Local and Indigenous Knowledge Regarding the Land Use and Use of Other Natural Resources in the Aspiring Rio Coco Geopark

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Abstract. There is a limited number of studies describing the situation and importance of current or potential usage of the local and indigenous traditional environmental knowledge in the region of Northern Nicaragua. To fill this gap, the author supported by a local team conducted the participative research in this rather neglected Central American region, concretely in the northern area of the aspiring Rio Coco Geopark. The purpose of this research was to identify the local and indigenous knowledge regarding the present and traditional use of natural resources including land use and to analyse the contribution and potential of the usage of this knowledge for the local development sustainability. The practical long-term impact of this research is expected mainly in the form of enhancement of the local geotourism sustainability. The research process itself was of the same importance as its results, especially the involvement of the local and indigenous people. In this participative research, young local and indigenous people obtained training and served as co-investigators who later interviewed representatives of the local households. The other field methods included life history of elders, discussions in the focal groups involving common people from local communities as well as the mapping and photo-documentation of the identified local and indigenous traditional environmental knowledge. The participative character of the research process not only facilitated the data collection and validation but also supported the revival of the community memory and revitalization of its cultural and natural identity. The research findings point out that the more distant and more dispersed are the local settlements the better conserved local and indigenous knowledge regarding the traditional land use and other use of natural resources is. Among the best-conserved local and indigenous traditional environmental knowledge in the northern area of the aspiring Rio Coco Geopark was the usage of the earth material and plants. The local indigenous people are not expressing and transmitting the spiritual dimension of their traditional environmental knowledge (sacred times or sites, rites, rituals or taboos regarding the traditional land use and other use of natural resources) anymore because they were experiencing a continuous repression realized by the dominant (colonial) society in the past. They are not accustomed to appreciating the aesthetic values of the landscape as do visitors, but they are open to share their authentic life with them. The majority of the identified traditional land use and the use of the other natural resources as well as related traditional environmental knowledge in the researched northern region of the aspiring Rio Coco Geopark seems to be more sustainable than the present land use practices and the use of natural resources generally for agriculture, medicine, constructions etc. The local communities should dedicate much more attention and efforts to conserve, transmit and use this local and indigenous traditional environmental knowledge to enhance the sustainability of their development as well as geotourism emerging in this part of the aspiring geopark.
1. Introduction
The present socio-environmental global problems force the responsible bodies across various sectors and levels of the society to search for local optimal solutions. They are looking for the economically, socially appropriate and acceptable adaptations to changes which have undesired impacts on local inhabitants and their environments. With efforts to find the most efficient and the least risky adaptations, they try to identify the best available knowledge and practice. Scientists as well as decision makers have been increasingly becoming aware of the limits of their scientific “modern” know-how. At the same time, they have been started to rediscover and appreciate the traditional knowledge accumulated, transmitted and used by the local and indigenous communities regarding nature and universe [e.g. 1, 2, 3 and 4]. One of the main advantages of the system of the so called traditional ecological knowledge (TEK) or local and indigenous knowledge (ILK) is its territoriality [4]. This is presented by local based collective memory and wisdom including knowledge, veneration and multiple use of local species as well as the knowledge of the local habitats and the local natural processes. The adaptive measures based on the combination of the scientific “modern” know-how and local ecological knowledge generally lead to better results than the pure application of the universal academic knowledge [4].

The purpose of this study was to identify the local and indigenous knowledge regarding the present and traditional use of natural resources including land use and to analyse the contribution and potential of usage of this knowledge for sustainability of the local development. The assessment to what extent this knowledge could serve for enhancement of the local geotourism sustainability of this aspiring geopark was also of high importance.

2. Theoretical backgrounds
It is generally accepted, that the interdisciplinary approach is needed if the researched phenomenon is to be described and analysed in a holistic way [5]. This work is based on continuous research [2 and 3] applying interdisciplinary, holistic, post-cultural, place-based and people-centred approaches. Its theoretical background is premised on several disciplines and fields of human science. The methods of cognitive anthropology [4 and 6], ecological anthropology [6], possibilism in the frame of human geography, in particular the concept of “genre de vie” [7] and social exchange theory [2] served for the terrain research as well as for the analytic work and the final synthesis.

