Natural Resource Regeneration:

Its Impact on Behavioral Changes in the use of

Cooking Fuels and Health

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Abstract

Exposure to traditional cooking fuels has been strongly linked to respiratory and other serious health problems in women and small children. Its use is also associated with poverty. The study undertaken was part of a wider research into health outcomes related to environmental regeneration. In this paper we investigate the outcomes of Watershed Development (an environmental regeneration effort) implemented in drought-prone areas and its impact on cooking fuels used. A total of 1,320 households from 28 villages under the Indo-German Watershed Development, Maharashtra, India, were recruited into the study, grouped according to the stage in project implementation. The correlation between the response variables (type of fuel used and the kitchen located in a separate room) and the explanatory variables (years in WSD, socio-cultural communities, women's involvement and women's literacy levels) was studied. The results suggest that with the progress of watershed development and the associated increase in income, households constructed a separate kitchen (p-value =0.01). The active involvement of women's groups has a significant impact on the adoption of the more efficient fuels (p-value =0.01) irrespective of the high levels of illiteracy of adult women (p-value >0.05). Households that use cleaner fuels spend less time cooking (p-value <0.05). The self-reported health complaints (cough and irritation of the eyes) of the main cook are less in households using the cleaner fuels.

This study has policy implications as it addresses the challenge that developing countries face: of having poor rural households desire, afford and use cleaner cooking fuels. As an alternative to the ban on tree felling, when the use of cleaner fuels is proposed as an expected outcome, the shift will be hastened as the attention of participating NGOs and local inhabitants will be drawn to it.

Keywords: Natural resource regeneration; cooking fuels and health; women and development; Watershed Organization Trust (WOTR); Indo-German Watershed Development Programme; India.

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I Introduction

Indoor Air Pollution (IAP) in developing countries has been identified as the cause of 6% of the overall burden of disease. It is responsible for an estimated 290,000-440,000 premature deaths due to Acute Respiratory Infections in Indian children under 5 years of age (Murray and Lopez 1996) and chronic respiratory problems (Cor pulmonale, bronchitis, tuberculosis and lung cancer) in non-smoking women of a younger age in rural areas. An analysis of the National Family Health Survey (NFHS:1992-93), India, has linked traditional biomass fuels (wood, agro-wastes and dung cakes) to 51 percent of active TB cases, 17 percent of partial and 20 percent of complete blindness, cataract and the other chronic respiratory illnesses in women (Mishra and others 1999). Other studies have linked IAP to otitis media (Daigler 1991; Strachan 1998), still births and low birth weights (Murray and Lopez 1996). An association has also been demonstrated between the traditional fuels (wood, agro-wastes, dung cakes) used and the demographic picture of a country. The greater the use of traditional biomass fuels, the higher the infant and child mortality, total fertility and the lower the life expectancy (Bloom and Zaidi 1999). Poverty is the underlying denominator.

Attempts are being made by the Indian Government to reduce smoke output by traditional stoves. Since the introduction of the National Programme on Improved Chullas (cooking stoves) in 1983 [though even at best, biomass stoves do not greatly reduce the health-damaging pollutants (Ezzati and Kammen 2001)], approximately 30 million stoves have been disseminated with the state subsidizing at least half the cost. India's Ministry for Non-Conventional Energy Sources had by the end of 1998 installed almost 2.8 million biogas digesters and had identified a potential for 12 million (UNDP 2000) more. The availability of kerosene and liquefied petroleum gas (LPG) through the Public Distribution System is but another attempt by the government to promote cleaner fuels. Yet, despite these efforts, the NFHS of 1998-99 revealed that in rural India, biomass fuels provide 89.6 percent of cooking energy sources, coal / coke (1.7 percent), kerosene (2.7 percent), biogas (0.5 percent) LPG (5.1 percent) and other sources (0.4 percent).

Deep-rooted local traditions have been identified as a cause of resistance to change. Others have indicated that policy makers have not sufficiently considered gender issues, although women are those usually involved with and affected by cooking fuels (Parikh J and Vijay Laxmi 2000). The low acceptance of efficient energy sources is also closely associated with affordability and its availability. While efforts are being made towards improving technology and making clean fuels available at lower costs, the challenge is to help the majority poor households desire and have access to these cleaner fuels on a sustained basis.

With 92.7 million hectares of degraded and waste-lands (Mohan Daria Committee Report 1995) that contribute to its poverty situation, India has millions of households caught in the poverty trap. Efforts are being undertaken by both the state and external donors, to drought proof these regions and help towards poverty alleviation by natural resource regeneration and watershed development (WSD).

Watershed development consists in the regeneration of the environmental resources of a catchment / basin of a stream or river system. Treatments comprise of developing forests, pasturelands, raising soil conservation measures and building water-harvesting structures (gully plugs, check-dams) along the water-courses. It also includes developing appropriate land use and economic strategies that meet both conservation and production needs.

