EduBioMed

CAPACITY BUILDING FOR EDUCATION AND APPLIED RESEARCH IN MEDITERRANEAN UNESCO'S BIOSPHERE RESERVES

Mediterranean Biosphere Reserves: the nexus for environmental management, education and research

The project eBook

Universitat Autònoma de Barcelona

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Capacity Building for Education and Applied Research on Mediterranean UNESCO's Biosphere Reserves

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About Edu-BioMed

The project aims to strengthen, ameliorate and upgrade academic activity at four Moroccan and Lebanese Higher Education Institutions (HEIs) in the context of Mediterranean Biosphere Reserves (BRs), in collaboration and through networking with BRs' stakeholders (citizens, visitors, managers and technicians), public administrations and EU Partners.

Partners:

- Universitat Autònoma de Barcelona, Spain (coordinator)
- Université d'Aix Marseille, France
- American University of Beirut, Lebanon
- Université Saint-Joseph, Lebanon
- Université Cadi Ayyad, Morocco
- Université Mohammed V de Rabat, Morocco
- MAB France, France
- Association for the Protection of Jabal Moussa (APJM), Lebanon
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Chapter 12

Architecture and the biosphere environment in pedagogy: design visions for sustainable dwelling communities

Carla Aramouny

1.52. Introduction

Architecture today must evolve out of the bounds of its immediate built limits to extend into environmental surrounds and must concern itself more holistically with questions of natural preservation and sustainable development. Through design, architects need to inherently address questions related to the natural environment, and the integration of building and landscape, while promoting sustainable strategies that not only tackle the performance of the built structure but also extend to its natural context and community. In areas of biosphere reserves, especially in buffer zones, architectural development should involve conceptual, formal, behavioral and programmatic strategies that can support and connect to the extended community of the biosphere, through communal projects that integrate sustainable living, working, and connecting to the natural terrain. In this paper, I will address the pedagogical experiments of engaging with the biosphere reserve of Jabal Moussa in Lebanon, through the work of 3rd year architecture students at AUB. The paper will discuss the pedagogical methodology, the contextual framework of Jabal Moussa, and select design visions that try to imagine potential sustainable housing community that can work symbiotically with the biosphere. As such, the work presented here reflects on the necessity to address biosphere reserve areas through architecture in a holistic sustainable approach moving beyond the limits of the built form to encompass usage, integration, material, and the extended natural and human environments.

1.53. Architecture and the Environment

The work presented here starts from the premise that architecture today must work in synergy with nature and must perform symbiotically with it to enhance the performance of the built environment. Rather than reducing architecture to only its spatial and programmatic capacities, we need to rethink and redesign a more sensible and productive architecture that can link to its natural context and incorporate active environmental functions, thereby synergistically contribute to better both the built and natural environments. This is enabled by incorporating in the design process a deep understanding of the natural environment, its behaviors and environmental conditions,

and to establish the possible synergies that can happen between the human habitat and the natural habitat in a non-intrusive sensible manner. As such, and within this studio, the question of the natural environment in Lebanon is tackled through the particular focus on integration with biosphere reserves and their surrounding community through design, programming, and environmental performance.

The concern for architecture's extended impact on the environment, has been growing more urgently in recent years in the field, especially the larger impact of the built on our natural resources extending beyond the bounds of the building itself the to the larger urban and territorial scales. Moving beyond the aspects of environmentally responsive solutions at the building scale, the intersections of the built environment with the natural environment at large need to be tackled from a more holistic ecological perspective, where both entities form a material, operational, and social continuity. As such the natural and built environments should be considered as forming a single and sensible ecology.

In his text "After Habitat, Environment", Hadas Steiner[1] describes an evolution of the understanding of habitat, or the enfolding (natural or built) environment sustaining life, within contemporary architecture discourse. Referring to Conrad Waddington's work in the 1960s, he describes the latter's understanding of environment as a hybrid between technological/physical and natural interactions, between various ecologies and organisms.

> *"*This shift away from the language of habitat to that of environment, from regional territory and biology, to global informational networks, was thus marked by a loss of binary opposites as those between natural and social, open and closed systems, city and country.*"*

The shift towards recognizing environment as a larger encompassing dynamic field intertwining both the man-made and the natural led, according to Steiner, to a habitat-based model of urbanism since the 1940s, bringing forth the idea of "ecology" as model for conceiving and understanding the built environment in synergy with nature. James Corner[2] further elaborates on the ecological model in design as a dynamic organizational system that encompasses both landscape and architecture in flux and continuous feed-back with one another.

The biosphere reserve in general presents an interesting condition of intersection between natural habitats and human habitats, between a natural reserve protecting particular ecosystems, and the human and communal habitats intersecting with it. The biosphere reserve as a condition thus brings forth this ecological model of co-habitat,

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[1] Steiner, Hadas. "After habitat, Environment" in Ibañez, Daniel, Katsikis, Nikos; "New Geographies 6 : Grounding Metabolism", Harvard University Graduate School of Design, 2014, pp. 88-97.

[2] Corner, James, "Organizational Ecologies", in Belanger, Pierre, "Going Live: from States to Systems", Princeton Architectural Press, 2015, pp. 76-77.

where human, animal, built and natural environments work synergistically. In Steiner's essay he refers to the work of evolutionary biologist Julian Huxely, who defined three ecological scales of interaction in habitats from the large climatic and regional scale, to the topological or terrain scale, to the biotic or immediate biological scale. The biosphere reserve involves these three ecological scales of habitat through its core, buffer, and development areas, where interactions and feed-back become key to sustain the life of the biosphere reserve.

Using this ecological model of understanding, our design studio approach was to work with nature and the biosphere of Jabal Moussa in particular in a more integrative manner. The projects developed by the students tackled the integration of new architectural interventions, specifically for housing communities in the buffer area of the biosphere, that could have a synergistic engagement and a more responsive attitude towards the natural environment.

1.54. Jabal Moussa Biosphere reserve and the studio's premise

The studio focused on the Jabal Moussa Biosphere reserve in Lebanon as an area of research and was developed in collaboration with the Nature Conservation Center at AUB, where architecture design and pedagogy became agents to engage students with biosphere reserves in research and conception.

Biospheres reserves in general are protected extended environments that integrate natural, social, and cultural heritage, while supporting adjacent communities and people. Under the program Man and Biosphere developed by the UNESCO, the Jabal Moussa Biosphere reserve was granted its status as a preserved area in 2009[3]. It is a mountainous area surrounded by seven villages between the Keserwan and Jbeil districts, with a rich natural biodiversity from flora and fauna, to cultural heritage and ruins dating back to Roman and Phoenician periods. The reserve further incorporates eco-tourism through its hiking trails, guesthouses, in addition to local produce markets and a tree nursery. Through its different aspects, the reserve relies on and supports the adjacent local communities, from villagers in the region who work in it, to the establishment of guesthouses, small eateries, and villagers' kitchen. The Jabal Moussa biosphere reserve is formed out of three zones, the core natural zone, the buffer area including towns such as Qehmez and Mchati on its southern edge, and the larger development or transitional area including further villages and towns.

The studio recognized the biosphere reserve of Jabal Moussa as a valuable zone that enables regional development, and that has the potential to integrate new programs, especially in its buffer areas through an engagement between the central natural core and the outer development and peri-urban areas. The students were asked to imagine architectural interventions in the buffer areas around the reserve, to incorporate viable housing strategies that reshape the possibilities for sustainable

[3] Jabal Moussa website: https://www.jabalmoussa.org/reserve.

domesticity. The idea was to incorporate new communal models for living and working, close to these natural zones, and away from the polluted urban areas, allowing inhabitants to escape from the mundanity of suburban housing into a communal living that reconnects them back to nature. Furthermore, these eat-live-work communities would support the reserve and enhance the connection between peripheral urban areas and the close-by villages. The preferred sites for such interventions were selected in areas within the buffer zone that are within proximity to dense urban environments, as the project aims to propose viable autonomous communities that can serve as the link between the biosphere reserve and suburban centers. The chosen sites included upper and lower parts of the village of Qehmez and the village of Mchati near the Nahr el Dahab river.

