Are adolescents from a forest community well-informed about forest management?

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Introduction

Sustainable management practices that promote conservation and involve forest communities in developing countries is a major social and political issue. There are only a few countries where communities have access to large forests; Mexico is one (Bray and Merino, 2004).

Mexican indigenous communities have access to nearly 80% of the country’s forested area (Thoms and Betters, 1998). More than a thousand are managing forests for wood production, following self-administration models stemming from the formation of Community Forest Enterprises (CFE). These CFE models were created in the 1970s by government agencies to give communities a stronger social organisation, economic development and participatory decision-making. Decisions are made in periodic assemblies of the entire community.

These communities are self-governing, administering their own forest technical services. Frequently, members of the communities working in this area have a technical training in forestry, biology and agronomy (Bocco et al, 2001); others have a university degree. The communities combine logging strategies with reforestation programmes to ensure long term forest management, profits and resource conservation. Their administrations look for economic and social development at community, not individual, level (Bofill, 2002). They provide employment, economic input into social programmes and equity distribution of the benefits (Bray and Merino, 2004).

Forest enterprise workers usually get better salaries than people working in other jobs. Some Mexican CFEs have developed national and international markets for their wood products and have invested in diversified production processes (PROCYMAF, 2003). This kind of activity offers more social and environmental benefits than other forest enterprises.

Mexico is undergoing rapid land use/cover change with a high rate of deforestation – some 0.51% per year between 1976-2000 (Mas et al, 2004). The permanence of these forest enterprises is an important challenge for many indigenous communities. Therefore, it is crucial to know if younger generations want to continue with these sustainable forest management practices, how well-informed and prepared they are on environmental issues, and what the role of the school plays in this process.

In the search for solutions to deforestation, researchers have paid scant attention to the benefits that schooling could have on conservation (Godoy and Contreras, 2001). Education recognises the central role of people in conservation efforts (Jacobson and McDuff, 1998). However, few studies in rural communities have worked closely with schools in order to find out what are the needs, interests and expectations of the school population towards environmental issues.

Previous research in Mexican forestry communities with primary and secondary school children, Barraza and Ceja-Adame (2003) and Barraza and Pineda (2003), found that forest management does not have a direct influence in environmental knowledge, attitudes, perceptions and sense of responsibility of adolescents. However, the educational learning system seems to have a strong effect on the way adolescents learn about forest ecosystems. This is why promoting and developing joint environmental projects between the school community and CFE workers is crucial.

Even successful CFEs need trained young people in forest management to guarantee conservation and forest production. In addition, working with young people is a challenge for three major reasons:
1. They represent an important sector of the population because many have finished their formal education and have started searching for jobs.

2. They are in a crucial stage of developing active participation and will later be leading and taking decisions in their communities.

3. There are few studies about interests and attitudes of adolescents concerning their professional future (Barraza and Pineda, 2003). They should be encouraged to look at problems by giving them accurate information to generate proposals, and so participate actively in different environmental projects.

The school should act as a bridge between the final stage of formal schooling and forest enterprise activities. This will enable continuity and success within the forest management plan: working with adolescents at high-school level is important for the continuity of CFE in forest communities.

In this paper the results of a participatory environmental education study, carried out in the successful central-Mexican indigenous forest community of San Juan Nuevo Parangaricutiro are discussed. The level of knowledge, the interests and expectations that high-school students (15-18 years old) have in relation to forestry and environmental issues are analysed. These examine the students’ interest in forest management as potential employment and the effect that the educational system may have on environmental learning.

Some studies suggest that people with more knowledge about the environment have more polarised attitudes (McFarlane and Boxall, 1999). However, there is still a discussion whether human attitudes are influenced or not by knowledge (Posch, 1993). Cognitive understanding does not automatically lead to strong attitudes about an issue (Moyer, 1975). The affective domain (feelings and emotions) seems to be crucial in understanding how children think and learn. Access to environmental information is important, but to ensure this information is being understood and assimilated by young children, more attention needs to be given to how this information is transmitted (Barraza and Cuaron, 2004). According to Fishbein (1967), attitudes and behaviours have a strong correlation with what people believe and perceive about the environment, so what people know and how they learn affects their interest. This research looked at whether or not there is an association between adolescents’ knowledge and their interest in community forestry.

