

## COVER PAGE (1 page)

Title of the proposal "Toward a CAMEL tRAnsnational VAlue chain"

Acronym CA.RA:VA.N

Proposal ID (number given when you register on the submission system platform)

List of participants:

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\* Please use the same participant numbering as that used in the administrative proposal forms.

## 2. Project summary (no more than 3,100 characters, spaces included)

ALGERIA: AUTONOMIA ALIMENTARE, DIVERSIFICAZIONE PRODUTTIVA (RISPETTO A IDROCARBURI)

ALFABETIZZAZIONE

INTEGRAZIONE DELLA RICERCA NELLA SOCIETÀ E NELL'ECONOMIA

DISOCCUPAZIONE E FUGA DEI GIOVANI LAUREATI

Here, we propose an applied project where the foundations for a modern, effective genetic selection scheme in dromedary camels in Algeria are laid down through: (i) standardization of dairy/meat/fertility traits phenotyping protocols; (ii) evaluation and standardization of camel identification systems; (iii) implementation of standardized animal identification and phenotyping protocols in pilot farms, and (iv) establishment of a first genealogical, phenotypic and genotypic database for further valorization through detection of selection signatures, GWAS analysis, and, possibly, modelling of simple and robust embryonic design for genomic selection approaches. Among the expected impacts: increased milk/meat production, higher profitability of the camel sector, more structured and enforced breeders associations.

## 3. Scientific quality of the project

### 3.1 Concept and objectives

#### - Relevance of the proposal with regards to the topics addressed by the call

The proposal addresses the urgent need for the camel sector to move toward a **SYSTEMIC ORGANIZATION OF THE BREEDING AND THE FOOD CHAIN** at national and transnational level, as a tool for **ECONOMIC DEVELOPMENT OF LOCAL COMMUNITIES** in disadvantaged desert areas of the Mediterranean where the dromedary shows a triple function "work-meat-milk" production. In these areas, the dromedary camel indeed represents a strategic resource, as it is the most adapted and productive livestock species, with a good potential to contribute to the local activities and **FOOD SECURITY and SOVEREIGNTY** in Maghreb countries. Furthermore, it represents an element of **CULTURAL IDENTITY** and continuity

for sedentarized nomads. Being mostly extensive, or semi-extensive, camel rearing plays a fundamental role in **CONSERVING CRITICAL AND ENDANGERED SEMI-NATURAL HABITATS** of relevant **ECOLOGICAL VALUE** and **COLLABORATE WITH SEVERAL CULTURAL ACTIVITIES SUCH AS AGRICULTURE, TOURISM AND TRANSPORT**. Camel milk has a great market potential for its **NUTRITIONAL QUALITIES**. In addition, it represents a possible alternative to meet **NEEDS** of specific categories of **CONSUMERS**.

The production, transformation, and commercialization steps are all considered and actions will be put in place to promote **HORIZONTAL AND VERTICAL INTEGRATION** along the value-chain. Set up of a **TRANSNATIONAL PERMANENT PARTICIPATIVE NETWORK OF STAKEHOLDERS** in the dromedary sector will be addressed. At the production level, **STANDARDIZATION** of animal identification and phenotyping systems will be carried out, and an initial **TRANSNATIONAL DATABASE** of phenotypes for traits of economic interest will be developed with the aim to estimate genetic parameters and contribute to **GENETIC IMPROVEMENT** of work/milk/meat production and fertility traits in peri-urban farms, also through application of **NEXT-GENERATION GENOTYPING** technologies. Techniques of lineal assessment will be implemented in order to evaluate the working morphotype in the animals as well as the movement gait, trot and canter. **FOOD SAFETY** issues (milk and meat) will be addressed as a fundamental prerequisite for any commercial valorisation. We will focus on dairy products obtained through simple, robust and **TRADITIONAL "PROCESSING" TECHNOLOGY** (naturally-fermented raw milk) and commonly present in the market via informal, poorly structured supply chains. **HAZARDS AND RISK ASSESSMENT "FROM FARM TO MARKET"** will be carried out to identify critical points and suggest practices to guarantee high **QUALITY STANDARDS** and **IMPROVEMENTS IN SHELF LIFE**. Collection and taxonomic identification (through advanced molecular biology techniques) of native lactic acid microorganisms will open the way to further **TECHNOLOGICAL IMPROVEMENTS** in the production of fermented dromedary milk. Logistic aspects along the market chain will also be addressed, and **SHORT SUPPLY CHAINS** will be preferred, due to lower environmental impact, fair farmer remuneration, and easier control of food safety critical points. Special attention will be paid to the commerce of alive animals and their products among regions and at the international level. The transversal **POLITIC** and **SOCIO-ECONOMIC** dimensions will be taken into close account in any of the above steps. Indeed, southern regions of Southern Mediterranean countries, where dromedary camel rearing is most concentrated, are generally facing retard in development compared to more rich Northern regions. Promotion and valorisation of dromedary food products, expression of the traditional local savoir-faire, in a more modern perspective, may significantly contribute in reducing this gap, as it represents a possible strategy to create employment, reduce exodus toward urban centres, and create **ENDOGENOUS SELF-GENERATED SOCIAL AND ECONOMICAL DEVELOPMENT AND GROWTH**, thanks to the special place occupied by the dromedary in Sahel culture and societies.

#### **- Background / state of the art in the field and concept**

**Relevance of the camel sector and recent trends in target countries** - The Mediterranean agriculture systems have known increasing pressures that include strong **DEMOGRAPHIC GROWTH**, **URBANIZATION**, increasing demand for high value products like animal products and vegetable, and a high **COMPETITION FOR LAND AND WATER**. In this context, pressures on resources raise many challenges and sometimes competition in the trade-offs of the use of resources (land, water, and nutrients) that can affect the sustainable development of these systems. Besides, some marginal zones in inland know a dramatic departure of their active labour forces through **MIGRATION** that induces important changes of the global social and natural functioning of these zones. This is particularly relevant in arid and desert lands of south Mediterranean countries where the traditional societies used to explore and valorise vast uncultivated arid lands thanks to original livestock systems based on camels, grazing systems and mobility, and kinships links to manage common resources in their spatial and temporal dimensions. Camel farming still plays a marginal role at the global level. Yet the ability of these animals to adapt to arid environments and to make rational use of resources in these areas, as well as their numerous functions make them valuable allies in the current context of **CLIMATE CHANGE AND DESERTIFICATION**. Indeed, in southern areas of Southern Mediterranean countries, camel farming plays a pivotal role in the conservation of rural societies, in the valorisation of natural resources in desert areas (*sensu strictu* agricultural activities being confined in oasis areas) through a multifunctional livestock production system, and in the management of water scarcity. As such, camel farming has an impact on the large socio-economical issues in the Mediterranean basin: combat against desertification, alleviation of poverty in marginal rural areas, promotion of food security in fragile systems, limitation of rural exodus and of migratory movements. Camel farming has been generally perceived as an asset of secondary relevance, and the camel farming system is generally considered poorly productive and inactive. On the contrary, a **RAPID**, though

fragmentary and disorganized, CHANGE is ongoing in the camel sector, with DIVERSIFICATION and TECHNOLOGICAL INNOVATION in associated products that are now growingly entering the market, and there is growing interest in the capacity of these animals to ENHANCE DESERT ECOSYSTEMS. Moreover, biomedical research is turning its attention to the therapeutic properties of some of these products.

Among the major drivers in the evolution of camel farming systems are urban growth and CHANGING DIETS, both contributing to accelerate the commercialisation of camel products. As a consequence, camel herders are forced to settle on the outskirts of cities and to INTENSIFY their production in order to offer products that are better suited to the needs of urban populations. To meet this demand, the number of PERIURBAN DAIRY FARMS is increasing and mini-dairies start to be set up; this type of farming, which is traditionally hyper extensive, is thus becoming more intensive. The result is RADICAL CHANGES IN CAMEL MANAGEMENT PRACTICES: increasing use of artificial insemination, shorter calving intervals, above ground feeding, highly concentrated feed, machine milking, early weaning, higher culling rates, and breeding of the best milk producers, with very different levels of combinations of the above factors being possible.

Lessons learned from other livestock species have demonstrated the tremendous genetic gain possible with adoption of appropriate and effective SELECTION SCHEMES AND STRATEGIES, though consequences from the population genetics point of view have been in some cases severe, due to a remarkable erosion of genetic variability and, consequently, fitness and adaptability. This aspect is of particular relevance in the dromedary species where recently produced genomic sequence data (Fitak et al., 2016) have clearly highlighted an already reduced polymorphism in the dromedary genome compared to the bactrian and even the feral two-humped camel. On the other side, the general homogeneity of the worldwide dromedary population observed at microsatellite and mitochondrial DNA markers (Almathen et al., 2016), and at genome-wide SNP data (Ciani et al., 2016), presents the advantage of allowing, as a future perspective, the adoption of an international (Northern African) phenotype database and selection scheme, thus permitting adoption of cost-sharing approaches among different countries. The future development of a chromosome-anchored reference genome sequence will allow genetic linkage levels and decay to be estimated for the dromedary species, and hence also contribute in optimal design of genome-wide SNP genotyping densities for SNPchip tools to be adopted, eventually, in genomic selection schemes. However, FOOD SAFETY CONCERNS are still major constraints hampering wider market opportunities for dromedary milk, and meat, in modern systems. Indeed, previous study (Montet et al. 2015) highlighted several food safety hazards in North African countries. Pathogenic bacteria (*Escherichia coli*, *Staphylococcus aureus*, etc.) constitute a serious health problem in particular in selected products of relevance to health and trade. Mycotoxins, in particular M1 aflatoxin in milk must be subjected to special monitoring. Food products are sometimes stopped at borders due to pathogens. For exportation, food products are indeed meet the standards of importing countries which applies EU regulation 178/2002 for the food and Regulation 2073/2005 (amended by regulation 1441/2007 of December 5, 2007) for microbiology. Microbial contamination responsible for foodborne illness should be detected as quickly as possible. Rapid detection methods are needed so that products are tested before being distributed. Camel productions being achieved mainly in remote places, the transfer to consumption basin remains problematic in most of the cases. For example, camel milk is generally carried in traditional containers or without efficient cold chain. The contamination by environmental bacteria as coliforms is relatively common, especially as traditionally, camel milk is consumed under raw form. Similar figures regarding camel meat could be observed, the slaughtering conditions of camel (most of the slaughterhouses are not adapted for camel carcasses processing) being not optimal even if in most of the cases, the commodity channel is very short. If the cooking habit of camel meat (mainly boiled or cooked for long time) avoids contamination in consumers, the perspective of processed meat for urban consumers (saussages, camelburger, etc...) requires primary matter with better hygienic quality. Moreover, milk SUPPLY SYSTEMS are often POORLY STRUCTURED AND INFORMAL, which also represents a weakness in the camel value chain. Despite being under a more industrial circuit compared to the milk chain, the meat chain also suffers from poor organization, as recently documented by a survey carried out in Tunisia within the context of the ENPI CBC MED project PROCAMED, and focusing on the meat processing segment of the value-chain. Due to market uncertainty and instability, professional meat processors may have a flexible and multi-functional role along the chain, also playing a role in camel farming, fattening and commerce of young animals, slaughtering. In any case, meat commercialization still occurs following very traditional channels, without any role from the organized distribution system and/or specialized restaurants. No commercial valorization is in place, with the carcass being dissected without any criteria of differentiation among different commercial cuts, and a unique selling price for these mixes of meat and bones. Generally, no organized retail system is in place, and dromedaries are bought by slaughterers as living animals. A number of animals are still slaughtered out of official channels. SUPPLY CHAIN are generally SHORT, to reduce animal transportation and associated organizational and economical issues. Based on the above, camel meat is currently considered as a marginal product, despite its growing interest in terms of nutritional attributes (Kadim et al., 2008).

Increase in milk productivity has been reported in some countries, mainly in Asiatic countries, for dairy camels as a consequence of better management and even simple genetic selection schemes. In Morocco, a country that is only partially representative of the Maghreb situation, the available dromedary food products (milk, cheese, dry meat, hump fat) are marketed in large Northern cities (for example, by a distribution chain named *Nadweyya*, in Guelmim and Rabat). However, the volume of production is still low and the supply is often restricted to special events such as fairs and expositions. Among the major constraints, are the poor productivity of the camel rearing system and the long distance between the production areas and the regions where more interested consumers live. The worldwide increase in camel meat production is estimated to be the result of both increase in the slaughtering age, in the slaughtering rate and likely also in meat productivity. In Tunisia, a recent study performed within the frame of the PROCAMED project, showed that young animals, during fattening period, have an average daily gain ranging from 306 to 673 grams during the first two months. The profitability of the fattening activity has been shown to start, in the considered scenario, when the daily gain is higher than 500 grams. Even the general mechanization is replacing the camel force in the agriculture and transport, as happens to horses and donkeys in other latitudes, camels are still essential for the local communities as a triple functional animal work-milk-meat, but today the expansion of the tourism is finding in these animals a new role, linked to their work capacities to excursions, typical transport of tourists. This is particularly true in some of the considered countries, notably the Canary Islands and Morocco, where the dromedary camel plays an important and growing role in the TOURISM sector. FARMER AGGREGATION capacity is of fundamental importance in order to allow implementation of modern and effective genetic selection schemes. In the very recent years, first steps in this direction have been done in Northern African countries and in the CANARY ISLANDS (Spain). Here, the Asociación de Criadores del Camello Canario (A.C.C.C.), was established in 2008. The A.C.C.C. is the only recognized association, and brings together breeders from the islands of Lanzarote, Fuerteventura and Tenerife. Since 2015, the A.C.C.C. manages the herd book. In the same year, it started out the registration of adult animals in the herd book. There are about 857 camels, of which 405 are females, 83 males, 174 reared animals and 202 castrated male. The Canary camel is listed as breed in extinction danger. The goal of A.C.C.C. is the preservation and enhancement of the breed. The organization chart of the A.C.C.C. has a President and an Executive Board. There is a technical secretary of the association (responsible for the technical part of the association and the conservation program). Notably, The A.C.C.C. is responsible for (i) identification (microchips) and registration of animals in the Herd Book; (ii) advice to farmers; (iii) coordination of the Conservation Program; (iv) DNA paternity tests (in collaboration with UCO); (v) studies on productive alternatives and products; (vi) promotion of the breed. Indeed, since the 60s, camels have been relocated as a working animal in the tourism sector. This use is limited and it is important to look for other productive alternatives that encourage breeding more camels. The use of camel in the tourism sector has been the main reason for not extinction in the Canary Islands but it is necessary to seek other alternatives to promote their breeding. Importantly, the health status of the Canary Islands makes it the only place from where the EU can import camels (as camel farming is increasingly spreading in several European countries). The sale of animals for breeding to the EU is, in fact, an interesting economically activity for some breeders. In TUNISIA there are currently four dromedary breeder associations, in Tataouine (50 associates, about 3000 animals, created in 2013), in Medenine (20 associates, about 1000 animals), in Tozeur (100 associates, about 1000 animals) and in Kébili (200 associates, about 5000 animals). These associations provide agricultural services for the camel breeders, personalized consulting, organization of general meetings/roundtables/workshops on dromedary issues, supplying farmers with inputs such as concentrated food and drugs. Concerning animal identification, about 7000 new animals are identified per year, with a total of 60,000 animals currently identified in Tunisia by the responsible authority, Bureau of livestock and pasture (Office de L'Elevage et des Pâturages, OEP). Among the major problems identified by the association for the dromedary sector in Tunisia are the insufficiency of feed resources, the decrease in the number of camel herders and the absence of organized markets for camel products. Among the opportunities identified by the association are the possibility to export camel products under the organic label (milk and meat) and to identify possible foreign investors in the camel sector. In ALGERIA, the Fédération Nationale des Éleveurs (FNE) has been created under the umbrella of the Union nationale des paysans algériens (UNPA) on 26.11.2008 by the President of the Algerian Republic in Djelfa. The National Council is established in 2010 and the National Office in 2011. FNE covers the national territory (27 wilayas) and farmers of the four ruminant/pseudo-ruminant species (sheep, goats, cattle and camels), FNE plays an important socio-economic and syndicate role, and promotes aggregation among farmers to protect and develop the livestock system and society. Besides FNE, local associations of dromedary breeders exist, their primary role being management of compensations and subsidies to farmers and other agro-veterinary services.

In Morocco, a national camel association does not exist yet, due to some conflicts among different provincial camel breeders' associations, mainly based in the South of the country. The existing provincial camel breeders' associations, created



right after the launching of the Green Morocco Plan (national plan for rural development) during 2010-2011, despite their official mission to develop dromedary farming and improving milk and meat production, still have a poor impact on the camel system and does not significantly contribute to development and improvement of the dromedary breeding. Data on the exact numbers of members for each association is not given and most of the time the organization is on a tribal basis. There is no performance control or selection program going on. Associations have a role in participating to promotion events such as fairs and shows. Officially, Morocco has a national legislation imposing camel identification systems based on era tags plus electronic devices but, based on unofficial information, only about 60-70% of the heads are actually identified. The major constraint, as said above, is the poor capacity to overcome conflicts and aggregate at national level. The major potentiality is the large demand from consumers, both in North Morocco cities and South Morocco zones, concerning dromedary milk and meat.