1.54.1. *Studio Methodology and Research in 3 scales of operation*

Based on the previously mentioned ecological model, the studio methodology was developed through three main scales of research, understanding, and design operations:

– The Biosphere reserve scale / Engage: The first scale is that of the entire biosphere and includes a proactive engagement with it through rigorously understanding its conditions and learning about its mechanisms and the potential for architecture and people to contribute further to its livelihood.

– The habitat scale / Perform: This involves the scale of the habitat and its integration with the immediate contextual and climatic conditions of the site for the housing project, by enabling the architectural space to react, behave, and operate in symbiosis with the outside environment.

– The human/organism scale / Activate: The third is that of the community, where the research focused on enabling new socio-cultural user interactions, communal activities and supporting programs that benefit and synergistically connect with the towns and the biosphere environment.

1.54.1.1 *The Biosphere reserve scale: Engage through a proactive approach*

This first scale involved deep understanding of biosphere reserves in general and focused on the Jabal Moussa context and its surrounding villages of Mchati, Qehmez Plateau (upper), and Qehmez Valley (lower). Through in-depth research, mappings, and analysis, the students gained thorough knowledge of the context within which their architecture projects could be imagined. Their investigations of the area were approached from different perspectives but focused generally on climatic and environmental factors, local ecosystems, spatial typologies, and socio-economic realities.

The research used available resources from books, references, and online information and maps. However, to understand the site more intimately, a hiking and weekend trip was organized with the Nature Conservation center's support for the

students and professors to engage directly with the biosphere. The group visited the biosphere area and explored it through the different walking trails, and spent time in the local nearby towns and their available facilities from the eating houses to local small markets. They also interacted with the local community to help formulate a clearer picture about the intersections of Jabal Moussa with the community surrounding it.

The students' research tackled different aspects of biosphere reserves in general and the Jabal Moussa biosphere reserve in particular. They understood biosphere reserves first as the rich ecosystem and life-sustaining layer on Earth that forms the habitat of all living creatures, living together in symbiosis. The UNESCO Man and Biosphere program moves from this premise to identify and protect rich biosphere around the world, that designate a particularly rich biodiversity, community integration, and cultural and natural heritage, while enabling economic and sustainable development. Each biosphere is structured along three interrelated areas: the core, buffer, and transition zones. As one of the 33 UNESCO Biosphere reserves in the Arab World, Jabal Moussa is understood as a particularly rich landscape and community, home to protected species and local cultural heritage, and engaged with 7 surrounding villages. It is a mountainous area in the Keserwan district of Lebanon (Figure 1), bound by two rivers and covering an area of 6500 hectares, at an altitude ranging between 350 meters and 1,700 meters[4]. It includes a rich ecosystem ranging from riparian in the valleys to open woodland in the mountainous area, with varied and unique flora and fauna. In its forest area, it includes species such as Oak, Juniper, Pine, and wild Apple trees, in addition to various types of wild orchids and endemic plant species such as the cyclamen and the Lebanese oregano. Jabal Moussa is also an important migratory bird habitat, and bottleneck for migratory routes, with bird species such as eagles, storks, and sparrow hawks (Figure 2). Different species of wild animals also inhabit Jabal Moussa, such as the striped hyena and wild boar, with some particular to the Middle east region and Lebanon like the rock hyrax (Figure 3). The students in their research further understood different climatic conditions in the area, from wind direction and speed in different seasons, sun orientation, and varying humidity levels (Figure 4). Additionally, they looked at socio-economic and bio-integrated programs that form part of the richness of Jabal Moussa, from recreational eco-tourism activities, to medicinal plants, honey making and local food produce (Figure 5).

[4] "A Walk through Jabal Moussa", MAB Med 2015, PDF online, viewed on https://www.jabalmoussa.org/sites/all/themes/jabalmoussa/img/walk-through.pdf.

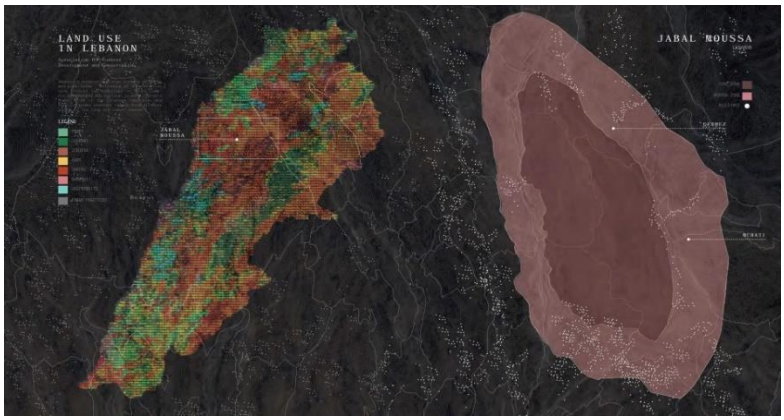

Figure 33.1. Jabal Moussa Biosphere reserve in Lebanon (Lea Tabaja, Yara Haidar, Noura Bissat).

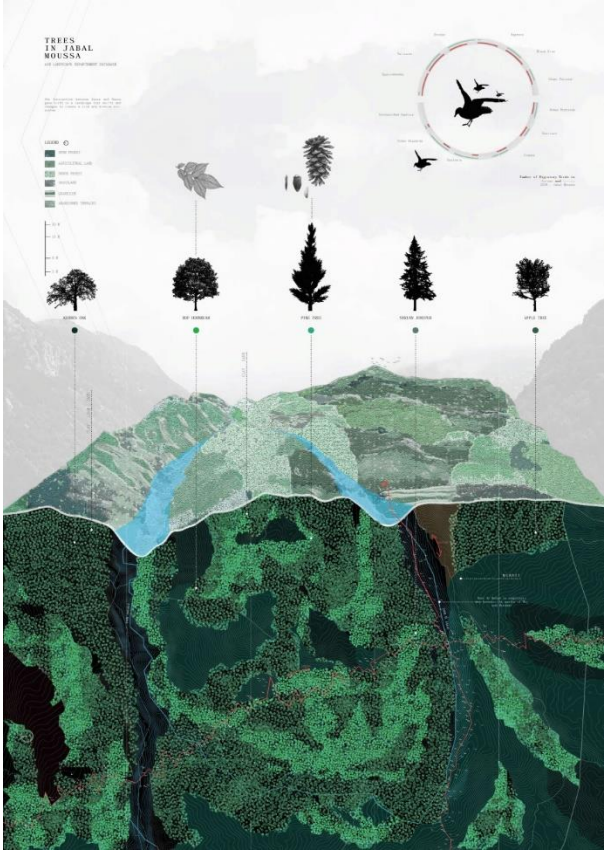

Figure 33.2. *Flora, Fauna, and migratory birds (Lea Tabaja, Yara Haidar, Noura Bissat).*

