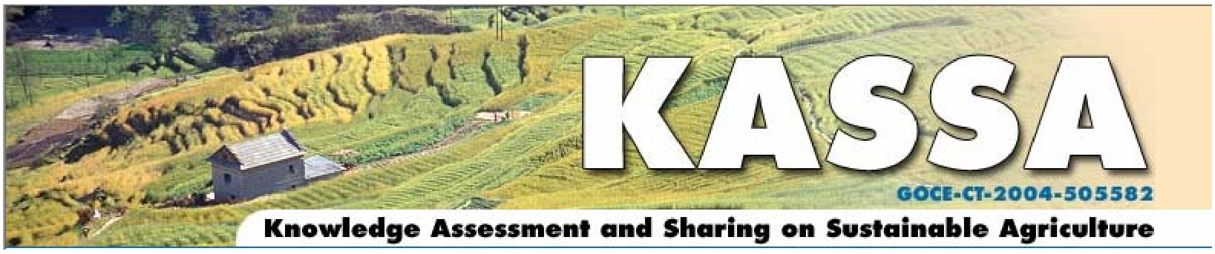

Comprehensive inventory and assessment of existing knowledge on sustainable agriculture in the Mediterranean platform of KASSA

J.L. Arrúe[1*], C. Cantero-Martínez[2], A. Cardarelli[3], V. Kavvadias[4], M.V. López[1], F. Moreno[5], R. Mrabet[6], J.M. Murillo[5], J.J. Pérez de Ciriza[7], A. Sombrero[8], J.L. Tenorio[9] and E. Zambrana[9]

[1]Consejo Superior de Investigaciones Científicas (CSIC), Estación Experimental de Aula Dei (EEAD), Avda. de Montañana 1005, 50059 Zaragoza, Spain
[2]Universidad de Lleida (UdL), Avda. Rovira Roure 191, 25198 Lleida, Spain
[3]Centro Internazionale Crocevia (CIC), Via Tuscolana 1111, 00173 Roma, Italy
[4]National Agricultural Research Foundation (NAGREF), Lakonikis 87, 24100 Kalamata, Greece
[5]Consejo Superior de Investigaciones Científicas (CSIC), Instituto de Recursos Naturales y Agrobiología de Sevilla (IRNAS), Avda. de Reina Mercedes 10, 41012 Sevilla, Spain
[6]Institut National de la Recherche Agronomique (INRA), BP 578, 50000 Meknès, Morocco
[7]Instituto Técnico y de Gestión Agrícola (ITGA), Avda. Serapio Huici 20-22, 31610 Villava, Spain
[8]Instituto Tecnológico Agrario de la Junta de Castilla y León (ITACyL), Ctra. de Burgo, Km. 118, 47071 Valladolid, Spain
[9]Instituto Nacional de Investigaciones Agrarias (INIA), Ctra. de la Coruña, Km. 7,5, 28040 Madrid, Spain

[*] Platform Coordinator

Centre de coopération internationale en recherche agronomique pour le développement
Avenue Agropolis, 34398 Montpellier, France

www.cirad.fr

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Michel Griffon (CIRAD, France);
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Jaromir Kubat (VURV, Czech Republic);
Roberto Peiretti (AAPRESID, Argentina).

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Presentation

The following report is presented as the result of the first Mediterranean platform meeting held in Zaragoza from the 25th to the 27th of April 2005 where the WP1.1 draft report was validated by the project partners representatives.

The report is divided in three different parts. In part 1, a general overview of the Mediterranean region, its climate, soils, and environmental issues are shown, as well as a short reference to the main Mediterranean cropping systems. In this part are also detailed the main driving forces and constraints for the adoption and dissemination of Conservation Agriculture (CA) and Organic Farming (OF) in the region.

Part 2 summarizes the knowledge achieved and inventoried by the different partners and that can be found in the intermediate country WP 1.1 reports (see Appendixes at the end of this report) as a function of the agronomic, environmental and socio-economic impact.

In part 3 a synthesis of the main conclusions and proposals, discussed during the meeting, is presented. It should be emphasised that this report represents a consensus among a limited number of CA / OF expert groups who represent a small number of Mediterranean region countries.

I. Concepts and Practices

I-1. Description of cropping system designs and management

I.1.1. The Mediterranean region: climate, soil and environmental issues

Mediterranean climate has been described widely and is one of the most typical climates in the world. Its name come from Mediterranean Sea and is characterised by the variability of the weather conditions in the Mediterranean basin, but can be found in other areas of the world like south-eastern and Western Australia and some small specific areas in North and South America.

In the Mediterranean basin and the surrounded areas of the Mediterranean Sea, climate has very variable rainfall and temperature; however there is a typical pattern. Rainfall is low, variable and erratic, with high-volume and high intensity storms. Records in most of the countries range between a total annual rainfall of 250 and 700 mm. However, the most typical characteristic in the Mediterranean climate is the rainfall distribution, existing two precipitation periods in autumn/early winter and spring (this last only in the western areas). Months in the central winter and summer have very limited rain. Autumn and/or winter rainfall is considered the soil water recharge that has the most influence on the development and performance of rainfed herbaceous crops. Spring rainfall helps to raise the best performance in the yields the years when autumn rainfall has been enough. General drought is endemic in the whole region and dry spells are all possible in early, mid and late seasons. Temperature can be also variable and in some areas Mediterranean climate becomes continental having extreme cold winter conditions and very hot summers with high evapotranspiration rates. Coastal areas, however, have milder conditions and winter and summer are less extreme, being very interesting for a wide range of crops if water is available from irrigation. Many areas are accompanied by moderate winds that increase the evapotranspiration and consequently the drought conditions.

Soils in the Mediterranean region present an enormous variability according to different soil taxonomy systems (USDA, FAO, etc…). This soil diversity reflects differences in climate, geological origin, vegetation, land use and historical development of Mediterranean landscapes. In general, soils have medium to poor fertility, with low organic mater contents due to low natural vegetation developed on them (rainfall influence) and because the active human activity from more that 2000 years of cultivation. Limitations to crop growth are imposed all around by soil depth (that influences soil water holding capacity), poor soil structure, salinity, alkalinity and stoniness that aggravate the drought conditions. More site-specific could be P and K levels.