The camel milk supply chain in North Africa is rudimentary, except in Morocco where some small dairy plants proposing pasteurized camel milk has established a beginning supply chain from Laâyoune to the northern part of the country. In Algeria, an intensive camel farm based at Ghardaia has implemented a small dairy plant for the local market. But, in general, camel milk is poorly valorized through efficient supply chain. The consumption of camel milk is low in the region (0.11 l/hab/year in Tunisia, 0.21 in Morocco, 0.34 in Algeria and 0.43 in Libya (Faye et al., 2014), Although camel population is 4% of the total TLU (Tropical Livestock Unit) in the region, the part of camel milk in consumed milk is only 0.73%. In most of the time, camel milk is self-consumed or sold directly to consumers through familial or tribal channels without any control. Yet, on local market, camel milk is sold à higher price than cow milk due to its expected medicinal virtues. The consumption of camel meat is also low: 2.84 kg.hab/year for all the region. If several trials have been achieved for meat processing in Tunisia (Kamoun, 1995), only in Morocco, a private company has promoted different camel meat products (sausages, mortadella, ham,). In this country, traditional processing is also common (drying camel meat as loudek or tichtar). The camel meat market, contrary to milk, can be linked to the trans-border market and the North Africa imports live camels from Sahelian countries for slaughtering (more important in Egypt and Libya however). But, if the live camel supply chain is relatively well organized (even if it is sometimes without control), the camel meat supply chain is limited to local butcheries, specialized or not. There is no camel meat in supermarket for example.

**Needs for research, innovation, transfer, organization and planning** – Based on what described above, the camel sector in Northern Africa is rather heterogeneous, with a small number of young, active and open-minded actors making efforts to move toward sustainable intensification of the production, transformation and supply systems. Based on discussions with project partners during the development of the project idea, promotion of networking actions throughout the value chain, to promote and strengthen horizontal and vertical integration among actors is of fundamental importance to assure a long-term success participatory strategy development. Unfortunately, application of socio-economic methodological analytic tools in the dromedary sector is still very limited so a comprehensive overview and a deep knowledge about the structure, the organization, and the potential of the dromedary system in Northern Africa is currently lacking. Existing data from punctual, local, surveys need to reach a higher level of organization, and meta-analyses over geographical regions and time period need to be performed in order to refine the picture. Furthermore, a strong action of sensitization of institutional organizations and policy-making authorities is needed, as poor attention is currently given to the dromedary species that, despite still playing a marginal market role, has a relevant strategic role face to the big societal and environmental challenges southern Mediterranean countries are, and will be, facing.

Research and innovation, as well as capacity transfer will play a crucial role in the capacity of the camel sector to exploit at best its potentialities, with North/South collaboration being pivotal for transfer of highly innovative technologies adapted to local scenarios, and East/West collaboration among Maghreb countries being an essential element of the integration and enforcement process. Notably, research in dromedary sector will need to find appropriate answers to the following major themes: (i) increase milk/meat productivity and reproductive performances in a socio-economically and environmentally sustainable way; (ii) implement new breeding criteria to improve the working abilities of camels in a cultural integrated scenario, but also in touristic new development; (iii) take control over a multitude of safety issues still poorly managed in the dromedary sector; (iv) identify, and communicate, healthy and nutritional properties of dromedary food products; (v) identify, and spread, technological processes able to increase food security, shelf-life, palatability, product diversification and added value. Among the above, the first point presents a particular innovation potential. Indeed, new technologies (application of AI, RFID system for the identification of animals, high-throughput genotyping technologies, database applications and software to manage, analyse and make report from large datasets involving genomics, phenotypes and their possible interactions) have been made available to bring positive changes in conventional animal breeding, especially in

developing countries, potentially able to produce a rapid, vertical growth in animal productivity. However, VALIDATION OF TECHNOLOGIES THROUGH ADAPTIVE RESEARCH to the needs of developing countries is needed. Dromedary's milk constitutes an important protein source in pastoral societies; it is traditionally fermented from natural flora that contains a large panel of lactic acid bacteria still poorly characterized (Hassaine et al. 2007; Khelid et al. 2009) which could reveal, in future, interesting peculiar technological properties. Large expectations in this field come from culture-independent approaches and methodologies for rapidly fingerprint microbial diversity in different complex ecosystems including varied range of fermented food. The currently world-wide increasing interest by researchers in the dromedary species, also as animal model for understanding its outstanding physiological and adaptation features, is gradually shaping relationships within the scientific community, which is now highly dynamic and motivated, as attested by the creation of the International Society of Camelid Research and Development (ISOCARD), and the recent launch of the ICC-GIC initiative (7-9 April 2015 Riyadh, Saudi Arabia; 6-8 June 2015 Almaty, Kazakhstan)

Beside doing high-level research, the biggest challenge for researchers in the very near future will be the TRANSFER AND APPLICATION OF MODERN TECHNOLOGIES to the various fields of the dromedary sector, in order to generate sustainable development opportunities. Most of the above processes are now in their infancy stage and need hence to be strongly supported, accompanied, facilitated and put into a larger network perspective. This is the case, for example, of a recent call for "Coordinated Research Projects" (CRP Code D31028 - AIPS Project 2000011) opened within the frame of the Joint FAO/IAEA Programme Nuclear Techniques in Food and Agriculture and entitled "Application of Nuclear and Genomic Tools to Enable for the Selection of Animals with Enhanced Productivity Traits", where a five-years Research Contract was initially dedicated to the application of genomic tools for enhancing the efficiency and effectiveness of genetic improvement of dromedaries. Due to a limited amount of financial resources allocated for such a demanding task in a sector, like the dromedary one, where all basic infrastructure, organization systems and technologies already established for major livestock species are lacking, a very few proposals have been submitted which not reached the standard levels imposed by the call. The above experience corroborates our vision that only an integrated transnational participatory approach could represent a choice option given the current scenario. In the late 2015 a project has been launched within the frame of the Programme Maroc Vert, as a collaboration between FAO and Agence du Sud/Ministère de l'Agriculture et de la Pêche Maritime, entitled "Appui à la valorisation des produits camélins au Maroc" aiming to provide support to strengthen rural organizations and institutions and facilitate empowerment of rural poor. Specific activities are planned to improve the dromedary milk, meat, wool, and leather value chain, the above being a clear proof of the growing government interest toward the camel sector strategic role in the Moroccan socio-economic dimension. A close collaboration and intersection will be put in place with this recently established project in order to capitalize and synergize experiences and actions.

#### **- Aim, objectives and hypotheses**

The general aim of the project is to put in place a combined and coordinated set of inter-disciplinary measures able to generate knowledge, capacities, and practices contributing to socio-economic development of the dromedary sector and local communities.

The specific objectives (and underlining hypotheses) of the project are the following:

- **Enforce the Mediterranean Research Area** through closer collaboration among North/South and East/West partners within the frame of the Arimnet2 proposal and beyond (WP1 & WP6). The rationale behind this objective is the strong believing that only sharing knowledge and experiences, abolishing disparity, and adding value to scientific as well as local traditional know-how it will be possible to effectually revive and valorize our common Mediterranean ancestry and root.
- **Promote horizontal and vertical integration among actors along the dromedary value chain**, at national and transnational level (WP2), as a key strategy toward a fair, self-sustainable, and participatory development process. The rationale behind this objective is that a structured value chain can better cope with internal and external problems, implement innovation and be competitive.
- **Increase dromedary work, milk and meat production, and reproductive performances** through implementation of a modern organization system for animal identification, genealogy and phenotypic recording, linear assessment of morphological and work functional traits, DNA banking and genotyping (WP3). The rationale behind this objective is that increase in productivity (more than just increase in numerical production) is essential to meet the growing consumer demand for dromedary food products.
- **Promote food safety and quality along the dromedary food value chain** through identification of critical points and setup of possible management solutions. The rationale behind this objective is that no commercial valorization can exist without compliance to high regulatory and voluntary safety and quality standards.

- **Promote knowledge-transfer and capacity-building** in the dromedary sector, as instruments to guarantee self-sustainability and continuity of the project actions. The rationale behind this objective is that no good practice or innovation can be successfully implemented if human resources lack basic and /or advanced knowledge and competencies in a specific field of intervention, both at the professional and scientific levels.

### **3.2 Quality and effectiveness of the scientific project, and associated work plan**

- Overall strategy

The overall project strategy is centred around the following principles: (i) **SCIENTIFIC EXCELLENCE and EXPERTISE** (all the selected participants have recognized expertise, competencies and access to facilities related to the topic addressed within the project); (ii) **SYNERGIC INTEGRATION OF COMPLEMENTARY COMPETENCIES** among different countries and among different institutions, taking advantage from several previously established bi-lateral collaborations among partner participants; furthermore, the project integrates different operating levels, the R&D, the professional, and the policy-making ones; (iii) **HIGHLY INTERDISCIPLINARY APPROACH** (the project include competencies such as social and economical sciences, agricultural and veterinary sciences, animal breeding and genetics, chemistry, microbiology, epidemiology, molecular biology and biotechnology, bioinformatics, reproduction, physiology, management of livestock systems, food technology, IT and communication technology, administrative and financial management, policy making, etc.); (iv) **TRANSNATIONAL VISION** (WP2 , WP3 and WP4 are entirely penetrated by a transnational perspective); (v) **SOCIAL UTILITY** for local communities (with special emphasis on return to project beneficiaries in terms of information, knowledge, capacity, innovation, competitiveness and development); (vi) **TECHNICAL FEASIBILITY** (simple, robust and affordable technologies, sometimes modified to be better adapted to specific situations in Southern Mediterranean countries, have been the choice within the project, also when addressing highly innovative technologies, such as the genomic-based ones, in order to increase project workability and success, and, whenever possible, to increase possibilities of technological transfer in Maghreb countries); (vii) **CLEAR DEFINITION OF ROLES AND RESPONSIBILITIES** (the project proposal currently presents an informative, though general, definition of roles and responsibilities. A fully-detailed map of roles and responsibilities will be produced during the preparation of the negotiation phase, considering individual's competencies and authority, as well as possible context evolutions. Such an *ex-ante* map will be periodically monitored and revised, if necessary, to take into account possible weaknesses and inadequacies in the project organization and functioning.

- Overall work plan and project's target objectives

The following section is articulated following the project structuring into different Work Packages (WPs) to allow easier and prompt acquisition.

**WP1 Project management, coordination and monitoring** (Please, see section 4.1).

**WP2 "VERTICAL AND HORIZONTAL INTEGRATION along the camel value chain"** - The target objectives of this WP being (i) the identification of a national and transnational strategy to add value to the dromedary sector and (ii) to promote implementation of local territorial participatory processes, the following actions have been planned. Three two-day Work Meetings (WM) will be organized (one per year and per Maghreb country) with an average 30 participants per meeting (total 90 participants, mixed nationalities). Each WM will be under the coordination of 2 meeting entertainers. The WM #1 will be in Algeria (at month 6) and the theme will be "Stakeholders of the dromedary sector: characteristics, critical points and potentialities". WM activities may be carried out in parallel sessions. Preparation of WM #1 and early identification of local entertainers and observers will start from the very beginning of the project, and organizational details will be defined during the first Coordination Meeting (CM) (WP1). In addition, a strict collaboration with action 1 in WP4 is foreseen to acquire more detailed knowledge on local stakeholders composition and role. WM #2 will be held in Morocco, immediately sequential to the CM #2 (also in Morocco) and, if possible, it will be planned in close temporal and spatial proximity of the ISOCARD2018 International conference (very likely to be held in Morocco), in order to magnify project visibility (link with WP6) and facilitate international exchanges. The theme will be "Problems and obstacles to the development of a permanent national/transnational network of actors involved in the dromedary sector". WM #3 will be held in Tunisia (month 24) and the theme will be "Which strategy to add value to the dromedary sector?" During each WM, a Working Group (WG) will be appointed (with a fraction of participants in common to the 3 WGs, to assure continuity in subject development and methodology). WGs discussion and activity will progress for three months after the WMs, through a dedicated IT platform and thanks to a continuous remote entertainment action. Output documents from a previous WM will represent inputs for

the successive WMs. At WM #3, a general synthesis document will be produced and presented to the large public in the closing Dissemination Meeting (DM) in Canarian islands (WP6).

**WP3 “Toward implementation of a MODERN DROMEDARY SELECTION SYSTEM”** - The target objective being the implementation of a modern system of selection for morpho-functional traits of economic interest in order to increase dromedary productivity, four main actions are planned within this WP: (i) Analysis and standardization of guidelines and practices for work/milk/meat/reproductive phenotyping in dromedaries; (ii) Analysis and standardization of guidelines and practices for dromedary individual identification and genealogical recording; (iii) a transnational pilot project for the implementation of (i), (ii), the development of linear assessment protocols and the initial utilization of new-generation genotyping technologies, in Southern Mediterranean countries (Morocco, Algeria, Tunisia); (iv) a pilot project in Canary islands for the development of linear assessment protocols to evaluate the work aptitude of the dromedaries through body and functional (gait, trot and canter) characteristics related to work performance. Actions (i) and (ii) will be partly carried out in remote mode, through IT technologies (web conferencing and document-sharing) already tested in the project set-up stage, and will involve outstanding contribution from FAO, ICAR, ISOCARD, ICC-GIC and other relevant intergovernmental organizations acting as Advisory Board (AB). WP3 discussion groups will meet in a dedicated session during the 3 planned CMs. Action (iii), being transnational in nature, but requiring strict coordination at national level, will be co-coordinated by local coordinators in Algeria, Morocco, and Tunisia (see section 4.2 Individual participant qualification) and will be carried out through strict collaboration with local government bodies (e.g. OEP in Tunisia) and local breeder or development associations (see section 4.2) that will allow a large representative capacity in the wide dromedary southern territories of Maghreb countries. Action (iv) will be carried out, under UCO coordination, by *Asociación de Criadores de Camellos Canarios*, the two participants having a longstanding history of collaboration on themes related to dromedary breeding, genetics and rural development.

**WP4 “The dromedary food value chain: FROM KNOWLEDGE TO PRACTICE”** - The target objective of this WP being the conversion of scientific and traditional knowledge into improved operational practices along the dromedary value chain, three major transversal dimensions have been considered: (i) the socio-economic dimension, (ii) food safety issues, (iii) food quality issues, and (iv) food technology issues. Actions in (i) will specifically focus on new sector dynamics and trends driven by recent socio-economic and environmental changes, exploring the current role of dromedaries in today societies in Maghreb, with special attention to the Moroccan scenario. Acquisitions from actions in (i) will complement and integrate the knowledge generated over the dromedary value chain by actions in WP2. A coordinated set of analytical tools (see below section on Methodology) has been preview in (ii) to address the most relevant food safety concerns. In the four target areas, samples of milk and meat will be collected by local partners at different steps of the value-chain and, after simple and cheap sample preparation, will be sent to UM for the corresponding analyses. In Algeria, this task will also include a parallel delivery of samples to INRA-URTAL for additional analyses using complementary methodologies. Milk samples will be collected from 3 to 5 different geographical zones, and sampling will be repeated at least once per year (possibly on a semester basis) to also infer the effect of geographical and seasonal factors. Samples from at least 5 different farms for any of the considered zones will be collected to assure representativeness. Individual milk samples will also be collected following a dedicated sampling scheme to enhance data interpretation. Meat samples will be collected at slaughterhouses (in Algeria, see section 4.2), and in shops. Actions in (iii) will focus on a relevant case-study in southern Algeria (Tamanrasset) for which preliminary data are already available (Drici et al., 2016). Tamanrasset is indeed a rapidly expanding town in a surrounding area of historical tradition for dromedary rearing where elements of dynamism and transition to more modern organization of the value-chain may be recognized. Analysis of critical factors from milking to retail that can affect microbiological quality, and, hence, health, nutritional and organoleptic status of milk, will be carried out. A geographically and temporally representative collection of milk samples will be carried out. Samples will be, partly prepared for shipment (to UM and INRA-URTAL, in France) and partly immediately used for physical, chemical and microbiological analyses in loco (see section below on Methodology). Integration of actions, information and data exchange between partners involved in (i), (ii) and (iii) is planned, as well as integration and shared efforts for activities carried out in the Tamanrasset area by the Centre Universitaire de Tamanghasset-Sis for WP4 (ii and iii) and WP3 (iii), with milk samples being collected from farms possibly enrolled in the pilot project, for which genealogical and phenotypic data will be also available. (iv) food technology pilot project in Canarian islands developed in collaboration with ICIA institute and aimed to cheese and milk products as well meats.

