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Why women's traditional knowledge matters in the production processes of natural product development: The case of the Green Morocco Plan

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ABSTRACT

Traditional Knowledge (TK) is well recognized for its contribution to climate change adaptation strategies and community-based natural resource conservation. In Morocco, traditional knowledge is now increasingly incorporated into natural product development derived from natural resources as policies advocate the creation of income generating activities via cooperatives; these initiatives ultimately seek to empower rural women economically and to lift them out of poverty. Focus groups, semi-structured interviews and in depth observation were conducted in six cooperatives in Rhamna province to examine the extent to which women's traditional knowledge is applied and whether it is recognized. Our study reveals that the women's traditional knowledge is readily integrated in the development of natural products, vital in product development, yet is not officially acknowledged by the employers and national legislation. With international organisations increasingly putting pressure on countries such as Morocco to integrate the Access to Benefit Sharing (ABS) and particularly article 8j of the Convention on Biological Diversity (CBD), the challenge lies now in securing recognition of women's traditional knowledge involved in these activities.

Introduction

Traditional knowledge, as a cumulative body of knowledge, practice and belief, is vital for the maintenance of the land, water and agricultural resources upon which people depend, and enters into decision making processes of almost every stage in production, management, distribution and consumption of such resources (Berkes, Colding, & Folke, 2000; Ellen & Harris, 2000; Folkes, 2004; Grenier, 1998; Turner & Garibaldi, 2004). When it comes to women's traditional knowledge in particular, women are widely recognized as the gatekeepers of traditional knowledge linked to natural resource management (Howard, 2003). As the responsibilities of rural women mainly lie in providing daily subsistence for their families, they possess a strong traditional ecological knowledge, and interest in environmental protection and management, often suppressed in male dominated environments. They nurture a special relationship with the environment, and tend to be more concerned about the availability and access to natural resources (Gutierrez-Montes, Emery, & Fernandes-Baca, 2012; Howard, 2003). For instance in medicinal plant knowledge, women tend to be more knowledgeable than men because they are responsible for maintaining the healthcare of their families at household level (Howard, 2003; Teixidor-Toneu, Martin, Puri, Ouhammou, & Hawkins, 2017; Montanari & Teixidor-Toneu, 2019 *(in preparation);* Voeks, 2007; Wayland, 2001).

The integration of traditional knowledge is at the heart of world debates for its valuable contribution for climate change strategies (Ford et al., 2016), sustainable agriculture, natural resource and water management initiatives and community conservation endeavours (Berkes, Berkes, & Fast, 2007; Sillitoe, 2018; Strauch, Rurai, & Almedom, 2016; UN-CFCCC, 2013). More recently, the economies of developing countries have focused their interests on the commoditisation of natural products derived from natural resources. Governments worldwide are currently pushing forward to implement policies to improve the socio-economic conditions of the poor. Poor rural communities living in isolation are increasingly pressurised to enroll in development incentives, lead by the belief that they will benefit from these endeavours. In Morocco, the current trend of natural product development in women's cooperatives is believed to foster financial and social autonomy and to trigger gender balance and equity, especially in the context of the Green Morocco Plan. The Green Morocco Plan (GMP) (2008–2020) was – at least officially – designed to help address the country's most pressing issues of climate change, food security, natural resource conservation, poverty alleviation, and economic growth (INDH, 2018). It aims to improve the living conditions of those living in the country's deprived rural areas, including addressing the challenges to women's employment and social integration.

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However, with the increased number of women enrolling into development schemes like income generating activities (IGA) that include natural resources, the commoditisation of natural/genetic resources into natural products raises the issue of Access to Benefit Sharing (ABS) and particularly article 8j of the Nagoya Protocol under the Convention of Biological Diversity (CBD, 2018). The concept of benefit sharing should in theory create a win-win situation that leads to transfer technology and to the creation of genetic conservation, as the rich pool of genetic resources of developing countries meets the rapid expansion of bio-industries. While in theory, the concept seems valid, in practice its application is complex (De Jonge, 2013).

Several studies on women's income generating activities and cooperatives under the Green Morocco Plan are currently available. Authors have claimed that the creation of income generating activities (IGA) in cooperatives lift women out of poverty and allow them to gain financial autonomy, particularly with the exponential development of argan oil cooperatives destined for the international markets (Ahrouch, 2011; Ibourk & Amaghouss, 2014; Charrouf & Guillaume, 2009; Dossa, 2011; Drainville, 2001; Elkandoussi, Omari, & M'Zali, 2011; Perry et al., 2018). Other authors have published on the involvement of women in the cooperatives (Gillot, 2017), and the eminent changes that occur within the social organization triggered by their participation (Damamme, 2014; Damamme & Saussey, 2007); Aboukhsaiwan (2014) measured the impacts of rural women working in IGA in the region of Marrakech and described how women gained financial autonomy and decision-making in the household, particularly for the decision-making related to children. However, he cautions that although they were able to gain some form of “financial independence” and influence in the decisions related to their children, it does not mean that women became empowered in other aspects of their lives. Similarly, Le Polain de Waroux, 2013; Lybbert, Barrett, and Narjisse (2002) and Turner (2014) described that commercialization can stimulate local development and reduce poverty and benefit the population up to a certain point; however they also warn that the profits do not necessarily trickle down to the local level; in addition, Faysse, Bouzekraoui, and Errahj (2015) and Le Polain de Waroux and Lambin (2013) have published on the interaction between the factors of participation and the skills needed to improve the women's integration in the cooperatives. They found that improving the skills of the members can contribute to stabilizing the women's participation within the group.