Nowadays we can remark that the main environmental problem in the Mediterranean area is soil degradation by soil erosion due to low vegetation cover, the rainfall intensity, and cropping management. Intensive cropping and over-grazing have led to declining of soil fertility. Environmental concern about using chemical fertilisers is high in some European countries but of less importance in North African countries.

In terms of agricultural systems, we can consider that:

(i) extensive rainfed agriculture under diverse soil types, with low organic matter contents and poor quality, where stubble burning and over-grazing practices and the lack of organic residue incorporation reduces fertility and biodiversity, deteriorates the initial soil properties and quality and increases desertification problems under adverse climatic conditions;

(ii) intensive irrigated agriculture, characterised by excessive chemical rate applications, in any case higher than those applied in rainfed crops, determines higher environmental impacts associated to important nitrate and pesticide lixiviation, with subsequent contamination of underground waters.

I.1.2. Mediterranean cropping systems: soil and water management

Agricultural activity in the Mediterranean basin differs among countries. Due to social and economical factors, there exist a marked difference between southern and northern countries. Northern countries have a more developed agriculture because a better access to technology in the last century that permitted better social and economical development. Nowadays they are included in the European Union agricultural policies that have allowed a fast organisation and further development. Southern countries historically have had less development and thus higher social and economical constraints. As a result of this, southern countries have more populations related with agriculture, while northern countries have few populations living from agricultural activity. In most southern countries agriculture is a major sector of the country's economy that consumes water and energy resources (not Algeria). In northern countries water is the natural resource highly consumed in agriculture, being energy consumption in a second level. Thus, in this entire dryland region water is the main constraint for agriculture. Added to this, we have constant soil losses as another main constraint in natural resources.

Food security issues, considering all sort of natural resources as soil, water and energy and other inputs, are most tentative long-term objectives in North African countries.

As a consequence, the Mediterranean area has a sort of dryland farming systems limited by weather, land topography, water resource conditions, low potential soils, intensive soil management and soil losses. From more humid rainfed regions to semiarid and arid dryland areas we found different farming systems but with many similarities in crops and cropping systems. Livestock has played an important role in all the areas and still have a key role mainly when OF is practised and by its traditional linkage with cropping technologies in southern countries as Morocco, Algeria, Tunisia and other eastern Mediterranean countries. Cattle husbandry, mainly sheeps and goats, is closely interrelated with crop and pasture lands through crop residue and stubble grazing.

Due to its climate and soil conditions and probably also influenced by social factors, the most important crops in the Mediterranean area have been winter cereals (wheat and barley), which are those crops best adapted because of the matching of their growth and development period with water availability. Tree crops, such as olives, almond, nuts and vineyards, accompany winter cereals where soil conditions permit the use of available water to the crop in summer months. Other crops are grain legumes (peas, faba bean, lentils, chickpea…) and forage legumes (alfalfa, sainfoin, vetches…). However, these crops have more difficulties than winter cereals for growing in Mediterranean areas. Canola is a successful alternative crop to winter cereals in some areas, while sunflower is restricted to some semiarid areas or irrigated areas. Other wide range of field crops (potatoes, sugar beet, cotton….) and all sort of horticultural crops and fruit trees as apples, peaches, pears, and citrus can be grown if there is enough available water, mostly coming from irrigation. Crop productivity is very variable depending on crop rotation, country and the area inside the country, but cannot reach to Central and Northern European levels because length cycle limitation and water availability. It is possible crop failure in the driest areas in a 20-30 % or more of the years.

Crop rotations are common but limited to water availability at sowing and filling grain periods of the crops. Long clean fallows (one-year fallow) have been traditionally practised, but in many areas have been proved inefficient for water and fertility accumulation. Thus, and due to the population pressure on the use of land, continuous cropping of the more adapted crop rotations is now common. Some areas are devoted to dryland permanent pastures, mainly in highlands. Livestock (cattle, sheep and goat) interacted with pasture lands and crops as barley and wheat systems, where stubble is commonly grazed. In other cases straw is baled and used for feeding and bedding of the animals. In many places of the northern countries, hog and poultry production systems are ordinary and increase the benefits of these farming systems. Application of manure and slurry are used as fertilisers to recover soil fertility but when used in excess this practice promotes pollution and contamination of soils and waters.

Bench terracing is very common in all areas to increase soil and water availability and to avoid soil erosion and runoff. Crop management tends to be simple. Field herbaceous crops are based in tillage and sowing of improved and landraces varieties, N-P-K fertilisation, and weed control and harvesting of grain, straw and forage. Tree crops added to this, the simple technology of pruning. Plant material and crop technologies have been adapted to avoid the stresses imposed by cold or heat and drought.

Environmental problems in rainfed areas arise from repeated, intensive or continuous tillage, the removal of crop residues and when there is reliance on excessive organic fertiliser applications (manure and slurry), which merge to increase soil erosion, N and P accumulation and pollution. Intensive production areas in irrigated agriculture are scattered and, consequently, soil compaction, contamination and pollution from agriculture are still local. In the Mediterranean region, especially, in southern countries, desertification is becoming a normal phenomenon.

Soil cultivation by intensive tillage has been traditional over the last two millennia and even before the Roman empire. The 20th century marked the development of the mechanisation and tillage and all farming technologies were improved. In European Mediterranean countries tractors are totally used for tillage, however, in North African countries some farmers are still using animal drawn implements (i.e., 20 % in Morocco). Intensive tillage with mouldboard plough as a primary tillage is still used for different tilling depths until 30-35 cm, followed by different hoe and disk harrow implements for seedbed preparation. On these traditional systems and previous to tillage operations, crop residues are removed, grazed or even burned. Off-set disk for both primary and secondary tillage operations is becoming also common in some areas. Reduction of intensive tillage in the Mediterranean region begun in the 1960's with variable impact and mainly driven by the necessity for a reduction in different inputs (fuel, machinery and labour). Chiselling and minimum tillage with small hoe cultivators are now more common than 40 years ago, having become the traditional system in some areas in substitution of the conventional mouldboard ploughing. Development and adoption of no-tillage has been very irregular in the Mediterranean region. While knowledge of this technology has not reach all places in Mediterranean countries, in some particular areas the practice of no-tillage accounts for up to 80%.

