# Building Solutions for Date Processing in a Jeopardizing Environment

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**Written for presentation at the**
**2007 CIGR Section VI International Symposium on**
**FOOD AND AGRICULTURAL PRODUCTS: PROCESSING AND INNOVATIONS**
**Naples, Italy**
**24-26 September 2007**

**Abstract.** *The project carried out in Dhi Qar Province (Iraq) required to set date palm processing lines inside a clean and hygienic facility in order to prevent the food from contamination and sandstorms. Activities in the field were planned to be carried out during peaceful period. But situation was jeopardizing and because of the uncertainty, location was in the worst social condition to realize a building project. As political decisions changed very fast, it was hard to control work progress. Moreover it was difficult to find carpenters; access to energy supply could not be continuous, etc.*

*Due to the necessity to complete the activities of the project, three different solutions were elaborated to get capacity of working in changing situation. In this paper the criteria of choosing various approaches are described and discussed.*

*a) The first solution is represented by a versatile prefabricated structure composed of a modular box, preventively organized. This structure is simple to mount in a safety area in order to assemble and test all the date processing equipment. In such a way it is possible to train local workers. Furthermore the structure is quick to dismantle and move to the final location. This solution was tested during the project (September-October 2006).*

*b) The second solution can be realized using a solid existent building, previously checked by local partners of the project on the spot. In this case the processing equipment can be installed inside the structure after the restoration.*

*c) As third enduring solution, to realize during a relative peace period, a factory building can be specifically designed for date processing. In the project it is necessary to take the traditional taste of building beauty into consideration, but at the same time to fulfill the international safety requirements for construction.*

*All the studied solutions must be furnished with a 20 ft container modified to become fumigation, dryer chamber and date warehouse, used also for shipping some of the stuff. It is an economic and sustainable way to make easier some critical parts of the date processing. Furthermore solar energy can be used to cover the lack of power supply during the production process. Photovoltaic panels were used in our demonstrative plant not only to power the conditioning system of fumigation and dryer chamber, but also to light the area during the night. Hot water necessary for the process was provided by solar panels.*

**Keywords.** Sustainability, food production, date palm processing, Middle-East Countries, jeopardizing environment.

## Introduction

Building something during a war conflict is a hazard idea. Most of the basic conditions necessary to start this kind of activity do not exist.

After the end of the war in Iraq, the Italian Ministry of Foreign Affairs asked the Department of Agriculture and Forest Engineering to take part in the reconstruction phase. Our proposal of an "Integrated Feasibility Project to Support the Production of Date Palm Trees and Exploit Their Products" was approved. The project started first quarter of 2006. Situation at the time was not completely peaceful and there was no signal that it would improve.

A part of the project was to work out a small scale system for processing date palm products. This system was thought to be carried out and set in Iraq in order to show its benefit. In another two papers presented in the Symposium it is possible to have a clear and complete overview of all activities (Beltrami *et al*., 2007; Barbari *et al*., 2007). Housing the machinery was not considered in the project budget but we were asked to propose and decide the best constructive solution for our system.

We approached the problem studying several points of view in order to resolve the complexity of the building. All aspects of construction, starting from normal standards finishing up with those concerning the jeopardizing environment where activity was planned, were taken into consideration. Afterwards, recipients had to provide a constructive solution in order to satisfy the requirements fixed by our department.

In this paper we describe three different solutions that can completely meet the needs of our project. One of them was realized within the project in order to avoid failure of the rest of activities.

### *Habitat outlook*

Average winter temperature varies from 4°C to 18°C, the summer one from 25°C to 45°C. During summer, night temperatures drop of 15 to 20 degrees. Except near rivers and marshes humidity is low. The climate of the province is classified as desert, so landscape is predominantly expose to erosion phenomena. Agriculture land is available just from nearly 1 Km from both sides of river or channel, after which fertility decays as availability of good irrigation infrastructure. Total area covered by date palm trees is 4.000 ha.

Sandstorms during the summer season are common.

### *Social and political outlook*

Dhi Qar province (Arabic: ذي قار) is situated in an area of 12.900 square Km in the South Iraq. The capital is An Nasiriyah. Estimated population is 1.454.200 people, mostly Arab Shi'a but the province is a mosaic of religions: Shi'a, Sunni, Chaldean Catholic Christian, Mandaeism, etc. As far as ethnics are concerned there are: Arab, Kurds, Sabians, etc. Ancient Sumerian ruins of Ur, Eridu, Lagash and Girsu are present in this area.