In the present globalized word, the cognitive, moral and cultural value of preserving and studying of indigenous knowledge systems is growing. The cognitive anthropology combined with ecological anthropology rediscovers not only accumulated collective knowledge of ethnics still directly connected to the natural resources (without mediator role of the trade industry and market mechanism) but it studies also the interrelations between ecosystems, ecosystem services and local culture presented by its noosphere (figure 1). This complete and holistic object of study could be labelled with the term coined as ABC (abiotic, biotic and cultural) concept by Ross Dowling [8]. Regarding the indigenous noosphere, it includes the natural resources management and land use strongly influenced by indigenous cosmology and veneration of Mother of Earth, the human impact on ecosystems and landscapes as well as the feedback of changed ecosystems on quality of human life.

The local and indigenous people have the knowledge regarding not only the individual species and habitats, but also their time space behaviour and related trends [1]. In spite of the increasingly accepted importance, which has the application of this knowledge to the land use and natural resource management in various localities and regions [e.g. 1, 2, 3, 4 and 6], the geographical aspects of indigenous and local knowledge are not researched adequately. The question is if there exists causal correlation between the spatial distribution of the usage intensity of indigenous and local knowledge in land use and natural resource management and spatial distribution of the quality level of ecosystem services (ecological status of the landscape and land use sustainability). The locally embedded ecological knowledge is valuable because of its “placeness”, territoriality, indigeneity and authenticity, the indigenous and local knowledge regarding nature is many times as “endemic” as the species, habitats and natural processes recognised by indigenous and local knowledge.
Figure 1. Traditional and scientific knowledge concerning nature and its natural resources management as a part of one Noosphere

3. Research area, methods and process

Central America is home to 80 indigenous ethnics occupying almost 40 % of its land and waters [9]. In 2016, the International Union for Conservation of Nature (IUCN) elaborated a map to indicate the potential benefit of alliances among conservationists, governments and indigenous peoples of the region [9]. Findings of the related research [9] show that „supporting Indigenous Peoples’ rights to maintain their way of life is an effective means of preserving biodiversity. In other words, Indigenous community forest rights that are legally recognized and protected by governments often mean reduced deforestation and lower emissions of carbon dioxide.” With the exception of the study of the indigenous ecological knowledge elaborated by the UNESCO team in the Mayangna region [10], local and indigenous knowledge is not an adequately researched topic in Nicaragua. In this context, considering the UNESCO Global Geopark aspiration, the research area was selected.

Rio Coco Geopark is located in the mountainous region of the north-western Nicaragua, on the border with Honduras (figure 2). It includes the substantial part of the department of Madriz covering an area of 967 km², which consists of five municipalities, three of them recognized as indigenous communities: San José de Cuzmapa, San Lucas and Totogalpa [2 and 3]. The Rio Coco Geopark headquarters is located in the town of Somoto which is at the same time capital of the Madriz Department. The study area is located in the northern part of the aspiring geopark (northern half of Somoto Municipality, identified as Microregion I). The key geotourism attractions of this area are geosites called “Piedras Pintadas” (Painted Stones) and “Cañón Seco” (Dry Canyon), both of them situated near to Icalupe Community, the capital of the Microregion I. The “Piedras Pintadas” geosite created by the scenically impressive outcrop decorated with an amount of ancient colourful petroglyphs presents an extraordinary archaeological value with a high potential for geotourism. The engraved figures represent various persons, shamans, animal, rituals etc. These still researched symbols recorded in stones, the ancient staircases engraved in surrounding rocks as well as the archaeological rests (ceramics) in environs of this geosite, all that reflect a rich indigenous knowledge, customs, rituals and life style of the ancestors of the local people.
The indigenous inhabitants of the Río Coco territory are probably Chorotegas, descendants of Maya ethnics who came to the Northern and Pacific region of Nicaragua from the area of present Chiapas (Mexico) [2, 3, 11 and 12]. They are living in rural communities characterized by the diet based on the so called “basic grains” (corn, beans and sorghum) and by the traditional ceramics and textile handicrafts [11 and 12]. The substantial part of their indigenous knowledge is already lost because of the continual repression they experienced under the colonial regime. Chorotegas represent the strongest indigenous ethnic group of Nicaragua, with the total population overreaching the size of 200 thousand [2 and 3].

There are nine dispersed rural communities in the mountainous Microregion I, inhabited by 300 rather poor households, 240 of them without the direct access to drinking water and the same number of households is without electricity. All of them have limited access to the state health care and there are no commercial facilities. The closest fairs, shops and services are available in Somoto (nearly 30 km distant) or in Honduras. These conditions make the local people strongly dependent on the natural processes and rhythms which seem to contribute to their connection and respect for nature.