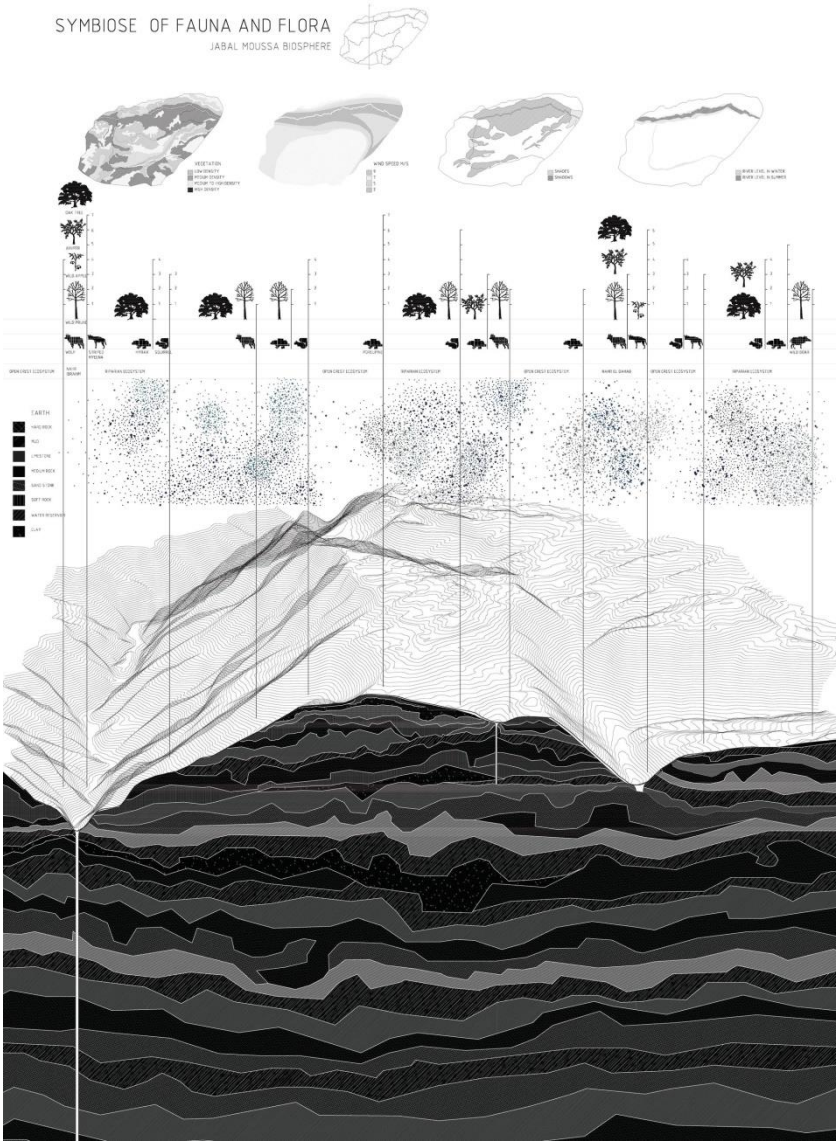

Figure 33.3. *Wild animals of Jabal Moussa (Myriam Abou Adal, Marc Faysal, Amir Moujaes).*

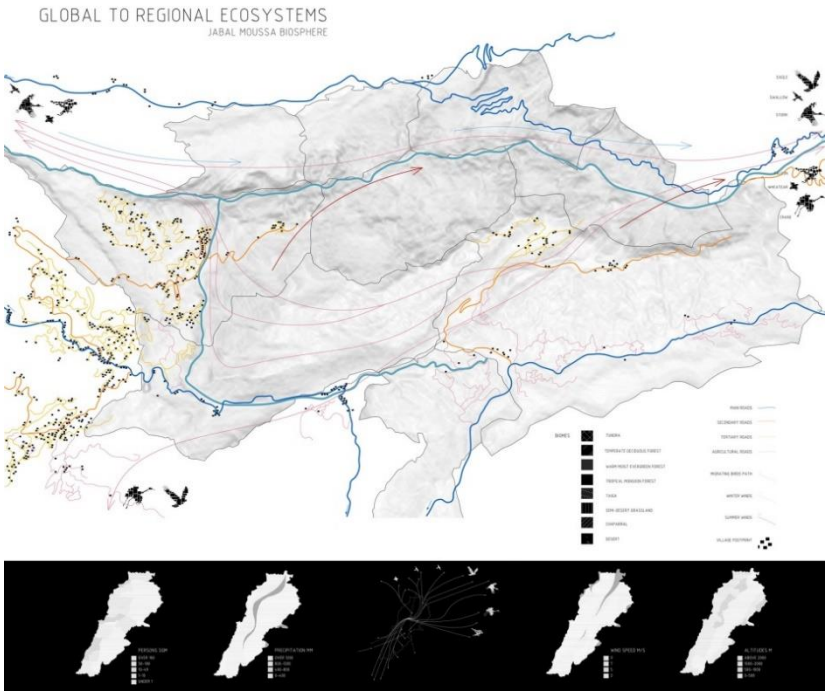

Figure 33.4. *Wind speed, seasonal flows, and local villages (Myriam Abou Adal, Marc Faysal, Amir Moujaes).*

Furthermore, they zoomed in to select areas around the villages of Mchati at Nahr el Dahab and Qehmez (upper and lower sections of the town), to understand in more depth their various environmental and social characteristics. The upper plateau of Qehmez was understood as a productive agricultural plain with links to Jabal Moussa through a main entrance into the reserve, and proximity to local guesthouses and the tree nursery (Figure 6). The lower section of Qehmez in the valley, was also understood a rich agricultural area with tomato plantations and affected by a direct proximity to local uncontrolled quarries (Figure 7). The area featured traditional single unit house typologies, with terraces and vine shaders in connection to the agricultural fields. The village of Mchati was also researched and understood as a town that is adjacent to the Nahr el Dahab river. Featuring a series of terraced zones on the side directly adjacent to the steep slopes of the biosphere, Mchati includes many direct supporting programs to Jabal Moussa, from a local produce market, to a guesthouse and eatery that engage with visitors to the biosphere (Figure 8).