Furthermore the province administrative system is under pressure of political instability due to the option of forming a Shi'a state in the South Iraq. This situation causes lack of institutional hierarchy, lack of transparency and bribery.

Generally uncertainty makes hard the development of economic structured background.

### *Work outlook*

The place of work is located near An Nasiriyah and the geographical coordinates are 31° 01' 40.24" N and 46° 18' 9.87" E. This area is not considered safe by military forces. As a result nobody from our project staff has the possibility to get there. Any information about it comes from satellite pictures and from our local partners.

Site access characteristics have negligible effect on the duration of construction projects (Boussabaine, 2001).

Evaluation of the contractor, taking into consideration quality of performance, project safety and financial strength among thousands of firms, is normally complex in a peaceful place. In a jeopardizing environment, as it is in our case, it becomes fairly more difficult because of the costs rising due to low availableness of skilled labour, availability of goods, expensive costs of control and security. In addition the matter is complicated by terrible environment conditions during certain seasons.

## Methodology

Before starting any activity of the project, we considered necessary to start with a profound background based on references and picture analysis. Our research was concentrated on constructive solutions for food manufacture system, in particular on traditional buildings for date palm processing. A special attention was dedicated to the study of different styles of construction beauty in the described area. Islamic, Arabic, Babylonian and local interpretations of the style became our inspiration in designing some of the constructive solutions. For example, we reinterpreted the concept of repetition used to build Wahhabite mosques in the African countries. Moreover we used some lines from typical cabins used for tribal unions in the South Iraq.

As any other kind of building activity, time, cost and quality are the indicators on which the success of project is assessed. In our case, time to complete all the activity of the project was one year extended of six months. The budget of the project did not provide expenditure for construction but a local beneficiary asked to make it available. Their capital appropriation was limited so fare of all works to make site usable had to be low. Thus the quality of structure was valued in order to satisfied target of the project and to cover the duration of the economic life of the entire system as it usually happens in this type of SME investment activity.

To achieve the goal of this project the method of problem solving was adopted.

The final building had to respect certain aims:

- simplicity of the construction in order to respect times of the project;
- spaces sufficient for safe and comfortable work;
- materials available on place, alternatively cheap materials easily shipped;
- hygienic conditions for food and workers;
- security measure to protect the place at the time of construction and production;
- industrial safety.

At the end of the works we proposed three different solutions to get capacity of working in changing situations. However, those three solutions had some common parts described above.

### *Common Parts*

The first three aims (simplicity of the construction, spaces, materials) vary among the three proposed solutions. The rest of targets are common to all solutions and will be presented successively.

In order to achieve hygienic conditions for food and workers different solutions were adopted:

- Orientation of the premises was thought in the way to prevent occasional sandstorms from entering inside and contaminating the food. In fact, it replaces the traditional procedure that requires the product to rest on mats in the palm trees' shade, exposing it to the risk of people stepping on it, animal contamination and sand storms.
- Layer of all the building parts was planned to be higher than the ground to reduce dangerous effect of seasonally overflow. Water accumulation inside the working room and warehouse could damage the machinery and cause mould contamination.
- Shadowing net was used to cover the outside work space. As a result conditions of work and quality of dates improved.
- Additional energy supply was thought to face dangerous lack of energy. We used photovoltaic panels to provide the propeller fan with uninterrupted electricity during the post-fumigation of dates. What is more, solar panels were installed to provide warm water to wash dates.
- All floors and walls were made washable as well as any machine of the processing line.
- Work clothes were introduced, especially for food manipulation.

With the purpose of reaching security measure to protect the place at the time of construction and production we proposed these devices.

- Road network inside the property was planned with an elbow to make hard to arrive directly in the core of the system and with two different gates (one enter and one exit) to control the access. System of ramps was thought to arrive to the level of work.
- Enclosing the work area with mesh-fence allowed to see outside the property and to control the situation.

Last but not least, to reach industrial safety we intended:

- To install information safety cards near every corresponding machine. The cards are written in big size type both in English and Arabic using alarming fluorescent colors like red, yellow and black. Those cards were washable and easily to read from the position of work.
- To put non-slip floors in the working rooms to prevent accidents during the wet phases of processing and the final cleaning.
- To design all the spaces without any obstacles for work flow, ex. staircase, steps and holes.