**WP5 “Training and capacity building”** Being aware that no practice can be successfully implemented if human resources lack basic and /or advanced knowledge and competencies in a specific field of intervention, both at the professional and scientific levels, a great emphasis will be given to training and capacity building actions throughout the whole project implementation. However, considering some limits imposed by budget availability, only very targeted actions are



proposed and, whenever possible, use of remote IT technologies will be preferred, provided they do not compromise final output attainment. A reasoned list of targeted actions (and main contributors to the training) is provided here. Training on (i) participatory local planning and management (CREA, CIRAD-SELMET), (ii) animal phenotyping in the dromedary species (ICC-GIC), (iii) linear morpho-functional assessment protocols development and application (UCO - INRAT), (iv) genome-wide SNP data generation and analysis (UNIBA), (v) culture-dependent Rep-PCR methods for microbial strain monitoring and species-specific PCR applied to microbial isolates (INRA-URTAL), (vi) culture-independent quantitative PCR (qPCR) methods applied to DNA extracted from food samples (INRA-URTAL), (vii) PCR-DGGE analysis to follow the contamination along the chains and the regions and to identify the hazard points (UM), (viii) training on community-based herd management under low input production systems (INRAT). Number of participants to the above trainings is generally very limited (1 to 6, depending on the training) and it is defined on a case by case basis, with priority for candidates from southern Mediterranean countries. For professional trainings, priority will be given to figures whose professional position will permit, in turn, to transfer the acquired knowledge and competencies to the maximum number of persons (feedback to direct beneficiaries and field-partners). A larger audience will be possible in the case of the course programmed by INRA-URTAL in Algeria, Tunisia and/or Morocco to inform and exchange about innovative (technological) and traditional practices that could be applied to add value to local milk at small scale, with special attention to food shelf life, safety, low inputs and reduced waste. Mobility of students and junior researchers among partner countries will be promoted, by (i) including dedicated budget from Arimnet2, (ii) applying for institutional funds, and other national and international mobility programmes (ERASMUSPlus, EU/Africa EACEA Intra-Africa Academic Mobility Scheme, mobility grants from CIHEAM, Agence Universitaire de la Francophonie, etc), (iii) inquiring for sponsorship from private organizations. Opportunities to and from non-partner countries will also be monitored and considered, if functional to the development of project specific objectives.

**WP6 “Project visibility, dissemination and sustainability”** - Besides Arimnet2 website and instruments, project visibility to large audience will be assured, throughout the project through modern IT and communication systems (project website, web-based media and social networks). Visibility amplification will be pursued also via major international organization like FAO (website announcements, Domestic Animal Diversity Network, DAD-Net), ISOCARD (website announcements, dedicated session at the 2018 international conference), ICARDA (website announcements, dedicated space at national and international events), EAAP (website announcements), local development agencies and public administrations (e.g., in Spain: SERGA, INIA, in Italy: Assessorato al Mediterraneo della Regione Puglia, ARTI-Puglia; In France: website announcements by Agence Nationale de la Recherche, INRA (both in the national and in the Dijon's section at <http://www.cepia.inra.fr/> (CEPIA being the division dedicated to Science and Process Engineering of Agricultural Products), single project partners and associated partners (website announcements, dedicated space in local or international events, such as; in Italy: Fiera del Levante di Bari; in France: Salon International de l'Agriculture; local broadcasting emissions, scientific and professional networks of relationships of single project participants in specific action fields, etc. Specific information and dissemination material (brochures, posters, banners, etc) will be produced in a very targeted fashion. At the end of the project, a final Dissemination Meeting (DM) will be organized in the Canarian islands to present project outputs and open perspectives to large audience, including EU authorities.

To assure sustainability of actions over the end of the project, several measures are implemented. Among them, actions planned in WP2 (Working Group “Which strategy to add value to the dromedary sector?”, including early engagement of governmental bodies to develop specific strategies, plans and actions and to maintain the network structure and function); the creation of permanent national project contact points to allow an effective follow-up, and possible enhancement, of the established actions, promotion of public/private agreements for local promotion and development actions, activities of fund raising at both the scientific and the professional level (e.g. in Tunisia: IEE MENA, Women's Enterprise for Sustainability)

## **- Methodology**

**WP1** See section 4.1 *Management structure and procedures*

**WP2** We will adopte methodological tools from the Stakeholder Analysis, to identify individuals or groups determining the positive and negative impacts on organization's actions. The implementation of Stakeholder Analysis is a constructive and interactive process with intersected activities that are grouped into three main phases named: (i) stakeholder identification, (ii) stakeholder mapping, (iii) stakeholder involvement (Giordano et al., 2010). During WP2 meetings, a two-way “focus group” approach will be adopted, as well as the Metaplan method, a facilitative technique based on “discussion visualization” practices, centered on (i) the collection of opinions from participant groups invited to discuss one or more themes of common interest and (ii) their successive organization in logical blocks (categories) where the major problems detected in

(i) are highlighted together with possible solutions to develop specific actions/activities. Involvement of stakeholders, including development agencies and policy-maker bodies, will be assured from the very beginning of the project, in order to facilitate the participatory process (commitment, design, engagement, integration) and enhance project impact. Measures for effective use and availability of resources are considered, such as remote working based on IT technologies, partial overlapping of WM with CM meetings, enquiry for local or international fundings for additional complimentary financment.

**WP3** Actions (i) and (ii) will be partly carried out in remote mode, through IT technologies (web conferencing and document-sharing), and will involve outstanding contribution from FAO, ICAR, ISOCARD, ICC-GIC and other relevant intergovernmental organizations acting as Advisory Board (AB). Ex-ante and ex-post participatory discussions with local stakeholders will be managed by national coordinators, under supervision of WP coordinators. Once available (month 6), the guidelines will be adopted within the pilot project (iii) in the three southern Mediterranean countries, to develop specific standard operating procedures for pedigree and performance recording, animal tagging (where not already available), data and record collection. The goal is to obtain repeated measurement of phenotypes over the three project years. Among the possible parameters: individual milk yield records, gross composition and somatic cell evaluation (in Algeria, see WP4), birth weight and date, weight-gains, father & mother IDs, sex, weaning-date, slaughtering-date, parturition date and weight, parity, dry-off date, order of lactation, lactation length, service date, weight at service, number of services per fecundation, etc..(Almutairi, Boujenane, et al. 2010). Existing applications (such as FAO LIMA) will be used to manage farm data. Genetic parameters estimates (repeatability, heritability, genetic and phenotypic correlations, and in case, additive genetic values) will be obtained. A large mobilization of field-staff is required, supported partly by research institution partners and partly by local breeder associations. A strong self-commitment and engagement by dromedary breeders will be fundamental and will be stimulated through preparatory meetings (with also contribution from ADVENTIEL, originally established in 1996 as a cooperative of French breeders, currently offering a wide portfolio of innovative services, including mobile electronic solutions, to the agricultural sector, from personalized design to implementation and follow-up, mainly in the field of animal identification, performance control, genetic selection, implementation and management of large databases, for which two-days consultancy visits in the three target countries and a one-week development visit in Algeria have been considered). Blood samples will be collected by veterinarians and stored using available facilities. On the whole, the project will identify lactating females and growing males, for which pedigree and performance data will be recorded and samples for DNA analyses will be collected. At the farm level, data, information on farm description, reproduction and breeding history, GPS coordinates, photo of animals, etc. will be collected. On a subset of selected samples, DNA isolation will be performed using cheap methodologies compatible with genome-wide DNA analysis. Based on the results from the previous steps, modern technologies for DNA analysis will be implemented to estimate diversity indices (inbreeding), allow random paternity verification, detect phenotype/genotype associations at targeted genes and/or genome-wide regions (signatures of selection, Genome-Wide Association Studies, GWAS) and to implement, in case, algorithms to obtain genomic-estimated additive values. For DNA analysis, Illumina Next Generation Sequencing (NGS) technologies will be preferred, associated to library custom enrichment/capturing approaches (Ciani et al., 2016). Actions in (iv) will be carried out adapting protocols from the horse species (Rustin M, et al. Multi-trait animal model estimation of genetic parameters for linear type and gait traits in the Belgian warmblood horse. J Anim Breed Genet. 2009;126(5):378-86 for the development of linear assessment protocols to evaluate the work aptitude of the dromedaries through body and functional (gait, trot and canter) characteristics related to work performance.

**WP4** (i) **SOCIO-ECONOMIC ANALYSIS OF THE DROMEDARY VALUE CHAIN** to understand the recent dynamics of the value chains related to camel products (mainly meat and milk), we propose to use a territorial value chain approach that aims to describe and to model the value chains of camel products in link with its social and geographical environment. This approach will be based on: (i) retrospective interviews among a set of key persons along the value chain in order to capture the past and present changes in the value chains of camel product; (2) semi structured interviews with actors along the values chains (from the camels breeders to the consumers). The main expected outputs: social map of actors along the chains with their functions; accounting analysis to define some opportunities or weaknesses (added value distribution; capital accumulation); define future dynamics in link with the past et present trends. The delimitation of the value chain (geographically and socially) will be used in the analysis of risk assessment along the chain (WP4 (ii) and (iii)) but also in the building of a national/transnational network (WP2). (ii) **FOOD SAFETY** – (A) On MILK samples from the four target countries (see quantitative indicators above): after sample collection, preparation and shipment, the following analyses will be performed (at UM): DNA extraction, PCR amplification, DGGE analysis (El Sheikha et al., 2011) as developed by CIRAD, to permit very rapid analysis of milk microbial contamination, also permitting to follow the contamination along the chains and the regions. An overview of the microbial contamination will be obtained by this global molecular technique which permits to analyze in a unique step all the main microorganisms (bacteria, yeasts, fungi) present in the milk or its

environment (farms) (Durand et al. 2013). (B) On MEAT samples from the four target countries (see quantitative indicators above): sample collection, preparation and shipment to UM will be done following Montet et al. (2008). At UM, the following analyses will be performed: DNA extraction, PCR amplification and DGGE analysis which is a global molecular technique developed by CIRAD to analyze in a unique step all the main microorganisms (bacteria, yeasts, fungi) present on the meat or its environment (farms). Mycotoxins analysis will be performed mainly on dried meat adopting HPLC-MS/MS that permit to analyze in a unique step around 90 mycotoxins. A rapid HACCP method (Bonne R. (2013). La gestion globale de l'hygiène dans les IAA : une méthode de facilitation pour la mise en œuvre des prescriptions d'hygiène du Codex Alimentarius. Bull. Acad. Vét. France 166 (2), 101-108) will be performed to identify hazard critical points. (iii) Food SAFETY and QUALITY (on MILK samples from Tamanrasset, Algeria): sample collection, preparation and shipment to UM and INRA-URTAL will be done following Drici et al., 2016. Sample for analyses on fresh milk will be preserved using chemicals like Potassium dichromate. For bacteriological testing, dippers sterilized for at least 15mm at 120° C will be used. Analyses: organoleptic (appearance, taste, smell), physical and chemical (ph, temperature, sediment, clot on boiling, alcohol, titratable acidity, freezing point), compositional characteristics (Gerber test for fat, solids test: total solids (TS) or solids non-fat (SNF), protein, lactose, ash, minerals, vitamins), hygienic characteristics (Resazurin test or Methylene Blue test; Total Bacterial Count test / Direct Microscope Bacteria Count test; Somatic Cell Count "SCC" (Detection of Mastitis); Veterinary Drug Residues (such as antibiotics, insecticides/ bacterial growth inhibition methods), microbiological quality (determination of cultivable numbers for specific spoilage bacteria, namely psychrotrophic bacteria and spore-forming bacteria; and for lipolytic bacteria, proteolytic bacteria, yeasts and molds) and tests for specific pathogenic bacteria (Listeria, Staphylococcus aureus, Salmonella). The above will be done on fresh raw milk at Tamanrasset. During spontaneous fermentation of fresh raw milk under controlled conditions, as a potential rapid and low-cost test for assessing milk technological quality, strain isolation (acidifying strains) and physico-chemical characterization (pH) will be performed at Tamanrasset adopting usual protocols. In France, a microbiological analysis will be carried out to investigate diversity of dominant populations, quantify some microbial populations at species level and identify strains potentially useful as acidification starters. These analyses will be carried out at UM (see above) and, in parallel, at INRA-URTAL (using Rep- and species-specific Polymerase Chain Reaction (PCR), and quantitative PCR according to Berthier and al., 2001; and Achilleos and Berthier, 2013). The above analyses will be carried out within the frame of training activities planned for WP5. UM will also evaluate mycotoxins as described above

**WP5** Trainings methodology will change mainly depending on the topic (lab vs. class trainings) and the target audience (scientific vs. professional, base vs. advanced, etc). Some trainings will be only possible in northern Mediterranean countries (trainings (v), (vi) and (vii)) where advanced lab facilities are available, the other, being less dependent from the location, will be activated where it would be most advantageous (anyway, at least one in any of the Maghreb countries). Selection of participants will be based on strict meritocratic and equalitarian criteria. For open trainings, large diffusion will be given to training announcements (see visibility networks in WP6), also to promote participation of voluntary paying participants, whose fees will be used to support participation of a minimum number of disadvantaged participants. Ex-ante and ex-post questionnaire surveys will be carried out to evaluate training effectiveness. Remote trainees follow-up will be assured through IT technologies. Fund-raising to further promote PHD/post-doc mobility will be carried out.

**WP6** A project website will be activated (UCO) and maintained throughout the whole project and beyond. A special section of the website will be devoted to interactive supervised discussions among stakeholders and elaboration of documents from the permanent network (WP2). Social networks and other web-based media will be routinely used. Project visibility amplification at zero budget will be also pursued through tom-tomming, and project announcements in institutional websites from project network participants (WP2) and other relevant international organization. Participation to fairs, expositions, events, etc, will be considered (at almost zero budget, by taking advantage of visibility spaces institutionally paid by local development agencies and public bodies; the only expenses being related to brochure and poster printing). Technical dissemination documents from WP2, WP3, WP4 and WP5 will be, whenever possible, distributed in electronic format through internet-based channels, with at least recapitulative bullet points written in English, French, and Arabic. All the scientific and internal documents will be in English. Project data will be published in relevant, highly-impacted scientific journals. Systematic enquiries for attraction of additional funds, sponsorships, training and mobility fellowships, collaboration agreements, competitive calls from both public and private organizations, will be realized throughout the project to assure sustainability beyond the three-year period.

- Innovative approach

Innovation will be present in several aspects of the project:

1. For the first time, a permanent national/transnational network of stakeholders in the dromedary sector will be implemented through participatory approaches and innovative socio-economic analysis techniques will be adopted (WP2 and WP4-(i))
2. For the first time, largely-concerted and internationally-accepted standard operating procedures (SOP) for dromedary identification, and genealogical and phenotypic recording (linear morpho-functional assessment for milk/meat/work) will be produced and implemented in pilot studies (WP3)
3. For the first time, targeted Next-Generation Sequencing (NGS) technologies will be applied to contribute to the understanding of the genetic architecture underlying traits of economic interest in the dromedary species
4. For the first time, an international survey on the presence (and the affecting factors) of pathogens in dromedary milk and meat will be carried out using innovative and complementary technologies in Northern African countries (WP4-(ii))
5. An extensive evaluation of the camel milk components and sanitary quality will be performed, as well as isolation of local native milk acidifying strains (in Algeria, WP4-(iii)), and original technological dairy transformation will be explored (in Canarian islands, WP4-(iv)), both being amenable to open new market opportunities.