**Why San Juan Nuevo?**

San Juan Nuevo Parangaricutiro is a Purépecha indigenous community located in the southeast region of the state of Michoacán. It has a population of around 15,000 inhabitants, of whom 1,300 are comuneros. The community is governed by the Mexican local administration and the indigenous traditional administration (Comisariado de Bienes Comunales).

Since 1981 San Juan Nuevo has a CFE, and it is one of the few successful community-managed forestry enterprises in Mexico. Most of its population rely directly or indirectly on forest activities, but only comuneros and their children can work in it. This Mexican community is probably the best-known internationally because of its strong social organisation and its sustainable management of forest resources. It has organised a fully integrated enterprise with diversified production strategies.

One of the major achievements of this community is its international recognition; the Forest Stewardship Council awarded it green certification for sustainable forest management in 1998, and this was renewed in 2006 (FSC, 2006). This designation is earned by companies conducting harvesting projects in accordance with a rigorous set of principles related to forest management activities.

In San Juan Nuevo formal education continues from preschool to high-school levels. However there is no environmental educational programme connecting the schools with community environmental activities at any level (Barraza, 2003). Therefore, in a community with an environmental management strategy like San Juan Nuevo, it is crucial to determine the expectations of adolescents about forest activities and discover to what extent the school curriculum develops programmes based on the interests of the community.

**Method**

**Sample and techniques**

San Juan Nuevo High School has 514 students from 15 to 18 years of age, 42% of them living in the community with less than 12% belonging to comunero families. The sample included 102 students in three groups, one from each year of schooling, which represented 20% of the total.

The methodological model of Barraza (2000) was used. In this: “environmental education is applied as a result of a research process in which the results determine the proposal for the educational program”. The framework theory was developed following the principles of the interpretative paradigm in environmental education research. Interpretative approaches to educational inquiry assume that human actions can be understood only in terms of meanings, and it is the task of interpretive approaches to explicate those actions and meanings (Robottom and Hart, 1993). How adolescents construct their environmental knowledge of the forests was explored by analysing their opinions, interests and perceptions.

Five assessment tools were used, two quantitative (textbook content analysis, and closed questionnaires) and three qualitative (sentence completion technique, interviews and observations).

**Text-book content analysis:** All 25 compulsory textbooks used in the high school curriculum were analysed in order to find out which environmental concepts were included in the curriculum, which were related with forestry issues and the frequency they were cited.

**Closed questionnaires:** Students were asked to choose the meaning of 10 general and local environmental concepts (Figure 1). They had to choose the one right answer from four possible definitions. To design questions about general environmental issues, five concepts were randomly chosen from the textbook content analysis: 1) ecosystem, 2) food chain, 3) sustainable development, 4) silviculture and 5) renewable resource. The other five questions were based on local and regional forest management information: 6) forest ecological function, 7) vegetation composition 8) vegetation structure, 9) forest degradation consequences and 10) Michoacán deforestation causes. Data was analysed according to the percentage of correct answers for each question.

**Interviews:** Teachers were interviewed about their teaching methods and to verify the use of the environmental concepts chosen for the closed questionnaire.

**Sentence completion technique:** This exercise provided information on the adolescents’ preferences and interests about
their professional life in relation to CFE. They were given five unfinished sentences to complete: on the curriculum (My favourite school subject is...); their professional future (When I finish my studies at high-school, I will...; I think going to university is...); their favourite place to live and their ideal job (When I will be 30 years old, I will work in...; In the near future, I would like to live in... and I would like to work in...). Data was evaluated using thematic categories for each sentence.

Observations: Observations in the classroom helped to understand how the learning process at high school related to environmental issues, forest management and activities done at the CFE. We also looked at the interactions and social dynamics between students and teachers, and among students themselves. The educational materials and techniques that teachers used in their classes were systematically recorded. We noted when teachers integrated other subjects while teaching environmental themes, for example if they mentioned forest enterprises in their explanations.

