forests for such collection; whereas those owning land tend to get fuel from their own crop residues. In general though, fuelwood is collected in rural areas, rather than purchased.

When fuelwood is collected for self-consumption rather than bought and sold on the market, the expected negative income elasticities do not work. We cannot expect market-type behaviour from that which is not traded on the market.

What are the economic factors associated with the use of fuelwood? An improved stove is a technology that saves labour without, however, increasing output. It is of the type of technology that has been called 'labour-saving', rather than 'land-augmenting' or 'production-increasing'. Thus, with improved stoves less fuel will be needed, but there is no increase in output. For a farm household that does not buy fuel, it is not the fuel use comparison that is important but the labour involved. Thus, the use of improved stoves should be seen as a way of economising on the labour of fuel collection.

The labour involved in the collection and use of fuelwood is mainly women's labour. The relevant labour comparison is thus that of women's labour. Under what conditions will money be spent on acquiring (or maintaining and subsequently replacing) an improved stove? Innovations of the labour-saving variety are unlikely to be used if there are no alternative uses of the saved labour that would yield an income greater than the costs of adopting the innovation. In the absence of such opportunities, the adoption of a labour-saving innovation would only decrease income or increase poverty.

This is illustrated by the Russian economist Chayanov's observation, at the end of the nineteenth century, of the difficulties in popularising threshing machines: 'in areas in which there are no crafts and trades in winter and, apart from threshing, nothing else with which the population can occupy itself. It is true that the introduction of the threshing machines would ease the work and free many hands …; but since these hands can find no other work to do, this does not increase peasant family income by a kopek. The cost of the thresher, though, is a considerable deduction from the meager peasant budget' (Chayanov, 1956, p.221).

We observed in Northeast Thailand (Nathan and Kelkar, 1999) that farmers near the town of Khon Kaen worked on their farms only at weekends, and had urban employment for the rest of the week. Since they needed to prepare their land in a short period of time, and all of them at the same time, every farmer who was employed in the cities owned a power tiller, which was clearly grossly underused. As in the Japanese case, they purchased these power tillers because they could earn more than the cost through paid urban employment in the time freed up. With many women also busy with such urban employment and the resulting difficulty of finding women's labour for transplanting, the farmers have also abandoned transplanting in favour of broadcasting seed. The decline in yield due to broadcasting rather than transplanting was more than compensated for by the increase in women's income.

What is interesting is that when urban employment, particularly for casual migrant labour, collapsed in the wake of the Asian economic crisis, the demand for power tillers virtually disappeared overnight. However, farmers were not returning to old methods such as using animal-drawn ploughs since they had neither the necessary equipment nor the knowledge for these methods. Rather, without the pressure of urban employment, it became possible for farmers to share power tillers under some form of informal hire arrangement.

6 Gender analysis of energy projects and programmes

Gender analysis implies recognising that households and communities are not solitary units with undifferentiated labour resources, but in fact are made up of women, men and children who may share, complement, differ or be in direct conflict in their need for or interest in improved technologies and social change. Gender analysis should not be used in isolation but linked with other social organising principles such as class/caste, ethnicity, age, religion, culture, urban/rural location.

The four major questions raised in gender analysis are:

- Who does what, when and where in enterprise, off-farm, farm and household maintenance?
- Who has access to, ownership and control over resources, production, knowledge, technology, time and decision-making? Having access but not control may lead to constraints and less flexibility in using the resource.
- Who benefits from the existing organisation of production, community and household resources? This question is closely related to roles, responsibilities and control over resources. For example, changes in women's ability to earn independent income and their capability to manage energy and resources affect not only household cash flow, but also enhance their self-confidence/esteem, dignity and decision-making.
- How and to what extent do cultural systems, poverty reduction policies and technology projects address or contribute to the transformation of gender relations and the relations between the disadvantaged and the advantaged?

There were three questions raised by Elizabeth Cecelski in the Cape Town meeting on Gender and Energy (April 2004):

- Have energy projects and programmes been more successful where gender has received attention? Energy interventions to do what: reduce poverty and/or improve the status of women?

- Under what conditions does improved access to energy empower women? Modern energy services are a necessary but not sufficient condition for sustained poverty reduction.

- What energy interventions can best improve women's power relations?

Can energy play a leading role in spurring social and economic changes? It is not energy itself that has certain inevitable consequences, but the economic and social situation in which technologies are introduced and the balance of forces at any time. Certainly systems for cooking, house cleaning, house washing etc., which reduce the labour in these activities, may make it easier for working couples to share domestic duties but such energy uses do not inevitably lead to such changes in sharing.

Japan is a good example where all the available energy uses have not led to any sharing of housework between the two genders. While women do not insist that their careers are not subsidiary to those of their husbands, and that housework be shared or socialised (or even commercialised in areas such as laundry or preparation of meals), there need not be any change in gender relations, no matter what energy is available.

Feminists have long argued that the family cannot be seen as an 'altruistic' institution in which the welfare of all is uniformly the principle of distribution of labour and benefits (Folbre, 1994; Kelkar and Nathan, 1992). The family is not a sacrosanct institution inside which the law cannot reach. In fact, one of the advances of the feminist debate over the last few decades is to extend the notion of human rights from merely regulating relations between the state and individuals to one between individuals within and across families, in a famous slogan 'the personal is political'. Further, the family also needs to be reformed, both in relations between the genders and in relations between the generations.