The Focus and Scope of this Study:

This study analyzes the effect of a WSD intervention on cooking fuels used and the health outcomes. It examines:

1. the changing trends in:
   - the choice of cooking fuels,
   - changes in house structure regarding the location of the stove and
   - the self-reported health complaints of the main cook related to the type of cooking fuel used.
2. It identifies the determinants of change in cooking fuels used and
3. identifies indicators, that when included as expected outcomes, would reflect the impact on health, related to cooking fuels.

2. General background on the Program and Area under Study

This research has been based on data obtained from projects of one such intervention, "The Indo-German Watershed Development Programme, Maharashra, India"[1]. Started in 1992, the IGWDP is being implemented in 129 projects (as of March 2001), involving 171 villages, in 77 blocks of 22 districts of Maharashtra. A total of approximately 1,80,000 people live in these villages. The treatment of 1,35,812 hectares, has either been completed or is in progress. Of the 129 projects, approximately 70 projects are situated in the rain shadow belt of the state and fall in the districts of Ahmednagar, Beed, Aurangabad and Jalna. At bilateral program level, on the German side are the GTZ (German Agency for Technical Cooperation) and the KfW (German Bank for Development) and their Indian partners are WOTR (Watershed Organization Trust, a NGO) responsible for the Capacity Building Phase,

[1] *In this article, the IGWDP comprises of two sub-programs 1) a major bilateral one, funded by official German Development Cooperation and 2) a smaller NGO [Misereor] funded sub-program (24 projects covering 13,411 ha.). The guidelines followed are similar for both.*

Women's Promotion, as well as for overall program coordination and NABARD (National Bank for Agricultural and Rural Development) responsible for the Full Implementation Phase. The main actors at the individual project level are the local inhabitants (watershed dwellers) and their Village Watershed Committee who implement the work with the support of an accompanying NGO. There are 63 NGO partners involved in this effort.

The Objective of the IGWDP is poverty alleviation through environmental regeneration on a watershed basis, through the self-help efforts undertaken by the local inhabitants. It is an attempt to retrieve desertified rural living spaces and alleviate poverty.

Health was not considered an integral component of the program (even at project level), because WSD requires an intensive community focus and effort. Introducing other activities although important would be distracting.

Related to this paper, the important features of the IGWDP are:

(a) A ban on tree felling;
(b) A ban on free grazing in areas brought under afforestation or pasture enrichment.
(c) Organization of a representative, empowered body of the people called the Village Watershed Committee (VWC) that plans, implements, manages the watershed effort and maintains the assets created;
(d) A statutory provision of 1/3 seats reserved for women on the VWC;
(g) The organization of women into self-help groups (SHG).

The Phases in the Project Implementation: Each watershed project goes through a Capacity Building Phase (CBP) - a "hands-on" training that lasts for approximately 12 – 18 months. If successfully completed, the watershed is accepted for full implementation. On completion of the CBP, a baseline survey is conducted for the proposed micro-watershed (ranging between 500 - 1500ha. = 5-15 sq. km). This includes a watershed treatment plan and budget and a socio-economic survey of all households involved. This baseline survey currently requires a maximum of 6 months. The total lifecycle of a project ranges from 5 to 6 years. Projects that entered into the Programme between 1993 and 1995 took a longer time for completion, either because the watersheds were much larger (over 2000ha.) and / or due to initial teething trouble.

Capacity building in the IGWDP was started in December 1993 and Women's Promotion and Gender Mainstreaming (WP) early in 1996. The watersheds of Pimpalgaon Wagha and Kasare of Group IV (refer to Section 3:1 below) had no CBP or WP, while Mendhwan had some elements of both included late in project implementation. The villages of Group III represent an experimental period, since WSD work had already begun and WP measures were introduced encourse. Only the villages of Group II and of Group I have

capacity building and women's promotion included from their entry into the program.

3. Description of the Research

3.1. Selection of Project Villages and Population for the study

3.1.i. Geographic location: 28 villages (out of 129) have been selected for this study. Of these, 23 villages fall in the rain shadow belt: 18 are in the Ahmednagar district (Western Maharashtra), receiving between 250-450 mm rain; 2 each in the districts of Aurangabad and Beed and 1 in Jalna (Marathwada) receiving 400-600 mm rain per annum. Besides these, the 3 projects that are situated in Vidarbha and 2 of Ahmednagar district do not fall within the rain shadow belt.

3.1.ii. Socially disadvantaged communities: Of the 28 villages, 6 have largely scheduled tribes (ST) communities; 1 village belongs to the other backward classes (OBC) (Constitution of India article 341 & 342). The 21 other villages have mixed populations. In these latter villages, the nomadic tribes, ST, OBC and schedule castes are less as compared to the other caste communities. All the predominantly (over 75 percent) tribal and OBC communities, with the exception of 1 village, are situated in remote areas.

3.1.iii. Age in Watershed Development : The project villages selected are in different stages, ranging from those villages that have agreed to, but have not yet entered into the program (at the time of data collection) to those in the post WSD phase (2-6 years after project completion). According to age, the projects are grouped as mentioned below. These groups will henceforth be referred to in this paper.