I.1.3. Development of Conservation Agriculture

Mediterranean agriculture has a long history of more than 2000 years of traditional cultivation using intensive tillage systems. Tillage intensity became high in Europe as mechanisation was developed in the middle of the 20th century. Southern countries in the Mediterranean basin had a delay due to less general development of mechanisation in these countries. It is from the 1960's in European Mediterranean countries and later in North African countries, such as Morocco (1980's), when ***Conservation Agriculture*** (CA) practices in general and no-tillage in particular have been developed.

Acquisition of knowledge started by the design and setting of field experiments for research and transfer of CA technologies to the farmers by public organisations, such as Universities and Agricultural Research Institutes. In some areas and countries, international and local private companies, co-operatives and farmers associations played an important role to the later CA development and expansion. In this respect, it is worth mentioning the singular study done in Syria by ICARDA, in which CA is considered as a promising and feasible strategy for the Mediterranean region (*Pala, M. et al. 2000. Tillage systems and stubble management in a Mediterranean-Type environment in relation to crop yield and soil moisture. Exp. Agr., 36:223-242*).

In Mediterranean countries, CA has received different names, such as Conservation Tillage, No-tillage, etc. Now CA includes conservation tillage technologies in field crops and maintenance of vegetal covers in tree crops. All of these terms are referred to soil management technologies promoting soil tillage reduction. Conservation tillage, for instance, is defined as technologies encouraging the reduction or elimination of soil manipulation before, during or after crop growing season thus permitting the maintenance of 30% or more crop residues and stubble after planting. No tillage is the strict form of conservation tillage in which no soil manipulation is done, a direct drilling planter is used for seeding of annual crops and weeds are chemically controlled.

In the Mediterranean area, where main concerns are soil, water and soil organic matter protection and maintenance, researchers were attracted by the environmental benefits of reduced or no-tillage systems. Thus, a number of projects, depending of the country, were developed focusing on soil and water conservation to see the possibilities to store scarce rainfall, increase the efficient use of water by crops, avoid soil erosion and runoff and losses of organic matter, obtaining higher yield stability. Despite researchers were concerned on these studies and the general benefits for all agricultural lands that come from these ecological aspects; the general motivation of the farmers for the introduction and adoption of this technology has been the reductions of cost in machinery and fuel; and the time-saving in the operations that permit develop other agricultural or non agricultural complementary activities. After a period of reticence by farmers, and after it has been proved the economical benefits, they recognise the mentioned environmental beneficial aspects of the conservation agriculture and even become motivated and more keen in the use of the technology.

We can account that CA has been adopted in few lands in Mediterranean region, however we can found scattered small areas with an important impact and adoption of this technology. The tendency is to increase. In European Mediterranean countries development and adoption have been higher that in North African countries, despite the important effort done by researchers in some countries (i.e. Morocco). Main cropping systems, where CA is now used, are field crops as winter cereals in rotations with legumes, sunflower and canola. The use of no-tillage and cover crops between rows in perennial crops (olives, nuts and grapes) is increasing in some areas. Few experiences at research and on-farm levels are being conducted in irrigated crops such as maize, alfalfa, etc.

Finally, and regarding research and extension service issues, as it was detected by the MEDRATE project (www.iamz.ciheam.org/RAP-RAG/research.htm#Research) (*Cantero-Martínez C., Gabiña D. (Eds.) 2004. Mediterranean rainfed agriculture: Strategies for Sustainability. Options Méditerranéennes. Serie A. Volumen 60. ISBN 2-85352-294-6*), it is still necessary to increase the efforts towards a more practical and integrated research and technology transfer activities with a larger involvement of farmers.

I.1.4. Development of Organic Farming

Low intensity agriculture (traditional) in some Mediterranean countries is close to *Organic Farming* (OF). Conceptually, OF is based on the view that agriculture is a form of agro-ecosystem management, designed to promote sustainable supply of food and other products to the home market. Thus, the farm is considered as a balanced unit, where production, environment and human activities are integrated. Chemical fertilisers and pesticides are replaced by organic forms of fertilisers and non-chemical crop protection strategies minimising pollution from the farm.

Within the European Union (EU), the differentiation between organically and conventionally produced commodities was institutionalised in the early 1990s when the European Commission introduced a specific regulation framework (EU Regulation 2092/91) that allows the certification, via inspecting organisations, of such commodities as “biological” or “organic”. Since then, organic practices in the cultivation of various crops have attracted interest across EU member-states, including the European Mediterranean countries (Italy, Greece, Spain). However, despite the widespread interest in organic agriculture, in most countries OF occupy only a small portion of the utilised agricultural area. This is not surprising considering the significantly lower yields and thus household income of organic farming systems.

In Greece, OF has its roots in the ecological movement at the beginning of the 1980s. The first organic farmers were mostly amateurs who experimented with different organic cultivation methods. Their products rarely reached the commercial market. Most of them were aimed to satisfy their own consumption needs. But soon after more systematic programmes of biological agriculture followed, organised on an entrepreneurial basis. Commercial organic agriculture started in 1982. From 1986 onward, a German firm supported the production of organic olives and olive oil for export. Individual farmers converted their farms in the following years, supervised by foreign certification and inspection bodies (Skal, Soil Association, Naturland). Their main products were olive oil, citrus fruits, wine, cereals, kiwis and cotton.

In Italy, OF practices also begun in the 1980's, in response to the growing demand for quality products across Europe. During the 1990's, following the profound changes imposed by the Common Agricultural Policy (CAP) and the sharper focus on the environmental impact of agricultural activities, OF gained increasing acceptance. In Italy, the earliest pioneering experiences in organic agriculture date back to the 1960's, but only took off in the 1970's, involving more and more farmers and consumers seeking an improved quality of life and consumption. During the mid 1980's, the first local co-ordination agencies established the "Commissione Nazionale Cos'è Biologico" (National Commission for Organic Agriculture). Made up of representatives of organizations and consumers associations from each Italian region, that Commission established the first nation-wide self-regulatory standards for organic farming.