There is a social prescription that it is women's responsibility to carry out household duties, including making sure that food is cooked. Women's withdrawal from such non-earning activities

depends on the extent to which the opportunity cost of their own labour increases; while an increase in the opportunity cost of men's labour is unlikely to have any effect or not much of an effect on women's withdrawal from low-return activities. Taking the collection and use of fuelwood in conventional stoves as a quintessentially non-earning activity, women's withdrawal from such activities depends on the extent to which the opportunity cost of their own labour increases. This may come about in one of three ways or a combination thereof. Women may adopt labour-saving devices; they may take to purchasing those services (e.g. the collecting of wood) that they themselves provided; and men may share some of the burden. The last option depends not just on a change in the opportunity cost of women's labour, but on a comparison of women's and men's opportunity costs. However, the crucial factor leading to the adoption of any of these methods, including technologies that economise on women's labour, is an increase in the opportunity cost of women's labour.

We can say that women's gendered role or responsibility to produce domestic services is a household public good, i.e. a service that is consumed by all members of the household. With women's responsibility for providing this public good, and a fixed amount of money and their own labour time available for this function, whether women adopt labour-saving equipment or not depends on whether women are able to earn an income higher than the cost of this equipment. If this were not so, the provision of the public good would itself be reduced. If, however, women were able to earn an income higher than the cost of the equipment, then they could themselves compensate for its cost and not have to reduce some other part of the domestic budget. This outcome does not depend on the identity of the decision-maker. Even where women make household decisions on spending cash, as observed in matrilineal societies in Eastern Bhutan and Meghalaya, India, women themselves tend not to invest in equipment that saves domestic labour, unless its cost can be compensated for by the income from the labour saved. This is a change in the provision of domestic services without, however, changing gender roles.

7 Energy and gender responsibilities

Why is women's labour over-used, in the sense that women work longer than men? The burdens of collecting fuelwood and cooking are two of the main factors in women working longer hours than men. Why is there not a sharing of responsibilities in the production of non-purchased goods such as fuelwood?

In a household system of fixed responsibilities, where women's responsibility is for preparing food, this gendered responsibility will result in a form of separate spheres or separate labour budgets. Women's labour is used to fulfil women's responsibilities, while men's labour is used to fulfil men's responsibility. In a low-income household, the marginal utility of income is high for both men and women. Women can allocate their time between income earning and producing an intra-household public good. An intra-household public good is one that is consumed by all members of the household, e.g. cooked food or space heating. Of course, even this consumption may not be equal. One of the implications of the separate spheres and conjugal contract model is that, with a high marginal utility of cash income, there is likely to be a tendency to supply relatively little of woman's labour to the intra-household public good, even if the opportunity cost of labour is low.

We would argue that this is simply not so. A woman does not have the option of reducing her supply of the intra-household public good. This is particularly so for a final good, the good that is consumed, such as cooked food. The way the labour devoted to the production of the intermediate good (fuel) can be varied is through technological change, or the purchase of a good, or a combination of the two – or a change in the sharing of labour. Each of these changes comes about

because of a change in the opportunity cost of a woman's labour and an increase in her cash income.

Given the system of gendered responsibilities, when economic opportunities are unchanging there may be no reason for a change in the system. When the marginal opportunity cost of women's labour is low and unchanging it is likely that the existing division will continue. However, when the opportunity cost of women's labour rises, and particularly when it rises above the marginal opportunity cost of men's labour, there could well be a change in gendered responsibilities.

The above possibility is borne out by the case studies in Laos and the Naxi villages around Lashi Lake, China. In the first case, women's earning possibilities increased very substantially with the commercialisation of weaving, but there was no change in the earning potential of men. The marginal opportunity cost of women's labour was the income they could earn by spending the time weaving. The marginal opportunity cost of men's labour was very low (the income that could be earned by collecting and selling non-timber forest products). The marginal opportunity cost of women's labour was about ten times that of men. In this situation, along with the adoption of mechanical milling to reduce women's labour in non-earning activities, there was also some substitution of men's labour for women's labour in fuelwood collection. Thus, gender responsibilities were not immutable. Men even took over some of the responsibility for childcare and, to a small extent, for cooking, in preparing food for themselves when their wives were busy.

In the Naxi villages, where stem families (i.e. a couple with their children and the husband's parents) stay together, women, including older women, are involved in field and animal raising labour. Old men participate both in collecting wood and performing some of the cooking and childcare labour. The opportunity cost of old men's labour is almost zero, so there is a tendency for their labour to be used for non-earning tasks.

In both cases, gender roles are somewhat flexible. It is not that gender roles are solely determined by comparative opportunity costs, rather, they come out of historical patterns and are, at least initially, a given for women and men in any generation. But changes in the comparative marginal opportunity costs of women's and men's labour does have some effect in making changes in gendered responsibilities more possible.

These, however, are not automatic effects although there can well be a situation where gender roles are renegotiated in the household following changes in comparative opportunity costs. Evidence from the effects of microcredit in Bangladesh show that with women's entry into, or advance in, income-earning there are many processes of renegotiation as a result (Kelkar, Nathan and Jahan, 2004). Initially, many men may resent women's attendance at meetings since this can have an effect on the timing of meals. Over time, some flexibility is accepted in these matters. In Laos, where there was a dramatic increase in women's income earning capacity, along with a historically matrilineal system, the redefinition is more substantial, with not just some flexibility in women's provision of domestic services, but even with some sharing by men of domestic labour (Nathan and Kelkar, 2002).