Group I Recently initiated projects and those about to enter **10 projects.**
Of the 10 projects in this category, 7 have less than 2.6 years since entry into the program, while 3 have not yet entered.

Group II Projects currently under full implementation **7 projects.**
The baseline studies were completed between 1997 – 98, but capacity building was initiated approximately 12 months earlier. Both capacity building and women's promotion measures were undertaken from the outset.

Group III Projects completed between year 2000 and May 2001. **8 projects.**
The baseline surveys were conducted between 1993 and 1996. They had undergone capacity building, but women's promotion measures were initiated only later.

Group IV Post Watershed Development Projects (2-6 years since project completion) **3 projects**.

These were initiated between 1988 and 1990. Villages Pimpalgaon Wagha and Kasare were not IGWDP projects. Mendhwan had some components of capacity building. Women's promotion was initiated very late in project period.

3.1.iv. Selection of households for study : Being part of a larger study that includes outcomes related to the nutritional status, data was collected from households that have children of 5 years and below. This represents approximately 35 percent of total households. Selection by this category is considered inclusive since all socio-cultural communities and classes of the population are represented. Since all households living within the watershed are included in the project, the study would reflect the impact on the village/s as a whole.

3.2. The Data Collection and Sources

3.2.i. A socio-economic survey + health survey (questionnaire).

For individual households, the socio-economic survey format (developed in 1997) has been used for the Baseline Survey as also for Survey 2000 (survey pertaining to this study). Survey 2000 also included health related questions. For all 28 villages, Survey 2000 was completed between December 2000 and February 01.

The villages and households included in this study are as follows:

Groups	No of Villages	No. of Households
Group I	10	359
Group II	7	426
Group III	8	377
Group IV	3	158
Total	**28 villages**	**1320 households**

3.2.ii. Focus - Group Interviews were conducted with 5 villages. Two villages and some of the participants were not included among the households surveyed (Survey 2000). These were villages where many households are now using LPG or biogas. The purpose was to understand why this particular activity was prioritized, how the local people were involved and whether they saw any relation between the use of LPG / biogas and their health. In mixed groups (men and women), a total of 83 women and 33 men participated in these interviews.

3.3. Data Analysis

The analysis is presented in three parts: The first (Figure 1) is related to the changing trends in the use of cooking fuels and the location of the kitchen. For the purpose of this study, fuels used daily for cooking and heating water are considered and not fuels used less regularly or occasionally. The *p*-value

from the chi-square test was examined for the differences between groups with regard to the changes related to use of fuels and the shift to a separate kitchen.

The second part (Tables 1,2, 3 and 4) is related to the factors affecting the change in fuel use. The baseline and survey 2000 data for income of households of groups II, III and IV were compared. The Spearman Correlation Coefficient was used to measure the degree of association between the response variables (cooking fuels regularly used and the location of the kitchen in a separate room) and the explanatory variables (years in WSD, female illiteracy, the socio-cultural communities, the intervention promoting women's involvement). The **years in WSD** were calculated from the month when the project entered into the program. The composition of the **socially disadvantaged communities** was calculated from the percent of households (in the village as a whole) that belong to the schedule tribes, nomadic tribes, other backward classes and schedule caste communities, as these are considered economically poor and backward. **Female illiteracy** was defined and calculated on the basis of households surveyed (survey 2000) that have no adult woman who has entered primary school. **Women's involvement** was calculated by rating the project according to (i) the percent of all adult women (of the village/s) involved in their self-help groups' (SHG) saving and credit operations and the number of years of SHG activity, (ii) developmental activities undertaken (implementation of kitchen gardens, latrines, biogas, LPG, health activities, adult literacy classes etc.), (iii) income-generating activities undertaken, either individually or in groups, but mediated through their SHGs and (iv) implementation of activities that involve decision making and responsibilities at village level (eg. a drinking water project, child care center -Anganwadi). The score obtained was from a maximum of 40 points. Women's involvement in the WSD activity and the VWC has been assumed, as this is an expectation in all IGWDP projects.

The third part of the analysis (Tables 5 & 6) consists of the health impacts. In Table 5 we observe the association between the self-reported health complaints (the previous 2 weeks) of the main cook associated with the fuels regularly used. As observed in Figure 1, while households using the cleaner fuels may also simultaneously use traditional fuels regularly, to avoid double counting in the study on the health complaints, households using cleaner fuels were deleted from the total using traditional fuels; thus the total of 1320 households was maintained. Table 6 relates to the hours spent using the different fuels. The hours spent in cooking were an estimate reported by the main cook. The chi-square test was used to examine the difference between the hours spent cooking with the 3 different types of fuels used.

4. Research Findings and Discussion

4.1. Limitations of this study

A limitation is that there are just 2 each of the Vidarbha and Marathwada regions (in Group II and III) as compared to 11 villages of the Western Maharashtra hence a valid regional comparison cannot be drawn. One might say that this study is mainly representative of the Ahmednagar district that has approximately 45 of 129 villages of the IGWDP.