Data analysis
Interviews, observations and the sentence completion technique were analysed qualitatively, describing and interpreting them through constructing categories. Additionally, the sentence completion exercise, the textbook content analysis and students’ answers to the closed questionnaire were analysed by frequency and percentage.

In addition to descriptive data analysis, statistical significance was tested using the ordinary least-squares (OLS) regression of five variables within two possible associations. Regressions were constructed with data obtained from the closed questionnaire and sentence completion exercise data (Table 1):

Table 1. Summary statistics of variables used in regression.

<table>
<thead>
<tr>
<th>Name</th>
<th>N</th>
<th>Mean</th>
<th>Std Dev</th>
</tr>
</thead>
<tbody>
<tr>
<td>Knowledge</td>
<td>102</td>
<td>6.196</td>
<td>1.741</td>
</tr>
</tbody>
</table>

**Outcome variable**

<table>
<thead>
<tr>
<th>Job</th>
<th>Gender</th>
<th>Living place</th>
<th>Comunero</th>
</tr>
</thead>
<tbody>
<tr>
<td>81</td>
<td>102</td>
<td>102</td>
<td>102</td>
</tr>
</tbody>
</table>

**Explanatory variables and controls**

a. Desert, temperate forest, tropical forest
b. Wetland, atmosphere, forest
c. Tree, coast, coral reef
d. Biosphere, desert, sea

2. It is the function of the plants in the food chain
a. Decomposers
b. Consumers
c. Producers
d. None of them

3. What does sustainability means?
a. Using natural resources to satisfy human current necessities
b. Keeping natural resources to future generations, without using them now
c. Using natural resources to satisfy human current necessities taking into account future generations’ necessities
d. Consuming natural resources without limits now and in the future because they never finished.

4. What does silviculture means?
a. Fish cultivation
b. Syllabus cultivation
c. Agriculture of trees
d. Tropical forest cultivation

5. Which one of the following sentences is true?
a. Fossil combustibles are a renewable resource
b. Water is a renewable but limited resource
c. Tropical and temperate forests are not renewable resources
d. Solar energy is not a renewable resource

6. What is the ecological or environmental function service of forests?
a. They provide wood
b. They are in the mountains
c. They are an oxygen source
d. They offer shadow

7. Which group of plant species can you find in the forest of San Juan Nuevo?
a. Silver fir, tule, pine
b. Pine, oak, banana tree
c. Huizache, pine, lemon tree
d. Pine, oak, silver fir

8. What is dominant in San Juan Nuevo forests?
a. Tree
b. Shrub
c. Herb
d. None of them

9. What it is happening in the world because of forest destruction?
a. Nothing because there is still enough vegetation
b. There is an ozone hole
c. Increment of soil degradation and reduction of water availability
d. Biodiversity is increasing

10. What are the main causes of forest degradation in the state of Michoacan?
a. Forest fires
b. Land use change for agriculture and illegal logging
c. Houses made with wood and cooking using wood
d. Timber harvest to make furniture and paper
### Table 2. Environmental concepts found in textbook analysis.