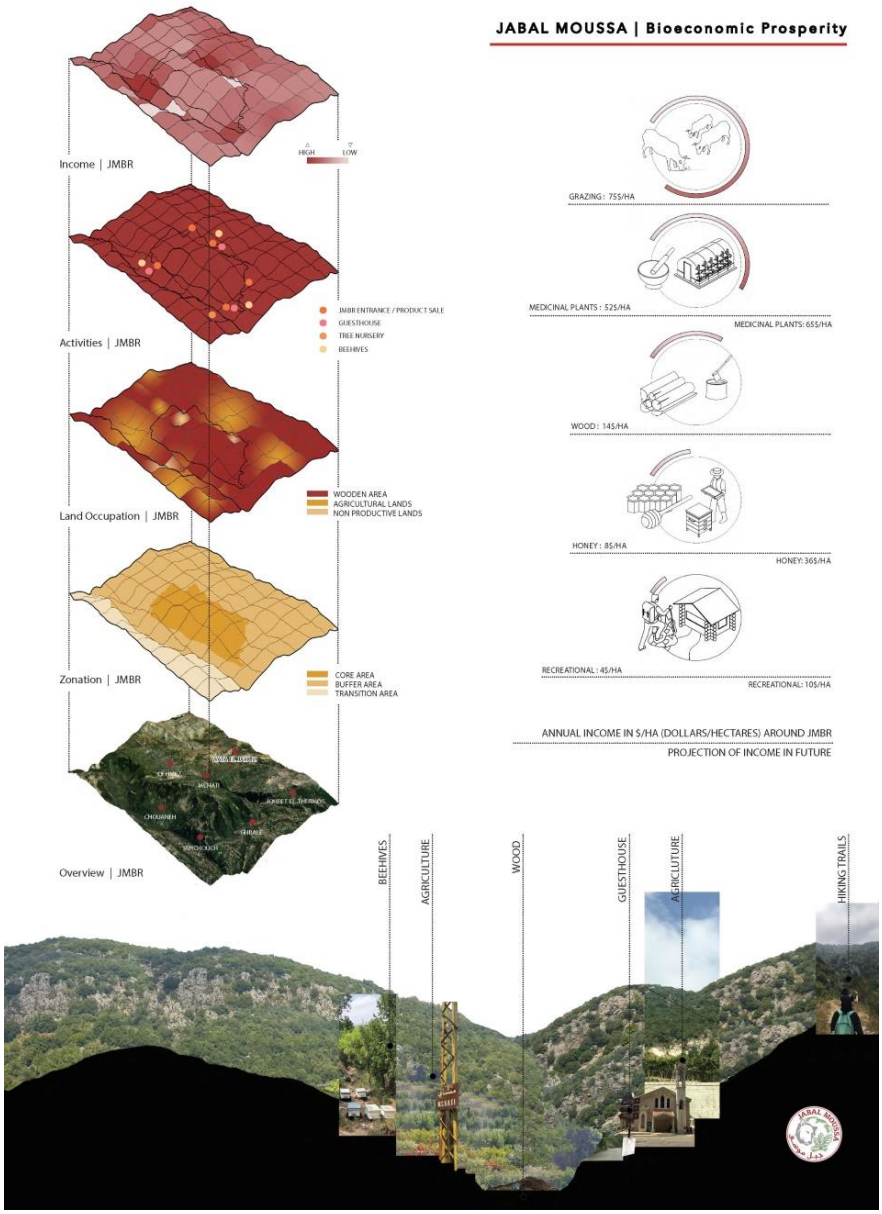

Figure 33.5. *Local activities and bioeconomic potential (Joseph Chalhoub, Aya el Husseini, Baraa Al Ali, Samer Abboud).*

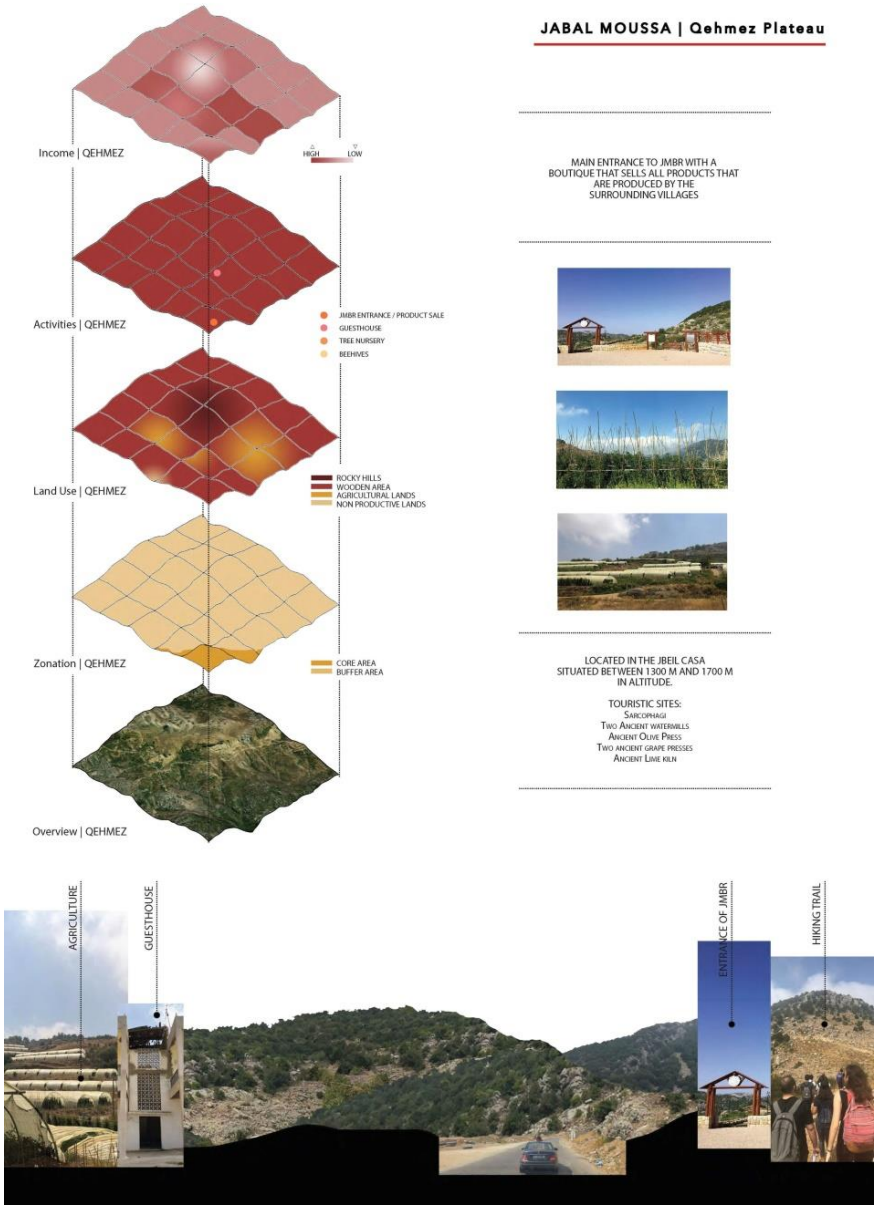

Figure 33.6. *Qehmez plateau (Joseph Chalhoub, Aya el Husseini, Baraa Al Ali, Samer Abboud).*