Two parts of the date processing system were planned to be outside the main building. These are the fumigation chamber and the warehouse. The reasons of setting them outside were different for each one. The fumigation chamber is a modified container that has to enclose frame of dates. It is unsafe because during the process of fumigation toxic substances are used. Being dangerous it needs to be placed in a windy zone far almost 10 m from human activity.

As far as warehouse is concerned, the situation is comparable, because it is a modified container too. Engineers involved in the project thought to place the warehouse into a container to give scalability to the system (more dates are worked, more containers are needed). For this reason the warehouse was set outside.

## Proposition of three different solutions

### a) Modular box

The simplest solution proposed to achieve goals of the project was a versatile prefabricated structure. It was composed of a modular box, two containers previously modified to become fumigation chamber and warehouse. The simplicity of this solution derives from various aspects:

- cheap costs of the system and of its shipping as well as of ground transport from Kuwait ports to location in Dhi Qar Province.
- possibility of organizing facilities inside the premises directly in Italy in order to reduce man work on site. The modular box was preconfigured to take in the electricity system, the plumbing and the air conditioning system, etc.
- ability of installation in 60 hours of manual work in a safe area to assemble and test all the dates processing equipment, capability of training local workers.
- the structure is quick to dismantle and to move in the final location.

Figure 1. Modular box carrying out stage

Figure 2. Project sight of temporary site

The modular box, 10 m in length, 6 m in width and 2.5 m in height, was manufactured in plastic material. It had six windows, one door and the floor covered of non-slip plastic. After the dismantling the modular box could be put inside 20 ft open top container in order to be shipped.

This solution was successfully tested during the project (September-October 2006).