8 The opportunity cost of women's labour

To the extent that women's cash contributions not only satisfy the requirements for producing domestic services but become a contribution to the rest of the household budget, there will be an increase in the say that women have over the manner in which the overall household budget is used. Ignoring the arguments of the separate sphere and separate income model, even with a pooling of household income this result would hold. As observed in Laos, with pooled income, the voice of the

person who actually earns the cash matters in deciding how to spend the pooled income. In such a situation there is a change in the manner in which cooking services are produced – some of the needed inputs may be bought rather than produced by women's labour, and some labour-saving equipment may be purchased. For men to take over some time of the burden of domestic labour needs a change in attitude, but this change is more likely to come about when the opportunity cost of women's labour is higher than that of men. The greater the difference in these two opportunity costs, the greater will be the pressure for a change in gendered roles.

The relationship between the opportunity cost of women's labour and the adoption of labour-saving equipment is not confined to poor, rural economies in developing countries, but can also apply to well-developed and rich capitalist countries as can be seen from the following case in rural Canada (personal communication with June Corman, January 2003).

In rural Canada, a generation ago, women did not work outside the home. They consequently used their time to stretch the income dollar as far as possible. They sewed clothes and preserved food to reduce cash expenditure. More recently, however, this has changed. With the increasing uncertainty of farm income, farm women have taken to getting jobs. This has led to the purchase of clothes and many food items that were formerly produced at home. It has also led to an increase in men's involvement in childcare, as women are more regularly away from home.

From the above we may conclude that the adoption of labour-saving equipment by a farming family depends on the possibility of utilising the labour saved on income-earning opportunities that yield more than the cost of the equipment, i.e. the opportunity cost of the labour saved. The higher the opportunity cost of the labour saved the more likely it is that the labour-saving equipment will be acquired. However, we should add a corollary to the above statement.

The farm family does not have a unique opportunity cost of labour. Rather, it is faced with a hierarchy of opportunity costs, with male labour tending to have a high and female labour a low opportunity cost. Since it is female labour that accounts for the overwhelming majority of hours spent on collecting and using fuelwood in poorer countries, it is the opportunity cost of women's labour that is relevant to the analysis, not the opportunity cost of men's labour nor a generalised non-gender specific opportunity cost which, as argued here, does not exist.

Why are there different opportunity costs for labour by women and men? In the first instance it is related to the different employment opportunities for women and men. There are more employment opportunities for men, who can travel longer distances and generally get higher wages in the market.

But this is intertwined with another factor related to different gendered-responsibilities within the family, manifested in women's overwhelming responsibility for unpaid domestic labour in the family including preparing food. While men may play some role in child care (children who are not being breast-fed and not yet old enough to either attend school or go to the fields are left with men in the village), they do not prepare food, which should be seen as including collecting fuelwood and fetching water. They may play a minor role in fetching fuelwood, but that is neither frequent nor regular.

Women, because of their responsibility for preparing food, use all their available labour time in producing goods for family consumption. The asymmetric responsibility for domestic labour means that men do not similarly use all their available labour time for producing goods for family consumption. They may use some of their available time for leisure activities, which may include hunting although this no longer yields any real returns.

During the fieldwork, we observed Akha couples in Yunnan returning from the swidden fields. The woman would be carrying a load in a basket strapped to her forehead, which would include vegetables she was bringing back from the field where she had been weeding and, simultaneously, spinning some yarn as she walked. The man would walk with a hunting rifle over his shoulder, showing nothing for the day spent in the fields. In such conditions, hunting has become a virtual recreational activity, akin to golf among the world's affluent. On returning home, the men either gathered in the village square, holding on to small children; or lounged on sofas, listening to music from a cassette player. The women went out to collect water and set about cooking.

This asymmetric responsibility also means that women undertake productive activities, including collection from uncultivated trees, as long as there is something to collect. As a rule, one would expect that the output should be judged to be of greater value than the energy expended in collecting/producing it. But this need not always be the case, and there could well be situations where women mine their own bodies (i.e. expend more energy in production than they get from the product, or get back less than they use or produce because they deny themselves in order to feed other family members). Men also mine their bodies for their families, but it is the asymmetric mining of the gendered bodies of women and men that is our concern here. This is particularly likely for crucial inputs, such as fuelwood and water, which are critical for the family's nutritional intake.

The asymmetric responsibilities of women and men for domestic labour means that while women at or below the subsistence level will use all their time producing goods for domestic use even at low levels of return, men will not necessarily utilise all their available time in domestic production.

9 Supporting rural fuel transition

There are two ways of approaching the adoption of improved stoves and related fuel transitions. One is to subsidise their use and the other is to increase the opportunity cost of women's labour by increasing productivity in income-earning activities. Considering subsidies for improved stoves, as pointed out earlier, the experience with subsidised 'smokeless *chulhas*' in India and Nepal has not been very good. The stoves are at best used during an initial period, but they are not repaired and certainly not replaced.

More recently, the Government of Andhra Pradesh (India) undertook the free supply of gas stoves to poor women across the state. However, the women could not afford to buy new gas cylinders, the price of which went up because of the withdrawal of subsidies. Subsequently, many of the poor women ended up selling their gas cylinders at low prices to middle-class women (Personal communication, with Vasanth Kannabiran). In November 2003 one could see many gas stoves stored away on house roofs, while the women had gone back to cooking on collected wood and dung.

To illustrate the generality of problems with subsidised, and even free, supply of labour-saving equipment we refer to the case of corn shellers and other such equipment in one project in Vietnam (Nathan, 2001). Households did not feel obliged to use their own income to undertake necessary repairs. When given free, such equipment was welcomed, but no effort was made to use their own incomes for repairs, with the result that the equipment ended up laying around unrepaired.