<table>
<thead>
<tr>
<th>Biology</th>
<th>Ecology</th>
<th>Environ</th>
<th>Problems</th>
<th>Forest elements</th>
<th>Forest management</th>
<th>Disciplines</th>
</tr>
</thead>
<tbody>
<tr>
<td>23 concepts</td>
<td>21 concepts</td>
<td>16 concepts</td>
<td>29 concepts</td>
<td>21 concepts</td>
<td>22 concepts</td>
<td>7 concepts</td>
</tr>
<tr>
<td>292 quotat.</td>
<td>159 quotat.</td>
<td>192 quotat.</td>
<td>200 quotat.</td>
<td>168 quotat.</td>
<td>94 quotat.</td>
<td>21 quotat.</td>
</tr>
<tr>
<td>Living being</td>
<td>Ecosystem</td>
<td>Water</td>
<td>Pollution</td>
<td>Forest</td>
<td>Logging</td>
<td>Environmental education</td>
</tr>
<tr>
<td>Photosynthesis</td>
<td>Biodiversity</td>
<td>Soil</td>
<td>Environmental change</td>
<td>Tree</td>
<td>Silviculture</td>
<td>Botany</td>
</tr>
<tr>
<td>Vegetation</td>
<td>Biological</td>
<td>Environment diversity</td>
<td>Deforestation</td>
<td>Pine</td>
<td>Conservation</td>
<td>Environmental law</td>
</tr>
<tr>
<td>Specie</td>
<td>Limiting factors</td>
<td>Environ</td>
<td>Biodiversity lost</td>
<td>Leaf</td>
<td>Resource rational use</td>
<td>Ecology</td>
</tr>
<tr>
<td>Plant</td>
<td>Ecological succession</td>
<td>Nature</td>
<td>Environmental degradation</td>
<td>Seed</td>
<td>Sustainability</td>
<td>Zoology</td>
</tr>
<tr>
<td>Flora</td>
<td>Natural resource</td>
<td>Oxygen</td>
<td>Environmental alteration</td>
<td>Stem</td>
<td>Resource exploitation</td>
<td>Geobotany</td>
</tr>
<tr>
<td>Wildlife</td>
<td>Renewable resource</td>
<td>Environmental conditions</td>
<td>Ecological problems</td>
<td>Root</td>
<td>Resource extraction</td>
<td>Forest policy</td>
</tr>
<tr>
<td>Vegetal</td>
<td>Not renewable resource</td>
<td>Non biotic factors</td>
<td>Ozone layer</td>
<td>Tropical forest</td>
<td>Reforestation</td>
<td></td>
</tr>
<tr>
<td>Biotic factors</td>
<td>Ecological importance</td>
<td>Nutrients</td>
<td>Species extinction</td>
<td>Forest resource</td>
<td>Recycling</td>
<td></td>
</tr>
<tr>
<td>Animals</td>
<td>Community</td>
<td>Climate</td>
<td>Environmental impact</td>
<td>Wood</td>
<td>Waste separation</td>
<td></td>
</tr>
<tr>
<td>Population</td>
<td>Ecological trap</td>
<td>River</td>
<td>Pollution sources</td>
<td>Holm oak</td>
<td>Cut down</td>
<td></td>
</tr>
<tr>
<td>Biocoenosis</td>
<td>Habitat</td>
<td>Field</td>
<td>Species lost</td>
<td>Conifer</td>
<td>Human activities</td>
<td></td>
</tr>
<tr>
<td>Angiosperms</td>
<td>Biome</td>
<td>Mountain</td>
<td>UV-rays</td>
<td>Cellulose</td>
<td>Forest industry</td>
<td></td>
</tr>
<tr>
<td>Gymnosperms</td>
<td>Environmental interactions</td>
<td>Surrounding</td>
<td>Chemist contaminants</td>
<td>Timber products</td>
<td>Sustainable development</td>
<td></td>
</tr>
<tr>
<td>Plantae</td>
<td>Stratum</td>
<td>Land</td>
<td>Erosion</td>
<td>Mix forest</td>
<td>Ecological preservation</td>
<td></td>
</tr>
<tr>
<td>Biomass</td>
<td>Abundance</td>
<td>Sea</td>
<td>Desertification</td>
<td>Pine wood</td>
<td>Sowing</td>
<td></td>
</tr>
<tr>
<td>Biotope</td>
<td>Richness</td>
<td></td>
<td>Greenhouse effect</td>
<td>Wood resource</td>
<td>Forest management</td>
<td></td>
</tr>
<tr>
<td>Animalia</td>
<td>Adaptation</td>
<td>Perturbation</td>
<td>Fir</td>
<td>Integral use of resource</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Consumer</td>
<td>Pollinator</td>
<td>Acid rain</td>
<td>Oak</td>
<td>Forest activity</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Biodegradable</td>
<td>Ecological system</td>
<td>Thermal inversion</td>
<td>Branch</td>
<td>Forest production</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Producer</td>
<td>Ecological consequences</td>
<td>Forest fires</td>
<td>Resin</td>
<td>Sawmill</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Decomposer</td>
<td></td>
<td>Environmental damage</td>
<td>Adequate use of resource</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Plant/Animal growth</td>
<td></td>
<td>Fertilization</td>
<td>Pesticide</td>
<td>Environmental crisis</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Notes:**