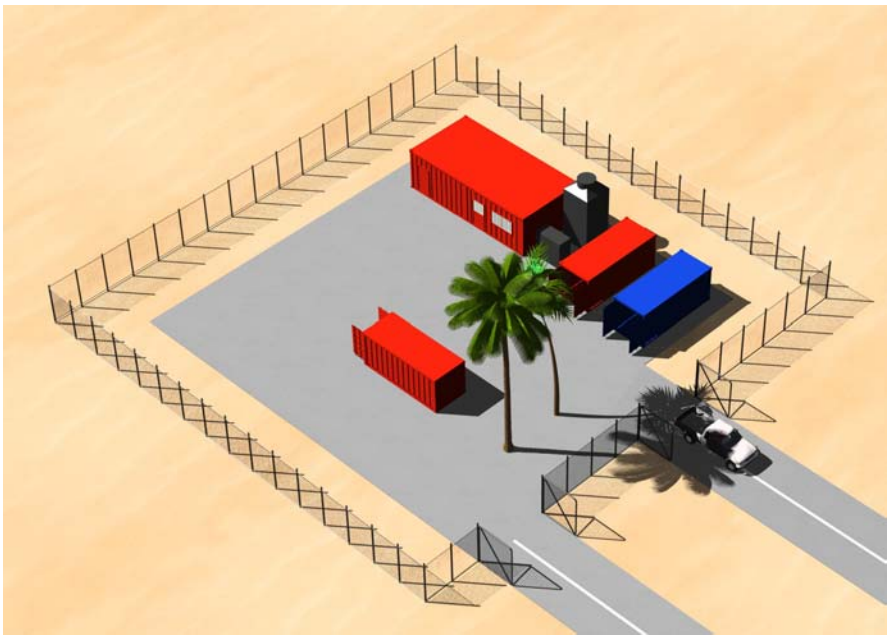

Figure 3. 3D simulation of modular box solution

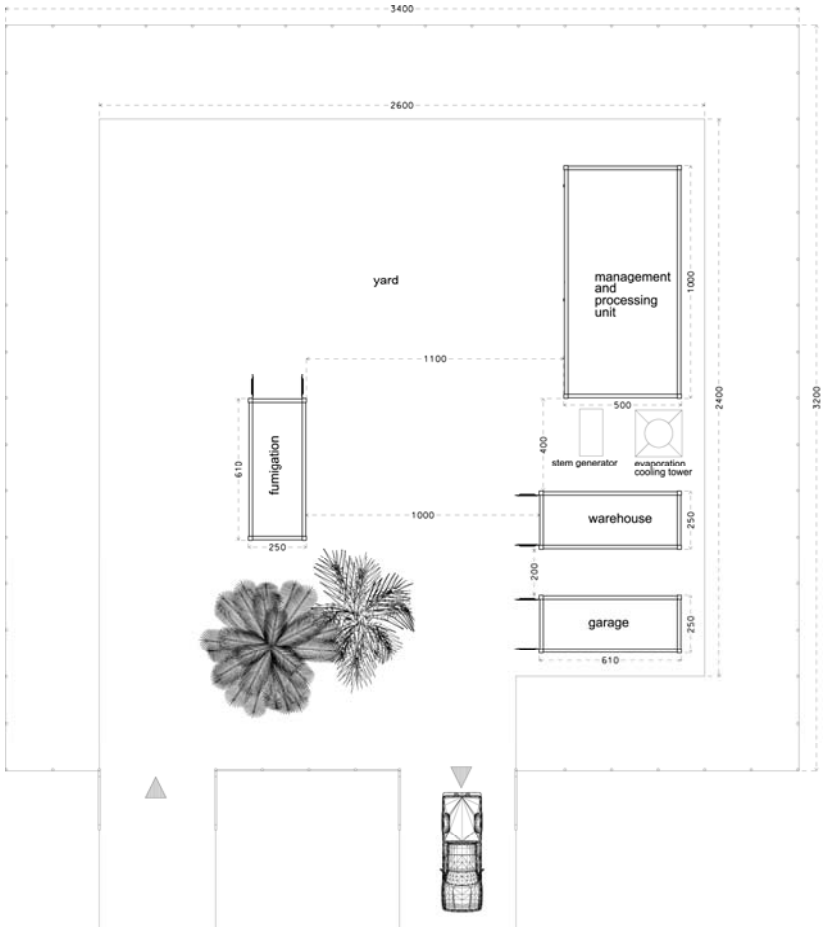


Figure 4. Lay out of modular box solution

**b) Restructuring and reconstruction of an existing building**

One of our proposal was to ask beneficiaries to provide us with some old construction, maybe damaged during the war or by misuse. We thought that this kind of activity would have been cheaper and easier to control than building new premises. Beneficiaries showed us several possible solutions. They were: old industries, unused new cattle barn and others buildings.

To be used, these buildings needed some serious interventions:

- realize all the security measures described above;
- open new windows and install light system to fulfill standard comfort of work;
- make all walls and floors washable and non-slip;
- carry out a drainage system to remove water from rooms' cleaning;
- remove main obstacles for the processing flow and for workers' safety (staircase, steps and holes).

In some cases it would have been necessary to build new rooms and to change completely the internal structure. If this solution had been adopted, the responsibility of previously checking and coordinating of work would have been of our local partners. In this case the processing equipment could be installed inside the structure after the restoration.

Figure 5. Archetype of traditional building in South Iraq

Figure 6. Example of characteristic building design in South Iraq

**c) Babylonian style brick building**

As third enduring solution to realize during a relatively peaceful period, a factory building was thought to be specifically designed for date processing.

An Iraqi workgroup of engineers was involved in the project. They were given hospitality in Italy for two months. During this period they participated in the design building decisions. Their suggestions, guidelines and choices were considered of primary importance. The study of the beauty concept in the South Iraq conducted before showed to be very useful. The immense documentation was collected on the subject of general environment of the area and local shapes of human mark on the landscape and some of them go back to the beginning of the History.

The search of the minimum costs compatible with the respect of the primary objectives played an important role too.

Besides, even if in the zone there are no records of particular problems concerning seismicity, it was considered useful to preview the application of Italian set of rules to build in an area situated in zone 3 of earthquake.

Therefore simple shapes and constructive techniques were privileged as they involve the employment of procedures and materials widespread in the local population.

A list of the operative choices is introduced:

- Foundations and substructures: are realized in reinforced concrete; particular precautions have to be adopted because of waterbed full of saline contents which is close to the ground level. In general it is necessary an adapted concrete cover to reinforce parts and give particular attention to the decision about particles dimensioning and humidity of the concrete. After the assessment of real local conditions it could become necessary to use additive chemicals which could not be available on site.