To the extent that the labour-saving equipment was used, the main benefit seems to have been that it enabled the women to get up later and go to bed earlier, not that they undertook additional economic activities. Increasing women's leisure is a valuable objective in itself, and can even justify a measure of subsidy if the social benefit of increased leisure time is valued as being more

than just its private benefit. However, when individual households make decisions, it is unlikely that, at the current low levels of income, money will be spent to increase leisure.

The above analysis points towards the proposition that whether a farming family does or does not seek greater efficiency in fuel use, the adoption of an improvement which will cost some money will depend on the opportunity costs of labour in fuelwood collection and cooking. Fuel collection can be converted into a monetary value, using the existing price of fuelwood, in order to give a cash measure of the value of fuelwood collection. For example, suppose the rate of wood collection is 3 kg/hour, while the local market price is Indian Rs.2 per kg. This gives a 'value' on collecting fuelwood of Rs.6 per hour. Then, if the minimum labour wage was Rs.12 per hour, it would clearly, *if employment were available*, be preferable to earn cash as a labourer and buy wood, rather than collect it. However, in the absence of employment or other income-earning opportunities such a substitution will not take place. This lack of an incentive to reduce labour time will similarly affect the farming family's decisions regarding investing in an improved stove. If the time a woman could save by using an improved stove has no alternative income-earning possibilities then, even if women were the family decision-makers, they would not decide in favour of spending cash on improved stoves. This might explain why even in matrilineal communities, as in Eastern Bhutan, the improved stoves programme has been a failure.

In contrast, China's 'best' rural areas, where the improved stoves programme has been most successful, have a high level of village-level industry and commercial production of livestock and vegetables. Women significantly participate in these income-earning activities, even through their childbearing years. This major participation by women in the income-earning labour force is reflected in a strong drive to economise on women's labour in fuel collection and use (and other household duties), and this results in a high adoption rate for unsubsidised improved stoves.

So, when labour time becomes a constraint on expanding economic activities, labour-saving machines are purchased. Whereas, when labour time is not a constraint on expanding economic activities, then cash is not spent on repairing, let alone buying, labour-saving machines. The one example we found where women were reported to be willing to buy labour-saving machines was from better-off households in Dong Van. The labour-saving machines were said to help the women increase the number of animals they raise. The amount of corn that can be shelled and ground, and fodder that can be cut, was increased through using machinery.

Similarly, in the IDS case studies (IDS, 2003) in the village of Housanxi many households had bought electric grinders to mill grain and chop pig food. Milling grain and chopping pig food are both typically women's tasks. What the purchase of electric grinders reflects is that this labour had become a constraint in increasing the number of pigs raised.

Fuel transition is not an automatic by-product of increasing women's productivity in income-earning activities. However, it has been observed that as economic practices change there is likely to be a greater assertion by women of their role in household decision-making, as seen in the studies on micro-credit in Bangladesh and East Africa by Kelkar, Nathan and Jahan (2004) and Kabeer (2001); and in East Africa by Nathan (2004). Thus, an increase in the income of women in the household is likely to be translated into an improvement in their position and in the conditions for acquiring fuel and cooking food in a manner that reduces women's work load (e.g. purchased rather than collected fuels) and a consequent reduction in the negative effects on women's health (fossil fuels rather than biomass fuels, improved stoves rather than traditional stoves).

In assessing fuel transition as it relates to women's wellbeing, we can propose the following ascending order of energy indicators:

1. Collected biomass fuels with conventional stoves
2. Collected biomass fuels with improved stoves
3. Collected biomass fuels with men sharing the labour of collecting fuel and preparing food
4. Purchased biomass fuels
5. Purchased fossil fuels or electricity, with appropriate cooking equipment - rice cooker, pressure cooker, etc.

A policy of continuing subsidies in energy initiatives tends to distort ownership patterns in communities and households and this undermines project viability. An analysis of an earlier programme of fuel-efficient stoves in India suggests that permanent subsidies serve to weaken the sustainability of alternative energy approaches. Furthermore, the continued high cost of subsidies to the state, and the fact that most benefits of subsidy accrue to non-poor urban households, rather than the rural poor, may present problems. Nevertheless, a recent government programme in Himachal Pradesh, India, that promoted the use of LPG, combined with subsidies for pressure cookers to increase energy efficiency, resulted in a greater outreach of clean fuels into rural areas (Modi, 2004, p.26).

Short-term policies may be an appropriate strategy through subsidising initial costs and providing community-based credit arrangements or public financing to offset investment in energy equipment. For example, in Naxi and Mosuo villages in Yunnan, kinship financing or community-based credit arrangements were needed to help poorer households meet the high initial costs of energy equipment but the households were then able to afford the daily running costs. Repayment of these credits was spread out over time with small payments similar to operating costs. A critical role for public policy is to have an area-specific appropriate strategy for subsidies to assist the wellbeing of the rural poor, 'as well as the inclusion of 'sunset' strategies to phase out subsidies when they are no longer justified'. (UNDP, 2001, p.22)

10 Increasing women's income earning opportunities

Increasing women's income-earning opportunities is not seen as an intervention in what is regarded as 'energy policy'. However, there is no *a priori* reason why important influences on energy use should only come from within what is considered the field of energy policy, which deals with the availability and prices of different fuels. The same point was made by Irene Tinker, 'In fact, once the central energy problem of women's time is recognised, there may be other ways to address the rural time and fuel constraints, such as by increasing income, that will have a more immediate impact than imposing, for example, improved stoves or bio-gas digesters' (1990, p.7).