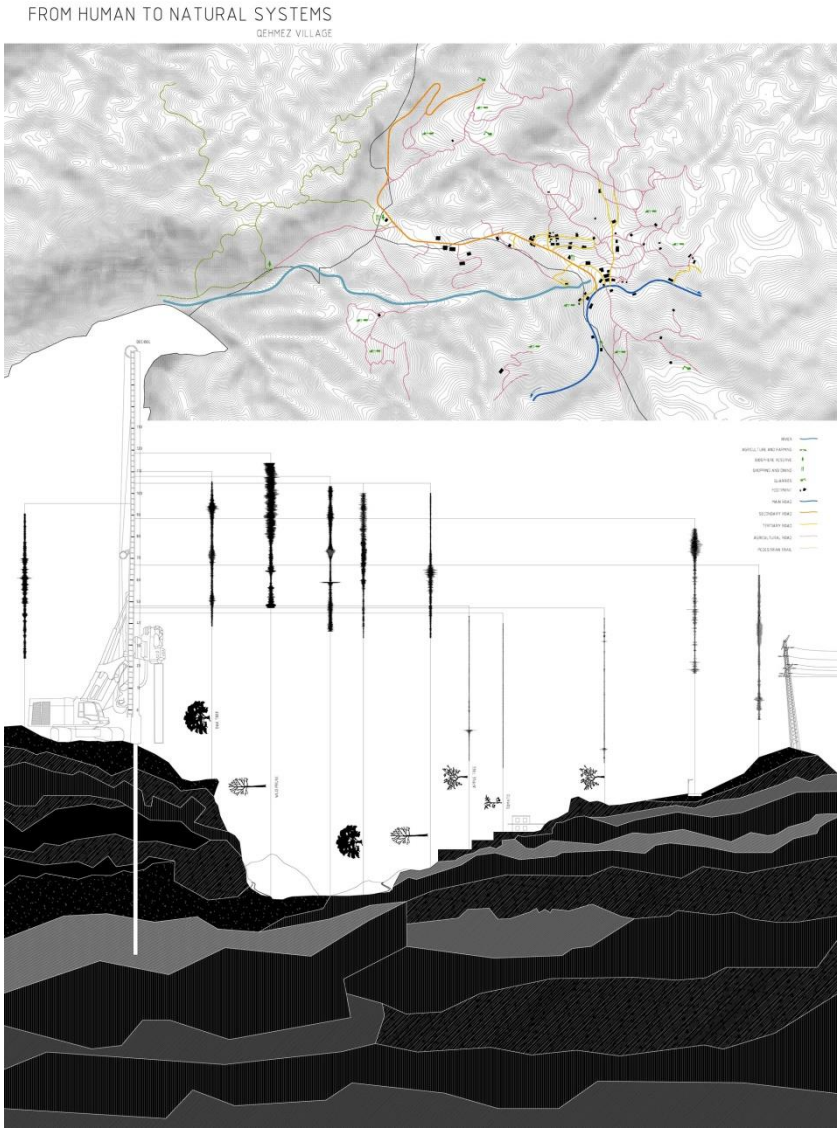

Figure 33.7. *Qehmez valley (Myriam Abou Adal, Marc Faysal, Amir Moujaes).*

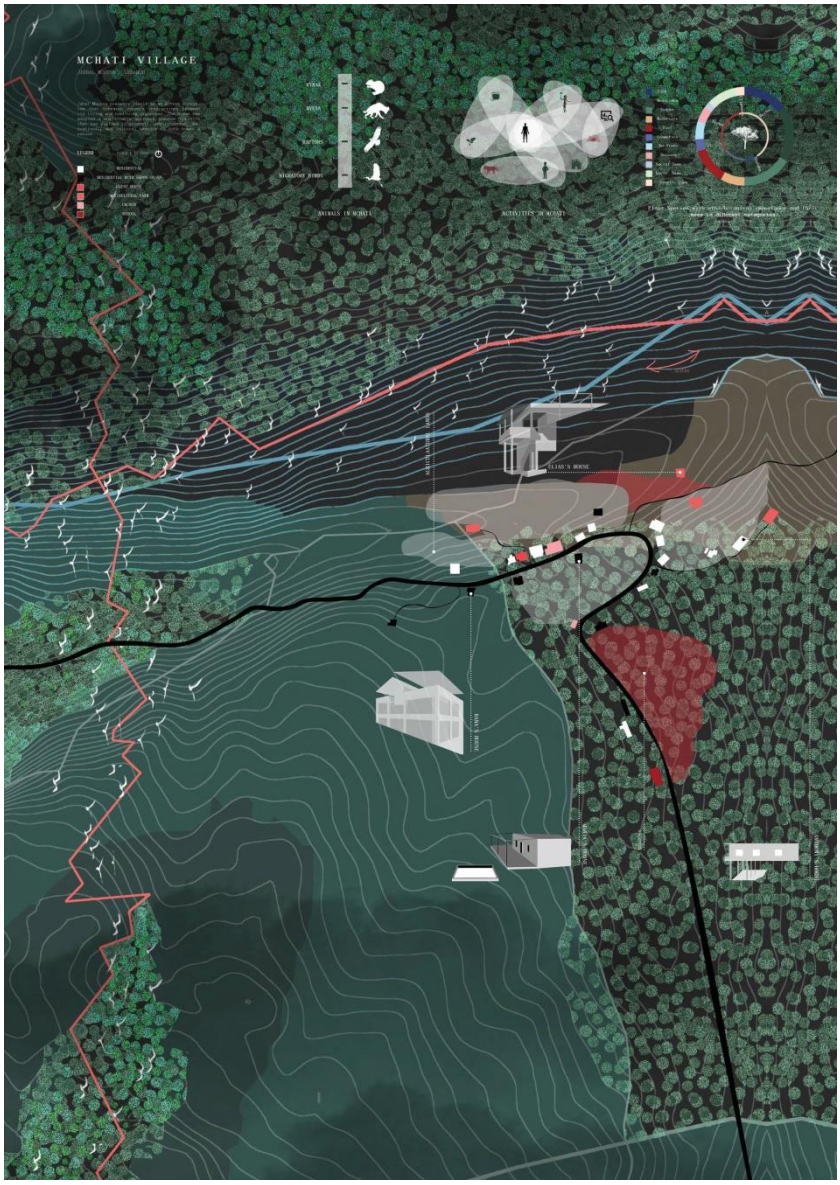

Figure 33.8. *Village of Mchati (Lea Tabaja, Yara Haidar, Noura Bissat).*

1.54.1.2 *The Habitat scale: Perform through environmental responsiveness and housing*

The second scale of the studio process involved understanding environmental behavior and site conditions as extensions of an architectural space through a design

process of abstract physical models. The environment and climatic conditioning of an architectural building were looked at in depth within this studio. Inspired by works of architects like Philip Rahm, the approach involved understanding climatic and atmospheric conditions, from heat, wind, humidity and others, as dynamic flows that are implicated by the form and spatial parameters of an architecture project.

> *"*The aim is to conceive an architecture free of any formal and functional predetermination: variable, fluctuating, open to meteorological permutations and the passage of time, to seasonal changes, to the alternation of night and day and moreover to the sudden appearance of unanticipated functions and forms. *"*[5]

To start conceiving of their model experiments in relation to climatic conditions, the students narrowed into a site of their choice in one of the three selected villages. They began conceiving of an architectural spatial intervention that can foster good climatic and sustainable synergy with its site and context. The students understood through further research issues such the site's materials and landscapes, its orientation, as well as wind and energy flows, sustainable materials, passive design strategies, and typological integration with landscape.

The design process used to achieve this focused on developing physical experimental models at a scale of 1/20. The models were developed as abstract spaces that intersect environmental behaviors and performance with architectural typologies. Drawing upon specific site conditions from wind direction, sun orientation, and others, the students each created and imagined a space that optimizes climatic behavior while creating an interesting architectural and landscape experience. Accordingly, each produced model intersected three main parameters:

– Natural elements: the space in the model should help enhance or reduce the behavior and flows of natural climatic elements, such as heat, cold, air and wind circulation, rain, and humidity.

– Architectural Typology: the form of the model should start from specific spatial typologies (such as courtyard, tower, elevated mass, or other) that can optimize or transfer these natural flows. The selected typologies should also provide a meaningful spatial experience

– Context: The architectural model should also articulate or respond to a condition of the site, such as a tree or landscape species, a water feature, a rock formation, or another locally found characteristic.

Each of the students' models thus provided a climatic concept and formal approach that allowed them later to design a more developed housing scheme. Moving from

[5] Rahm, Phillip, "Form and Function follow Climate", AA Files, No. 55 (Summer 2007), Architecture Association, London, pp. 2-11.

these abstract experiments into housing typologies, each of the houses designed by the students became thus a spatial result that intersects site issues, with landscape, and climatic behaviors. This abstract experimental phase allowed the students to understand architectural space and form as a parameter that controls climatic energy flows and enables certain levels of comfort and shelter. It also allowed the students to factor in spatial experience and living atmosphere while critically solving climatic needs. (Figures 9-11)