- Description of the work packages and list of deliverables (using templates provided in annex)

WP1	Start date: March 2017							
"Project management, coordination and monitoring"								
Participant number	P1	P2	P3	P4	P5	P6	P7	P8
Participant short name	UCO	UM	INRA-URTAL	UNIBA	CREA	UABT	IAV	INRAT
Person months per participants	10	2	2	6				

<p><b>Description of work</b></p> <p><i>Responsible partner:</i> P1 (UCO) - Juan Vicente Delgado Bermejo</p> <p><i>Tasks:</i></p> <p>1.1 Bridging between Call Secretariat (CS) and <b>partners</b> – A permanent link during the whole project will be maintained among the partners by the Coordinator through web-based technology (email, web-conferencing, web data-sharing) already tested during the participated design of the project proposal. As such, all partners will collectively receive constant updates from the CS (inward flow). Contacts with single partners will be implemented for any country- or theme-specific issue. To foster flow of information/data from the partners to CS (through the Coordinator), periodical follow-up web-based meetings and recall emails will be arranged.</p> <p>1.2 – Reporting. A partial inform of the project evolution will be yearly implemented by the responsible of each WP. Using this information, the coordinator will develop the annual general inform. At the end of the project a definitive inform will be compiled by the coordinator using the year informs. The annual general informs will be publically presented and discussed open to all actors. Final inform will be presented and discussed in a international conference to be held in the Canary Island as final action of the project</p> <p>1.3 – Supervision of the project workflow. An external Advisory Board (AB) and the Project Management committee (PMC) will be established to follow up the development of the project activities..</p>
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<p><i>Deliverables:</i> (brief description and month of delivery)</p> <p>1.1–Minutes, protocols, documents. Coordinator will be responsible of the dissemination of all internal official documents produced in the project development. Minutes from (online) meetings (internal), minutes and/or material from follow up meetings with the ARIMNET2 funding agencies (internal), partner newsletters (internal) and emails (internal), official letters of communication to CS (internal) will be managed and delivered at the moment of its production</p> <p>1.2 – Reports. Scientific, technical and administrative annual and final reports will be produced by the compilation of the partial informs submitted every year by the responsible of every WK. All informs will be internally discussed in videoconference meeting (annual reports) and in the final conference on camels which will be held in the Canary Islands. After discussion all reports will be public. A general proceeding of the conference will be published in collaboration with an international scientific journal. Delivery of the reports will be held at the last month of each year.</p> <p>1.3 – Fully detailed action list (internal), early risk identification, sharing and management strategic document</p>
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(internal)
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WP2	Start date: March 2017							
"VERTICAL AND HORIZONTAL INTEGRATION along the camel value chain"								
Participant number	P1	P2	P3	P4	P5	P6	P7	P8
Participant short name	UCO	UM	INRA-URTAL	UNIBA	CREA	UABT	IAV	INRAT
2	6			2	7	8	10	30

**Description of work**  
*Responsible partner:* P5 (CREA) - Grazia Valentino & P7 (IAV) – Ismail Boujenane  
**2.1 – Participative process of strategy development for the camel sector (national and transnational vision and strategy).**  
 In any of the focus areas (Canarian Islands & Northern African countries), a participatory decision process will be activated to define an economic programming strategy to improve value chain competitiveness.  
 Actions will be developed in three main steps, with the following goals:  
 a) Identify, analyze and segment stakeholders directly interested or able to influence issues related with valorisation of camel rearing  
 b) Collect local knowledge from stakeholders and social perception concerning issues related with valorisation of camel rearing  
 c) Activate participative decision processes through involvement of stakeholders on issues and strategies related with valorisation of camel rearing  
 Step a) will be implemented by applying tools from the “stakeholder analysis”, conveniently adapted to the specific socio-geographic context and theme. This analysis represents a decision process aiming at identifying and studying the group or the individuals orbiting around administrative bodies (National Agriculture Ministries, in this case), the reciprocal influences, their attitude toward the administrative bodies and the relative targets. In particular, we will operate through bibliographic analysis, interview to privileged witnesses, administration of semi-structured questionnaires to a sample of stakeholders, identification of stakeholders potentially interested to participate to a decision process that will be activated within the frame of the project. In addition, we will define stakeholder features, roles played within the community, degree of involvement in participated decision processes, relation systems, needs. Through steps b) and c) we will activate actions of consultation, concerted, active and informed participation of actors, in order to generate an effective and multi-directional dialog among stakeholders. The final goal is to build consensus around future strategies for the sustainable management of the dromedary value chain. Knowledge of local actors on different issues will be structured through definition of “conceptual models” to highlight key elements perceived by stakeholders in study areas. To this aim, methodologies from the “Group Model Building” will be adopted to allow, through meetings, focus groups, metaplan methodology, workshops and open space technologies conveniently organized, to improve understanding of participants about the system under study, possible issues and solutions.  
**2.2 - Establishment of a Network of stakeholders in the camel sector (National nodes & trans-national network).** After the results from Task 2.1, a network of stakeholders will be developed to act as a leverage element for the economic development of the value chain.

**Deliverables:**  
 2.1 – Map of stakeholders, Interest/Leverage Matrix, conceptual maps, national and transnational vision and strategy documents (public)  
 2.2 –Network model (organization and functioning; public), permanent network of stakeholders (public, with some restrictions)

WP3	Start date: March 2017
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<b>"Toward implementation of A MOD-ERN DROMEDARY SELECTION SYS-TEM"</b>								
<b>Participant number</b>	P1	P2	P3	P4	P5	P6	P7	P8
<b>Participant short name</b>	UCO	UM	INRA-URTAL	UNIBA	CREA	UABT	IAV	INRAT
<b>Person months per participants</b>	6			8	10	8	5	4

#### Description of work

*Responsible partner:* P1 (UCO) – Juan Vicente Delgado Bermejo & P4 (UNIBA) - Elena Ciani

*Tasks:*

3.1 – *Analysis and standardization of guidelines and practices for work/milk/meat/reproductive phenotyping* - Collection of phenotypes adopting standardized methodologies is the first step toward any genetic improvement action. Unlike other livestock species, no specific guideline is currently available for the camel species. In collaboration with the International Camel Consortium for Genetic Improvement and Conservation (ICC-GIC), acting as advisory board, guidelines will be developed, through a participative transnational approach, for the most relevant camel phenotypic traits (meat/dairy/fertility). Input from the International Committee for Animal Recording (ICAR) or other international organizations will be also considered.

3.2 - *Analysis and standardization of guidelines and practices for dromedary individual identification and genealogical recording* - Individual identification, as well as, parentage recording, are key components of any genetic improvement program. Current available methodology will be analyzed on the light of peculiarities and constraints of the camel sector. Specific guidelines for the camel will be hence developed.

3.3 – *Transnational pilot project* - In selected work/dairy/meat farms (in Tunisia, Algeria, Morocco and Canary islands – Spain): implementation of (i) guidelines for standardized phenotyping; (ii) genome-wide genotyping via NGS techniques; (iii) targeted genetic analysis of candidate genes for meat/milk production and fertility; (iv) analysis of genotype-phenotype associations for the identification of genetic markers (Single Nucleotide Polymorphisms, SNPs) for dairy, meat and fertility traits.

3.4 - *Pilot project in Canary islands* - Development of a linear assessment innovative methodology to evaluate body and functional (gait, trot and canter) characteristics of the camel related to their work performance, in order to be use in the genetic improvement of the local breeds involved in the project. This task will be supplied with on line training courses to prepare human resource to apply in situ the protocols

*Deliverables:*

3.1 – Guidelines for standardized phenotyping of work, dairy, meat and fertility traits in camels (public)

3.2 – Guidelines for camel identification and parentage systems (public)

3.3 – Document presenting the results of *ex-post* evaluation and update of the guidelines for camel phenotyping (public); optimized protocol for cheap DNA isolation suitable for genome-wide analyses (public); database of phenotypic and genotypic (SNPs) information (public); list of SNPs associated with work, dairy and meat traits (public); scientific publications (public).

<b>WP4</b>	<b>Start date: March 2017</b>							
<b>"The dromedary food value chain: FROM KNOWLEDGE TO PRACTICE"</b>								
<b>Participant number</b>	P1	P2	P3	P4	P5	P6	P7	P8
<b>Participant short name</b>	UCO	UM	INRA-URTAL	UNIBA	CREA	UABT	IAV	INRAT
<b>Person months per participants</b>	2	4	10	5		5		5

#### Description of work

*Responsible partner:* P2 (UM) – Corinne Teyssier & P6 (UABT) – Habiba Drici

*Tasks:*

4.1 - **SOCIO-ECONOMIC ANALYSIS OF THE DROMEDARY VALUE CHAIN (CIRAD-SELMET)**- To understand the



recent dynamics of the value chains related to camel products (mainly meat and milk), we propose to use a territorial value chain approach that aims to describe and to model the value chains of camel products in link with its social and geographical environment. This approach will be based on: (i) retrospective interviews among a set of key persons along the value chain in order to capture the past and present changes in the value chains of camel product; (2) semi structured interviews with actors along the values chains (from the camels breeders to the consumers). The main expected outputs: social map of actors along the chains with their functions; accounting analysis to define some opportunities or weaknesses (added value distribution; capital accumulation); define future dynamics in link with the past et present trends. The delimitation of the value chain (geographically and socially) will be used in the analysis of risk assessment along the chain (4.2 and 4.3) but also in the building of a national/transnational network (WP2).

4.2 - FOOD SAFETY (C. Teyssier - D. Montet) (A) On MILK samples from the four target countries (sample collection, preparation and shipment at UM where DNA extraction, PCR amplification, DGGE analysis for rapid analysis of milk microbial contamination will be carried out. (B) On MEAT samples from the four target countries (sample collection, preparation and shipment to UM where DNA extraction, PCR amplification and DGGE analysis to analyze in a unique step all the main microorganisms present on the meat or its environment (farms) will be carried out together with mycotoxins analysis on dried meat by HPLC-MS/MS. A rapid HACCP method will be perform to identify hazard critical points.

4.3 - Food SAFETY and QUALITY (H. Drici - F. Berthier and C. Teyssier - D. Montet) (on MILK samples from Tamanrasset, Algeria): sample collection, preparation and shipment to UM and INRA-URTAL. Analyses: organoleptic physical and chemical, compositional and hygienic characteristics, microbiological quality and tests for specific pathogenic bacteria (on fresh raw milk at Tamanrasset). During spontaneous fermentation of fresh raw milk under controlled conditions, strain isolation (acidifying strains) and physico-chemical characterization (pH) at Tamanrasset. In France, microbiological analysis (diversity of dominant populations, quantification of some microbial populations at species level and taxonomic identification of strains potentially useful as acidification starters) at UM and, in parallel, at INRA-URTAL (using REP-PCR and qPCR, within the frame of training activities planned for WP5). UM will also evaluate mycotoxins as above.

4.4 - FOOD TECHNOLOGY pilot project in Canarian islands UCO (M.R Fresno). Based on the large experience of Dr. Fresno in the technology of the milk, especially in the traditional cheese characterization at physic, chemical, bromatological and commercial levels, in the present project some traditional camel cheeses will be reproduced in the laboratory, together with some other innovative. On these cheeses will be determined the characteristics under the aspects mentioned above. Chemical and Physical characteristics will be tested in the laboratory of the ICIA in Tenerife (Canary Islands), as the bromatological characteristics based on an experienced panel of tested. Commercial Characteristics will be accessed from specific inquiries developed in the commerce.

**Deliverables:**

- Description document concerning the dromedary value chain, with special emphasis on the Moroccan scenario (public)
- Reports on the native north African strains in the milk and meat chain (public)
- Reports on Hazard points (pathogenic bacteria) along the milk and meat chain (public)
- Report on mycotoxin content in milk and dried meat and producing fungi along the milk and meat chain (public)
- Report on improvement in the milk and meat chain that could be proposed (public)
- Report on protocols for technological processing of milk into dairy products (delicatessen markets) (public)

WP5	Start date: March 2017							
"Training and capacity building"								
Participant number	P1	P2	P3	P4	P5	P6	P7	P8
Participant short name	UCO	UM	INRA-URTAL	UNIBA	CREA	UABT	IAV	INRAT
Person months per participants			4	2				6

**Description of work**

Responsible partner: P8 (INRAT) – Sonia Romdhani Bedhief

**Tasks:**

Training on: Participatory local planning and management (CREA, CIRAD-SELMET); Community-based herd management under low input production systems (INRAT). Animal phenotyping in the dromedary species (ICC-GIC); Linear morpho-functional assessment protocols development and application (UCO - INRAT); Genome-wide SNP data generation and analysis (UNIBA); Rep-PCR (strain monitoring) and species-specific PCR applied to microbial isolates (culture-dependent method) (INRA-URTAL); Quantitative PCR (qPCR) applied to DNA extracted from a food sample (culture-independent method) (INRA-URTAL); PCR-DGGE analysis to follow the contamination along the chains and the regions and to identify the hazard points (UM).

A course programmed by INRA-URTAL in Algeria, Tunisia and/or Morocco to exchange about the technological ways based on traditional practices that could be applied for valorising local milk at small scale, with special attention to food shelf life, safety, low inputs and reduced waste.

Remote trainees follow-up will be assured by web-based communication systems.

**Deliverables:**

Training material (public), results elaborated from ex-ante and ex-post anonymous questionnaire survey data (public), scientific and technical reports from on-field and on-lab stages (public)

<b>WP6</b>	<b>Start date: March 2017</b>							
<b>“Project visibility, dissemination and sustainability”</b>								
<b>Participant number</b>	P1	P2	P3	P4	P5	P6	P7	P8
<b>Participant short name</b>	UCO	UM	INRA-URTAL	UNIBA	CREA	UABT	IAV	INRAT
<b>Person months per participants</b>	8					3		

**Description of work**

*Responsible partner:* P1 (UCO) – Juan Vicente Delgado Bermejo & P6 (UABT) – Souheil S.B. Gaouar

**Tasks:**

*Internal communication* and exchange (see WP1, task 1.1). Up to the beginning of the project a mailing list will be implemented enclosing the addresses of the general coordinator and the WP coordinators. The last will maintain their own mailing list with all the personnel implied in the respective WP. So the email network will be promptly established supporting the communications among partners. It will be delivered just in the first month. Moreover, the consortium will dispose in the official web page of the project of a restricted area to exchange documents and information private to the project.

*External communication* - A communication plan will be developed and periodically updated. Results, conclusions and any other output of general interest will be disposable to the general public thorough the open accsses section of the official web page of the project. It will count with external links to the most relevant web pages of the sector, such as ICC-GIC website, ISOCARD website, FAO website, DAD-NET mailing list, ICARDA.. It will be delivered in the third month and the Web Master will be Dr. Vincenzo Landi (University of Córdoba). Among other adopted tools and initiatives: press, TV and radio, IT and web-based communication systems (web-based media and social networks), website announcements on relevant international organizations, dedicated space in local or international fairs, expositions, events (Salon International de l'Agriculture, Fiera del Levante, etc), local broadcasting emissions, tom-tomming through scientific and professional networks of relationships of single project participants in specific action fields, information and dissemination material (brochures, posters, banners), scientific publications (at least five cooperative scientific articles published in high impact journals, several communication presented in international events)

*Dissemination and long-term project sustainability.* A final general international conference in the Canary Islands, with proceedings published in a scientific international journal (Archivos de Zootectia). In order to maintain in the time the critic mass developed in the project, an international scientific NGO will be performed as a network including all the research groups integrated in the project but open to other incorporations of groups interested in camel production and

breeding and camel products valuation. Systematic enquiries for attraction of additional funds.
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<i>Deliverables:</i> <ul style="list-style-type: none"><li>- E-Mailing list as a network in two levels, the first for the coordinators of the project and the WP; and the second with all partners</li><li>- Web page, implemented as an organ of diffusion of the information with open and restricted sections</li><li>- press articles, TV and radio emission registrations, minutes from Skype calls, statistics from social networks, list of announcements on website of relevant international organizations, list of local or international fairs, expositions, events where the project has been illustrated, brochures, posters, banners,</li><li>- Proceedings of the international conference in the Canary Islands published in Archivos de Zootecnia, copies of scientific publications (abstract, poster, full papers, etc)</li><li>- statute and list of participants to the established NGO</li><li>- list of the financing call and competitions to which member of the project participated with proposal strictly connected to the themes addressed by the project, list of public and private sponsors.</li></ul>	
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- Timing (Gantt chart)

		Period																
Action or milestone		-3	3	6	9	12	15	18	21	24	27	30	33	36	+3			
WP1	CARAVAN Consortium Agreement signature																	
	Signature of National contracts																	
	Appointment of PMC & AB																	
	Partner electronic mailing list																	
	Coordination Meetings (CM): kick-off, mid-term, final.																	
	Project coordination and trimestral project monitoring																	
	Final Report																	
	Project full-detailed strategic document (actions, roles, responsibilities)																	
WP2	Document on the preliminary stakeholder analysis (see also WP4)																	
	Working Groups (WG) meetings, and related reports																	
	WG remote web-based discussions, and related reports																	
	General synthesis document from the whole activity of WGs																	
WP3	Guidelines and SOP for work/milk/meat/reproductive phenotyping																	
	Guidelines and SOP for individual identification and genealogical recording																	
	Transnational pilot project (collection of field blood and milk samples and data) <sup>1</sup>																	
	Transnational pilot project (genealogical, phenotypic, and genotypic data analysis)																	
	Canary islands Pilot project (collection of preliminary info & data, development of SOP)																	
	Canary islands Pilot project (SOP implementation)																	
WP4	Document on the preliminary stakeholder analysis (see also WP1)																	
	Report on the presence and impact of pathogens in milk																	
	Report on the presence and impact of pathogens in meat																	
	Recommendations for pathogen control in dromedary milk and meat																	
	Fresh fermented milk (report on quality attributes, problems, recommendations)																	
	Tamanrasset milk supply chain (descriptive report)																	
	Tamanrasset milk supply chain (recommendations)																	
	Tamanrasset milk supply chain (strategic document)																	
	Canary islands dairy technology (experimental set-up and realization)																	
WP5	Canary islands dairy technology (descriptive report)																	
	Canary islands dairy technology (report on marketing and consumer perception)																	
	Training (participatory local planning and management, CREA/CIRAD-SELMET)																	
	Training (community-based herd management under low input production systems, INRAT)																	
	Training (animal phenotyping in the dromedary species, ICC-GIC)																	
	Training (linear morpho-functional assessment protocols development and application (UCO-INRAT-IAV)																	
	Training (genome-wide SNP data generation and analysis, UNIBA)																	
	Training (culture-depend. Rep-PCR for microbial strain monitoring and species-specific PCR, INRA-URTAL)																	
	Training (culture-indep. qPCR applied to DNA extracted from food samples (INRA-URTAL)																	
	Training (PCR-DGGE analysis to follow contamination and identify hazard points (UM)																	
WP6	Course on innovative and traditional dairy practices/technologies, INRA-URTAL) in Algeria																	
	Course on innovative and traditional dairy practices/technologies, INRA-URTAL) in Morocco																	
	Course on innovative and traditional dairy practices/technologies, INRA-URTAL) in Tunisia																	
	Monitoring and evaluation report on training activities																	
WP6	Project website and social network profiles																	
	International ISOCARD conference participation																	
	Closing Dissemination Meeting																	
	Monitoring and evaluation report on visibility, dissemination and sustainability actions																	