As against Tinker's mention of 'simply' income, we would stress the importance of women's income. As argued above, if men's incomes increase, but women's involvement in income-generating activities remains the same, there will not be any change in the pattern of utilising women's labour for fuelwood collection. Low-priced or unpriced labour will not be saved. It is higher-priced labour that is saved. This applies to the individual worker and not to the family as a whole.

Women's unvalued domestic labour has been the last component of social labour to become mechanised. This is also borne out in the history of the advanced capitalist countries, where it was only with the entry of women into the labour force that mechanisation (and then sharing) of domestic labour really began to take place.

The increased involvement of women in economic activities, besides leading to the adoption of improved stoves, can also lead to the abandonment of collecting wood for fuel altogether. Instead of

collecting wood, families may choose to buy the wood. This would then make fuelwood a commodity, and as a commodity it would be subject to the features of commodity consumption – in particular, the substitution by superior fuels as income increases. When fuelwood becomes a commodity, it is seen as an inferior good. There is no reason why the same should not apply in rural areas, as incomes rise there is likely to be a substitution of inferior by superior goods.

11 Purchased and non-purchased fuels

In a number of the case studies (Lao PDR, China) it was seen that one way of reducing women's labour time in fuel use (which includes collection, preparation and cooking) is to switch from women collecting wood to purchasing it. The ENPOGEN case study data for China shows that labour-saving devices were adopted in Housanxi, where many households purchased electric grinders to mill grain and chop pig food. Milling grain and chopping pig food are both typically women's tasks. Why was this labour saved - because women's labour was a constraint on increasing the number of pigs raised.

Given this situation, there could also be other savings of women's labour in non-earning tasks, so as to release more time for earning tasks. Some saving of non-earning labour was found related to heating, but not to cooking. In Housanxi, 31% of responses stated that the most important fuel sources for heating were purchased. The preparation of fuel for heating is not solely women's work, and men contribute. As 'all farm-based cash earning activities were generally seen as primarily the responsibility of men or as joint undertakings….even [in] small livestock production, … though women often played the lead role in tending pigs or chickens' ((IDS, 2003, p.94), it is likely that the ascription of cash to men enabled them to use it to reduce their own labour involved in heating, rather than women's labour in cooking.

With women not being, or supposedly not being, primarily responsible for cash earning activities in the Chinese villages studied, there is an overwhelming reliance on non-purchased (wood, crop residues, animal dung) rather than purchased (coal, charcoal, solar cooker) fuels for cooking. In one-third of cases in two of the villages (Zhaoshan and Xiapai) purchased fuels were reported as the two most important cooking fuels. In all other villages, in less than 10% of cases purchased cooking fuels were reported as the two most important fuels.

When wood is purchased, rather than collected, then it becomes a commodity. Given that wood is an inferior fuel (effectively being more expensive per unit of cooking, besides having adverse health effects), albeit with a lower initial cost of associated equipment, as income goes up it will be substituted by more efficient fuels with higher initial costs. This is the type of transition witnessed in the tourist village of Luoshui, Lugu Lake, China. It would not be surprising if the villages on the Lao-Thai border in North Sayaboury were undergoing a similar transition.

This leads to an important proposition: an energy transition is more likely to occur where households rely on purchased fuels. Further, a policy of subsidising the fixed costs of fuels such as LPG, which are less harmful to health than biomass fuels, is more likely to result in a continued use of such fuels when the households already rely on purchased fuels than when households have relied on non-purchased fuels.

12 Policy considerations

1. In order to promote a rural fuel transition there should be greater stress on investing public money in providing energy based on fossil fuel or electricity to increase the productivity of women's labour and less stress placed on public subsidy of domestic fuel consumption. Rural household fuel transition also depends on an increase in men's labour absorption so that we do not have a situation where lower-priced men's labour replaces higher-priced women's labour in collecting rather than purchasing fuel. However, the key factor is to increase the productivity of women's income-earning labour in order to bring about an economic worth in the use of women's labour and thus induce a change in the household energy use system.

The Mosuo case study of a tourism-intensive village showed that the increase in productivity of women's income earning labour led, after some time, to a complete rural fuel transition. In Nonghet District of Laos, initial attempts to supply milling machines to the Hmong failed to have any impact on women's drudgery. Subsequently, women's income from road-building enabled them to increase their holdings of pigs. The consequent increased production requirements for milled corn for feeding the pigs made women's labour a key constraint in increasing household income. Only when women's labour became a constraint was there greater use made of mechanical milling to save women's labour time.

The sequence need not necessarily be first enterprise development or income generating and then household fuel use. In the absence of the former (development of women's enterprises or income generation), however, households are unlikely to invest their own income in changing the fuel collection or fuel use system, and any change in the latter is unlikely to be sustained. In Nepal, as an example, the rural micro-hydro development programme reduced time spent in preparing and processing food; with the time saved used to run a poultry business (Rana-Deuba, 2001). It then made sense to invest household income in buying a pressure cooker, since the time saved in cooking could be used in the poultry business, which more than compensated for the cost of the pressure cooker.