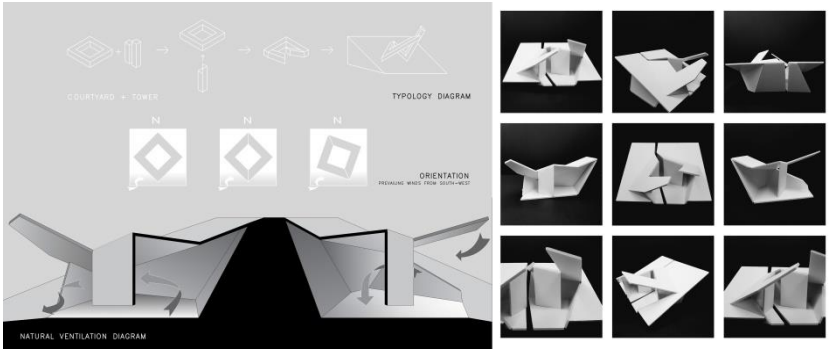

Figure 33.9. *Climatic model. Joseph Chalhoub.*

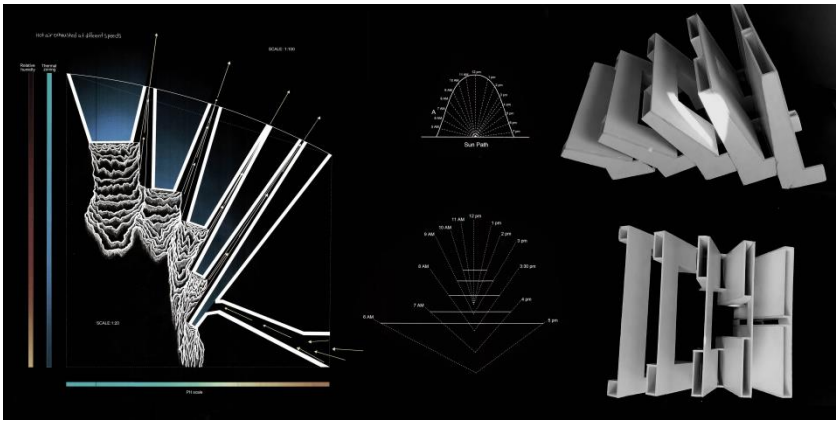

Figure 33.10. *Climatic model. Omar Ayache.*

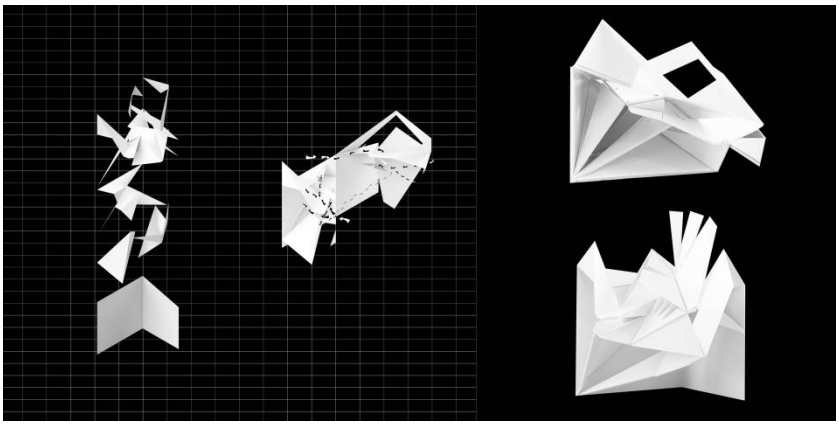

Figure 33.11. *Climatic model. Lea Tabaja.*

1.54.1.3 *The Human/organism scale: Activate programs & community engagement*

In the third scale of research within the studio, the students moved on to develop and propose potential programs and communities, which could be imagined to relocate to the vicinity of Jabal Moussa. Based on their in-depth site research, each of the students delved into their own programmatic proposal, foreseeing a new type of community living and working and supporting the biosphere. The proposed program served as a link between the incoming inhabitants and the local area and its people, and as a potential communal and sustainable space that can link to existing synergies and resources in the different towns. The students relied on their investigations of local services, the different towns, their resources and produce, in addition to currently existing synergies between the biosphere reserve and the villages, to propose new types of programs that can be situated in the proposed housing community and that can engage with the biosphere reserve and villages.

For example, one of the students had looked at existing economic potentials in the village of Mchati and found that honey making can be a good source of production due to precedents in the area. The student's new programmatic proposal centered around beekeeping and honey production through a community including beekeepers and researchers, living together and co-producing honey to be sold through the biosphere reserve's shops and markets (Figure 12).

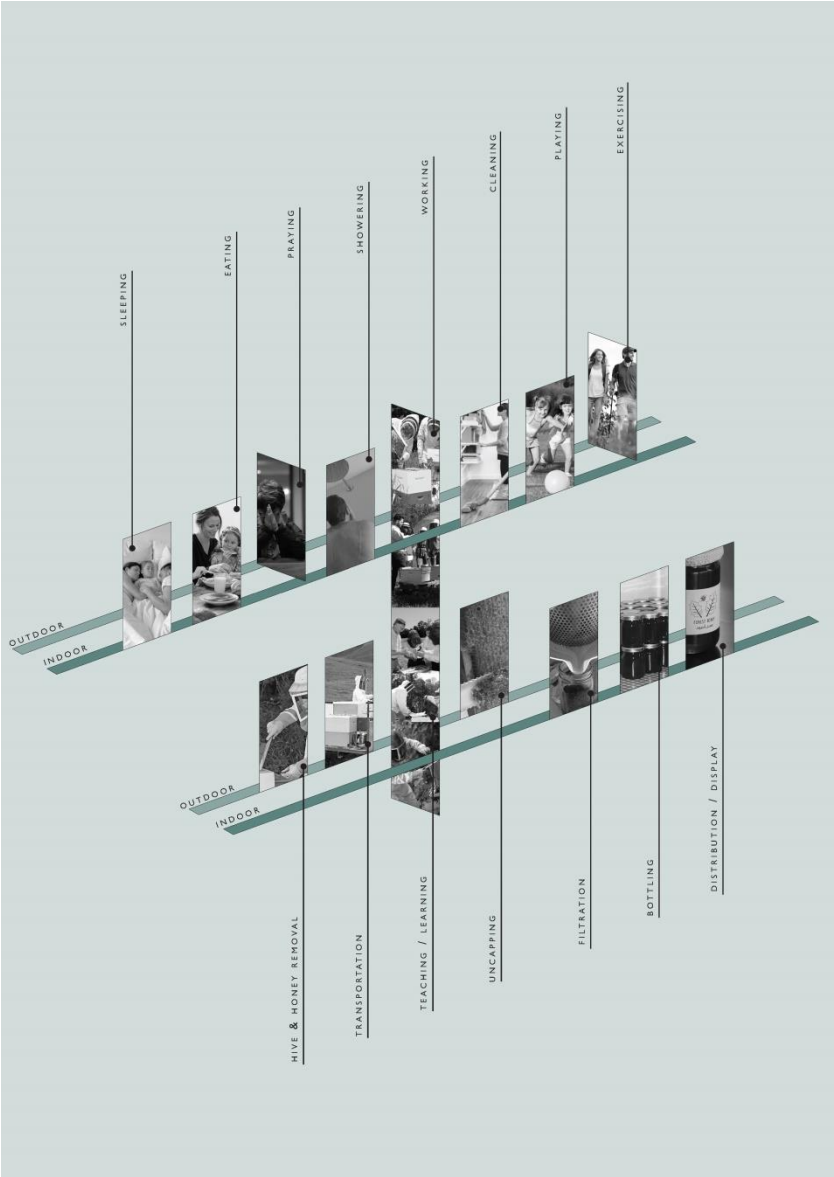

Figure 33.12 *Honey making community program. Joseph Chalhoub.*

Another example looked at a program on a site near Qehmez that can seasonally house local nomad shepherds, who m ove yearly between the Bekaa valley and Jabal Moussa vicinity. The proposal combined communal dwellings for three shepherd families with local eco-tourism, including play areas and camping sites, food production, agricultural zones, and farmers market (Figure 13).