<sup>1</sup> Interconnection with WP4

<sup>1</sup> Interconnection with WP4

## 4. Project Implementation

### 4.1 Management structure and procedures (Governance and global organization of the project, organisation structure of the project team)

#### PROJECT STRUCTURE AND FUNCTIONING:

The role of COORDINATOR has been appointed by mutual consent to Prof. J.V. Delgado (UCO) based on his wide experience in project coordination and, notably, in cooperation projects with developing countries, as well as his valued and recognized personal and professional value and integrity. Moreover, he can put at the service of the project an efficient and prepared institutional support staff from UCO which will be of fundamental importance not only for the routine management and coordination of the project (WP1) but also for successful visibility and dissemination actions (WP6), and capacity of further attracting funding from other financing agencies. Due to the specific Arimnet2 call features (budget autonomy of each participating country), a special role will be assigned to the PROJECT MANAGEMENT COMMITTEE (PMC), that will be responsible, together with the project coordinator, for monitoring the project (on a trimester

basis) progress status, identifying early critical points and suggesting possible alternative solutions. PMC will include at least one member from each country. The following gender-balanced national representatives to be included in the PMC have been currently identified: Delgado J.V. (Spain); Ciani E. (Italy); Teyssier C. (France); Boujenane I. (Morocco); Gaouar S. (Algeria); Romdhani S. (Tunisia). Also, most of the representatives, though being internationally recognized in their field, are young mid-career scientists, very active and IT-technology oriented. A transnational ADVISORY BOARD (AB) will be appointed, identifying participant among different relevant categories (R&D, policy-makers, representatives of institutions and the private sector). Coordination of WPs is, in most of the cases, shared among two partners (one from Northern and one from Southern Mediterranean countries) in order to allow a more balanced, robust, effective, and participatory coordination action. National representatives (see above) will also manage relationships among different project participants from the same country (even when contributing to different WPs). For example, in **FRANCE**, the working team is composed of two principal partners (UM and INRA-URTAL), whose activities are mainly integrated within WP4, where highly complementary approaches and technologies will be put in place for the “milk” path, also in strict collaboration, in Algeria, with Centre Universitaire de Tamanghasset-Sis and, in Morocco, with CIRAD-SELMET and IAV. In **ITALY** the team is composed of two principal partners (UNIBA and CREA), co-coordinating WP2 and WP3, respectively. Within CREA (under the supervision of the Ministry of Agriculture), two branches exist (Politics and Bioeconomy, WP2; Animal Production, WP3). An external expert will be under contract by UNIBA (with competencies on WP2 themes) to act as bridge between WP2 & WP3. In **SPAIN** the team is composed of UCO (co-coordinator of WP3; involved in WP4) and *Asociación de Criadores de Camellos Canarios* (both WP3 & WP4). In **ALGERIA**, UABT had a great aggregation capacity. Beside internal participants (Gaouar S., Azzi N.), several external partners are involved, whose specific role has been defined during participatory preparative meetings. Notably, for WP3: the Federation des éleveurs d'Algérie (represented by Amrani Brahim), the Association of camel breeders (represented by Derradji Harek, its honorary president), the University of Oran (Cherifi Youcef, also contributing here his personal network of camel breeders). For WP4 (milk), a close collaboration has been established with the Centre Universitaire de Tamanghasset-Sis (Responsible person, Habiba Drici), that will participate as sub-contractor to the project activities, and will contribute with a total of 13 employees, for a total of 118 person-months. Indeed, several on-field actions have been planned for WP4, that justify the large commitment of the Institutions. In addition, the group from Tamanghasset will support UABT in tasks concerning animal identification, genealogical and phenotypic recording (WP3) for the specific area of Tamanghasset. Being this area a very large and dromedary-populated one, these activities will be shared with Derradji Harek, the task force for field-visits also including Youcef Cherifi and Djallel Eddine Gherissi. A further collaboration is established with Direction des Services Agricoles de Ouargla (Baaissa Babelhadj) for WP4 (meat). Prof. Gaouar will coordinate the different participants within the Algerian unit. In **MOROCCO**, the leading partner (IAV) will take advantage of the fundamental collaboration with the Association “Phosboucraâ”, active in extension services to breeders in southern Moroccan dromedary regions. Similarly, in **TUNISIA**, the leading partner (INRAT) will strictly collaborate with OEP (under the Tunisian Ministry of Agriculture) and with relevant territorial dromedary breeder associations (see above “Background / state of the art in the field and concept”).

#### **4.2 Individual participants** (Qualification of the individual persons involved in the management of the project including subcontractors)

##### **SPAIN**

**Juan Vicente Delgado Bermejo** (UCO). Is involved in the Project as General Coordinator and so responsible of the work packages WP 1 and WP6, participating also in the coordination of WP3 together with Dr. Elena Ciani. Dr. Delgado is Titular Professor and Researcher in Animal Breeding and Genetics in the University of Córdoba (Spain). Born in 1960 count with more than 35 years of experience in Animal breeding and Conservation, Molecular Genetics and Applied Genomic. He has a large experience in the coordination of research projects at the national level with more than twenty but also at the international level standing out his coordination of the bilateral Brazil-Spain project titled CARACTERIZACION PRODUCTIVA, MORFOLOGICA Y GENETICA Y ESTUDIO DE LA BIODIVERSIDAD DE LAS RAZAS CAPRINAS DE APTITUD CARNICA DE ANDALUCIA Y EL NORDESTE DE BRASIL (PHB2002-0026-PC) funded with 85000 € by the Spanish and Brazilian ministries of Science and Technology (2002-2006), Also the project CATTLE-CON IKTA-IMPROVING, TRANSFERENCE AND APPLICABILITY OF KNOWLEDGE IN CONSERVATION AND CHARACTERIZATION TECHNOLOGIES IN CATTLE BREEDS FROM EGYPT AND THE IBERIAN PENINSULA (FP7-PEOPLE-2009-IRSES) was an important coordination of Dr. Delgado inside the MARIE CURIE, ACTIONS of the European Commission funded with 173000€ during 2011-2013. But perhaps his most important coordination has been **the Excellance Network RED CYTED XII-H of the Iberoamerican Program of Science and Technology for the Development** funded

with 140000 € per year between 1999 and 2004 later transformed in an international NGO as CONBIAND Network, involving today more than 20 countries. Dr. Delgado also coordinated the Spanish partnership in projects such as [Characterization of genetic variation in the European pig to facilitate the maintenance and exploitation of biodiversity](#) (BIO4980188-FP4-BIOTECH 2, 1998-2000) and EUROPEAN GENE BANKING PROJECT FOR PIG GENETIC RESOURCES (RESGEN-CT95-12) funded by the DGVI of the European Commission during 1996-2000. Presently Dr Delgado is president of the CONBIAND Network; vice-president of the Spanish Society for the Animal Genetic Resources and member of the advisory committee of Rare Breed International and SAVE Foundation. Also is the responsible of the research group PAIDI-AGR-218 Improvement and Conservation of the Genetic Resources of the Domestic Animals and was promoter and founder of the Spin Off Animal Breeding Consulting L.S. His scientific production is very large with more than three hundred papers, one third published in journal of high impact, and more than 30 books or chapters. He has directed more than 20 PhD thesis and has an exploited patent.

**Francisco Javier Navas** (UCO) Veterinarian, MTS in Zootechnic and Sustainable Management, contracted young researcher of the University of Córdoba is specialized in linear assesment of behavioral, functional and morphological, traits subject where he is ending his PhD studies.

**María del Rosario Fresno** (ICIA) PhD in Veterinary Sciences specialized in milk production and milk technology. Researcher and presently Scientific Director of the Canary Institute of Agricultural Researches (ICIA), Titular Professor of food technology in the University of La Laguna. She has been President of the Regulatory Council of the Geographical Origen Denomination “Queso Palmero” (Palmero Cheese). She has dozens of papers in cheese technology participating in several national and international projects in this subject.

**Vincenzo Landi** (ABC, SL) Agriculture Engineer, PhD in Animal Genomic, is a contracted researcher in the Spin Off Animal Breeding Consulting Ltd. He has participated in several international research projects in Europe, Africa and Latin America. Invited Professor in Universities of México and Brazil always teaching Applied Animal Genomics. He is coordinator of BIOOVIS Consortium dedicated to biodiversity studies in sheep. Also he has a solid formation in design and maintenance of Scientific Web Pages as web master. He has an important scientific production in terms of impacted papers, speeches in meetings and conferences, and books and chapters. He has directed two PhD works.

**Mayra Gómez** (ABC, SL) Zootechnic Engineer, PhD in Natural Resources, and MTS in Zootechnic and Sustainable Management, specialist in Animal Breeding, contracted young researcher in the Spin Off Animal Breeding Consulting Ltd. She worked in linear assessment of morphological and functional traits in horses but she has certain experience in Applied Animal Genomic

**María Esperanza Camacho**. Titular Researcher in the Andalusian Institute of Agricultural Research (IFAPA), PhD in Animal Breeding and Genetics, specialist in Meat Science but with a large experience in other subjects such as Livestock Science, Animal Breeding and Conservation. She has published dozens of papers, books and chapters. She has coordinated three national research projects, and she has been partner in much more at the national and international level. She has directed three PhD works.

**Sergio Nogales** Veterinarian, MTS in Zootechnic and Sustainable Management, contracted young researcher of the University of Córdoba is specialized in Meat Science, subject where he is ending his PhD. He has published several impacted papers in Animal Breeding and Meat Science. He has a previous labor experience as Technical Manager of Breeders Associations of native breeds of cattle, horse and chickens.

**Gabriel Fernandez de Sierra** Veterinarian, PhD in Animal Breeding, specialist in Linear assesment desing in livestock species. Ex Titular Professor in the National University of the Republic of Uruguay, he count with several important publications in animal breeding and conservation and participated in numerous research projects in this subject. Presently he is Technical Manager and geneticist of the Breeders Association of Canarian Camels. (*Asociación de Criadores de Camellos Canarios*). He has a large experience in *in situ* developments of animal breeding and conservation programs

## ITALY

**Elena Ciani** (UNIBA) Role in the project: Co-coordinator of WP3, bridging between *on-field*, *on-lab* and *in silico* activities. Researcher in Animal Breeding and Genetics, with special expertise in livestock population genomics. Member of the International Sheep Genomic Consortium ([www.isgc.com](http://www.isgc.com)); among the promoters, and currently, Secretary of the International Camel Consortium for Genetic Improvement and Conservation ([www.icc-gic.weebly.com](http://www.icc-gic.weebly.com)); member of the International Society of Camelid Research and Development ([www.isocard.net](http://www.isocard.net)); member of the Working Group for the implementation of a linear evaluation system for morphofunctional traits in the Murghese horse; partner of the EU ENPI CBC MED Project PROCAMED I.B.1.1/493 «Promotion des filières camelines pour le développement durable des territoires sahariens», coordinated by B. Faye (CIRAD – France): Responsible for Action 2.2. “Genetic characterization of camel populations”. **Publications:** - Ciani E., Burger P. and the ICC-GIC First insight on the genetic structure of *Camelus dromedarius* populations through



genome-wide SNP markers. Accepted as oral presentation at the ICAR 2016 Satellite Meeting on Camelid Reproduction Tours (France) 1-3 July 2016. - Muzzachi S., Oulmouden A., Cherifi Y., Yahyaoui H., Zayed M.A., Burger P., Lacalandra G.M., Faye B., Ciani E.. 2015. - Sequence and polymorphism analysis of the camel (*Camelus dromedarius*) myostatin gene. *Emirates Journal of Food and Agriculture*, 27 (4):367-373. - Moiola B, Pilla F, Ciani E. Signatures of selection identify loci associated with fat tail in sheep. *J Anim Sci*. 2015 Oct;93(10):4660-9. - Ciani E, ... Delgado Bermejo JV, Sarti FM, Kijas J, Lenstra JA, Pilla F; International Sheep Genomics Consortium. Merino and Merino-derived sheep breeds: a genome-wide intercontinental study. *Genet Sel Evol*. 2015 Aug 14;47:64. - Gaouar SB, Da Silva A, Ciani E, et al. Admixture and local breed marginalization threaten Algerian sheep diversity. *PLoS One*. 2015 Apr 13;10(4):e0122667. - Ciani E, et al. Genome-wide analysis of Italian sheep diversity reveals a strong geographic pattern and cryptic relationships between breeds. *Anim Genet*. 2014 Apr;45(2):256-66. - Lenstra JA, ... Ciani E, et al. Molecular tools and analytical approaches for the characterization of farm animal genetic diversity. *Anim Genet*. 2012 Oct;43(5):483-502. - Kijas JW, Lenstra JA, Hayes B, ... Ciani E, et al. Genome-wide analysis of the world's sheep breeds reveals high levels of historic mixture and strong recent selection. *PLoS Biol*. 2012 Feb;10(2):e1001258.

**Lorenzo Guerra** (UNIBA) Role in the project: Identification of gene products affecting dromedary meat traits (WP3). Researcher in Cellular and Molecular Physiology, with special expertise on functional characterization of cell proteins. Collaborated to the PROCAMED project (see above) by characterizing at the molecular level the myostatin gene (negative regulator of muscle development) in the dromedary species. Supervisor of a Master student on the above topic.

**Davide Monaco** (UNIBA) Role in the project: Contribution to standardization of protocols for reproductive phenotype recording; On-field farm visits. Veterinary doctor, with expertise in camelid reproduction. Participated to the PROCAMED project (see above). **Publications** - Padalino B, Rateb SA, Ibrahim NB, Monaco D, Lacalandra GM, El-Bahrawy KA, 2016 Behavioural indicators to detect ovarian phase in the Dromedary she-camel, *Theriogenology*, doi:10.1016/j.theriogenology.2016.01.027 - Monaco D, Padalino B, Lacalandra GM. 2015 Distinctive features of female reproductive physiology and artificial insemination in the dromedary camel species. *Emirates Journal of Food and agriculture*, 27 (4): 328-337 - Padalino B, Aubé L, Fatnassi M, Monaco D, Khorchani T, Hammadi M, Lacalandra GM (2014). Could dromedary develop stereotypy? The first description of stereotypical behaviour in housed dromedary camels and how it is affected by different management system. *PLOS ONE*, vol. 9, p. 1-9, ISSN: 1932-6203, doi: doi:10.1371/journal.pone.0089093

**Bianca Moiola** (CREA) Role in the project: contribution to the development and standardization of simple and robust recording systems for dromedaries, bioinformatic analysis of genome-wide SNP data (WP3). Senior Researcher, with expertise in animal recording and breeding; molecular genetics; genome-wide association studies (genome-wide SNP data mining). Coordinator of the ICAR Working Group on milk performance recording in buffalo (1996 to 2004), contributed to draft the "Guidelines for simplified buffalo recording for low to medium production systems" (ICAR Technical series N. 4, 2000). Currently member, in quality of expert, of the Technical Committee of the Italian Holstein Breed Society (ANAFI) and of the Technical Committee of Milk Recording of the Italian Animal Breeders Association (AIA). **Publications**: - Moiola et al. 2006 Genetic improvement of dairy buffalo: constraints and perspectives. Invited paper, 8th World Conference of Genetics Applied to Animal Production, August 13-18, Belo Horizonte, Brasil. - Moiola et al. 2012 Genetic variation of C18:1 and C18:2 isomers in sheep milk fat. *Small Ruminant Research*, 103, 187-193. - Moiola et al. 2013 The ACACA gene is a potential candidate gene for fat content in sheep milk. *Animal Genetics*, 44, 601-603. - Moiola et al. 2013. Signatures of selection identify loci associated with milk yield in sheep. *BMC Genetics*, 14, 76. - Moiola B., Pilla F., Ciani E., 2015. Signatures of selection identify loci associated with fat tail in sheep. *J. Anim. Sci.* 93, 4660-4669 - Moiola et al. 2015. A genome wide scan highlights differences in the genetic architecture of fat and protein contents in dairy sheep. *Small Ruminant Research*, 131, 21-28. - Moiola et al. 2015. Genomic scan for identifying candidate genes for Paratuberculosis resistance in sheep. *Animal Production Science*, <http://dx.doi.org/10.1071/AN14826>. - Moiola et al. 2016 Identification of missense mutations in the PCP4 and CD109 genes to validate the effect of neutral genetic markers. *Czech Journal of Animal Science*. Accepted 21 March.