A second limitation is that the health effects observed are from self-reported complaints. There was little data available from the Government Health Sub-centres, primarily because many of the people go to private practitioners who do not keep records of the patients attended to. Besides, the government health sub-centers that service most of these villages are managed by Multipurpose Health Workers who record only the symptomatic treatment given to the patients.

4.2 The Changing Trends

(a) Fuel sources: In Figure 1 it is observed that the sum total of the percent of fuels used regularly does not total to 100 percent. In Group I (most recent in WSD), the total is 102.4 percent, in Group III (projects just completed) it is 129.8 percent. When households begin to use the more efficient fuels (that have monetary cost), it is not uncommon to find that two or more fuel sources may be used daily. It is also observed in Figure 1 that in the Group I villages, almost all households (99.4 percent) depend on the traditional fuels. This gradually declines to 65.8 percent in the Group IV villages. Simultaneously, there is an increase in the use of kerosene and biogas / LPG.

(b) There is also a gradual increase in households constructing a separate kitchen (either attached to the main house or an independent structure), from 19.2 percent in the Group I villages to 56.6 percent in the Group IV. The change is significant for both (a) and (b) with a *p*-value of <0.001.

4.3 Determinants of change in use of cooking fuels and the location of the kitchen.

The factors affecting the change are observed in Table 1, 2 and 3 (for the different groups) and Table 4 (for the villages of group IV).

i. Socially disadvantaged communities: Villages that have a higher percent of schedule castes, other backward classes, schedule tribes and nomadic population, appear to be associated with the use of traditional fuels (*p*-value = 0.045), although these villages may be well advanced in WSD. But, little difference is observed with regard to the location of the kitchen. All

communities construct a separate kitchen when resources are available. It must be stated that the predominantly (over 75 percent) tribal and other socially disadvantaged villages are located in remote areas, have bad roads and had little or no prior exposure to developmental initiatives.

ii. The illiteracy of adult women in households: In table 1 it is seen that in all groups, the number of households where the women have not attended primary school is high (exceptions being Dhanora and Wadgaon of Group II). The NFHS 1998-99 reveals that there are 48.6 percent of women in Rural Maharashtra who are illiterate and another 18.7 percent who have less than primary school completed. The data of this study is quite consistent with that of the NFHS. Table 4. shows that Mendhwan, despite its 71.2 percent of the adult women who have not attended primary school, has 56.1 percent of households that have adopted LPG / biogas. And for Group IV as a whole, despite 75.9 percent of the women not having attended primary school, 28.5 percent have adopted LPG / biogas. The illiteracy of women does not appear to be significant in the acceptance of cleaner fuels (p-value = 0.06) nor the shift of the kitchen to a separate location (p-value = 0.09). This important finding shows that the drawback of women's illiteracy may to a fair extent be bridged by measures that foster women's promotion, organization and involvement.

iii. The impact of the years in WSD: Associated with an increase in income (p-value <0.001 ref. Table 2), this appears to be the basis of change and a significant factor (p-value = 0.0001) influencing the shift to more efficient fuels and a separate kitchen. There is a notable leap between the average 3 years of Group II (4.7 percent for kerosene and 3.1 percent for LPG/biogas) and the average 5.8 years of Group III (17 percent for kerosene and 26.8 percent for LPG/biogas). A preference for LPG/Biogas over kerosene is noted.

During the project period, there is a steady wage income from work done on watershed project sites. Hence the beginnings of the shift are noted early in the Group II villages. One may question the sustainability of the shift to cleaner fuels if this is dependent on wage income during the implementation phase (approximately 5 years). The response is given by the group IV villages (2-6 years post implementation) that continue to adopt kerosene and/or LPG / biogas. Other studies have indicated that as a result of WSD, agricultural productivity increases, diversification in the livelihood system occurs and value addition activities (eg. dairy) are undertaken, resulting in a general and increasing rise in income levels (NABARD Jan 1999; NABARD March 1999; Kulkarni and others, May 1999). This more than compensates for the loss of wage income (on watershed site) due to project closure. Moreover, it has been observed that the people in these villages continue to be responsible for maintenance of structures in the post-WSD period as well as enforcing the disciplines that have been extant.

iv. Women's Involvement: Together with increase in income and the years in WSD, women's involvement appears to be an equally significant determinant in the adoption of cleaner fuels (*p*-value <0.005). In Chart 1 and Table 1, it is noted that while women's involvement has 23.4 points for the Group II villages (average 3 years in WSD), there are only 4.7 and 3.1 percent of households that have adopted kerosene and LPG/biogas respectively. In the Group III villages (5.8 average years in WSD) that have an average of 27 points for women's involvement, there are 17 and 26.8 percent of households that have adopted kerosene and LPG/biogas respectively. While in the Group IV villages (with an average of 10.7 years in WSD) there is an increase of a mere 8.3 percent kerosene users and 1.7 percent biogas/LPG users viz-a-viz Group III. The marked difference is in the 27 points scored by group III villages as against the 15 points that Group IV has scored for women's involvement. The significance of women's involvement is more clearly noted in Table 4, where the three almost equally placed villages of Group IV are compared. There is a marked increased in acceptance of kerosene (39.4 percent) and biogas/LPG (56.1 percent) in Mendhwan that has 24 points for women's involvement, as compared to Kasare (25 and 2.1 percent for kerosene and LPG respectively) that has 15 points for women's involvement and Pimpalgaon Wagha (2.1 for kerosene and 15.9 for biogas / LPG) that has 6 points for women's involvement.