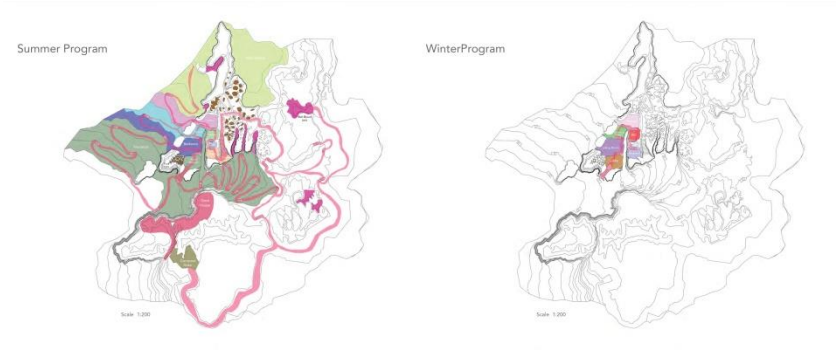

Figure 33.13 *Shepherds and eco-tourism. Omar Ayache.*

A third example considered the possibility of integrating in Mchati a hybrid program that can support the biosphere while also supporting particular people in need. The idea was to combine a nursing home for the elderly with a children's orphanage, while integrating and supporting food production and farming practices. Connecting to existing terraces and vines, the program instigated a connection between the elderly/ children community to nature, agriculture, and the biosphere (Figure 14).

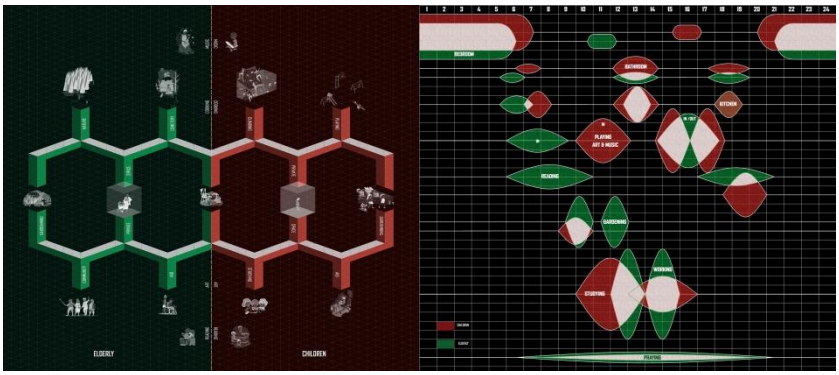

Figure 33.14 *Housing for elderly and children. Lea Tabaja.*

1.54.2. *Student architectural proposals and results*

Following up on these different scalar investigations, from site research, climatic model experiments, to programmatic proposals, the students moved then to develop their architectural proposal for the dwellings, by first starting with an individual housing unit to accommodate a single individual or a family. The design of each of the housing units relied on the programmatic needs of their proposed program and users, in addition to climatic behavior, spatial experience, and internal connectivity.

Each design of the house had to establish a clear relationship to the outdoors and the natural site, and to involve a sensitive integration with the landscape and local materials. From the design of the unit, the students then moved to develop strategies to combine the individual units together to form communal clusters and agglomerations, and to conceive of their overall community scheme including additional production and recreational areas. Within the communal agglomeration, the houses needed to interact together both spatially and socially, as they respond to site, climatic, and programmatic conditions.

Different student projects developed out of the semester, each approaching the three scales of research uniquely, and resulting in varied design visions that cross communal housing with environmental integration and biosphere synergies.

The first project focused on the socio-economic potential of the area, and in the village of Mchati specifically, through incorporating a productive community interacting with the biosphere through honey making. Developed by student Joseph Chalhoub, the project for the community housing and honey production facilities is developed as an integrated architecture within existing terraces on the Mchati slopes, facing the river and adjacent to Jabal Moussa's lower entrance. In his proposal, Joseph focused on designing first a single housing unit that sits within the slope, and that relies on his earlier physical models to design large southern openings and ventilation flows that optimize the climatic conditions of the unit. To create the community, he went on to cluster each two houses together, centered around a shared outdoor landscape, with all the other clusters aligning to different levels of the existing terraces. A central communal outdoor area links the inhabitants of this community together. The community would maintain beehives in close-by lots adjacent to the biosphere and uses their communal and production spaces at the lowest end of the development, to produce honey as an important local produce. The design also makes use of local stone materials and local plants and agricultural to create a holistic and productive environment. (Figure 15)

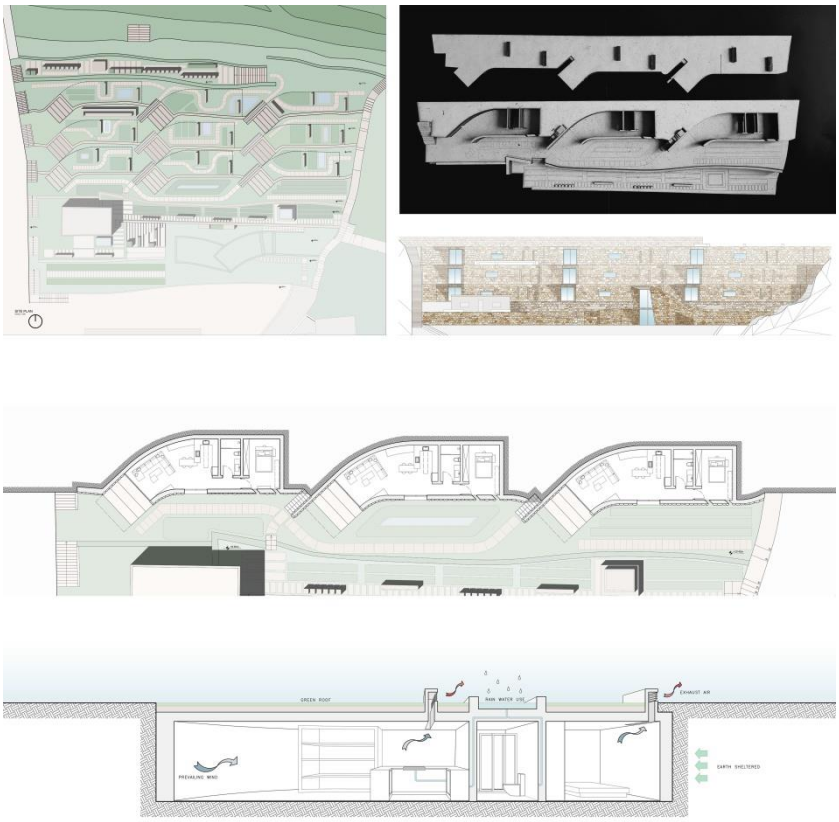

Figure 33.15. *Integrated community dwellings and honey production. Joseph Chalhoub.*

A second project by Omar Ayache focused on embedding architecture within the natural landscape and on supporting existing vulnerable communities in the vicinity of Jabal Moussa. Omar started by working on an existing rocky area in Qehmez, with varied geological formations. In his first part investigating humidity and the resulting formation of underground cavities through erosion, Omar experimented with different relationships between heat and humidity transfer, and conditions of height and width of subterranean spaces. His intervention involved casting and creating clay layers with vertical inlets within the artificial rock, allowing it to erode and develop spaces and cavities in time with varying heat and humidity levels. This new rock formation would merge together with the site's natural limestone and form well-conditioned spaces over time. His previously mentioned program that crossed housing and shelter needs for local shepherds also included local and visitor programs, from a farmer's market, to guesthouses and camping sites. The program was situated within the architectural cave-like space following geothermal factors and comfort needs, ranging from higher warmth to lower humidity levels. Housing three families of shepherds mainly, the

community would thus revolve around the interaction of the shepherds, the local farmers, and local tourists to the biosphere and the area. The design itself is formed out of the natural process of erosion and is created as a multileveled house, where each room is positioned according to heat and coolness factors. The houses also open up to and connect to one another through communal areas and meeting zones. (Figure 16)