- **Biology:** Represents the biological aspects of the environment.
- **Ecology:** Refers to the study of ecosystems and their components.
- **Environ:** Refers to the environment and its components.
- **Problems:** Represents the problems associated with environmental issues.
- **Forest elements:** Represents the elements related to forest management.
- **Forest management:** Represents the management strategies applied to forests.
- **Disciplines:** Represents the disciplines involved in environmental studies.
follows: 1=CFE, 0=not CFE. All responses of “I do not know” or where a question was not answered were excluded from the analysis.

Living place: Related to whether adolescents live in the community, this variable was coded as follows: 1=San Juan Nuevo, 0=not San Juan Nuevo.

Comunero: Regarding whether an adolescent’s parents were working in the forestry enterprise or not: 1=comunero family, 0=not comunero family.

Gender: 1=female, 0=male. This variable was used as a control.

The following hypotheses were tested:

H1) Adolescents’ knowledge of environmental concepts is associated with the place where they live and with being comunero. What young people effectively learn about the environment is closely related to what their parents do in the community (Barraza, 2003).

H2) Adolescents’ knowledge of environmental concepts is influenced by their interest in forest management. Students who want a job in the forest enterprise will know more about environmental issues.

Results

Forest issues in the high school curriculum

Textbook content analysis revealed that the number of environmental concepts about forest management, in comparison with all cited environmental issues, was fewer and limited: 22 of a total of 272 concepts founded. The major quoted concepts on forest management were: logging, silviculture and conservation. Terms referring to major problems in the forest were also scarce (29 concepts). Pollution, environmental change and deforestation were the main problems identified by students (Table 2).

Results also suggest that forestry issues were mainly present in social subjects such as the History and Culture of Michoacán. Accordingly, observations made in the classroom and in teachers’ interviews showed forestry-related subjects to be few, mainly Biology and Ecology; and teachers used a single textbook as a resource to teach these lessons. Besides, data from classroom observations showed that teachers did not integrate other subjects into the teaching process and they did not carry out fieldwork with the students.

Environmental knowledge

Overall, students correctly answered only 6 of the 10 questions about environmental topics (general environmental and forestry issues – see Figure 2). Students were familiar with the concepts of ecosystem (67%), food chain (61%) and sustainable development (68%). They also knew about the ecological function of the forest (86%), its composition (86%) and the structure of the vegetation (80%). However, students had difficulty answering questions about silviculture and renewable resources. Only 33% knew the meaning of the term ‘silviculture’. In addition, 57% of the students could not give an answer about the consequences of forest degradation and 75% did not know the causes of forest cover loss in the region where they lived. Even though these were concepts taken from the school curricula, students had difficulty in establishing causal connections (see discussion).

Hypothesis 1 was rejected because data analysis showed no statistically significant association between adolescents’ environmental knowledge and having a comunero parent. However, environmental knowledge from adolescents differed significantly between males and females (OLS regression, P < 0.05). Male students knew more about ecological topics and the environment of their community than female students (Table 3).

Interest in environmental issues, forestry and enterprise

In general, students from the first and second years of schooling showed a stronger interest in the natural sciences, such as Biology, Ecology, Mathematics, Physics, Chemistry and Computing, while those in their last year preferred social science subjects. 86% of the students in their 3rd year mentioned that they would like to continue with their studies at university, and 57% of them wanted to work as lawyers, administrators, accountants, educators, etc.

When students were asked where they would like to work and live in the future, only two of them (2%) answered they would like to work in CFE; 36% wanted to live in other communities or cities, in Mexico or in a different country; 59% mentioned they would like to live in their community but not doing forestry-related work – and 3% of the students answered that they did not know where they were going to live or what they would be doing in the future.