Women have little decision-making power and more so when it pertains to the adoption of cash-purchased household items related to "their duties" eg. cooking stoves. Hence in rural areas, changes are slow to occur. Efficient fuels are generally opted for when alternatives are affordable, available, when men also accept the investment costs and when women have some control over finances. In the interview with the group of Kangar (one of the 5 villages of the focus-group interviews), the women recalled how early in WSD (1996), because of the ban on tree felling, they wanted to purchase the improved earthen stove at the cost of Rs25/- (US $ 0.60). Many of the men had refused, saying that the traditional stove had been used since centuries and that they saw no need for a change. In 1999, homes in this same village began the construction of household biogas digesters. They took up this activity after they had visited the village of Kalamkarwadi, where 72 out of 146 households regularly use biogas. The amount they now invested was Rs5,500/- ($ US125)! These women, as members of self-help groups (SHGs), had taken a loan from their groups for the same. Biogas digesters were now accepted even by their men-folk.

The process of women's involvement is slow. It touches long-lived, established traditions. In the IGWDP, there is a planned process for actively involving women in the WSD effort. Since the entire village (men and women) participates, women are encouraged to organize themselves into SHGs, beginning with savings and credit as the initial activity. Besides this, they are also encouraged to discuss topics of their concern and to take up

relevant activities. Linkages with government departments are fostered. Inter village exchanges (village-to-village and women-to-women) that form part of the Capacity Building process for WSD and Women's Promotion in the IGWDP, are encouraged (WOTR 2000). The five villages interviewed in focus-groups stated that it was the experience of the other women that was shared and observed (during inter-village exchange visits) that motivated them to take up the LPG/biogas. Their SHGs provided them with the required capital (loan) to meet the initial costs. The women specified that they now spend less time and physical energy collecting fire-wood, cooking, as well as cleaning up the blackened vessels and house. Their men-folk have realized the benefit of time saved, that is now utilized productively. Households using biogas reported the additional advantage of financial savings, since they do not have recurrent monthly costs (except for the maintenance). All groups mentioned that the majority (75 – 90 percent) of the households of their village would like to shift to these fuel sources as soon as opportunities permit.

v. Other Inherent Components of WSD and the IGWDP that affect the change: These factors could not be examined separately, as only 2 of the 28 villages were not part of the IGWDP. This is too small a control group to be compared with.

a. Capacity Building of the local actors: This is a "hands-on" training and accompaniment pedagogy involving both the local NGO and the village participants – the village watershed committee (VWC), who are the main implementers of the watershed project. In brief, CB includes technical aspects, accounting procedures and especially social mobilization and management skills. Enforcing the disciplines of a mandatory local contribution, the ban on free grazing and tree felling is the responsibility of the VWC. The Participatory Operational Pedagogy includes active steps for women's involvement at all stages (WOTR 2000) and is initiated early in the CBP. Since the ban on tree felling is imposed on all (affecting women's household chores) and since the VWC is responsible for its compliance, the NGO, the VWC and the women's organization are responsible for finding alternatives. During the CBP, a conscious effort at gender mainstreaming which seeks to involve men in the advancement of their womenfolk is made. A consensus building approach (as against a confrontationalist one) that promotes women's enablement and participation, in a manner that increases family well-being, while yet creating space and financial security for women, has resulted in its acceptance and promotion by the men-folk in general, as it is not perceived as threatening. Without this support, the shift to cleaner but costlier fuels would not have been possible. Hence one may consider this "capacity building" input, an important factor in facilitating the change to cleaner fuels.

b. The Ban on Tree Felling and the Ban of Free Grazing on afforested areas: The baseline data (source: WOTR - records of the baseline survey of projects) of the villages of Groups II and III reveal that almost all households of

Western Maharashtra and Vidarbha regions used fuel wood, cattle dung and agro-wastes to meet the daily energy requirements for cooking and heating water. Fuel wood was obtained from the trees on their own lands, common property resources (CPR) and from forest-land. Kerosene was used, but by only very few households. Biogas / LPG may have been used by just 2 or 3 of the rich households of the village. This corresponds with the present situation of the Group I villages, where a mere 2.2 and 0.83 households use kerosene and LPG / biogas respectively. One thus observes that biomass from local sources especially from forest-land, CPR and wastelands provided the bulk of energy sources for cooking and heating water in villages, corresponding with NFHS 1998-99 data that indicates that 73.1 percent of rural households use wood, 8.1 percent use crop residues and 8.4 percent using dung cakes. In this context, the ban on tree cutting and free grazing imposed by WSD assumes importance. These social disciplines are imposed for sustainability of the regenerated resources. While lopping of branches may be done, no tree should be so damaged that it would later perish or be destroyed. Both bans are strictly adhered to (in the IGWDP) and the VWC is responsible for its compliance. These are topics discussed in the Gram Sabha (village general body meeting) and a penalty is imposed by the VWC on defaulters.