**Antonella Chiariotti** (CREA), Researcher, graduate in Agricultural Sciences. Expertise: rumen microbial ecology, molecular techniques applied to microbiology. Researcher since 1990, in 1997 moved to CREA-PCM (Agricultural and Economical Research Council- Animal production department) working on characterization of rumen ecosystems through traditional cultivation and molecular techniques. The research activity regarded the microbial ecology and mostly rumen microbiology of various ruminants (buffalo, cattle, sheep) with particular interests in fatty acid rumen bio-hydrogenation and lipid profiles in animal product. Since 2010 her research has focused also on industrial biotechnology, bio-refining and microbial studies in order to gain an in depth understanding of metabolic pathways which are important for effective fermentation. As far as biorefinery is concerned she participated in the MiPAAF project "SOS-ZOOT Development of sustainable models for livestock production. Sub-project MAREA "Hydrogen and Methane from zootechnical wastes" (2010-2013); is the CRA-PCM responsible for MIUR Cluster AGRIFOOD Project 4 Sustainability of the food chain (SO.FI.A) OR 4 - Recovery of by-products and biomolecules from the dairy industry (2013-2016) and the regional CO-RESEARCH action "Development of a two-stage high-performance pilot plant for hydrogen and methane production from agricultural wastes" SVOLTA (selected but not yet funded). Her work is done in collaboration both with internal and external academic and industry partners. Example of external academic linkages includes the Institute of Biological, Environmental and Rural Sciences (IBERS), Aberystwyth University (UK) and industrial partners includes Granarolo. **Publications** -Meo Zilio D., Bartocci S., Di Giovanni S., Servili M., Chiariotti A., Terramoccia S. 2015. Evaluation of Dried Stoned Olive Pomace as Supplementation for Lactating Holstein Cattle: Effect on Milk Production and Quality. *Animal Production Science* (Vol. 54). - Chiariotti A., Lembo G., Contò G., Cali M., Liberatore R., Signorini A. 2014 Biogas production: hydrolytic and methanogenic activity of rumen inocula. Poster at International Conference on Anaerobic Digestion (26-30 October) Vienna, Austria.- F. Sarubbi, A. Chiariotti, R. Baculo, G. Contò and S. A. Huws 2014. Nutritive value of maize and sorghum

*silages: Fiber fraction degradation and rumen microbial density in buffalo cows. Czech Journal of Animal Science (59), (6): 278–287- Concetti S., Chiariotti A., Patriarca C., Marone A., Varrone C., Contò G., Cali M., Signorini A. 2013. Biohydrogen production from buffalo wastewater codigested with agroindustrial by-products in an anaerobic reactor. Buffalo Bull. Jour.32 (special issue)- S.A Huws, A. Chiariotti, F. Sarubbi, F. Carfi, and V. Pace. 2012. Effects of feeding Mediterranean buffalo sorghum silage versus maize silage on the rumen microbiota and milk fatty acid content. J. Gen. Appl. Microbiol., 58, 107-112. - V. Pace, G. Contò, F. Carfi, A. Chiariotti, G. Catillo 2011. Short- and long-term effects of low estrogenic subterranean clover on ewe reproductive performance. Small Ruminant Research 97 94–100.*

**Graziella Valentino (CREA)** Agricultural economist. Specific experience on structures and relations of regional agricultural and rural aspects, on definition of public policies choices. Specific background on European Union Structural Funds and on Monitoring of public investment programmes (2007-13, 2014-2020). Researcher for Working Package: Coherence and complementarities of European policies (Cohesion Policy)- INEA, Project manager with P. Pallara for the Rural Development and territorial policies (Creating a System of Knowledge for Rural Development Programme of Apulia Region 2007 – 13) - Apulia Region, INEA and CIHEAM-IAM Bari.

**Massimiliano Schiralli** (CREA) Agricultural economist. Specific experience on the "Rural Development "System of agricultural knowledge" and "Environment". Specific background on European Union Structural Funds and on Monitoring of public investment programmes (RDP 2007-13, 2014-2020 - management of processes and participatory decision-making methods). Particularly he conducts research in the field of organizational models and stakeholder analysis and environmental issues related to sustainable forest management.

**Giulia Diglio.** (CREA) Under temporary contract. Research field: regional, National and EU Rural Development Politics, with specific interest to aspects concerning competition protection laws, public intervention in agriculture and fisheries, the public support to agricultural research and experimentation. **Michele Nori** (European University Institute, Florence, currently Marie Curie fellow) Role in the project: Before and during the WP2 meetings (*in situ* and in remote): contact facilitator (national, regional, international organizations and entities), animator, observer, contribution to themes development, elaboration of output documents. Socio-Agronomist, Specialist in Agro-Pastoral Livelihoods, Food Security and Rural Development. About 20-year experience in different regions in livelihood systems, natural resource management and food security in arid and semi-arid environments. Worked with many organizations at different levels: UN agencies, various Donors (including EC), NGOs and Research institutes. Specific expertise in interdisciplinary studies and interfacing development practice, research and policy making.

## FRANCE

**Corinne Teyssier** (UM) Associate Professor in Bacteriology at the University of Montpellier (France), belongs to the Food Safety team of QualiSud. PhD in molecular microbiology and biotechnologies. Author of 26 publications in peer-review journals, 2 book chapter and 40 presentations in different national or international congress. She has an H-index of 15 (June 2016).

**Noël Durand** (UM) is a molecular microbiologist who obtained his Ph.D. from Montpellier University in 2010. As a researcher in the CIRAD the food safety team, he develops molecular tools to study food microbial ecology for safety and traceability purposes. Notably, he supervised studies on post-harvest treatments on coffee and cocoa. He is an international expert in mycotoxin analysis. The team has a modern HPLC-MS/MS that permits to analyze all the major mycotoxins in a unique analytical step

**Didier Montet** (CIRAD) leads the team of Control of contaminants along the food chain (food safety team) at CIRAD in Montpellier, France. He got his Ph.D. in Food microbiology in 1984 at the University of Montpellier. He is also vice-chair of Biotechnology group at the National French Agency for food-safety (Anses). His main research topic concerns the understanding of the microbial ecology of food and food-safety. He has published nearly 140 papers in the field of food. He currently runs a Europe Aid Project in Côte d'Ivoire and participates in different European projects. He was food expert for the French Embassy in SE Asia and was professor at the Asian Institute of Technology in Thailand (1997-1999). He managed also in this region an expert committee identifying the food safety hazards.

**Françoise Berthier** (INRA-URTAL) Role in the project: contact person for partner INRA; methodological and interpretation supports for the studies dealing with milk; and involvement in the training and capacities building package. Researcher in microbiology, with special expertise in (i) molecular biology (35 years of experience); (ii) dairy ecosystems and technology, and chain for dairy traditional products (18 years of experience); and (iii) lactic acid bacteria (28 years of experience). Partner of the European Project (6th PCRD) 'Traditional United Europe Food (TrueFood)'. Current main research topic: Factors determining the early microbial activities in cheese ecosystems and impacts on these activities on cheese characteristics. Member of the French network 'RMT Fromages de Terroir' (2007- ), especially of its group working on 'microbial ecosystems of milk and cheese'. Published 30 publications, and especially has co-coordinated a review on traditional cheeses actually highly cited and hot (Web of Science).

**Christine Achilleos** (INRA-URTAL). Role in the project: qPCR training. Food Industry. Engineer. 20 years of experience in dairy technology research with special interest in the sensory quality of traditional raw milk cheeses. Current research topic: the respective role of the raw milk, the microbiota, and the applied processes, their variability and their interactions. Development and implementation of analytical tools for the research with expertise in molecular biology, biomolecular interactions, immunochemistry.

**Veronique Alary** (CIRAD – SELMET) Agronomist with a PhD in economics. She has carried out research on household viability, risk management and vulnerability in rural areas over the last twenty years in several developing countries (Cameroon, India, Mali, Tunisia and Egypt). During the last 15 years, she has co-coordinated 6 re-search projects in Maghreb and Egypt on innovation adoption and impact in dry areas; adaptive capacity of families and efficiency of crop-livestock integrated systems; and the traditional milk value chains. Based at ICARDA Office Morocco since sept. 2015, she will have in charge the development of the approach of the dynamics of value chains of camel products in Morocco.

**Guillaume Duteurtre** is an agro-economist specialized in dairy value chains analysis. He has twenty years experience in applied research, expertise and project coordination. He participated in research projects in Africa, Central Asia, Southeast Asia, and Latin-America. He will work in strict collaboration with V. Alary on action 1 of WP4.

### ALGERIA

**Souheil Gaouar** (UABT) Role in the project: Coordinator of the Algerian partnership; Co-coordinator of WP3 (in collaboration with E. Ciani). Professor of Population Genetics at the University of Tlemcen. Head of the research group on Biodiversity, management and improvement of genetic resources at the Department of Molecular and Cellular Biology, University of Oran. Coordinator of a collaborative project for the phenotypic and genotypic characterization of the major dromedary populations in Algeria, and supervisor of a PhD student from the University of Oran (Cherifi Youcef, see below), involved in the on-field sampling activities, and the genotyping work using microsatellite markers (in collaboration with E. Ciani, at UNIBA). Supervisor of 4 Master students within the Master "Molecular techniques applied to characterization of dromedary resources in the El-Kheïter region, wilaya of El-Bayedh". Collaboration with Dr. G. Vaccari (Istituto Superiore di Sanità, Roma) for the genetic study on the prion disease in dromedaries. Collaboration with A. Blondeau Da Silva (University of Limoges, France) and E. Ciani (UNIBA) for the genetic characterization of local sheep breeds from Algeria using microsatellites and Single Nucleotide Polymorphisms (SNP). Promoter of the University degree in "Population Genetics", the Master degree in "Génétique: Gestion et Amélioration des ressources Biologiques", and the PhD course in "Génétique appliqué à la Gestion et Amélioration des ressources Biologiques" at the University of Tlemcen. Participated at international meetings concerning strategies of management of genetic resources (such as the ones organized by "Bureau inter Africain des ressources animales", in Tunis in February 2015 and in Cairo in November 2015), member of scientific committee in several workshop at the national and the North African level, organizer of various workshops at the local and the international level. **Publications:** - Moussi N., Gaouar S.B.S., Chérifi Y. et Saïdi-Mehtar N. Le dromadaire dans le sud-ouest de l'Algérie : Conséquences génétiques de la situation actuelle. Journée scientifique sur la biodiversité, Tlemcen, Algérie, 22 Mai 2011. - Chérifi Y., Gaouar S.B.S., et al. Le camelin dans le sud ouest de l'Algérie: état de la biodiversité. 2ème salon national du dromadaire, Ourgla, 28, 29 Mars 2012. - Gaouar S.B.S., Da Silva A., Ciani E., et al. 2015 Admixture and Local Breed Marginalization Threaten Algerian Sheep Diversity PLoS ONE, 10 (4) e122667. Gaouar S.B.S., ..... Ciani E., Da Silva A. Genome-wide analysis highlights critic genetic dilution in a sheep world gene pool. Under second round of revision in Heredity.

**Noureddine Azzi** (UABT) Role in the project: interface with the laboratory for physic and chemical analysis of milk samples (WP3); contribution to standardization of reproductive phenotype recording (WP3). Assistant Professor (Class A) at Department of Agronomy (University of Tlemcen). PhD student in Biotechnologies applied to ovine and camelid reproduction.

**Habiba Drici** (Laboratoire des Sciences et Environnement « Bio-ressources, Géo chimie-Physique, Législation et développement Socio-Economique» Centre Universitaire de Tamanghasset-Sis, Serssouf, Tamanrasset) Role in the project: WP4: Survey on different practices along the dromedary milk chain (milking, storage, transport) and identification of critical points; survey of dromedary milk quality and properties from different farms (in the Tamanrasset area) through physic, chemical and microbiological analyses; evaluation of milk somatic cell count, as indicator of the possible presence of clinical and sub-clinical mastitis; analysis of pH modifications, D-lactic acid production, and microbiological dynamic evolution at different steps (from farm to market) to study spontaneous fermentation processes, and evaluate microbiological quality. In parallel, native microorganisms isolated from dromedary milk will be stocked in order to be afterward identified using phenotypic and/or molecular techniques, and eventually tested for their technological use. WP3: On-field visits to dromedary farms; milk/meat samples collection in the wilaya of Tamanrasset (in collaboration with Dr. Harek D., see below). Habiba Drici expertise: microbiology and molecular biology. **Publications:** - Drici H, Berthier F, Aigle M, Darrigo C, Delacroix-Buchet A. (2016). Bacterial composition of Algerian raw camel milks after commercial-like storage, as revealed by TTGE and DGGE. ARPN Journal of Engineering and Applied Sciences. 11, (1), 309-3014. - Gabed N, Yang M, Bey Baba Hamed M, Drici H, Gross R, Dandekar T, Liang C. (2015). Draft Genome Sequence of the Moderately Heat-Tolerant *Lactococcus lactis* subsp. *lactis* bv. *diacetylactis* Strain GL2 from Algerian Dromedary Milk.

doi: 10.1128/genomeA.01334-15. *Genome Announc.* 2015 19;3(6). pii1334-15. - Drici H, Gilbert C, Kihal M, Atlan D. (2010). Atypical citrate-fermenting *Lactococcus lactis* strains isolated from dromedary's milk. doi: 10.1111/j.1365-2672.2009.04459.x. *J. Appl. Microbiol.* 108, (2), 647-657.

Other participants from Centre Universitaire de Tamanghasset-Sis: **Dib Nacer** (expertise: IT technology; role: data collection and analysis); **Labed Bbrahim** (expertise: applied organic chemistry; role: physics and chemical analyses of raw milk and fermented milk (under natural and controlled conditions)); **Farhet Abderrazek** (expertise: rural economy; role: on-field surveys on livestock management practices, milking, transport and commercialization); **Bouhoreira Abdelaziz** (expertise: applied organic chemistry; role: physics and chemical analyses of raw milk and fermented milk (under natural and controlled conditions)); **Oueld Cheikh Noureddine** (expertise: nutrition; role: monitoring antibiotic presence in milk); **Kaki Mohamed** (expertise: environmental sociology; role: collection of sociological data); **Hamadi Wassila** (expertise: applied microbiology; role: milk somatic cell counts); **Chegga Abdallah** (expertise: pedology; role: cartography of different livestock practices); **Azzaoui Abdelbasset** (expertise: economic sciences; role: administrative and financial management); **Djouad Mokhtar-Eddine** (expertise: molecular biology and genetics of microorganisms; role: in milk fermented under controlled conditions, identification of fermenting potential of raw milk, isolation of acidifying starter strains).

**Baissa Babelhadj** (Direction des Services Agricoles de Ouargla) Role in the project: contribution to standardization of protocols for phenotype collection; on-field visits to dromedary farms (WP3), milk/meat collection and physic and chemical analyses (WP3), in the wilaya of Ouargla. Veterinary Inspector at "Direction des Services Agricoles de Ouargla". PhD student in Livestock systems in arid zones at Université Kasdi Merbah, Ouargla. **Publications:** Babelhadj B. et al. (2016) Étude ostéo-biométrique comparée des « races » camelines algériennes Sahraoui et Targui (*Camelus dromedarius* L., 1758) *Revue Méd. Vét.*, 2016, 167, 3-4, 77-92.

**Brahim Amrani** (Representative of the *Fédération nationale des éleveurs*). Role in the project: Facilitator of contacts and interactions with dromedary herders (for WPs from 3 to 5). Contribution to the establishment of the Algerian node of the permanent participative Transnational network of stakeholders of the dromedary sector. Contribution in participatory strategic planning and sensitization of policy-makers.

**Djallel Eddine Gherissi** (Assistant professor at Institut des Sciences Agronomiques et Vétérinaires, Université de Souk Ahars) Role in the project: on-field visits to dromedary farms, milk/meat collection and physic and chemical analyses (WP3), in the Eastern High Plateau area. Veterinary doctor, with expertise in physio-pathology and biotechnologies applied to livestock reproduction. PhD in Biotechnology and Animal Production.

**Youcef Cherifi** (Université d'Oran Ahmed Ben Bella, Oran) Role in the project: on-field visits to dromedary farms (WP3), milk/meat collection (WP4) in the Western High Plateau area. PhD student in population genetics at " Université d'Oran" under the supervision of Prof. S. Gaouar. Participated to a large on-field study of phenotypic and genetic characterization of the major dromedary populations recognized in Algeria. Performed the molecular genetics characterization work at the University of Bari under the supervision of Dr. Elena Ciani. **Publications:** Cherifi et al. *Weak genetic structure in northern African dromedary camels reflects their unique evolutionary history.* Submitted 17th May 2016 to PLOS ONE.