A very similar point emerges from the small electricity-generating diesel engine programme, known as the 'Multifunctional Platform', in Mali. It was essential that the platform could be used to increase productivity in income-earning activities in order to pay for the cost of the energy service. As pointed out by Brew-Hammond and Crole-Rees, (2004, p.53) '… for energy services to be affordable by poor women (and men), they have to be for end uses that are directly productive and income generating. Enterprise development is therefore of critical importance to successful implementation of the multifunctional platform concept, as shown in Mali, where a number of enterprises have emerged around the multifunctional platforms. Welding of metal chairs, donkey carts, farming implements, etc., is a new business in many places that have acquired multifunctional platforms'. Besides such uses for men's enterprises, women could also increase their production of shea butter from 3 kg to 10 kg per day. Processing time was reduced and the recovery of the final product also increased. Women's control over their own income from shea butter not only paid for the energy use, it could also pay for milling corn. Women could reduce their own burden and increase their rest and leisure. However, all of this required higher productivity in income activities.

2. Energy policymakers and private sector programmes on rural energy problems need to pay greater attention to the subordinate position of women in rural society and how the development and implementation of rural energy services affect the lives of women. What will be the impact of modern rural energy services on income-producing activities by women and men inside the home and outside? Such policies and programmes are essential for bringing about health and education benefits to women, largely through reducing the time spent on fetching water, fuelwood collection, food preparation and cooking. For women and girls, investments in modern

energy services and infrastructure could create more time and opportunities for women's income-producing work; mean men spending more time at home and away from drinking joints in the late evening and thus reduced domestic violence (as reported in several case studies, sponsored by DFID/ENERGIA), and fewer interruptions to girls' schooling and after-school study.

3. Energy policies should address gender asymmetries in capabilities, control and ownership of assets, and participation in community governance. Concerted attention is needed to strengthen rural women's involvement in learning new skills such as accounting, marketing, managing an enterprise and about various energy technologies and how to operate them. Thus, creating conditions where rural women have the ability to demand, manage and use energy services.

4. A regular system of interaction with women's energy networks and other women's organisations can be a powerful tool for generating self-confidence and increasing social visibility among rural women. Networking is a particularly useful form of strengthening capabilities because it provides a means of spreading new ideas and sharing experiences to enhance the knowledge base and expertise in energy management and technologies. Furthermore, benefits of these strengthened capabilities need not be limited to project intervention; they can be a means of influencing the political process for women's inclusion and voice in the regional and national development of energy and infrastructure. This was clearly demonstrated in an energy project in Midu County in Yunnan: the local branch of the All China Women's Federation introduced and successfully managed several renewable energy projects. Another example of such change is seen with the battery-operated lamps produced by rural women in Bangladesh (Khan, in UNDP, 2001). Thirty-three rural women from Char Montaz engaged in the construction and sale of efficient fluorescent lamps helped other women to move away from traditional farm labour to skilled labour in the energy sector and enhanced their knowledge base for marketing activities, while at the same time meeting the community needs for lighting.

In the Andhra Pradesh Tribal Development Project; the India Women's Federation of Self-Help Groups (SHGs) have taken on several functions in addressing social and administrative issues such as the construction of toilets, repairing roads and improvements in drinking water and electricity supply. Likewise, matters of good governance in energy and infrastructure (such as adequate provision of drinking water and bus transport) were also taken up by some well-established women's SHGs in rural areas of Maharashtra, India.

5. Notwithstanding the above examples, rural women involved in the governance of energy and infrastructure throughout South Asia are confronted with a male stronghold that is not convinced that the development of women's agency in the energy sector is an integral part of social and technological progress, rather than just a women's issue (Dreze and Sen, 1999). **What is needed is a new deal for women in the energy sector: the adequate representation of women in energy management along with the necessary inputs of capabilities and credit support** could contribute to increasing the efficiency of resource use and production and, more importantly, enhance women's agency.

To ensure that the rural poor have access to clean and efficient energy and to reduce the current inequitable situation for most women in Asian countries, concerted efforts are needed to: 1) eliminate social and cultural limits on the opportunity costs of women's labour; 2) implement affirmative policies to strengthen women's capabilities, thus enabling them to articulate their needs and interests concerning health, technological education and future wellbeing; 3)promote end uses of commercial energy that directly increase women's productivity in income-producing activities; and 4) substantially increase the proportion of women involved in energy use and management bodies, as well as in all energy-influencing agencies and institutions.

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Annex 1: Village case studies in Yunnan, China[4]

Luoshui

Luoshui Village is located by Lugu Lake to the southeast of the Yongning plateau, 20 kilometres from the seat of the district government. It forms part of the larger Luoshui Administrative Village. The village is divided into two parts, the Upper Village and the Lower Village. The former sits next to the mountain slope, and its inhabitants are mostly Pumi. The latter is located near the lake, and its inhabitants are mostly Mosuo. According to 1998 statistics, there were a total of 76 households comprising of 485 people in the Upper and Lower Villages, of which the Mosuo made up 33 households and Pumi 21 households. The remainder were Hans and Bais. During my investigations in the Lower Village in 1993 and 1996, I found that of the 33 Mosuo households, 31 (94%) were matrilineal families. The Pumi in the Upper Village usually followed the *axia* (visiting marriage) practices of the Mosuo in the Lower Village.

With the development of tourism, drastic changes have taken place in transportation, communications, housing and other local infrastructure. The way of life and the mode of thinking have also undergone important changes. The former dirt highway to the district seat is now asphalted. Once impassable, using the road around the lake one can today reach Yanyuan County town in the dry season. Thirty-two out of 33 households have built new wooden houses, and telephones, refrigerators, washing machines, television sets and small appliances are increasingly popular. Every family has a flush toilet, and some households even have solar water heaters. However, they still retain their matrilineal system, *axia*, funeral customs and sacrificial rites. 'In fact, they have even further consolidated these practices, not for themselves, but as tourist attractions' (He Zhonghua, 2001).