The ban on tree felling was the most burdensome for the women. In the focus-group interviews, they recalled the earlier days (even prior to using the LPG / biogas) when they would spend a minimum of 4-5 hours a week (in some situations a whole day) wandering in search of fire-wood. They mentioned that besides the ban, wood in general was scarce as the forests were diminishing. This costly imposition compelled the women, their men-folk and the supporting NGOs to plan for alternatives. Initiatives were taken early on by some NGOs, who accessed government alternate household energy schemes. These villages and the individual households that had earlier constructed biogas digesters are now the ones who consciously or unconsciously motivate others into using the better fuels. They are the promoters, effecting this horizontal spread.

The ban on free grazing on afforested lands (private and common) is to ensure that the planted saplings survive and that the natural vegetation is given sufficient time to recover. The closure of afforested lands ensures that after a period of time, there is greater availability of biomass (wood, grasses and vegetation) for fodder and fuel purposes, within and near the village. Today, due to the tangible impact - an increase in fodder availability - the ban on tree felling and free grazing is appreciated. The enhanced land productivity and the fodder available on the degraded areas, have given an opportunity to households (and even landless agricultural labourers) to purchase cross-bred cattle, the dung of which feeds biogas digesters.

vi. Other contributing factors: Besides the above, there are other determining factors that affect the adoption of cleaner fuels such as, regional

and geographic circumstances. The villages of Vidarbha and Marathwada are slow to accept change, as compared to projects of Western Maharashtra that exhibit a definite upward trend in the adoption of cleaner fuels. A contributing factor could be the level of development in these regions. W. Maharashtra is considered more developed and forward looking than Marathwada and Vidarbha in that order. Another contributing factor is the tree cover. The Vidarbha region has a better tree cover (providing sufficient fuel wood from loppings and twigs), while the Ahmednagar district is just treeless and even twigs are hard to find.

Other influencing factors such as distance from towns, distances from the LPG / kerosene supplier and availability of supplies and of transport, play a role when opting for LPG / kerosene. Villages with a high tribal population, are usually located in remote areas with poor transport facilities. A cluster of villages in the Western Maharashtra district of Ahmednagar found a solution when a woman (member of a self-help-group) of village Sarole Pathar took the initiative and linked up with the LPG supplier. There are 5 WSD projects around, besides other villages (as reported in the focus group interview). This increased accessibility gave a fillip to the adoption of LPG in the WS villages.

4.4 The Health Opportunities:

Despite the limitation of not having clinical records from medical centers, the symptoms of related health problems (irritation of the eyes and cough) expressed in the self-reported health complaints (of the main cook) appear significantly associated with the type of fuel used. In Table 5 it is observed that 50.9 percent of those exclusively using traditional fuels complain of irritation of the eyes, as compared to 18.2 percent and 6.8 percent using kerosene and LPG/biogas respectively. Of the traditional fuel users, 21.2 percent complain of cough as compared to 11.4 percent and 5.6 percent using kerosene and LPG / biogas respectively. As stated earlier, those regularly using kerosene and LPG/biogas may also simultaneously use traditional fuels.

In table 6 one observes that of the households using traditional fuels, 37.4 percent spend approximately 2 hours each day on cooking as compared to 51 percent of the users of LPG / biogas (p-value = 0.008). This signifies that when households use the more efficient fuels, less time is spent cooking as compared to the traditional fuel users.

Another interesting observation noted was the average of 1.2 children in the kitchen where traditional fuels are used, as compared to an average of 0.84 and 0.51 children in households using kerosene and LPG/biogas respectively. This corresponds with the macro-level observations of Bloom and Zaidi (2000) that have associated traditional cooking type of fuels with the higher fertility and birth rates.

Smoke of solid (traditional) fuels contains small particles that are incompletely burned and that are found in far higher proportions than the permissible standards to protect health (Smith and others, 2000). Petroleum products (kerosene and LPG) also produce sulfur and other contaminants, but to a lesser degree, since their physical form permits higher combustion efficiencies, thus making them more efficient and cleaner (UNDP 2000). Concentration levels of respirable dust are highest when cooking is done indoors and when traditional fuels are used. Besides, the number of meals cooked per day using wood, has significant impact on women (Parikh. J, Vijay Laxmi 2000). When the kitchen is located in a separate room, fewer household members are exposed to the fuel pollutants, but this would not reduce the impact on the little children (under 5) and the main cook who are near the stove.