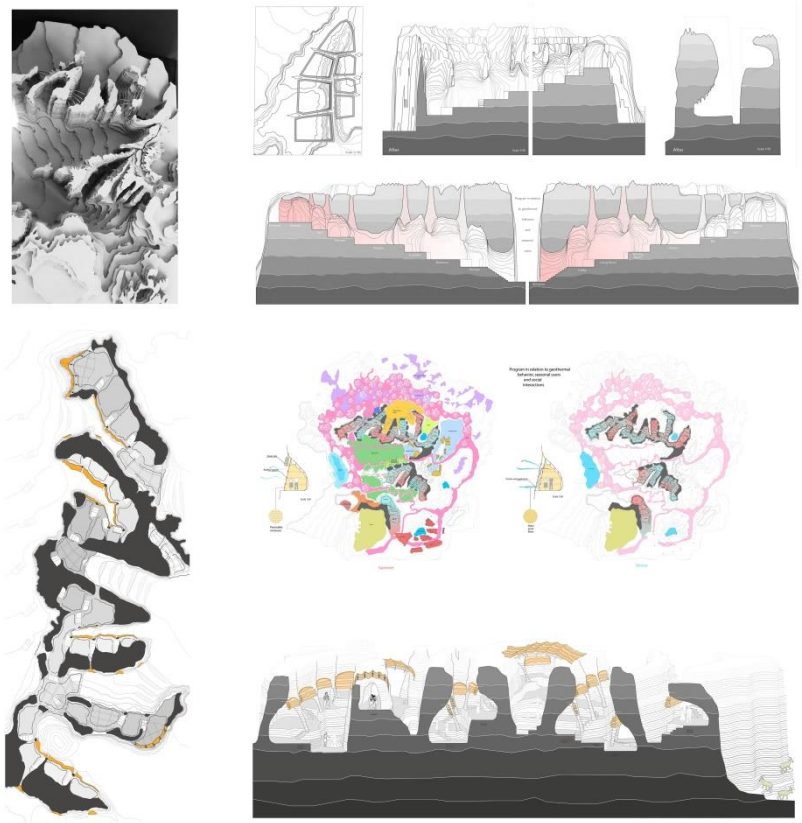

Figure 33.16. *Embedded geological dwellings for local nomads. Omar Ayache.*

The third project by Lea Tabaja focused on evolving a new hybrid community integrated on the agricultural terraces of Mchati, on specifically on a zone with existing vine climbers. Her project began through complex studies of intersecting surfaces on a slope, which could optimize cross ventilation and heat transfer. The existing vines on the site created an underlying grid that guided Lea's decision on where to intervene. Her program proposed that a group of elderly would move to and live in a housing community that also includes a children's home. The two groups, the elderly and children, would live within the same community, sharing intersecting spaces, from eating areas to gathering zones, while also having separate functions such as private bedrooms, reading and playing rooms. They would thus inhabit

together this communal dwelling while engaging with the adjacent biosphere and the local village. The design of the housing units started from the earlier formal and climatic experiments, and then evolved to incorporate programmatic needs and slope requirements. Each unit is designed as part of a dual cluster, with two homes engaging together with different types of supporting spaces. The programs were positioned relative to individual and common functions, and also based on the users' day /night activities and comfort needs. Sleep spaces for example coincided on similar private sides within the cluster, while more active play or activity areas happened in more open and connected spaces to the outdoors. The existing vines on the slopes further enabled an outdoor / indoor productive connection to landscape. (Figure 17).

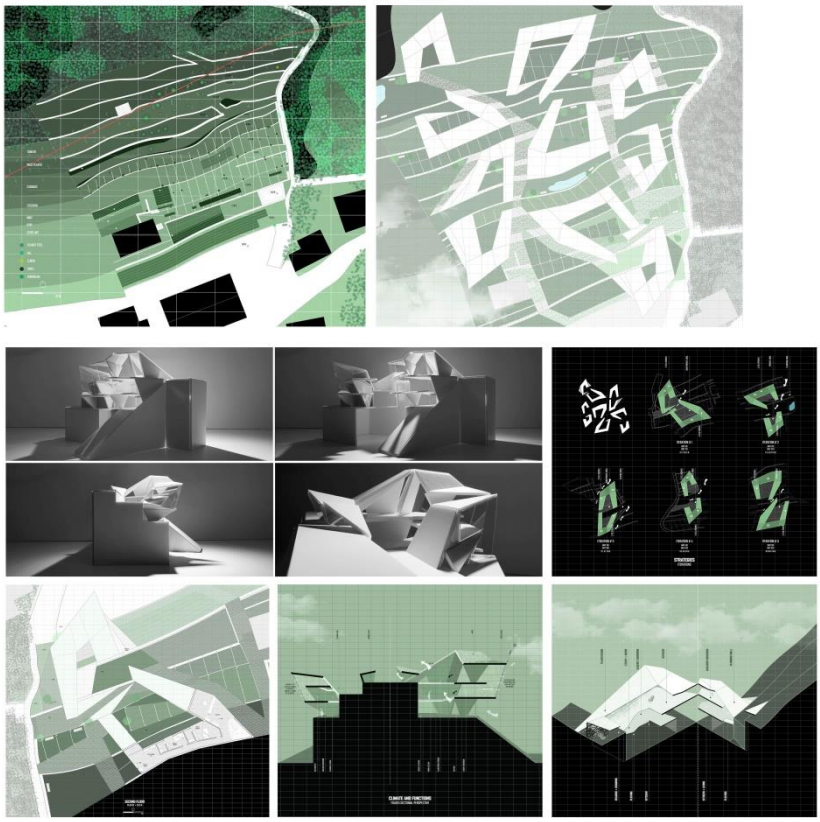

Figure 33.17. *Hybrid architecture and existing landscape terracing. Lea Tabaja.*

The fourth project by Myriam Abou Adal focused on an environmentally responsive architecture and proposed that a group of botanists would relocate to Qehmez to experiment and research on the different species in the Jabal Moussa area. The botanists would live together in this sustainable community, where the work and living programs intersect and meet. Different outdoor agricultural areas and indoor greenhouses form part of the community and engage directly with the houses and lab

spaces. The design of the housing units, and then later the clusters, were focused on an optimized indoor climatic performance with protection from harsh sun rays, while enabling thermal heat absorption by the walls and planted roof. Good cross ventilation and vertical stacking of spaces also allowed a continuous hot air flow throughout the space. The planted roofs further served as outdoor meeting areas and productive landscapes that serve the users. From a macro perspective, the entire community was designed to engage with the rocky site of Qehmez, while following the constraints of the slope, and intersecting architecture with landscape and infrastructural needs. The common areas included outdoor agricultural zones, a walking / exercising track connecting all the units, and a water collection system that provided for water needs in summer. Common supporting programs also included waste composting and a seed bank that would serve as an educational facility to incoming visitors. (Figure 18)

Figure 33.18. *Productive housing clusters and the environment. Myriam Abou Adal.*

1.55. Conclusion

The studio thus worked on bringing research and understanding of biosphere reserves right into the heart of the architectural studio, and to position it as an essential subject that students could engage with to propose more holistic and sensitive integrations of integrate architecture with environment. The biosphere itself served as a model of reference, as an ecology that includes necessary synergies between people, the natural environment, in all its encompassing richness from the ground layers to the atmosphere. Architecture as such as was seen and developed as a continuity of this ecosystem, and as an inherent synergistic space that engages with its surrounding and community. Through a scalar research methodology, that moves from the scale of the biosphere, the habitat, to that of the community, the work developed in this studio allowed students to design novel intersections of architecture and the environment, and to propose new visions for housing communities.

Using research, visualization, and experimental climatic models, the students were able to develop their projects as potential alternatives to urban or rural housing typologies, and to cross sustainable design strategies with productive landscapes. The aim overall was to develop new architectural ideas that can be situated in the buffer areas of Jabal Moussa and that could become crucial supporting programs to the life and development of the biosphere.

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