After the economic reforms in China, people began to seize political power. Men were the main political leaders: in Luoshui Village, the former Village People's Committee comprised of six men and no women. In April 1999, it began to have a woman director's seat, but the ratio was still eight men to one woman. Women are generally viewed as of poor ability, or less educated, incapable of participating in political affairs. In reality, some of the women are no less qualified, and some of the men are no more educated, yet the positions of village heads or officials are always said to be for the more able.

The gendered division of labour tended to be equal in the past. This is reportedly changing, with the power of men being consolidated and strengthened. Although of equal labour value, women's activities and capacity in forestry are not valued or recognised. They have fewer opportunities to join in scientific and technological training in the development projects of village communities. In this regard, woman committee member Cao Xuezhen complained that, for example, while it is women who usually plant, weed and fertilise apple trees, it is not the women but the men who receive technical training for this activity.

In 1992, Luoshui was beginning to be known as a scenic spot on Lugu Lake. Guesthouses were under construction, built as extensions to the main houses. The household fireplace was the centre of familial interaction, and guests too ate and interacted with household members around the fireplace. The oldest woman of the house had her bed right next to the fireplace. At that time only firewood was used for heating and cooking purposes. There was no electricity. Cooking was done on a tripod at the traditional fireplace, which also had religious, social and space heating significance. Collection of firewood was done mainly by women. Men also played a role in transporting the wood back to the village provided animal-drawn carts were available. These

[4] Fieldwork done by Govind Kelkar, 2004

animal-drawn carts were otherwise used for construction activities, men's main sphere of activity (besides practising Lamaism). Otherwise, women transported the firewood as head loads to the village.

By 1997, there were improved woodstoves in every house. Most of the cooking, for both the guesthouses and the families, was done on the improved stoves. The traditional fireplaces remained, but were mainly used for space heating and with their religious and social significance. The owners of guesthouses often had LPG stoves, but these were used only for emergency cooking when, for instance, guests arrived late. Electricity was used for lighting and entertainment.

Although wood remained the main fuel, it was no longer collected by the women of guesthouse owning families. Instead, they purchased wood from the Yi, who would bring it from the upper mountains once a month. Thus wood, although a traditional fuel, had ceased to be a non-purchased fuel for a number of households. Wood had become a purchased fuel, and thus would be subject to comparative economics. Charcoal also became a purchased fuel, again bought from the Yi, to be used for barbecues.

During a recent 2004 visit, further changes had become evident in the fuel use system. Most houses now had LPG stoves and electric rice cookers. Not only owners of guesthouses but also other households, including those who performed various tourist services, such as barbecuing, organising horse or boat rides and other forms of entertainment, had both LPG and rice cookers. For household cooking, these two options had become the dominant systems.

Women have taken the lead in organising LPG. They are the household managers and run the guesthouses. The LPG cylinders have to be obtained from Yongning town, 21 km away. A village person has set up a transport system for this – he gathers all the orders and then gets the cylinders from the town in his van.

Where larger quantities of food have to be cooked, large wood-burning stoves are used. People are employed for this type of cooking.

Zhengbo

In contrast to the transformations in Luoshui village, where tourism has emerged as the main source of income, the Mosuo village of Zhengbo has largely been unable to participate in this development (He Zhonghua, 2003). The village retains its traditional agrarian structure with animal husbandry as a sideline activity. However, one-crop farming and animal husbandry do not produce much income. In some households, people migrate to pick up odd jobs to earn some money. They also sell some of their grain, livestock, mushrooms, and medicinal herbs in order to buy daily necessities, such as woven bamboo articles, brooms and butter. Villagers commonly keep a dozen pigs and four or five horses for home consumption or use, but seldom sell them. At most they might sell a few chickens or piglets and, in the event of urgent need, possibly a horse or a cow may be sold. People still rely on the natural economy for self-sufficiency.

Farming as a single-product economy may solve the problem of obtaining food, but it is incapable of improving the living standards of villagers to any great extent. To date, only three households own a washing machine or telephone, and the whole village has only one truck to haul wood and this is not in use. Sixty percent of the households do not have television sets.

Fuelwood dominates energy supply; apart from wood only a small quantity of sunflower stems and corn stalks are burnt. Moreover, the consumption of firewood is very high with very few improved

stoves in use. The provision of this firewood is a serious problem for the village of Zhengbo because there are no trees around the village. People have to go into the state forests to collect firewood.

Zhashih

The Mosuo village of Zhashih is similar to Zhengbo. The main income is from agriculture, supplemented by animal raising. There is no tourism in the area. The traditional tripod stove is used for both cooking and heating and all the households in this village collect firewood, no-one buys it. Electricity is used for lighting.

The one recent change has been the introduction of a few rice cookers and LPG in a small number of households. Out of a total of 61 households, six have rice cookers and two have LPG. These are in households where the women work outside the village, creating obvious pressures on women's labour time.

In addition to the comparison of the Mosuo villages given above, there is a similar strong contrast between the adoption of improved stoves in tourism-dominated and non-tourist Dai villages in Xishuangbanna, Yunnan Province. The former showing a universal adoption of labour-saving equipment, not only improved stoves but also piped water, and the latter continuing with the traditional three-stone or tripod fireplaces. As one would expect, the growth in women's cash earning potential has led to savings in women's domestic labour in areas such as fetching fuelwood and water.