Author supported by a local team has been studying the local and indigenous knowledge and its sustainability potential in the aspiring Río Coco Geopark already for four years. In this research, which was conducted with the assistance of Somoto Municipality and Icalupe community leader (teacher) in August, she focused geographically on the northern part of the aspiring Río Coco Geopark (Microregion I) and thematically on the environmental and geographical aspects of the local and indigenous knowledge. The purpose of this research was to identify the local and indigenous knowledge regarding the present and traditional use of natural resources including land use and to analyse the contribution...
and potential of usage of this knowledge for the local development sustainability. The intention behind is to find out to what extent this knowledge could serve for enhancement of the local geotourism sustainability.

The research process itself was of the same importance as its results, especially the involvement of the local and indigenous people. In this participative research, 24 local and indigenous students obtained a brief training to be able to conduct terrain research in the form of the structured interviews. They served as co-investigators who interviewed representatives of local households to identify their knowledge regarding the use of natural resources. The author herself used field methods as life history of elders, discussions in the focal groups involving common local people and participant observation (living for 14 days in the local house with the local inhabitant, participating in the local community life). As complementary methods, she used the mapping and photo-documentation of the identified local and indigenous traditional environmental knowledge. The participative approach to the research not only facilitated the data collection and validation but it contributed also to the revival of the community memory and revitalization of its cultural and natural identity. The recorded data were transcript and their content (together with the diary notes) was analysed with the help of the grounded theory method [13].

The terrain research was opened by the meeting with the Research Advisory Committee. This body, constituted especially for the purpose of this research, consisted of representatives of all the nine communities of the Microregion I. The opening meeting served not only for explanation of the reason, philosophy, objectives and the work plan of the research, but also as an “ice-breaker” event facilitating the fair and equal participation of local communities. Author visited all the nine communities of the Microregion I and conducted the focal group discussions in each of them. All the discussions were recorded with the permission of the group. The trained local students (always in pair) interviewed 283 (out of 300) households with the help of a detailed formulary prepared by the author for the systematic recording of answers. The terrain research project was closed after the meeting with the Research Advisory Committee, which discussed the collected data and previous research results.

4. Results and discussions

The research findings point out that the more distant and more dispersed are the local settlements the better conserved local and indigenous knowledge regarding the traditional land use and other use of natural resources is. Among the best-conserved local and indigenous traditional environmental knowledge in the northern area of the aspiring Rio Coco Geopark was the usage of the earth material and plants (see table 1).

The local indigenous people are not expressing and transmitting the spiritual dimension of their traditional environmental knowledge (sacred times or sites, rites, rituals or taboos regarding the traditional land use and other use of natural resources) anymore because they were experiencing a continuous repression realized by the dominant (colonial) society in the past. The most developed is the use of earth for decorative painting on houses (mainly in the Icalupe community), the earth use for bricks and roof tiles and the local herbs and fruit both for medicine and diet.

Table 1. Research localities, methods and results.