Organic farming regulations

In 1991, the Council of the European Communities approved the EU-Regulation 2092/91. This brought about a major change in OF development and adoption all over Europe. In Italy and Greece, many farmers officially converted their farms to organic agriculture. A second expansion took place after the introduction of hectare subsidies in 1996 with the adoption of the EU-Regulation 2078/92. In Greece, the number of organic farmers and the corresponding cultivated areas have continuously increased and the annual growth rates of OF have ranged between 50% and 120%. A further stride ahead was the approval of a logo for organic products (Regulation (EEC) 331/2000) and the regulatory framework for organic livestock farming (Regulation (EEC) 1804/99). In Italy, and once the EU-Regulation 2092/91 was implemented, the numerous small associations of organic farmers and the producers and consumers committees operating in every region reorganized themselves, joining forces through mergers and a federative network.

Adoption and trends of organic farming

The evolution of Italian organic agro-food chain shows how the different actors have co-operated for the growth and expansion of the sector. The profit oriented private firms, the non-governmental organizations (NGOs), the public authorities played a big role, at local, regional, national and EU level. With more than one million certified hectares (Table 1) and over 44,000 farms, Italy is the largest producer of organic raw materials in Europe and represents one of the biggest final markets (>1.2 million Euro in 2000). Applied research, extension, training and education are also growing, thanks to public and private support. Increasingly, OF and food processing are important component of rural development projects, together with other diversification measures as landscape management and rural tourism. Currently, most of the organic area is devoted to permanen pastures or to grass production (Table 1) needed for restoring soil fertility or crop rotations.

In Greece, OF is still at an embryonic stage, compared to other countries. The factors which stimulated organic agriculture in other European countries (national labels, national laws, subsidies for farmers, trade and processing, consumer and farmer information, and state research) are just coming up in Greece. Since its official establishment, OF rapidly expanded with annual growth rates ranging between 50% and 120%. Though these rates decreased to 20-30% in the 1999-2000 period, the progress made in the last years has been impressive. Currently, the main organic products of Greece are olive oil and olives, followed by vine, other tree crops (especially citrus) and arable crops (Table 2).

Table 1.- OF area and productive trend in Italy by 31/12/03. *Source*: SINAB (Sistema di informazione Nazionale sull'Agricoltura Biologica), 2004.

Crops	**ha**		
	SAU in conversion	SAU organic	Total
cereals	56.195	153.181	209.376
Legumes	4.317	7.345	11.662
Potatoes	158	730	888
Sugar beet	102	3.887	3.990
Forage beet	102	215	317
Industrial	7.696	24.617	32.313
Horticulture	2.585	8.769	11.354
Flowers and ornamental	26	75	102
Forages	74.738	222.259	296.997
Other crops	3.319	5.838	9.157
Orchards	15.766	36.448	52.214
Citrus	5.834	10.915	16.749
Olive	24.792	61.410	86.201
Vineyards	11.439	20.271	31.709
Pastures	83.837	179.165	263.003
Other	9.236	16.734	25.970
TOTAL	**300.141**	**751.860**	**1.052.002**

Table 2.- Distribution of organic land in Greece per cultivation and stage. *Source*: DIO. 2004.Scientific Institute for Organic Agriculture (http://www.dionet.gr).

Cultivation	Area (ha/stage)			Total* (ha)	%
	Biological product	Conversion stage	Under control stage		
Arable	2671	872	3156	6699	31%
Vine	1300	391	410	2100	10%
Olive	6304	1540	2883	10728	49%
Citrus fruits	632	93	67	792	4%
Horticultural	328	42	65	436	2%
Fruit trees	531	111	201	844	4%
TOTAL	**11766**	**30495**	**67836**	**21600**	**100%**

*Total arable land in Greece: 4,000,000 ha

I-2. Driving forces and constraints to dissemination of alternatives to conventional agriculture (e.g., Conservation Agriculture and Organic Farming)

I.2.1. Driving forces for Conservation Agriculture in the Mediterranean region

There is a profusion of facts indicating that CA is technically feasible and ecologically beneficial for the Mediterranean region. Researchers and farmers agree that reasons for using CA are multiple, among them the following:

1. A much better economy at a farm level can be achieved by producers (labour simplification; less time requirements for tillage operations; less fuel consumption; less machinery required for tillage; less power machinery).
2. CA can offer large possibilities, particularly no-tillage systems, as flexible and early times for sowing, fertiliser application and weed control. Farmers are allowed the time requirements for other activities as livestock or orchard intensive production.
3. A much better water economy and efficient water use through a higher accumulation and infiltration of water in the soil profile and lower water losses by evaporation and runoff. This is especially well appreciated by dryland farmers in areas where the water available for crop growth becomes a limiting factor in dry years.
4. Soil protection is a direct benefit from applying CA with crop residue covers. Decline or full control of soil erosion. Soil organic matter increase. Less or complete removal of soil crusting. Better soil structural stability.
5. Cropping systems diversification. Double crop possibilities in some areas.
6. Yield increase (10% to 15% higher). Greater yield stability. Faster crop establishment and development (e.g., better emergence observed in crops sown in autumn due to warmer soil conditions in October and November).
7. Greater nutrient-use efficiency. Less use of fertilisers.

Overall, CA is a sustainable alternative to traditional agriculture from the ecological, agronomic and economical points of view and is less risky than conventional agricultural systems in the Mediterranean region.

I.2.2. Constraints for development and dissemination of Conservation Agriculture

In the Mediterranean region wide adoption of CA is still at the early stage. Not all the CA aspects agree with the premises of the farmers and sustainability. Different agronomic and environmental aspects are not yet solved and efforts have to be developed locally. Main constraints are:

1. Despite lower yield obtained in CA use is not a main limiting factor detected, there is a concern in the time to arrive to complete adaptation or stabilisation (soil and cropping technology) of the cropping system to the new situation.