There is also a shift from household-based collection of fuelwood from forests to either cultivation of suitable trees in the home garden or the purchase of firewood. In general, the development of tourism means a shift from a general to a specialised economy. Such development of specialised economic activities need not lead to a loss of sustainability. In fact, specialised commercialisation may actually promote sustainability. Take the case of fuelwood: where fuelwood is collected from common land, often using women's labour with a very low opportunity cost, there tends to be an overuse of labour in the collection of fuelwood and a lack of measures to increase the productivity of the product. But as commercial activities which involve the use of women's labour develop, then that community or village may cease to collect fuelwood and instead purchase it leading to commercial pressures to increase efficiency and sustainability.

The development of tourism in itself requires that some direct attention be given to forest conditions since these are part of the scenery that attracts tourists. The Hani village of Manmo has preserved its own forest in order to provide a 'walk in the rain forest' (Pierre Walter, 2004). Cutting trees or even collecting branches has been forbidden in this forest. While this has meant some movement towards growing fuelwood trees, there has also been a change in the area used for wood extraction. The 'other side of the hill', not visible to tourists, has been denuded. Thus, rather than a sustainable solution, there could be a displacement of the problem.

There may be either a simple displacement of the problem, with extraction shifted elsewhere; or an intensification of production, with a saving in the use of land and labour. The crucial factor is the availability of labour. So long as labour is available and has a low opportunity cost, extensive methods of fuelwood collection continue. However, when the opportunity cost of labour, in particular the opportunity cost of women's labour, increases there is pressure to reduce the labour cost of collecting fuelwood. From gathering fuelwood, the move is made to cultivating fuelwood, which is more sustainable than collection.

Forests' environmental service function, as scenery or recreational value, becomes more important than its direct income value. This holds true even for state-owned forests. The tourist village of

Luoshui, Lugu Lake, is very mindful of the condition of the state forest on the hills above. It is important as it protects the road leading to the village, and as part of the attractive scenery around the lake. Thus, unlike in many other parts of China and Asia, the villagers do not make a distinction between state-owned and village-owned forest, and so do not protect the latter and denude the former as occurs elsewhere. As a result, it is not difficult to enforce the rules that protect the state forest.

Xinrong and Xihu

These two villages are homes to the Naxi, a patrilineal minority community. They are close to the county town and the major tourist centre of Dayan by the Lashih Lake in Lijiang. Most young men of both villages work in the town. Young women and their mothers-in-law work mainly in agriculture and animal raising, and so work in the village. Older men tend to stay at home and look after children.

Electricity is used for lighting and rice cookers, which about half of the households in each village have purchased and use. There have been experiments with biogas, but the villagers were not enthusiastic due to the level of maintenance required. Pig feed is prepared on improved wood stoves in both villages. However, while in the village of Xinrong dinner is cooked in the traditional fireplace, in Xihu dinner is cooked either on the improved stove or using LPG (which 20 out of 72 households have). Women do most of the cutting and carrying of wood from the mountains, which takes two to three hours a day. The women commented that the men rarely helped them in cutting and storing the wood, and played *majong* all the time. They were pleased with a government regulation (1996-1997) that had enabled them to have fuel-efficient stoves, which reportedly halved fuelwood consumption. LPG was seen as expensive, so its use was limited to dinner and to some of the economically better off households. However, half of the households did use rice cookers. (Correct)

In both villages, the older men do a lot of the work in and around the house. Women, both young and old, tend to work much more in the fields and in raising animals. The older men also do some of the cooking, particularly lunch, and look after the children. Women however cook the main meal of dinner.

Villages on Lao-Thai border in North Sayaboury, Lao PDR[5]

In the second half of the 1990s, in the province of North Sayaboury on the border with Thailand, weaving changed from being an activity carried out by women for family consumption and for gifts, to an income-earning activity. There was a large demand for woven and embroidered cloth from across the Thai border. When a road was built connecting the two sides of the Lao-Thai border, weaving and embroidery became the major income-earning activity of Lao women in many districts along the border.

As weaving and embroidery became new income-earning opportunities, women spent more time on them and reduced the time spent, or even abandoned, earlier livelihood activities such as collecting non-timber forest products (NTFP) for sale. Along with substituting livelihood activities that yielded a higher return for those that yielded a lower return, women also modified various domestic activities. For example, they economised on time spent cooking: instead of cooking three times a day they cooked only twice.

[5] Fieldwork done by Dev Nathan (2002)

Further, they substituted commodified services for former labour-intensive methods of production for self-consumption. Instead of hand-pounding rice they took to using commercial rice mills. In the district town of Xienghone, two rice mills were established after the construction of the road and the advent of the cloth trade. This successful commercial investment in rice mills can be contrasted with the experience in another Lao province. In the province of Xienkhouang, the Mennonite Christian Church tried very hard, but unsuccessfully, to get Hmong women to adopt labour-saving but priced corn-milling services.

Substitution also took place in terms of fuelwood. In villages that were fully involved in the cloth trade, women no longer collected wood but bought it instead. There was a step-by-step transition: from initially only women collecting wood, to the collecting shared by women and men, to buying wood. Along with this, women also adopted the fuel-saving bucket stove in place of the old three-stone stoves. Thus, there was a two-fold change in women's provision of cooking services – parts of the labour were commodified (buying of fuelwood), while for other parts (cooking) labour-saving devices were purchased.

Finally, men also came to share a greater part of the burden of domestic labour. This was particularly with regard to childcare, and to an extent with cooking. Women commented that when men returned home hungry from the fields or forest, if the women were busy weaving, the men would prepare some food, at least for themselves.