Results from interviews and observations showed that teachers did not talk in the classroom about the economic, social and environmental importance of the CFE for the community. No field trips to the CFE were offered by the

![Figure 2. Adolescents' correct answers.](image)

Table 3. Association between adolescents’ environmental knowledge, their place of living and comunero status (H1).

<table>
<thead>
<tr>
<th>Questions</th>
<th>Knowledge</th>
<th>Explanatory variables</th>
</tr>
</thead>
<tbody>
<tr>
<td>1-ecosystem</td>
<td>-0.391</td>
<td>Living place</td>
</tr>
<tr>
<td>2-food chain</td>
<td>0.647</td>
<td>Comunero</td>
</tr>
<tr>
<td>3-sustainable development</td>
<td></td>
<td>Gender</td>
</tr>
<tr>
<td>4-silviculture</td>
<td></td>
<td>Control</td>
</tr>
<tr>
<td>5-renewable resource</td>
<td></td>
<td>N</td>
</tr>
<tr>
<td>6-forest ecological function</td>
<td></td>
<td>102</td>
</tr>
<tr>
<td>7-San Juan vegetation composition</td>
<td></td>
<td>0.860**</td>
</tr>
<tr>
<td>8-San Juan vegetation structure</td>
<td></td>
<td>Statistically significant at the 5% level</td>
</tr>
<tr>
<td>9-forest degradation consequences</td>
<td></td>
<td>Tested for robustness/heteroskedasticity at 1% level</td>
</tr>
<tr>
<td>10-Michoacán deforestation causes</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Notes: (1-ecosystem; 2-food chain; 3-sustainable development; 4-silviculture; 5-renewable resource; 6-forest ecological function; 7-San Juan vegetation composition; 8-San Juan vegetation structure; 9-forest degradation consequences; 10-Michoacán deforestation causes)
teachers. Nor had forest workers ever visited the high school in order to explain to the students what they did.

Finally, Hypothesis 2 was confirmed, in that adolescents’ environmental knowledge was influenced by their interest in forest management. What adolescents knew about environmental concepts was significantly and positively associated with their interest in gaining a CFE job in future (OLS regression, $P < 0.1$). This association was also significant when the gender variable was used as a control (Table 4).

Table 4. Association between adolescents’ environmental knowledge and their interest in working in CFE (H2).

<table>
<thead>
<tr>
<th>Dependent variable: Knowledge</th>
<th>Explanatory variable:</th>
</tr>
</thead>
<tbody>
<tr>
<td>Job</td>
<td>2.196*</td>
</tr>
<tr>
<td>Gender</td>
<td>0.854**</td>
</tr>
<tr>
<td>Living place</td>
<td>-0.070</td>
</tr>
<tr>
<td>Comunero</td>
<td>-0.251</td>
</tr>
<tr>
<td>N</td>
<td>81</td>
</tr>
</tbody>
</table>

*, ** statistically significant at the 10% and 5% level. Tested for robustness/ heteroskedasticity at 1% level

Discussion

The results of this study confirmed three major issues:
1) adolescents’ lack of environmental knowledge
2) their lack of interest in working for the CFE
3) a lack of initiatives from the community and the education authorities to encourage adolescents’ knowledge and interest in forest issues.

This study also confirms the environmental learning theory of the association between adolescents’ knowledge and interest, as well as the gender association.

General and local environmental knowledge

Even though all the environmental concepts could be found in the textbooks, students from high school showed difficulty in understanding environmental processes in terms of cause and effect. Barraza and Cuarón (2004) argued that, in order to engender environmental understanding, it is crucial to offer students learning techniques in which they can gain environmental information in different ways; here, projects linked to the community are important means. To ensure active learning, students should have the opportunity to ask questions, listen, and record information – and teachers must supervise students at all times (Kennedy and Krasny, 2005).