2. Compaction, poor aeration, flooding and excesses of moisture, reduction of infiltration are the disadvantages observed related with soil properties. Sowing is deficient in extreme sand and clay soils.
3. Weed control is a major constraint in some cases for the development of CA, although not completely generalised. In many areas, it is reported even a less incidence of several species of weeds. However, under other point of view (i.e. Morocco and other North African countries), small farmers consider weeds as an important source of nutrients for their livestock.
4. Pests and diseases incidence is another important constraint and also not completely generalised. Other negative aspects come from biological activity from the irregular incidence of rodent and slugs.
5. Crop residue management is a very important a focus of concern among users. Questions like how to manage the straw and stubble, amount to be retained and when to remove the excess crop residues are typical from farmers. Some areas face an excess of crop residues and allelopathic problems are observed and no well described and analysed. Other areas suffer of lack of sufficient mulch and even livestock grazing, feeding and bedding compete for straw and stubble.
6. Despite there is a high knowledge of nutrient dynamic under CA due to the different influence of residue recycling and nutrient release and despite there is some local information in the Mediterranean areas, there is still a lack of references related to fertiliser use and efficiency.
7. Although a large set of herbicides is available and has been tested in many conditions, including CA, there are some economical negative reasons related with risk and use of herbicides.
8. Regarding specific equipment requirements and despite the large amount of machinery displayed in developed countries, other less developed countries have problems to the access to adapted equipment. There is still in all region reluctance and economical negative reasons related with risk of expensive investment in CA machinery. INRA Morocco has developed its own no-till drill for farmers.
9. Lack of information regarding the performance of crop rotations under CA.
10. Direct seeding or no-tillage systems are more complicated than the other conventional systems and required more information and technical advice. In some areas the users complain for a low concern, information and technical support by the public extension services in this CA technology.

In summary, social, economical, and environmental aspects have to be considered at a local scale. Public opinion in European Mediterranean countries gives pressure in environmental sustainability. Extensive agriculture in these countries is considered in many senses a marginal activity that maintains low population in marginal lands. Agriculture activity is considered like “destroyer” of the ecosystems by much of the urban population. Policy makers “bomb” the agricultural activity with high set of regulation. In these countries it is necessary to convince the stakeholders of the environmental benefits of the CA technology. However, in North African Mediterranean countries, rural population is higher and requirements of the population are focused more in yield stability to satisfy the food demands, and under farmer’s side, to obtain an economical sustainability. Environmental and other social concerns from urban population are in a second level. Then, the priority of the objectives of CA can be same under some agronomic or economical aspects but different under others, depending of the country.

Other barriers to the adoption of CA are related with the land tenure and farm size. Aging and social relationships among farmers are sometimes a constraint to the development of new crop technology and, certainly, to the adoption of CA. Farmers who are against these techniques criticise them and discourage hesitant farmers. Farmers, who are against these techniques, criticise them and betray farmers who doubt. Rural population aging influences directly on the rejection of new CA techniques. Consequently, changes in mentality and attitudes are needed within the farmer population and this has to be encouraged by administrators and technical advisers.

However, the interest of CA by the administration and policy makers is very variable. Often administrators don't understand and positively support the long-term requirements for the CA to be developed and adopted.

I.2.3. Driving forces for Organic Farming in the Mediterranean region

The following facts and considerations refer to the current situation in Italy and Greece, two contrasting Northern Mediterranean countries in terms of OF implementation. In principle, the following statements should somehow reflect the situation of OF in other European Mediterranean countries like Spain where about 750,000 ha are presently devoted to OF practices.

ITALY

1. OF gained increasing acceptance in response to the growing demand for quality products.
2. The numerous food scandals which affected Europe.
3. A common understanding about the use of productive techniques more sustainable and environmental friendly.
4. The search for technical and economical alternatives by farmers, who have not decided yet to give up.
5. The important flow of direct and indirect subsidies, which have been channeled into the entire organic food chain.
6. The agroecological situation in some regions well adapted to less intensive cultivation.
7. The first steps made by few pioneers who started in the early 1950's to criticize the path into which the so-called technological progress and the agricultural policies were leading Italian and European farming made possible the development of OF.
8. For more than 30 years some pioneers have been struggling to convince the surrounding people and the Institutions that another food system is possible.
9. Things about research are changing and a lot of public and private organizations are doing a good job.
10. Farmer organizations are developing a good activity (farmer's initiative) in biodiversity and use of local variety (landraces).

11. The analysis done on research and experimentation programs indicate that after a long period, in which there was no interest at all, an increasing number of scientific institutions are focusing on the organic production method.

12. A comparative analysis of the 1994 census (Agro-environmental Observatory in Cesena) and the 1998 census (CEDAS – IAMB) showed that the number of organizations and researchers soared from 50 to 100 and from 70 to 500, respectively. In addition, approximately 80 specific research activities on organic farming have involved not only mainstream research groups, but also universities and national and regional research centers.

13. Over the past few years, the European scenario has substantially changed. Surplus management has outpaced food self-sufficiency and the demand for healthy and quality products has soared along with the awareness of the limited natural resources available.

14. The neighboring experience of Conféderation Paysanne in France, a model of local, socially, economically and environmentally sustainable peasant agriculture, is opposed to that of industrial production.

GREECE

1. Under the combined effects of recent food crises, which have discredited the conventional agro-food chain, and the post 1992 change of CAP architecture for building up a more sustainable rural development, organic farming becomes a promising way out of the impasse both producers and consumers face these days.

2. Among EU countries, Greece has the largest potential for OF. This can be justified by the fact that Greek regions favour OF due to its geographical and topographical structure which allows for crops to be grown in isolation and away from conventional "high chemical input" fields. This includes islands and isolated land pockets at varying altitude, from sea level up to almost 5,000 ft.

3. The research activities in OF are insufficient, they are randomly scattered across the country and are lacking of national funding.