Figure7. 3D simulation of the Babylonian style brick building

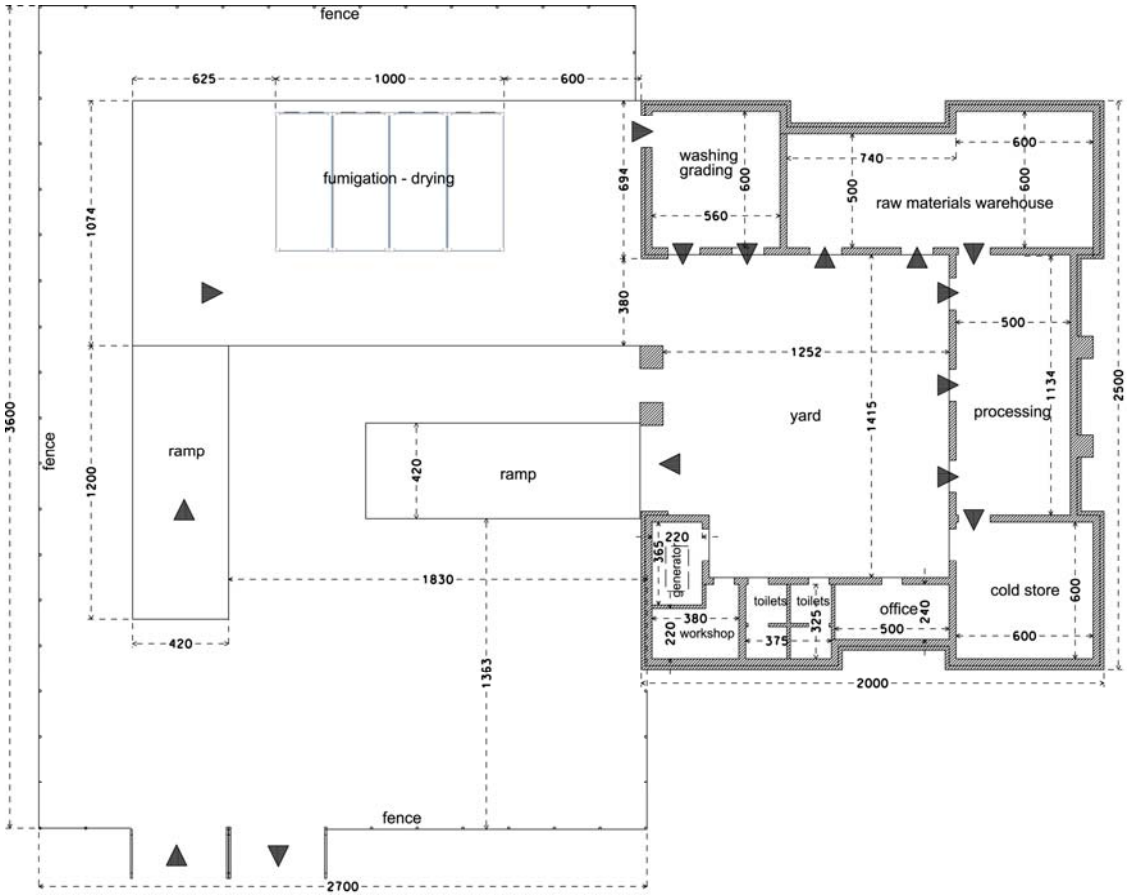


Figure 8. Lay out of Babylonian style brick building

- Load-bearing walls: the use of bricks, usually available, is expected. The energy transmitted by solar radiation to the walls is high all over the year. Then we tried to reduce the necessity of artificial air conditioning using a system of passive cooling. For the outside walls layer composition was thought to form a ventilated curtain walling, according to the following typology:
    - internal load-bearing wall build of bricks, thick about 0.25 m; the internal surface of the layer is plastered and where necessary it is covered with washable materials.
    - Middle layer made of insulating panel, thickness 0.05 m, and of reflecting aluminum sheet.
    - Ventilated Cavity Wall thick 0.10 m.
    - External brick masonry, thick about 0.12 m, with facework finishing according to the local tradition. This external layer is anchored on the internal wall with flat stirrups, as usually used in this kind of fronts.
- Floor: it is the most common type, made of reinforced concrete rib and tile slab construction, available on site. The use of floors with collaborating sheets as stationary formworks, for instance EGB2000 structural roofing system, may be adopted to reduce risks and times of realization. We believe that the importation of the sheets from Italy do not introduce serious problems, for the relative low total weight and volume of the items.