As mentioned in the introduction to this paper, the health problems associated with traditional cooking fuels are many and seriously debilitating, the most important of which are chronic respiratory problems (Cor pulmonale, bronchitis, tuberculosis, lung cancer) for the main cook - usually woman (Padmavati and Arora 1976; Pandey 1984; Norboo 1991; Gao 1996; Medina 1996; Gupta 1998; Mishra 1999) and Acute Respiratory Infections in children (Mishra 1997; Murray and Lopez 1996; Pandey 1985; Kossove 1982; Amstrong 1991). Besides eye problems (partial, complete blindness and cataract) and otitis media earlier mentioned, adverse pregnancy outcomes (still-birth and low birth weight) have also been linked to traditional cooking fuels (Malvankar 1991; Boy and others 2000).

As observed in Figure 1, although the households may use the cleaner fuels as well as the traditional fuels (to a lesser extent) the impact as noted in Table 5, is that the complaints are significantly reduced. From this, one may assume that with the adoption of cleaner fuels and the shift of the kitchen to a separate room, there will be less people exposed to the fuel pollutants and that the period of exposure to the pollutants would be reduced (Table 6).

The forgotten health impacts: Besides these measurable effects, human energy wasted in the collection of fuel wood for household and the health risks (for women and children -especially the girl child) associated with its collection (injuries, backaches, sexual assaults) are often overlooked. The time saved collecting fuel wood, in cleaning blackened utensils and the room was expressed in all 5 focus-group interviews conducted. By the adoption of cleaner fuels, women conserve their physical energy, have the other risks reduced and save time (approximately 2-3 hours a day). This is greatly appreciated by the women.

4.5 Indicators reflecting health Impacts

The promotion of improved fuel stoves (kerosene, biogas, LPG) and its inclusion as an expected outcome in environmental regeneration projects, would indicate reduced negative health impacts especially for women and children.

5. Implications

This paper argues that the shift to and the adoption of cleaner, less polluting cooking fuels in rain dependent drought prone regions, is greatly facilitated and promoted by undertaking natural resource regeneration efforts along watershed lines, characterized by the following features:

a) The local people are the planners, executors and maintainers of the effort and created assets.

b) A conscious effort is made to mainstream gender and actively involve women right from the beginning. The effort should foster the active support of the men-folk while at the same time create space for women and increase their financial security.

c) The effort is linked to the local developmental network so as to particularly avail of existing government programs promoting cleaner fuels.

7. Conclusion

It is observed in this study that Participatory Watershed Development (and natural resource regeneration efforts) has a significant potential for combating serious health hazards attributed to the use of traditional cooking fuels. It creates the climate necessary for a sustainable shift to cleaner and more efficient fuels by the in-built disciplines: the ban on tree felling that compels the locals to search for alternatives; the ban on free grazing that makes the otherwise barren, degraded lands a resource for fodder. The improved land productivity, the potential for an increase in improved cattle stock, (which in turn permits biogas digesters) and the human resource development, all contribute to enhancing the economic levels of the otherwise poor rain dependent households. A significant change is observed between 4-5 years.

This study also strongly indicates that these positive impacts are obtained when the local inhabitants, especially the women are organized and are actively involved in planning, implementation and management of *their* projects. Thus the capacity building of the local people (men and women) and their organizations (VWC and women's SHGs) play a key role. An active organization of women at the village level, that involves the majority of adult women, can to a significant extent, bridge the gap created by the lack of literacy and its negative effects on the development process. The process of

coming together to regenerate their environment, especially when women are consciously included from the very beginning, instills in the people confidence and enables them to improve their competencies and skills (a pre-requisite for enhancing family income and welfare) and adopt newer and better technologies.

Changes to the cleaner and more efficient fuels would significantly reduce health problems and the drudgery of women, associated with the use of traditional cooking fuels.

The inclusion of the use of cleaner fuels and the shift of the kitchen to a separate room in NRR project expectations, would automatically positively impact the health of especially women and small children and would address the challenge that daunts policy makers – of making cleaner fuels accessible to poor households.