4. The environmental awareness of consumers (food quality and human health factors) can be the basis of their willingness to pay a higher price for organic products.

5. The effort to increase income of Greek farmers may come from the expansion of organic farming.

6. There is enough know-how for organic olive production and wine, the second major organic product after the olive. The costs for organic olive cultivation practices are not much higher than the conventional costs, and the hectare subsidy is high. The increase in organic viticulture is also a consequence of the high hectare subsidy and restrictions on conventional wine production.

7. The demand for fresh fruit and vegetables, especially for the external market, has caused the area under organic cultivation to increase.

8. Economical use of raw materials (like residues of cultivations, agricultural industries, farmyard manure, municipal refuse) that can be used to produce high quality composts for organic fertilisation and improve soil quality characteristics of degraded soils in ecological sensitive areas of Greece.

9. Higher Quality products are attractive for Greek consumers, who seem to become more and more sensitive and demanding at the same time, when it comes to their nutrition and they seek for safe, natural and free from agrochemical food products.
10. Greek consumers know that the quality converges with higher prices and they would be willing to pay a higher price for a product of better quality.

I.2.4. <u>Constraints for development and dissemination of Organic Farming</u>

ITALY

1. Along a very consistent number of years, sustainable agriculture and organic agriculture have been relegated in very special rooms, namely associations or farms conducted by special entrepreneurs.
2. The resistance to change in Italy has been very strong and despite the blossoming of new ideas about sustainable agriculture the sector was characterized by some immobility. The research system was doing more or less the same and did not catch up with the new ideas.
3. The research in conservation agriculture and OF is insufficient and often neither a good extension in done to increase the awareness of the farmers/peasants.
4. The lack of money is also an actual problem to solve.
5. Rarely regional government sections have established any agrobiodiversity conservation and research network (Toscana and Lazio Region).
6. The major problem we have to face is the difficulty to find technicians trained in a sustainable way. Without them it is difficult to extend similar researches or studies in other environments and try to make application of research to improve agronomic practices.
7. Usually, it is difficult and mostly arbitrary to establish if one research or study belongs to sustainable agriculture, organic farming or conventional agriculture. In this respect, we think KASSA should play an active role to draw standard frameworks. In other words, we should prepare a model to establish how to classify the different works done so far.
8. The Italian scientific institutions are clearly lagging behind in the face of the fast-paced evolution, which is sweeping across the international arena and activities are randomly scattered across the country as they are often funded with local resources. Only two programs, which have been funded over the past few years by the Ministry of Agriculture and Forestry, can be regarded as truly nation-wide.
9. In Italy, the funds which have so far been invested in organic farming research activities are very few in the face of the relentless growth and the mounting technical difficulties presented by the Mediterranean climate and the fruit and legume sector. A projection, based on an estimate consistent with the European mean expenditure (20 Euro per ha and per year) calculates for Italy an overall investment per year of 19 million Euro.
10. The information gap remains in the Mediterranean regions where strategies are modeled on the northern European systems, which differ widely with regard to cropping systems and soil and climatic conditions.
11. The pattern of development, which is still prevailing, is modeled on intensive, specialized and highly productive farming which capitalizes on cutting-edge technologies. The impact of this production method on the environment and the conservation of natural resources

have long been seriously underrated or shamefully neglected while food self-sufficiency and economic profitability were in the spotlight.

GREECE

1. Agricultural policy networks (policy makers, politicians, organised professional interests, co-operatives, and individual farmers) in Greece lacks a cohesive and consistent vision of post-1992 rural development. In the case of agri-environmental policy, the delays in submission and approval of schemes led to their limited implementation and, as a result, to limited absorption of the allocated resources.
2. The marketing network of organic products in Greece is still in its infancy. This is due to the lack of well-organised distribution channels and the negative opinions of retailers regarding the promotion of organic products.
3. Organic farming is an expensive venture for farmers in terms of training, production, certification, and marketing.
4. There is lack of information for Greek producers throughout production, post-harvest and marketing processes. Lack of information and practical training, on the organic cultivation techniques with result the producers are not well informed and so they seem to be indifferent.
5. The small number of organic producer associations, as well as the small size of the majority organic operations, is a serious drawback for the marketing of organic products.
6. The range of the crops cultivated in Greece is considered to be small. The main reason for that is the fact that most farmers are used to produce some particular products and that growers are oriented towards perennial crops rather than annual ones.
7. Generally in Greece public awareness of organic agriculture and its relation to health and the condition of the environment is low and consumer education in these matters must be considered a priority.
8. Greek consumers do not have the appropriate information background for organic products.
9. The mistrust of Greek consumer for the organic products as for their appearance and the most important for their price
10. The prices of organic products in Greece are higher than those of conventional ones, since they are products of top quality and the cultivation/production cost is higher. The organic agricultural products are been provided by few shops, which are basic shops of healthy diet.
11. The small size of organic farms that is scattered and neighbouring with conventional in many Greek regions. This has as result the biological products to be influenced by the chemical substances that are used in the conventional agriculture. Thus is a problem of certification of biological products created, which often involves loss of identity of "biological". The growers in order to avoid the damage are forced to give the production to the conventional market, thus leading to the degradation of very good quality and loss of income.
12. There is high competition between organic and conventional products and there is competition between domestic biological products, with what is imported.

III. Significance and impact of the results

This section summarises the outcome of the country reports following exhaustive brainstorming discussions at the first meeting of the KASSA Mediterranean Platform at Zaragoza in April 2005. We discussed mainly those research issues that were identified as of Mediterranean-level concern. We discussed issues in two categories. Firstly, those topics already more or less well developed in the Mediterranean region in which should be additional investments, since CA/OF techniques in all the Mediterranean countries are far from being perfectly covered. These are issues that are at present more or less well funded, or which have reached some plateau of achievement in terms of knowledge. Secondly, those issues that should now be research priorities, including scientific and policy research.