| Community name | Applied methods                                                                 | Examples of local and indigenous knowledge regarding the use of natural resources and land use                                                                 | Illustrative photography |
|----------------|---------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------|
| Yaraje         | - discussion in focal group with “Problem Tree” identification - life history of Doña Guillerma Anrade | - local herbs used for medicine: e.g. Moringa oleifera (“marango”) for impotence problems (but it is used also as fodder for the cattle), Mentha arvensis (“hierba buena”) used for digestion, nausea, cough - endemic pine needles used for baskets elaboration | The local tradition of house painting with various types of earth is an expression of |
| Location        | Activities                                                                 | Observations                                                                 |
|-----------------|-----------------------------------------------------------------------------|------------------------------------------------------------------------------|
| Icalupe         | - interviewing of the representatives of 58 households                     | - earth used e.g. for decorative painting facades of houses, elaboration of bricks and ceramics In the past; use of the Ricinus communis ("higueria de castor") as a laxative |
|                 | - discussion in focal group with “Problem Tree” identification             | the local indigenous knowledge and cosmology.                                 |
|                 | - life history of Don Ramon Alfredo                                        |                                                                              |
|                 | - interviewing of the representatives of 54 households                     |                                                                              |
|                 | - participant observation                                                  |                                                                              |
| Germania        | - discussion in focal group with “Problem Tree” identification             | - local herbs used for medicine: e.g. Ruta graveolens ("ruda") and Chenopodium ambrosioides ("apazote"), both of them mainly to release metabolic and digestion problems, but “ruda” was labelled as a “multifunctional” herb - earth used e.g. for well-developed decorative painting of houses, elaboration of bricks and ceramics In the past: use of surface of rocks for engraving petroglyphs |
| Sectors:        | I. sector: 10 houses                                                        | House painting inspired by the “Piedras Pintadas” petroglyphs.               |
|                 | II. sector: 14 houses                                                       |                                                                              |
|                 | III. sector: 13 houses                                                      |                                                                              |
|                 | - life history of Doña Maria Tereza Lopez                                  |                                                                              |
|                 | - interviewing of the representatives of 37 households (3 sectors)         |                                                                              |
|                 | - local herbs used for medicine: e.g. valerian for problems with nerves, sleeping, Buddleia Americana ("hoja blanca") to release the inflammation or stomach infection - earth used e.g. for decorative painting facades of houses, elaboration of bricks and ceramics In the past: use of millstone for grinding of coffee and corn |
| Las Quebraditas | - discussion in focal group with “Problem Tree” identification             | - local herbs used for medicine: e.g. Ocimum basilicum ("albahaca") for regulation of digestion and to combat infections, bacteria and parasites, Pluchea carolinensis ("siguapate") to calm menstrual menstrual cramps, dysmenorrhea - earth used e.g. for elaboration of bricks and roof tiles In the past: “mondongo” soup full of various vegetable was a common part of diet, but in present days some of these vegetable species are not available anymore; the guano produced by bats was used as fertilizer |
|                 | - life history of Doña Quillerma                                           |                                                                              |
|                 | - visit of the local rock formations with engravings, an ancient paved trail with the rest of the mill stone |                                                                              |
|                 | - interviewing of the representatives of 10 households                     |                                                                              |
|                 | - local herbs used for medicine: e.g. for regulation of digestion and to combat infections, bacteria and parasites, Pluchea carolinensis ("siguapate") to calm menstrual menstrual cramps, dysmenorrhea - earth used e.g. for elaboration of bricks and roof tiles In the past: “mondongo” soup full of various vegetable was a common part of diet, but in present days some of these vegetable species are not available anymore; the guano produced by bats was used as fertilizer |
|                 | - natural “pulpit” with engravings painted in red and dark grey.           |                                                                              |
| Location   | Activities                                                                 | References                                                                 |
|------------|---------------------------------------------------------------------------|---------------------------------------------------------------------------|
| Santa Emilia | - focal group discussion in the Saniculo church  
                  - interview with Jose Taurino Moncada Sanchez (community leader)  
                  - visit of the Saniculo sector: Laguna Grande and local rock formations  
                  - interviewing of the representatives of 34 dispersed households | - forest fruit “nance” (plant *Byrsonima crassifolia*) used mainly for juice production  
                  - earth used e.g. for elaboration of bricks and roof tiles  
                  - In the past: the sap of “quapinol” was used as soap (for washing); the forest fruit *Annona cherimola* “anona” was appreciated for its antibacterial and antiviral powers; the stone was of multiple use there: for fireplaces, millstones, arms for hunting etc. |
| La Lumbra | - discussion in focal group with “Problem Tree” identification  
                  - interview with Don Ismael (community leader)  
                  - interviewing of the representatives of 8 households | - local herbs used for medicine: e.g. *Cymbopogon citratus* (“zacate limon”) and the eucalyptus to treat the flu, bronchitis, cough and digestion problems  
                  - stone used e.g. as water recipient for cattle, whetstone and weight  
                  - earth used e.g. for elaboration of bricks, roof tiles and ceramics  
                  - In the past: the use of the millstone was more frequent |
| La Ilusion | - discussion in focal group with “Problem Tree” identification  
                  - life history of Felipe Basquez Moncada (Chilamatal sector)  
                  - interviewing of the representatives of 30 households  
                  - climbing the forest trail in the gorge heading to community | - local herbs used for medicine: e.g. *Spondias purpurea* (“jocote”) to release gastrointestinal problems, fever and diarrhea; its fruits have antiseptic effects,  
                  - stone still used as a millstone for grinding of coffee and corn and for „dead barriers“ construction  
                  - In the past: the forest fruits of the plant *Casimiroa edulis* “matasano” with hypnotic and analgesic effects |
| Las Pilas Sectors: Las Pilas: 8 houses El Horno: 7 houses Maquelizas: 6 houses | - discussion in focal group with “Problem Tree” identification (Las Pilas)  
                  - live history of Enrique Ponze  
                  - interviewing of the representatives of 21 households  
                  - visit of the sector El Horno and the cave | - local herbs used for medicine  
                  - use of animal components: medicinal oils produced of hen, snake, pig or armadillo, decorations of the cow horn, musical instruments (drums) of the leather of cattle  
                  - stone used e.g. for construction of houses, as whetstone and weight  
                  - earth used e.g. for construction of stoves, decorative painting of houses, elaboration of bricks, tiles |
| Jocomico Sectors: Las Partidas: 8 houses Salamar: 7 houses Jocomico: 16 houses | - discussion in focal group with “Problem Tree” identification  
                  - life history of Olga Vicenta Sanchez interviewing of 31 households  
                  - visit of surroundings of the of Oscar Moncada Sanchez house (obsidians, rest of ancient ceramics) | - local herbs used for medicine: e.g. *Equisetum arvense* (“cola de caballo”) with regenerative, astrigent and diuretic effects and *Uncaria tomentosa* “uña de gato” to release the inflammation or combat infection, reinforces the immunity  
                  - animal fats used for medicine  
                  - animal leather used for chair, bed  
                  - earth used e.g. for elaboration of the bricks, ceramics and roof tiles  
                  - In the past: elaboration of obsidians |