Previous environmental education research in San Juan Nuevo with primary and secondary school children also found a lack of understanding of environmental concepts and no link between the school programme and CFE activities (Barraza and Ceja-Adame, 2003; Barraza and Pineda, 2003). For example, the concept of deforestation was one of the most cited terms in the secondary school textbooks, but only 25% of the students correctly answered the question about the causes of forest loss in the state of Michoacán. They also had difficulty with the concept of deforestation: they could not associate the absence of trees with deforestation (Barraza and Pineda, 2003).

Children at primary school also had a poor comprehension of environmental concepts (43%) and performed even worse when trying to apply and handle the concepts (29%) despite the environmental management of the community (Barraza and Ceja-Adame, 2003).

Adolescents’ poor knowledge could be explained by the absence of environmental practices at high school, but also by the lack of participation of the forest enterprise staff with the school teachers and students.

More surprising was a comparison of two Mexican rural communities with contrasting forestry management practices. Students from secondary level in San Juan Nuevo had a lower environmental knowledge level, despite their environmental community planning, than students from Atecuaro, a forestry community with no such planning (Barraza and Pineda, 2003). To minimise this lack of environmental comprehension in the school population in San Juan, there is an urgent need to develop an environmental education programme in which all members of the community (school, CFE, municipality) can interact and work together towards an environmental culture.

In Mexico, and particularly in rural areas, there is no structural coherence between educational programmes and the regional context of the communities (Barraza, 2001a). In most cases educational planning does not reflect the necessities and interests of these communities. Environmental problems can affect children’s perceptions, knowledge and understanding of the world (Barraza, 2001b), so if students are familiar with the problems from their community, it will be more likely that they will become involved in finding solutions to resolve them.

According to UNESCO (Colclough, 2002) one major principle to follow in the ‘decade of education for sustainability’ involves the construction of educational programmes that reflect local and regional community interests. In this study, most of the environmental concepts quoted in the textbooks were not concepts related to the regional environment or to the community. There is no connection between the environmental content of the curriculum, the activities planned and the goals of the CFE. The observations made in classrooms confirmed this.

These circumstances make the learning process more difficult for the students because there is no logical relationship between the concepts they are learning at school and their environmental reality. The formal education system in Mexico and the pedagogical approach used by the teachers has an important effect on the way children learn (Barraza and Walford, 2002). Thus it is important to develop new educational proposals for rural communities based on their social and environmental problems in order to give students from all levels an active role in the learning process.

Results also showed that community parents, particularly comuneros parents, seem not to be influencing their children by transmitting an environmental awareness.

All these results revealed two main facts:
1) the teaching and learning process as its stands in the high school did not promote adolescents’ interdisciplinary knowledge, nor their active environmental participation in community forestry
2) the forest management in San Juan Nuevo did not have a direct influence on environmental knowledge and the sense of responsibility of young people.

Therefore, it is crucial to define an environmental strategy in which students can apply their concepts and reinforce basic scientific abilities: observation, analysis, discussion, capacity
to solve problems and engagement to actively participate in environmental projects.

**Interest in forest management and CFE**

Students from the first and second years at high school were interested in natural science. This was not the case for students in their third year, mainly because there was no environment-oriented course on offer, nor a speciality on forest management. Instead there were only two areas that students could choose: Technical Drawing and Accounting.

This represents a severe problem for a number of reasons. In the first place, adolescents who are interested in environmental themes, or even in the activities of the CFE, have no place for training. This situation is reflected in the results, in the sense that adolescents showed no intention to work in the forest enterprise in the future. The message sent to the students and the rest of the community by not having a school programme oriented towards forest activities can be confusing and not in line with the environmental policies of the community. San Juan Nuevo has empowered its population in the appropriation of forest management by generating social and economic benefits reflected in the development of different programmes for the community.

The absence of new generations working in the CFE could be a serious problem for the community. Firstly in terms of the continuity of the sustainable management of forest and secondly in terms of having young people leading the community work. Thus, continuity and engagement of adolescents are two crucial elements needed for having successful community-based programs.