- Roofing: the shape upside-down asphalt roof is foreseen. It is composed of:
    - Floor as described above.
    - Waterproofing.
    - Layer, thick 0.50 m, made of insulating material. In case there is no available expanded clay or pumice stone, the insulating material can be made of sieved earth and sand present on site.
    - Dried flooring of brick tiles
    - Formation on the flat roof of boundary chimneys, as illustrated in the Figure 9, is thought to obtain a strong air flowing in rooms below.
    - Photovoltaic generators and solar collectors for water heating are disposed on the flat roof, also in order to reduce the amount of energy that arrives on the floor. The solar collectors produce hot water for dates' washing. The photovoltaic generators generate electricity for the propeller fan systems, present in many rooms, in the fumigation chamber, etc.
- Shading: mobile shading nets are used in the inside work yard. It is planned to plant as much as possible of palm trees around the building without covering the solar panels.

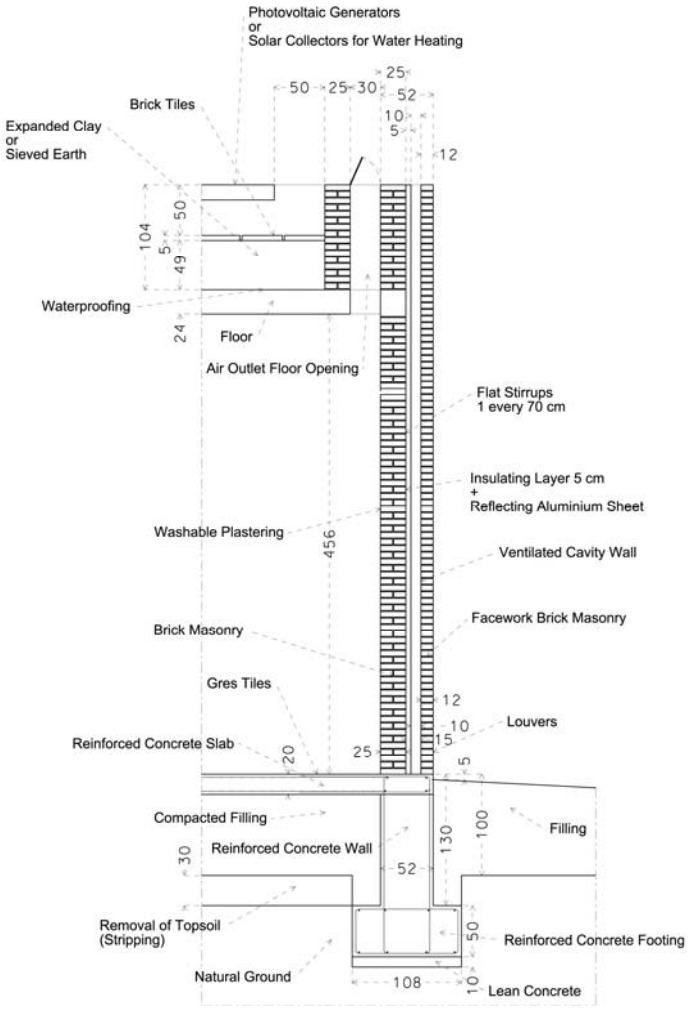

Figure 9. Vertical section of boundary chimneys

### *Use of 3D*

It is quite difficult to understand and be understood by partners while realizing a project without a direct contact with them. To avoid any misinterpretation, we decided to work out every single idea with the support of the 3D computer simulation. This decision helped us to imagine the building in an unseen context (the South Iraq). The obtained files were of size small enough to be sent by email. In this way our local partners, beneficiaries and institutional staff could actively participate in the decision making. Unexpected benefit from use of the 3D simulation that we noticed was an emotional involvement of Italian engineers, who knew very well the project. Some of 3D pictures are presented in this paper.

## Conclusions

Achievement the goal of establishing structures in a jeopardizing environment, as Iraq in the summer of 2006, was quite hard but not impossible. Thank to Information Communication Technology availability basic needs to plan the activities, to show draft and to record any kind of change (social conditions, political decisions, lack of logistic, etc.) are met.

In this paper we discussed three different adoptable solutions. They express three different approaches at the problem in order to fulfil changing conditions. However, all the suggestions show common parts as result respect of a sole methodology that foresees simplicity of the realization, hygienic and safe conditions of work, respect of local sense of beauty.

More researches about rural and productive settlement during conflict are necessary to develop and investigate all the key issues related to this subject.

### *Acknowledgments*

The project (*Integrated Feasibility Project to Support the Production of Date Palm Trees and Exploit Their Products*) was funded by Italian Ministry of Foreign Affairs.

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