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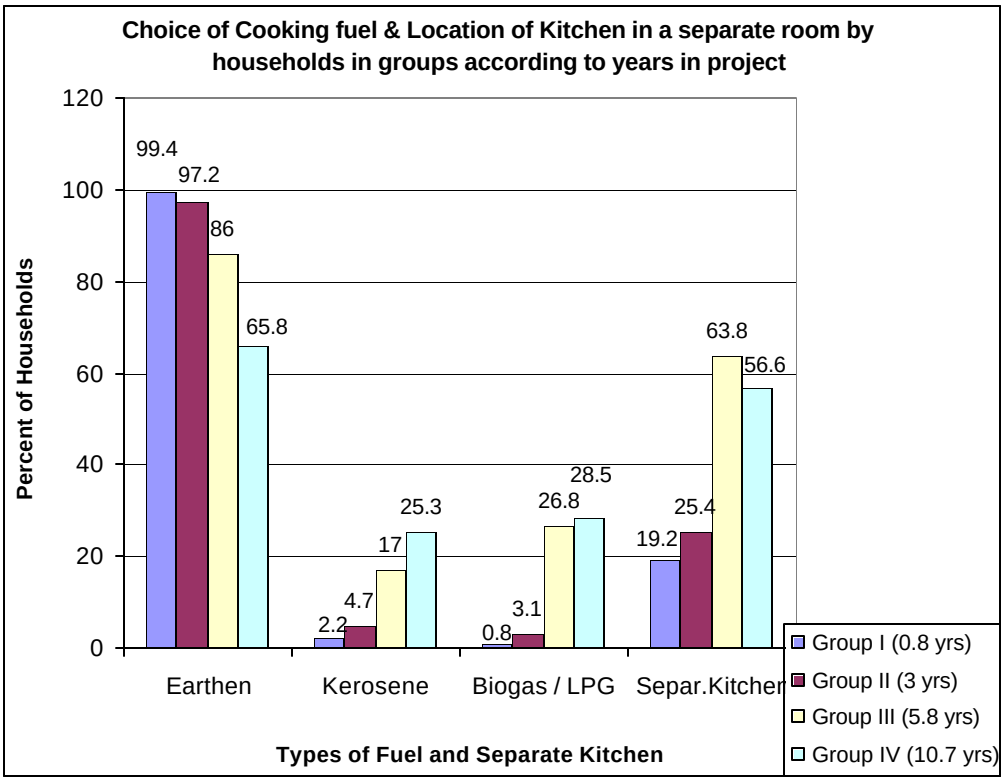
Figure 1



p- value < 0.001

Note: - The percent of HHs using the different types of stoves does not add up to a sum of 100. This is because one household may use more than one type regularly. The percent is calculated for each stove and group separately and according to the number of households of the group that regularly use the stove.

Table 1

Groups characteristics that effect the choice of fuels

Groups & Villages (No.)	Socially disadvantaged communities percent*	HHs with no adult women who entered Prim. School percent*	Years in WSD mean**	Women's Involvement Aver. Score/40***
Group I (10)	62.1	79	0.8	7.8
Group II (7)	26.1	61.3	3	23.4
Group III (8)	32.7	68.2	5.8	27
Group IV (3)	26.3	75.9	10.7	15

* The percent of each village was averaged for the respective group.
** The mean years for the group of villages.
*** The average score obtained over 40 for the group of villages.

Table 2

Comparison of the Income of the Baseline (Pre-WSD) Survey and Survey 2000 for villages II,III and IV

Groups & Villages (n)	Baseline Survey Households			Survey 2000 Households			Difference	
	observed	Mean	Std. Dev.	observed	Mean	Std. Dev.	Mean	*p*-value
Group II (7)	285	21804.4	22916.14	430	29733.34	34711.65	6251.56	0.001
Group III (8)	162	12161.47	12170.14	306	38283.03	45875.77	29399.78	0.0001
Group IV (3)	74	13471.7	19014.94	158	33690.06	26728.05	26973.23	0.0001

Note: The number of households in the Baseline survey and Survey 2000 are not the same because, some of the household are now nuclear. These belonged to joint households in the Baseline survey. The baseline data of some households could

Table 5
The predominant self reported health complaints of the main cook according to the type of fuel used

Type of fuel	Households Prioritizing No. of HHs	Irritation of Eyes percent*	Cough percent*
Traditional fuels	1026	50.9	21.2
Kerosene	132	18.2	11.4
Biogas/LPG	162	6.8	5.6

* percent who have the complaints.

Table 3
The Correlation tested by the Spearman Correlation Coefficient between determinants and the choice of fuels & the separate Kitchen (for 28 villages involving 1320 households)

	Earthen	Kerosene	LPG/Biogas	SeparateRoom
Women Illiteracy	0.31	-0.35	-0.22	-0.32
	0.11	0.07	0.25	0.1
Socially disadvantaged	0.38	-0.29	-0.34	-0.26
communities	0.05	0.14	0.07	0.19
Years in WSD	-0.66	0.59	0.59	0.46
	0.0001	0.0009	0.001	0.013
Women's Involvement	-0.48	0.5	0.5	0.35
	0.01	0.007	0.007	0.07

Note: The *p*-value is on the second line for each variable.

Table 6

Hours spent cooking using the different types of fuels

Type of Fuel	Households	maximum 2 hours		2.5-3.5 hours		> 3.5 hours	
	number	number	percent	number	percent	number	percent
Earthern Stoves	1026	325	31.7	318	31	383	37.3
Kerosene Stoves	132	38	28.8	60	45.5	33	25.7
Biogas / LPG	162	77	47.5	36	22.2	44	30.3

p- value = 0.008

Table 7

Average number of children under 5 years who are in the kitchen with the main cook. (break-up according to the fuels used)

Fuels used	Households	Children under 5 yrs.	
	number	number	Average
Traditional fuels	1026	1249	1.21
Kerosene	132	112	0.84
LPG / Biogas	162	83	0.51