**Knowledge, interest and gender effects**

The results of this study indicated that the education system, as established in this community, is neither promoting nor encouraging environmental awareness within the high school population.

The lack of interest is associated with their limited environmental knowledge. If students do not value the things their community does for the environment, it is very unlikely that they would be aware of forest conservation practices. If adolescents are motivated, however, they will be more interested in learning about environmental issues.

Teaching practices are becoming more important in the process of understanding concepts and applying knowledge. This is why it is so important for high school teachers and students to communicate with the CFE members in order to guarantee their constant interest and participation in forest management activities. The school is part of a transformation process in which adolescents can interact with their parents and teachers to improve the quality of life in their community (Barraza, 2000). It is fundamental to develop environmental policies, interactive methodologies and new participative and creative teaching techniques in formal education to promote environmental awareness and social responsibility in the community (Barraza and Ceja-Adame, 2003).

Significant statistical differences between genders and also between students interested in environmental issues were found when comparing the environmental knowledge of the adolescents (see Tables 3 and 4). Male students knew more about environmental issues and were more interested in working in CFE than female students. It is necessary to undertake an in-depth ethnographic study to find out why this is happening. One explanation could be that this difference is culturally dependent, particularly within developing countries. Arizpe (1994) mentioned that one of the criticisms of contemporary Latin-American education is the exclusion of females and indigenous groups from educational systems. It is not surprising then that worldwide two thirds of the female population is illiterate (UICN, 2006), and most of these are from poor countries (with low Gross Domestic Product).

In spite of San Juan Nuevo’s industrialisation of its forest enterprise, the community lifestyle is still based on a traditional society in which couples marry too young (16-18 years of age) and females stay at home, raising their children and relinquishing their aspiration to work. Decision-making in the area of forest management is still in the domain of male population in the community. Unless the community recognises the role that women have in the process of professionalisation, women will not have the opportunity to develop themselves and participate actively in the system of production.

**Educational implications**

Considering the environmental policies that the community has developed, high-school students from San Juan Nuevo were not as well-informed about forest management issues as expected. The lack of knowledge about environmental concepts was associated with a lack of interest in CFE. Consequently, adolescents showed no interest in considering the community forest enterprise as an option for employment in the future. They did not see themselves as part of the developing process of forest management and certainly not as key social actors for promoting, and providing continuity for, sustainable policies in their community.

On a global scale, the forest enterprise of San Juan Nuevo represents a small but important contribution to the protection of forests worldwide. The benefits that it offers to the community allow them to live in a sustainable way, maintaining a good quality of life. However, the educational system needs to reorganise its curriculum in order to consider local knowledge, as well as the interests and experiences of the community, so that it can follow the UNESCO principles on education for sustainability (Colclough, 2002) by encouraging students from all levels to participate in the construction of a sustainable society.

The education system seems to have a strong effect on the way adolescents learn about forest ecosystems (Barraza and Pineda, 2003). Knowledge has a direct influence on decisions about the environment. For this reason schools need to commit to promoting an environmental culture within the community. Therefore, it is fundamental to encourage adolescents’ intellectual and creative development by promoting their critical thinking and their active participation in forest management.

In order to achieve this it is vital to train teachers to incorporate participatory methods in the curriculum and to establish cooperative joint projects amongst community members. High school and community leaders have to work together. Establishing links among all is fundamental to achieving an efficient environmental education programme with a participatory process. Constant interaction between students, teachers, parents and community leaders is necessary in order to build up an environmental strategy for the community and to reinforce environmental learning at school and home.
The design and implementation of an environmental education programme focused on forestry management is recommended at all levels of formal schooling. This programme should be based on:

1) equal opportunities for male and female adolescents to work in the forest enterprise
2) the inclusion of local environmental issues in the school curriculum.

An important outcome of this study is the possibility of designing and establishing tangible methodological proposals for community-based education programmes in forest management practice. It also contributes to a better knowledge of the dynamics of the communities’ understanding of:

1) how the social structure develops
2) how the teaching and learning patterns evolve in the long term
3) how the participatory process works in local projects.

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