**Harek Derradji** (Institute of Agronomic Research of Algeria, Alger) Role in the project: contribution to standardization of protocols for phenotype collection; on-field visits to dromedary farms; phenotypic data analysis (WP3), milk/meat collection (WP3 & 4) in the wilaya of Tamanrasset (in collaboration with Prof- H. Drici). Researcher at Institute of Agronomic Research of Algeria in Animal Production and Breeding, with expertise in characterization of local livestock resources diversity. Member of the Research Group on Algerian local livestock resources (dromedary, horse, sheep, goat, poultry). Collaborated with Prof. S. Gaouar and C. Youcef in the phenotypic and genotypic characterization of the major dromedary populations in Algeria (see above).

## TUNISIA

**Sonia Romdhani Bedhief** (Institut National Agronomique de Tunisie, Tunis) Laboratoire des Ressources Animales et Alimentaires (LRAA) Senior scientist in Animal Breeding (PhD), with expertise in quantitative genetics and applied biotechnologies (molecular genetics and gene banking). Member of the FAO National Consultative Committee for Animal Genetic Resources, contributed her service to OEP for National genetic evaluation programs, to ICARDA for genetic improvement of sheep flock, expert for AU-IBAR (2016), KAFACI project coordinator (2016), INRAT-ICARDA- University of Göttingen (Germany) project coordinator (2016). She will collaborate, within the INRAT team, with Prof. **Mohamed Ben Hamouda** (DG-INRAT; expertise: Animal genetics), 1 PhD Student and 1 student Master degree.

**Wiem Bensalem** (Office Elevage et Paturage, OEP, Ministry of Agriculture, Tunis) is the sub - director of the section "small ruminants and camelids" within the Bureau of Livestock and Pasture, of the Ministry of Agriculture in Tunis. She has specific competencies on animal and fodder production. She will coordinate, within the project, the field actions, the contacts with farmers, and share with INRAT the responsibility over project dissemination and visibility actions.

**Ezzdine Belfkhih** (Office Elevage et Paturage, OEP, Ministry of Agriculture, Tunis) is the regional director of the Bureau of Livestock and Pasture in the governorate of Tataouine. He has specific competencies on animal and fodder production.

Within the project, he will be responsible for the practical implementation of on-field activities (identification and enrolment of breeders, coordination with the association of camel breeders, etc.)

### MAROC

**Ismail Boujenane** (IAV) Role in the project: Coordinator of the Moroccan partnership; Contribution to the development of simple milk and growth recording systems for dromedaries (WP3); contribution in phenotypic data analysis (WP3). Teacher and researcher in Animal Breeding and Genetics, with special expertise in livestock quantitative genetics. Worked on selection schemes of several livestock species, especially the estimation of genetic and phenotypic parameters for traits of interest and the estimation of animals' breeding values. **Publications:** Boujenane I. et al. 2015 Estimation of genetic parameters and maternal effects for body weight at different ages in D'man sheep. *Small Ruminant Research* 130: 27-35. - Boujenane I. et al. 2013 Estimation of genetic parameters and genetic gains for reproductive traits and body weight of D'man ewes. *Small Ruminant Research* 113: 40-46. - Boujenane I. et al. 2013 Genetic and environmental factors affecting perinatal and preweaning survival of D'man lambs. *Tropical Animal Health and Production* 45: 1391-1397. - Boujenane I., Hilal B. 2012. Genetic and non genetic effects for lactation curve traits in Holstein-Friesian cows. *Archiv Tierzucht / Archives Animal Breeding* 55 (5): 450-457. - Almutairi S.E., Boujenane I., et al. 2010 Genetic and non-genetic effects for milk yield and growth traits in Saudi camels. *Tropical Animal Health and Production* 42 (8):1845-1853. - Almutairi S.E., Boujenane I et al. 2010. Non-genetic factors influencing reproductive traits and calving weight in Saudi camels. *Tropical Animal Health and Production* 42 (6):1087-1092.

**Abdelilah Araba** (IAV) full professor in animal production, **Saïda BOUMAKRAT** (IAV), **Lyamani Abderrahmane** (Association Phosboucraâ, active in southern Morocco dromedary areas), and **El Moutaouakil Mohamed Mbarek** (President of the Association Sahara des éleveurs de dromadaire, in Laâyoune - Sakia Al Hamra, established in 2000 and gathering 277 dromedary farmers) will also participate to the project. The IAV members will be involved in explaining the project objectives to breeders, collecting data from the field (performance recording and surveys), analyzing them, writing reports, ensuring results feedback to stakeholders, and organizing meetings with institutional partners. The President of "Association Sahara" will facilitate the introduction of research team near breeders.

### OTHER PARTICIPANTS

ICARDA, ISOCARD, ICC-GIC, FAO will collaborate to the project in :acquisition of data, support in strategy and policy development, in capacity building, and in dissemination and visibility actions. A special role of external advisory member of the project will be played by Bernard Faye, worldwide recognized for its longstanding scientific and professional career in the camel sector.

**4.3 Consortium as a whole** (Statement describing how/why the proposal has a clear added value of being carried out on a transnational basis, description of the specific integration of participants in the transnational consortium structure)

The project core idea has been conceived since long, and from the very beginning, on a transnational basis. Indeed, the three Maghreb countries (Tunisia, Algeria, Morocco) are exposed to very **SIMILAR PROBLEMS AND OPPORTUNITIES** as what concerns the sustainable development of the dromedary sector. Also socio-economical, cultural and environmental implications of dromedary management are largely comparable in the three countries. On the other side, country-specific issues may significantly benefit from an **INTERNATIONAL EXCHANGE OF VIEWS, PERSPECTIVES AND SOLUTIONS**.

WP2 has been conceived to put in place an **INTERNATIONAL PERMANENT PARTICIPATIVE NETWORK OF STAKEHOLDERS** in the dromedary sector, with national nodes in the four considered camel countries (to assure country autonomies and specificities), and a transnational coordination interface (to assure a wider perspective, and shared engagement). Actions to promote **STRATEGIC INTERACTION WITH RELEVANT INTERGOVERNMENTAL ORGANIZATIONS** are included. Notably, implementation of WP2 will benefit from (i) the solid expertise in "stakeholder analysis" methodologies of the Italian CREA partners, Dr. G. Valentino and Dr. M. Schiralli, as well as (ii) the long-established Schiralli's experience in participatory strategic planning; (iii) the strong expertise of the French CIRAD partner, Dr. V. Alary, in socio-economic analysis of Mediterranean and tropical livestock systems, with special emphasis on dynamics at the landscape level, the adaptive animal/resources interactions and the management innovations in the livestock eco-systems; (iv) Alary's ability to animate cooperation in Morocco, also favoured by her current position, steadily based in the North African country; (v) the multi-decennial experience in arid and semi-arid countries matured by Dr. Michele Nori (European University Institute, Florence) in interfacing development practices, research and policy making.

WP3 has been conceived to **CAPITALIZE COMPLEMENTARY EXPERTISE IN KNOWLEDGE DEVELOPMENT, USE AND TRANSFER** from the six country research systems in the field of animal breeding and genetic improvement. Notably, implementation of WP3 will benefit from (i) the over thirty-year experience of the Spanish project coordinator in planning and implementing transnational animal breeding and genetic improvement plans; (ii) the solid supportive project-management staff from UCO; (iii) the strong "quantitative genetic" background of the Moroccan IAV partner, Prof. I. Boujenane,

and the Tunisian INRAT partner, Prof. Sonia Romdhani-Bedhiaf; (iv) the strong and wide field-knowledge of dromedary breeding systems of the Algerian partners, coordinated by Prof. S. Gaouar, and (v) Gaouar's ability to aggregate and establish robust interconnection among different key actors along the dromedary value chain and among different North-African research institutions; (vi) the strong experience in genomic data analysis of the Italian CREA partner, Dr. B. Moioli, and of the UNIBA partner, Dr. Elena Ciani, as well as (vii) Ciani's contribution to the vision and the recent establishment of an International Camel Consortium for Genetic Improvement and Conservation (ICC-GIC), that will act as project Advisory Board. By framing project actions within the ICC-GIC, **IMPACT OF THE PROJECT WILL EXTENDED WELL BEYOND ELIGIBLE AREAS** (ICC-GIC involves leading camel scientists and professionals from the major camel countries). Moreover, WP3 will benefit from the combined effort of the four camel countries, Tunisia, Algeria, Morocco and Spain (Canarian Islands), in collecting work, dairy, meat and reproductive phenotypes using a core-set of parameters under standardized protocols and new developments in linear assessment. This will allow to built up a **LARGE TRANSNATIONAL DATABASE OF PHENOTYPES**, that will permit genetic parameters (heritability, correlations, etc) to be estimated for traits of economic relevance in the dromedary species, where such data are still lacking or very fragmentary. Moreover, the transnational database will represent the first significant step toward a system for genomic evaluation of animal breeding values in the dromedary species, an approach that has been largely proved to be effective in other livestock species. The use of a transnational phenotypic database would not pose, in the dromedary, the problems that are known for the major livestock species. Indeed, surveys of genetic diversity in dromedary populations, carried out at the international level using microsatellite markers (Cherifi et al., submitted; Almathen et al., 2016), mitochondrial and ancient DNA markers (Almathen et al. 2016), as well as genome-wide Single Nucleotide Polymorphisms (SNPs) (Ciani et al., 2016), consistently support a scenario where genetic sub-structuring signals, traditionally observed in the major livestock species as a consequence of the breed formation process, are not observed in the dromedary species, that can be hence considered as a large, rather homogeneous, population. By adopting a transnational approach in building up the phenotypic database, effectiveness can be dramatically increased (by increasing the size of the base population compared to what single country effort could afford), **COST- AND RISK- SHARING** practices are implemented and a general attitude toward international (South-North and East-West) cooperation is promoted. Moreover, the need to identify, in each country, only a limited number of innovation-oriented (peri-urban) farms (due to the transnational collaborative approach described above) makes genetic progress for dromedary economic traits feasible and affordable, while allowing more extensive production system, of great societal and ecological value, to be preserved and protected.

WP4 core idea rests on the general trend, in several camel countries, toward an increased consumer appraisal for dromedary milk, perceived as a highly nutritional and functional component of an healthy diet, and also recognized as an interesting alternative to cow milk for particular problematic consumer categories. On the other side, however, food safety concerns are still major constraints hampering wider market opportunities for dromedary milk and meat. Hence, the project focus on dromedary milk and meat safety and quality as indispensable prerequisites for any further commercial valorisation action. The added value arising from transnational collaboration consists in (i) benefiting from the internationally renowned expertise, as well as updated technologies and facilities, of the French partners from UM and INRA-URTAL on the food safety and quality themes, and from the long established expertise of the North African partners on country-specific dromedary setup and practices; (ii) strengthening previously established relationships and scientific collaborations among North/South and East/West research institutions (e.g. INRA-URTALwith Centre Universitaire de Tamanghasset-Sis;), and identifying further possible interactions on the above themes, thus contributing to the enforcement of the general vision of a **STRONG AND COHESIVE MEDITERRANEAN RESEARCH AREA**; (iii) gaining a wider perspective on dromedary food safety and quality issues, through comparative analysis of country-specific dromedary setup, practices, weaknesses and strengths, thus allowing identifying a **CORE-SET OF SHARED STRATEGIES** (besides more country-oriented solutions) that can be more powerfully and effectively transferred to, and received by, value-chain actors, including policy-makers;

A large portion of WP5 actions are devoted to **TRANSNATIONAL TRANSFER OF KNOWLEDGE, COMPETENCIES, AND PRACTICES**. Different trajectories are taken into account, such as (i) an EU to North-Africa path (through participation to *in loco* organized workshops, theoretical/practical basic/advanced training sessions on the different topics addressed by the project, as well as through less expensive remote IT-based communication and data-sharing systems, largely and extensively tested among the project partners during the project proposal assembly and refinement), and (ii) backwards (through short-term exchanges of students, scientists and professionals for training and lifelong learning); (iii) an East/West path among the participant countries (both at the EU and at the North-African level), possibly benefiting from external resources, additional to Arimnet2, such as those coming from the Erasmus Plus programme mobility for students and teachers, the EACEA Intra-Africa Academic Mobility Scheme, mobility grants from CIHEAM; (iv) a diffusive (and inclusive) path reaching, at different extent, non-partner countries, notably, (a) Mauritania, Libya, and Egypt, in North Africa,



where similar trends and interests in the camel sector are known; (b) in other camel countries (Sub-Saharan and Eastern Africa; GCC countries, other Asiatic countries, Australia); (d) North America, where a flourishing New-World camelid sector exists (llamas, alpacas), and from where success stories and lessons may be learnt. Already established or newly-developed (formal or unofficial) scientific and professional inter-relationships with individuals and/or Institutions participating to the project will represent the first-level instrument toward inclusion of non-participating countries in an **INTERNATIONAL KNOWLEDGE-BASED SYSTEM FOR THE DROMEDARY SECTOR**, other more structured instruments being entrusted to the involvement of intergovernmental organizations (such as FAO, ICARDA, OTHERS). A major role in project dissemination at the international level will be also played by ISOCARD.

**4.4 Risks and contingency plan** (Description and definition of potential risks to the implementation and success of the project, description of how the chances for success are maximized, and proposition of a contingency plan)

Under a critical and responsible analysis of the proposal several risks which could affect the successes of the proposal has been determined:

- Linguistic and cultural heterogeneity. Countries involved have a big linguistic heterogeneity. Arab, Spanish, Italian and French are the maternal languages of the partner, but also a strong distance among cultures. It could represent a difficulty in the understanding and exchange of information among member, disturbing the good development of the project.
- Little farmer structure are disposable in some of the involved countries it could affect the self-commitment and engagement by dromedary breeders with respect the project purposes, something which will be fundamental.
- Political and Social instability in the region, which could affect the mobility of persons and samples, which together with the big geographic distance among countries could represent a sudden problem for the project course such lose of samples, bad quality of samples, bad conditions of transport and storage.
- Luck of camel specific facilities, such as slaughter rooms, milk and /or cheese management rooms, etc.

To prevent these possible problems a Contingency Plan has been designed by part of the Committee:

- Regarding data acquisition, the overall objective will be to have a set of equivalent, consistent and reliable information on the different collection sites. The main problem will be to group the data issued by all sites. Therefore, an information system including databases and ad hoc software capture and consistency check will be in place.
- The risk of instability of the zones in project and the dissemination of the areas populated by the dromedaries, could produce a temporal disconnection of these zones, generally far from capital or well developed cities. It is why the project has created a specific WP on training that will allow to favor the interactions and share of knowledge between the partners if field studies become difficult.
- Only the structural actions are fixed in just in secure points (Labs, Data Base, Documentation, etc), leaving in the field only the samples and data collection. All in situ developments will be performed by local researchers and technicians previously formed in the project training courses.
- Also in this sense, the dissemination ways and connections among groups are reinforced in the project in prevention of some imponderable which could disturb the management of the project.
- A dedicated amount of the budget (3,000 euro from "Other costs") for any of the northern Mediterranean countries (Partners 1, 2 and 4) will be immobilized up to month 30 of the project to prevent any of the defined Risk or other which could appear.
- The Committee will maintain a restriction in the confidentiality of some project output, especially those affecting the traditional milk or meat chains or the traditional trader's communities.
- Clear agreements with subcontractors will be established during participatory preparative meeting. Written agreements (although a single expenditure center to avoid bureaucratic problems and delays in money transfer) Formal agreements will be established with any sub-contractor during the preliminary negotiating phase in order to limit possible pitfalls.

## 5. Impact

### 5.1 Expected results and their impact/application, including the impact in terms of innovation (Expected impacts listed in the call text)

A great local impact is expected because camels are adapted to hard and extreme conditions where they are the only chance to produce work, milk and meat. In spite of these importance, very few high level researches are disposable in respect camel breeding and camel product characterization. Very few it is scientifically known about the social and environmental impacts of this specie in the desert region that they inhabit even much less about the potentiality of the camels in the rural development and in the fixation of the population to the land. All these aspects are taken into account in the present proposal. Some permanent deliverables of the project will increase the competitiveness of the local breeds of camel, a permanent network will be established, several protocols of animal identification; work, milk and meat recording, reproduction, product characterization, applied genomic tools will be implemented and integrated in the camel production systems.

Also camel genetics and camel products marketing and commerce will be explored in order to increase the added value of the production and the profitability for the farmers.

New challenges on the use of camel and the camel products in the tourism development and other human activities will be studied as well. Formation in the training courses and exchange of human resources will supply of specialist in camel production all the involved regions

The general impact of this project in the scientific community and in the society will be important as well. Desert and semidesert regions are disseminated in all the world, and most of them are almost completely disabled for animal production. Camel and camel productions could be considered a model exportable to other regions and countries, because camels are unique. The knowledge produced in the present project will disseminate the camel context as source to give value to the desert.