On the basis of the information and knowledge about CA (Spain and Morocco) and OF (Italy and Greece) inventoried, it was decided to synthesise in a series of Tables the degree of knowledge available on certain issues from research or experiences conducted so far on both CA and OF practices compared with traditional agriculture. This task consisted in analysing every topic and giving it a kind of score following an open discussion about the amount and coherence of the information available. The result of this validation strategy is summarised in the following tables as a function of the agronomic, environmental and socio-economic impact of the different topics.

I-1. Agronomic impacts

Table 3.- Synthesis of results regarding the influence of Conservation Agriculture (CA) and Organic Farming (OF) on crop performance and related parameters.

Topic	CA	OF
Crop yield	Positive under dry conditions Similar under favourable conditions	Similar or lower than in conventional agriculture
Product quality	There are results of the evidence in possibility to increase or improve the quality	Clear evidence of better product quality
Emergence and crop establishment	Positive or negative response is site and crop specific. But, in general, does not affect final yield	
Water use efficiency	Positive response under dry conditions Similar in favourable conditions	
Nutrient use efficiency	There are results of the evidence in possibility to increase or improve the efficiency	

Table 4.- Synthesis of knowledge about the impact of Conservation Agriculture (CA) and Organic Farming (OF) practices on different technical aspects of crop management.

Topic	CA	OF
Crop residue management	It is the basis for CA and it is very positive	It is the basis for OF and it is very positive
Crop residue amount	Difficulties at sowing and early crop development in high or low production areas	Not applicable
Weed management	Change and inversion of flora with positive or negative impact Should be more precise and with careful use of herbicides	Clear evidence of better control of weeds by mulching and by crop rotations and soil cultivation (tillage)
Pest and diseases management	Some negative incidences of particular pest and diseases in favourable humid areas	Clear evidence of positive benefit from biological control
Crop nutrition and crop fertilisation	N fertilisation increased productivity and more response is obtained under CA P banding has a positive response in CA In some cases, nutrient uptake has different pattern depending of CA techniques	There are evidences that organic materials (manure, compost, plant residues, etc) improve crop response Nutrient status is better than conventional When this material is applied in excess, can arise plant toxicity from microelements and salinity
Adapted genetic resources	Very limited data	Very limited data
Crop rotations	Permit higher crop diversification. Demonstrate to be positive for weed, pest and diseases control and crop nutrient management	Demonstrate to be a basis for OF Demonstrate to be positive for weed, pest and diseases and crop nutrient management
Fallow management	Increase or similar water storage. Crop residue maintenance and weed control (chemical fallow) are necessary for optimum performance of fallow under CA	
Intercropping and other crop associations		There are evidences of increase total crop production per surface unit
Cover crops (including sowed crops and weed covers between rows in perennial crops)	Improve water balance under CA Demonstrate to be positive for weed control	The use of cover crops under OF increases or improves the water status Cover crop mobilises the P to upper parts of soil profile Decrease weed population

II-2. Environmental impacts

Table 5.- Impacts of Conservation Agriculture (CA) and Organic Farming (OF) on different soil processes and properties.

Impacts	Parameter	CA	OF
Physical Properties and Processes	Soil porosity	Pore size distribution under conservation tillage was more homogenous than under traditional tillage. Amount of pores between 10 and 100 μm was higher under traditional tillage than under conservation tillage. In contrast, more biopores were observed in conservation tillage Better distribution of pores under CA Higher macroporosity (number and size of biopores)	Total porosity is improved Pore-size distribution improves
	Crusting		
	Soil structural stability. Soil aggregation	Aggregate size and stability is higher	Stability of micro-aggregates is increased
	Trafficability		
	Water logging		
	Soil strength	Increase in soil resistance to penetration	
Soil water	Soil hydraulic properties. Water fluxes	After several years different conclusions have been found in hydraulic conductivity	
	Water holding capacity. Water retention	Improves water holding capacity	Improves water holding capacity
Soil chemical properties	N cycle	Higher nitrogen content under CA in the upper part of soil Lower nitrate levels in all soil profile	Higher soil nitrogen accumulation
	P cycle	There is a higher soil P	P accumulation

		stratification Lower soil P content (available P) in deeper horizons Higher soil P content in upper layer	
	K cycle	There is a higher soil stratification of K Lower K soil content (exchangeable K) in deeper horizons Higher K soil content in upper layer	
	C cycle (CO_2 emissions, C sequestration, etc)	Increase Soil Organic Carbon (SOC) content at upper layers C stratification ratio increases Lower CO_2 fluxes Increase particulate organic matter (POM)	Increase SOC content at upper layers
	Other greenhouse gases		
	Pesticides Herbicides	Mobility and persistence of herbicides in soils (e.g., trifluralin and metmitron) lower under conservation tillage than under traditional tillage	
	Other pollutants		Some toxicity from accepted fungicides have been reported High levels of Cu in the soil have been reported due to Cu fungicides
	pH	In some cases, and after a long period have been reported a slight decrease of pH at upper soil layers	
	Salinity /Alkalinity		Increase salinity
	Micronutrients	No changes	
Soil biological properties	Microfauna. Microbial activity	Improve enzymatic activity	Improve enzymatic activity
	Mesofauna/Macrofauna	Earthworm population increase	
Erosion by	Soil losses	Reduction of water and	It is reduced due to use of

wind and water		wind erosion	cover crops

II. 3- Socio-economic impacts

Table 6.- Impacts of Conservation Agriculture (CA) and Organic Farming (OF) on some socio-economic parameters as compared with traditional agriculture.

Impacts on	CA	OF
Input Cost	Higher or lower depending of situations and cost of herbicides and energy	Same or higher
Labour	Lower	
Energy (Fuel)	Lower	
Total energy	(?)	Lower
Investment	High initial investment (machinery)	
Time in operations	Lower	
Profitability	In most cases is higher or depending on the CA systems and local conditions	Same or higher

III. Conclusions and proposals

III-1. Complementary research needs

In order to define future research needs and priorities on CA and OF in the Mediterranean region, we analysed and discussed in which aspects it appears to be a substantial gap of information.

To this end, we discussed the appropriate information contained in the intermediate country reports and classified the main shortcomings detected as a function of its agronomic, environmental or socio-economical relevance.