The archaeological rests (ancient house basements, ancient fireplaces, millstones, flint etc.) in the cornfield.

The mortar (to grind the coffee and corn) engraved at the top of the large stone.

Millstone, still used by local women.

Local way how to prepare the corn pancake („tortilla“) at the earth stove

Elaboration of the bricks with the use of local earth and endemic pine needles.
**Figure 3.** Examples of the individual and synthetized “tree of problems” perceived by local people (the problems are indicted in the trunk, their impacts in branches and their causes in the roots)

Each focal group discussion concluded with the design of the “tree of problems”, which illustrated the main causes (roots) and impacts (branches) of the problems (indicated in the trunk) identified in the discussion. The synthesised “tree of problems” (figure 3) shows that the main problems are connected with a lack of water caused mainly by the climate change and inappropriate land use connected with the
insufficient transmission of the indigenous traditional knowledge regarding nature and its processes. The local people admit that in the past the land was more fertile and the forests had higher biodiversity. They feel that from the reasons of their future sustainable life, they should rediscover some of the traditional and in some cases nearly forgotten practices regarding the use of the soil, vegetation, animals, water, earth and stone. They expressed that this is necessary not only for their physical survival but also for the enforcement of their indigenous identity. The focal group discussions proposed the special type of the tourism compatible with the indigeneity revival, which was coined by discussions participants as “turismo de convivencia”, which means that the visitors are invited to share authentic local life including the work, celebrations and decision making. This tourism should not provoke any intended adoption of the local life and environments to the visitors needs, on the contrary, the generated incomes should support the implementation of the development vision formulated and decided by local communities.

The interviewed people were asked to localize the various use of natural resources and elements of the landscape identified by them into the prepared maps of their region. The output of the final synthesis of those localizations (figure 4) was elaborated into a collective mental map [1] whose value is mainly processual (refreshing collective memory). It was evident, that they do not perceive the landscape and its phenomena (hills, caves, waterfalls etc.) in the same way as do people belonging to the modern “western” society. They do not perceive it scenically, as an object of visual admiration or as a destination to be visited. They are living in the landscape (not visiting) and they are open to share this authentic life and connected traditional knowledge with visitors.
5. Conclusions

The majority of practises of the traditional land use and the use of the other natural resources identified in the northern region of the aspiring Rio Coco Geopark seems to be more sustainable than many present practices used in modern agriculture, medicine, building and decoration of constructions etc. The local communities are aware of the fact that they should dedicate much more attention and efforts to rediscover, transmit and use their traditional environmental knowledge and thus to improve not only the sustainability of their life and emerging geotourism but also to reactivate their indigenous identity.

The researchers could investigate assumed causality between the geographical distribution of the intensity of the indigenous and local knowledge usage in the land use as well as in other natural resources management and the efficiency of the local ecosystem services. For the “sustainability science” as an emerging academic discipline, the applicability and credibility of holistic, cross-disciplinary, local based and participatory approaches are crucial, as well as a kind of epistemological synthesis based on the wisely balanced combination of the local and indigenous knowledge provided typically by the idiographic research and the modern scientific knowledge stemming rather from a nomothetic research.

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