Some of the out puts collected in the meetings minutes and recommendations from farmer association members and other relevant stakeholders will be:

- Guidelines for standardized phenotyping of dairy, meat and fertility traits in camels
- Guidelines for camel identification and parentage systems
- Document presenting the results of ex-post evaluation (after implementation in pilot farms) and potential updates of the guidelines for camel phenotyping and animal identification
- Optimized protocol for cheap and effective DNA isolation from whole blood
- Database of phenotypic and genotypic (SNPs) data
- Database of genealogical records
- List of SNPs possibly associated with dairy/meat/fertility traits.

Other strategically outputs to be stood out are:

The establishment of links between the political authorities with the actors in the camel sector in the southern areas will be an essential element for the temporal sustainability of the project. The reinforcement of the professional organizations and the actors at different levels also support the permanence of the project advances.

The promotion of the camel products in the cities and urban concentrations it is a guarantee of the economic viability of the project researches.

Succsses of the project will depend of three factors sensitization, political voluntee and professional competence of the actors, together with the adecuation of the offer and the demand.

Finally we will remark some Integrated approaches to address complex challenges linking technical and socio-economic issues;

- ▯ Improved soil and water quality and agronomic practices with limited input use (e.g. pesticides, chemical fertilisers, energy and water);
- ▯ Improved local products and farming systems best suited to Mediterranean conditions;
- ▯ Diversification and increase of farmers' incomes through access to new markets;

▮ Innovations along the whole food chain contributing to local development.

**5.2 Spreading excellence, exploiting results, disseminating knowledge** (Dissemination plan and/or exploitation of results. The dissemination plan should specify the planned national and international dissemination activities, communication and publication plans)

The topics are addressed in the dedicated WP5 and WP6 (please, see sections above)

**5.3 Mobility & training** (PHD and post-doc mobility between partners is highly encouraged)

The topics are addressed in the dedicated WP5 and WP6 (please, see sections above)

**6. References** used for the project's description (please use a format containing the following information: Surname, A., Surname, B. and Surname, C. (Year): Title of paper, Journal, Volume, Pages) max. 30 references.

Camel Meat and Meat Products a cura di Isam T. Kadim

Giordano R., Maraglino T., Pappagallo G., Ricco V., Schiralli M., 2010, The role of stakeholders' involvement to combat desertification: a Case Study in the Apulia region, in International EAAE-SYAL "Spatial Dynamics in Agro-food Systems: Implications for Sustainability and Consumer Welfare", Book of Abstract, Monte Università Parma Editore SRL.

Konuspayeva G, Faye B, Loiseau G. 2009. The composition of camel milk: A meta-analysis of the literature data. J Food Compos Anal. 22: 95-101.

Achilleos, C. and F. Berthier. 2013. Quantitative PCR for the specific quantification of *Lactococcus lactis* and *Lactobacillus paracasei* and its interest for *Lactococcus lactis* in cheese samples. Food Microbiology 36(2):286-295.

Françoise Berthier, Eric Beuvier, André Dasen, Rémy Grappin (2001). Origin and diversity of mesophilic lactobacilli in Comté cheese, as revealed by PCR with repetitive and species-specific primers  
International Dairy Journal 11: 293–305.

EL SHEIKHA Aly Farag, METAYER Isabelle, MONTET Didier. A Biological bar-code for determining the geographical origin of fruit by using 28S rDNA fingerprinting of fungi communities by PCR-DGGE: an application to *Physalis* fruits from Egypt. Food Biotechnology, 25, 2, 115-129 (2011)

**MONTET Didier, LE NGUYEN Doan Duy, EL SHEIKHA Aly F., CONDUR Ana, MÉTAYER Isabelle, LOISEAU Gérard. Application of PCR-DGGE in determining food origin: Cases studies of fish and fruits. Greening the Food Chain 3 and 4; 3: Traceability: Tracking and tracing in the food chain. Aspects of Applied Biology 87, 11-22 (2008)**

**7. Ethics** (Description of the societal and ethical aspects such as environmental, human or animal welfare, intellectual or cultural development that could cause societal or ethical concerns or contribute to progress in these areas) (Refer to the H2020 guidelines - [http://ec.europa.eu/research/participants/data/ref/h2020/grants\\_manual/hi/ethics/ethics-eit\\_en.pdf](http://ec.europa.eu/research/participants/data/ref/h2020/grants_manual/hi/ethics/ethics-eit_en.pdf)) (max. 0.5 page).

The project proposal does not includes serious ethical concerns or involves several significant or complex ethical issues. Notwithstanding, in line with modern orientations in ethical decision-making in project governance, both NORMATIVE and BEHAVIOURAL ethical issues will be addressed, thus allowing (i) the proposed research, practices and strategies to be in line with applicable international and national laws, and (ii) all the actions to be inspired by trust and integrity criteria. Soft actions (dedicated discussions) to create awareness among project stakeholders about ethical issues will be put in place, as "acceptance and discussion of ethical dilemmas is one step towards more ethically informed management". People involved in the project governance with responsibility roles have been selected, among other criteria, for their ability to adapt their general pre-understanding of situations on the light of empirical data and elements from the project participants, and to adopt a self- critique and reflexivity approach. ENVIRONMENTAL ethical issues will be also addressed, such as (i) adoption of measures for waste management and pollution control, and (ii) adoption of a risk-benefit approach in selection of laboratory reagents and protocols, as well as appropriate environmental safety measures, for actions involving

laboratory procedures. As what concerns HUMAN ethical issues, besides being inspired by general social utility criteria, project participants are particularly sensitive toward GENDER EQUALITY issues. Five WPs, out of six, are under the responsibility of women senior scientists of recognized expertise in their field of action and documented capacities in project management. Four additional women senior scientists will cover roles of responsibility within different WPs. Several women young scientists and professionals from the six participating countries will contribute at different extent to implementation of the project. Access and participation to the project will be open, on equal terms, to women, e.g. during competitions for studentships and training positions. Informed consent, privacy and data protection will be addressed. Ethical issues related to collection, storage, protection, destruction or exchange of biological data (milk, meat) from ANIMALS belonging to local resources will be addressed, and available transfer agreements formats (e.g. from FAO) will be adapted to the specific situation and adopted. INTELLECTUAL property rights will be addressed following international rules and with the support of specific boards inside the project partners.

#### **8. Resources to be committed:** Scientific justification of required funds

**P1 (UCO)** fees to cover participation to the 3 follow up meetings with the ARIMNET2 funding agencies. 3,000 contingency fund, ....3 Coordination Meetings (CM) and 2 Working Meetings (WM)

**P2: UM** will contribute Permanent staff (own funding) for a total of 6 months (30000 euro, not funded following ANR rules, marginal cost) of 2 MM, and 2 MM, and 2 MM involved in actions of WP4 (ii). Requested funding concerns: Travel and subsistence: (economy class) flights, Visa costs, transfer to and from the airport (train ride 2nd class/public transport). These costs apply to 4 people and 3 travels per year. Total: 15,000 €. Personnel: 4 Master students will be enrolled at Qualisud Total: 12,000 € Consumables: the amount requested will be used for microbial and molecular biology analyses (reagents, consumables, enzymes, primers and probes). Total: 18,800 € Other costs: Sequencing (NGS analysis= 12,000 euros) will be performed in private laboratories (400 € per analysis X 30 samples) and 34,800 € will be used for a collaboration contract with UR CIRAD Selmet in Morocco for 2 researchers, 2 Master students and extension staff for local visits. Total: 46,800 € Overheads (0.8% of eligible costs): 7,408 €.

**P3: INRA-URTAL** will contribute Permanent staff (own funding) for a total of 17.5 months (131,101 euro) of two engineers and three technicians involved in WP4 and WP5. Requested funding concerns: Consumables (57,400 Euro) for practical laboratory activities in WP5 (training #1 - at least 2 sessions: assessment of genotypic diversity at both strain and species levels among microbial milk isolates; 600 bacterial isolates from 25 Algerian herd camel milks, analyzed at 6 different periods, and 400 microbial isolates from Tunisia and Morocco; training #2 - at least 2 sessions: quantification of microbial population for 4 bacterial species by qPCR; for 25 Algerian herd camel milks at two periods, and for 24 milks/4 species or 48 milks/2 species from Tunisia and Morocco) Travel and subsistence: for WP5, 3 meetings (1 in Algeria; 1 in Tunisia; 1 in Morocco; 1 participant: F. Berthier); for WP4: three missions (one mission/year) for two participants; two missions per 1 participant, registration and participation to two scientific congress/meetings per one person). Total amount for registration, travel and subsistence: 18,350 euro. Overheads (around 9%): 7,575 euro.

**P4: UNIBA** will contribute Permanent staff (own funding) for a total of 12 months (32,476.8 euro) of a researcher dedicated to co-coordination of WP3, implementation of activities at (iii) of WP3, involvement in stakeholder identification and preparation of WMs (WP2), training actions in WP5 and visibility actions in WP6. Requested funding concerns: 4,000 euro for consumables (laboratory reagents for preparation of samples to genetic/genomic analyses), 8,000 euro for travel and subsistence (ten short missions abroad, including field visits, coordination and closing meetings, meetings for WP2 actions and ISOCARD congress registration and participation), 42,000 euro for "other costs (out of which 15,000 euro are dedicated to a collaboration contract with a scientist involved in WP2, having a background and proved experience in Socio-Agronomy, Agro-Pastoral Livelihoods, Food Security and Rural Development in arid and semi-arid environments with previous expertise as contact facilitator, animator, observer, interdisciplinary studies and interfacing development practice, research and policy making; the remaining amount, 27,000 euro being dedicated to external service providers for the genotyping work over samples from the four target countries), and 3,000 euro (5.3%) for overheads.

**P5: CREA-Rome** (Animal Production Research Centre) will contribute Permanent staff (own funding) for a total of 5 months (34,381 euro) of two senior researchers involved in WP3 (guidelines for animal identification and genealogical recording, genetic/genomic data analysis). Requested funding concerns: 8,000 euro for travel and subsistence (ten short missions abroad, including field visits, coordination meetings, ISOCARD congress registration and participation), and 1,000 euro for overheads. CREA-Bari (Politics and Bio-economy Centre) will contribute Permanent staff (own funding) for a total of 12 months (48,000 euro) of two senior researchers involved in coordination and implementation of actions in WP2, in collaboration with local partners and with the scientist under collaboration contract within the University of Bari group. Also, a collaboration will be established for actions in WP2 with one, or more, scientist(s) from partner countries with expertise in

the field of study, which will be hosted at CREA-Bari as visiting professors for short to medium periods (13,000 euro). Additional requested funding concerns: 8,000 for 2 months of a researcher currently under temporary contract with expertise on regional, National and EU Rural Development Politics, with specific interest to aspects concerning competition protection laws, public intervention in agriculture and fisheries, the public support to agricultural research and experimentation; 9,000 euro for travel and subsistence (eleven short missions abroad, including field visits, preparation of WP2 meetings, coordination meetings, ISOCARD congress registration and participation), 3,000 euro of overheads.

**P6: UABT** will contribute Permanent staff (own funding) for a total of 24 months (27,600 euro) of two senior researchers involved in WP3 national coordination and implementation of planned activities. Requested funding concerns: Consumables (a total of 9,500 euro), for the Federation eleveurs d'Algerie (1,000 euro to buy identification tags and devices), to buy material for milk/meat/blood sampling (2,500 euro), to buy material for isolation of DNA from blood (3,000 euro), to buy reagent and materials for physical/chemical and microbiological analyses on milk (3,000 euro). Travel and subsistence (a total of 9,500 euro) for on-field visits and sampling for WP3 (4,000 euro) and for WP4 (1,500 euro), for coordination and scientific meetings (4,000 euro). Equipment (1,000 euro) for electronic equipment for data management, storage and elaboration. Other costs (20,000 euro) for organization of the coordination and the WP2 meetings in Algeria (8,000), for a collaboration contract with ADVENTIEL (11,000 euro) for WP3 (see above), and for dedicated material/equipments (1,000 euro) to be used at Tamanrasset for WP4 (Habiba Drici).

**P7 (IAV)** The budget requested will be used for: 1. Travel & subsistence (25000 €). This expenses' rubric is the most important because it includes several activities: 1.1. Participation in the Project coordination and WP2 work meetings (members of the research team), 1.2. Participation to one relevant international conference for team members, essential for results dissemination, networking and career development opportunities for team members. 1.3. Field performance recording and surveys, foreseen to collect information from farmers and other stakeholders in the Laâyoune region (1250 km from Rabat). The total number of visits dedicated to the project for the entire period is 15, at a rate of 5 days per visit. The planned visits will allow performance recording, surveying some farmers and persons from each segment of the dromedary milk and meat industry. 2. Temporary staff expenses (3000 €) The personnel cost is foreseen for the temporary workers who handle animals at the time of performance recording as well as farmers as incentives. 3. Grant for two PhD students (3600 €) It is expected that two PhD students will work in this project in order to prepare their PhD theses. The amount of grant is 300 Euros per month for 12 months. 4. Consumables (4000 €) for lab reagents and glassware/plasticware. 5. Equipments (2000 €) (computers and electronic supplies). 6. Other costs (7000 €) concerning expenses related to organization of the WP2 working meeting in Morocco (for renting the room, translation costs, transportation, printing, etc.). 7. Overheads (4955 €) They cover the amount foreseen from our institution for administration.

**P8 INRAT** will contribute Permanent staff (own funding) for a total of 20 months (60,000 euro) of two senior researchers involved in WP3 and coordinating WP5. Requested funding concerns: Personnel costs: 12 months of temporary staff for activity (5,000 euro) and 6months for PhD students involved in activity 6 (6,400 euro). Consumables (4,000 euro),. Travel and subsistence (15,000 euro) for on-field visits and sampling for WP3 and WP4 (meat samples), for coordination and scientific meetings. Equipment (5,000 euro. Other costs (10,000 euro) for organization of the coordination and the WP2 meetings in Tunisia. Overheads (4,500 euro) for routine functioning needs.

Deliverables list						
No	Deliverable name	WP no.	Lead participant	Nature	Dissemination level	Delivery month
1	Annual informs and reports	1	UCO	?	Restricted to the partners	Month 12 and 24
2	General Inform and report	1	UCO		General	Months 36
3	Map of stakeholders, Interest/Leverage Matrix, conceptual maps, national and transnational vision and strategy documents	2	CREA/IAV		Restricted	Month 12
4	Permanent network of stakeholders	2	CREA/IAV		Restricted	
5	Guidelines for standardized phenotyping of work, dairy, meat and fertility traits in camels	3	UCO/UNIVA		General	Month 24
6	Guidelines for camel identification and parentage systems	3	UCO/UNIVA		General	Month 12
7	Document presenting the results of <i>ex-post</i> evaluation and update of the guidelines for camel phenotyping (public);	3	UCO/UNIVA		General	Month 6
8	Optimized protocol for cheap DNA isolation suitable for genome-wide analyses	3	UCO/UNIVA		General	Month 12
9	Database of phenotypic and genotypic (SNPs) information (	3	UCO/UNIVA		General	Month 24
10	List of SNPs associated with work, dairy and meat traits	3	UCO/UNIVA		General	Month 28
11	scientific publications	3	UCO/UNIVA		General	Month 36
12	Description document concerning the dromedary value chain, with special emphasis on the Moroccan scenario	4	UM/UABT		General	Month 14
13	Reports on the	4	UM/UABT		General	Month 18



	native north African strains in the milk and meat chain					
14	Reports on Hazard points (pathogenic bacteria) along the milk and meat chain	4	UM/UABT		General	Month 18
15	Report on mycotoxin content in milk and dried meat and producing fungi along the milk and meat chain ) (public)	4	UM/UABT		General	Month 18
16	Report on improvement in the milk and meat chain that could be proposed	4	UM/UABT		General	Month 24
17	Report on protocols for technological processing of milk into dairy products (delicatessen markets	4	UM/UABT		General	Month 30
18	Training material	5	INRAT		General	Month 10, 20 and 30
19	Results elaborated from ex-ante and ex-post anonymous questionnaire survey data)	5	INRAT		General	Month 24
20	Scientific and technical reports from on-field and on-lab stages	5	INRAT		General	Month 30
21	E-Mailing list as a network in two levels, the first for the coordinators of the project and the WP; and the second with all partners	6	Uco/UABT		Restricted	Month 10
22	Web page, implemented as an organ of diffusion of the information with open and restricted	6	Uco/UABT		Restricted	Month 3

	sections					
23	Press articles, TV and radio emission registrations, minutes from Skype calls, statistics from social networks, list of announcements on website of relevant international organizations, list of local or international fairs, expositions, events where the project has been illustrated, brochures, posters, banners,	6	Uco/UABT		Restricted	Month 10
24	Proceedings of the international conference in the Canary Islands published in Archivos de Zootecnia, copies of scientific publications (abstract, poster, full papers, etc)	6	UCO/UABT		Restricted	Month 36
25	Statute and list of participants to the established NGO		UCO/UABT		Restricted	Month 36
26	List of the financing call and competitions to which member of the project participated with proposal strictly connected to the themes addressed by the project, list of public and private sponsors.		UCO/UABT		Restricted	Month 36