In the following tables we have summarised the analysis performed. The statements in the CA and OF columns show the lack of knowledge observed, which might be considered to delineate future research programmes on sustainable agriculture and environment related matters.

Table 7.-Scientific knowledge gaps on the influence of Conservation Agriculture (CA) and Organic Farming (OF) on crop performance and related parameters.

Topic	CA	OF
Crop yield	More detailed research for some crops Lack of information on some species Lack of information under irrigation systems Site-specific and well-designed long-term experiments research are needed	Little information is available on some crops. More information in the performance of yield is needed for most of the crops Site-specific and long-term research is needed
Product quality	More information is needed to check the improvement on product quality	
Water use efficiency (WUE) and nutrient use efficiency (NUE)	Substantial information on WUE and NUE is available, but knowledge on a combination of both is still needed	Extensive research is needed in both topics

Table 8.- Scientific knowledge gaps on Conservation Agriculture (CA) and Organic Farming (OF) impacts on different technical aspects of crop management.

Topic	CA	OF
Crop residue management	More long-term information is needed on site-specific cropping systems More information is needed related with livestock husbandry	
Weed management	Research has to be focused on integrated studies on dynamics of weed population and herbicide environmental impacts An integrated weed control approach is required	Research has to be focused on alternative methods (other than mechanical).
Pests and diseases management	Research has to be focused on integrated studies on the dynamics of pests and diseases, control methods, and integrated pest management methods with a sound environmental approach	Research has to be concentrate on pest and diseases with difficult control
Crop nutrition and fertilisation	Research has to be focused on soil test calibration and plant analysis for recommendations under CA It is needed to carry out studies on banding fertilisers and type of fertiliser application in some areas	Research has to be focused in soil test calibration and plant analysis for recommendations under OF Studies are needed on some types of organic fertilisers.
Adapted genetic resources	More research is needed	More research is needed
Crop rotations	New crops have to be tested within common crop rotations Crop rotation under irrigation systems has to be experimented	Long-term experiments are needed for weed, pest and diseases control and for soil nutrient status assessment
Intercropping and other crop associations	Research is needed	
Cover crops (including sowed crops and weed covers between rows in perennial crops)	Research in new species to be used as cover crops	More research is needed to determine the optimum species in particular agro-ecosystems

Table 9 - Scientific knowledge gaps on Conservation Agriculture (CA) and Organic Farming (OF) environmental impacts.

Topic	CA	OF
Soil quality	Take advantage of available knowledge to identify the best criteria or indicators for the assessment of soil quality under CA Integrated studies of soil quality aspects (physical, chemical and biological) Soil suitability studies for CA adoption in Mediterranean conditions More soil erosion studies should be conducted	Take advantage of available knowledge to identify the best criteria or indicators for the assessment of soil quality under OF Integrated studies of soil quality aspects (physical, chemical and biological) Soil suitability studies for OF adoption in Mediterranean conditions
Soil organic matter and C sequestration	Research is needed on short and long-term dynamics and balance of C in soils	
Contamination and pollution of soil and water Greenhouse effect gases	More information to test the potential contamination of the environment using CA technologies	More research on the effects of cultivation practices on organic and inorganic pollutants in soil and water bodies
Soil biodiversity	More research is needed	More research is needed

Table 10 - Information gaps on socio-economic effects of Conservation Agriculture (CA) and Organic Farming (OF) systems.

Topic	CA	OF
Social	Studies on farmer perception of CA systems No-tillage sociology	More information flow between researchers and producers More studies on training are needed at research, extension and farmer levels
Economy and profitability (input costs)	Economic analysis and modelling	

As stated at the beginning of this report, it has to be taken into account that the above knowledge gaps represent a consensus agreed by a limited number of CA/OF expert teams who represent a small number of Mediterranean region countries. According to this limitation, they are priorities for Mediterranean-level research and policy, not for national or local research and policy.

II-2. Proposals

There had been some excellent research into CA in the Mediterranean region. We now wish to see it extended and better applied. As an example, preliminary knowledge obtained in recent studies conducted in some Mediterranean countries (Spain and Morocco) on soil organic matter dynamics and C stratification ratio under CA techniques indicates that soil C stratification appears to be a good indicator of soil quality. More specific research should be carried out to explore the suitability of this indicator for monitoring the evolution of soil quality on extensive CA farms over the Mediterranean basin.

Though OF is practised on large areas in Mediterranean countries (e.g., Italy, Greece, Spain) it has not been detected a substantial body of research and knowledge on this alternative to conventional agriculture. More research on OF is hence urgently needed. Thus,
OF methods based on measurable and comparable criteria must be devised to thoroughly explore the farm dynamics and the various factors that interplay in the agroecosystem. Such an approach is indispensable to assess Mediterranean tailor-made organic production methods and gauge the innovations stemming from the experimental activities at the farm level. The worldwide application of unified and/or harmonized production standards for organically produced foodstuffs is extremely important for a greater development of organically grown land and organic products markets.

Identifying forms for a sustainable use of land is a primary need in order to reduce the degradation of primary resources, biodiversity and rural environment. Land management through either CA or OF responds to the need for improving sustainability and management of natural resources. The crucial land access problem needs to be solved in the Mediterranean area where farm dimension doesn’t really permit a sustainable land management. Likewise, aging of rural population is another constraint that has to be solved.

The discussions had focused on CA/OF practical issues and a lack of relationship between researchers, agricultural extension services and farmers has been detected.

Finally, we were aware of the importance and opportunity of involving farmers in the process of developing CA and OF research and policy agendas for the Mediterranean region.

Appendices

WP1.1 Country Reports

Appendix 1: WP 1.1 joint report – SPAIN - Partner 16 – CSIC
Partner 17 – UdL
Partner 18 – ITA
Partner 19 – INIA
Partner 20 – ITGA

Appendix 2: WP 1.1 report – MOROCCO - Partner 21 - INRA

Appendix 3: WP 1.1 report – ITALY - Partner 22 - CIC

Appendix 4: WP 1.1 report – GREECE - Partner 23 - NAGREF