Our study is thus among the first to identify women's traditional knowledge and skills used in the cooperatives as a vital factor in the processes of product development; it describes the nature of traditional knowledge and asks whether it is recognized as a means of empowerment for women working in the labor chain in a context that privileges the technical aspect of production.

The article is organized as follows. The next section provides some background on the Green Morocco Plan with the recent agricultural policy reforms and the GMP's second pillar initiatives and the income generating activities schemes (IGA). It then gives an overview of the socio-political context related to the factors that impede rural women's autonomy in Morocco. The following section sets out the methodology. It is followed by a description and analysis of the traditional knowledge skills integrated in the development of products in the cooperatives, highlighting the lack of legal and economic recognition. Finally, we discuss these results in the light of access to benefit sharing (ABS) in India which has in the last few years integrated mechanisms of ABS in its national legislation.

The overall strategy of the Green Morocco Plan

Despite implementing numerous development programs funded by International organisations, Morocco still faces some pressing issues. These relate to climate change, food security, natural resource conservation, poverty alleviation, economic stagnation, and illiteracy (INDH, 2018).The Green Morocco Plan (GMP) (2008–2020) seeks to overcome these issues by improving the living conditions of those living in the country's most deprived rural areas, and to resolve the challenges of women's employment and social integration. The GMP is thought to be a panacea for developing the agricultural sector, by improving the socio-economic development of smallholder farmers in particular, as well as offering investment opportunities for export-oriented agriculture (Agence de développement Agricole, 2016; Badraoui, 2014; Moroccan Investment Development, 2016). It rests on two “pillars” of reforms. The first one is designed to achieve an accelerated development towards a modern and competitive export-oriented agriculture, relying on projects with high added value in agro-industries and private investment. With an investment of 75 billion dirhams (US$ 7 billion), this first pillar is expected to accomplish 962 projects by 2020 and to benefit 560,000 farmers. The second pillar is focused on supporting smallholder farmers through developing sustainable natural resources. With an allocated budget of 20 billion Dirhams ($ 2 billion), it foresees the creation of 545 social projects which are geared to help 860,000 smallholder farmers to transit from traditional subsistence agriculture to more intensive forms of agricultural production (Duporte, 2014; Laatar, 2014). However, its primary aim is to enroll rural women in socio-economic opportunities via the creation of income generating activities (IGA), and to create socio-economic development for the most isolated communities and to contribute to gender equality.

Restrictions to the labor market

In Morocco, the issue of women's rights and gender equality has been quite central in government affairs in the last few decades. For instance, in the work arena, women are not equally integrated compared to men. Recent figures from IFAD and International Labor Organisation (ILO) (2018, p.4) suggest that ‘in rural areas, agriculture accounts for three-quarters of employment, and women account for 42.5 per cent of workers. Furthermore, ‘overall, four out of five jobs in the Moroccan economy contribute to either the agricultural or service sector’ (ibid. p. 4). While these figures suggest that women in rural areas are employed, many activities are in fact not recorded. Women often work in unfavourable conditions and without receiving decent wages (Mejjati Alami, 2004). In addition to keeping the official unemployment rates low as these activities escape the official employment categories (FAO, 2018), the female labour force presents some attractive key features for employers: women are readily available and replaceable, do not compete significantly with their male counterparts, are not represented in syndicates and are subject to low wages, and neither contribute to nor receive social security benefits (Drainville, 2001).

While the women may be working hard to try to make a living, this form of labour does not fit into statistical categories and legislation does not offer any social protection or right to retirement as they are only remunerated according to the tasks provided. Furthermore, when women work in cooperatives, they are excluded from any legal status because the cooperatives do not fall within any of the main categories of taxation, and they are not required to make contributions to the National Social Security Fund (French equivalent CNSS) since the jobs they provide are not considered salaried jobs.

However, rural women face other challenges that prevent them from fully accessing their right to work and from entering the labour markets. Cultural issues such as deep-rooted traditions and inflexible mentalities prevail; as most rural women are confined to village life, they seldom receive first hand information coming from outside the village. This prevents them from receiving pertinent information relating to economic initiatives, opportunities and programs, credit facilities and insurance systems that would otherwise facilitate their access to markets and negotiate with lenders. In addition, men tend to appropriate the women's business endeavours once they become lucrative (FAO, 2018; IFAD, 2016; World Bank, 2017a, 2017b). For instance, the trade of thyme (*Thymus satureioides* Coss,) in the High Atlas

illustrates this well. While women proceed to the collection of the plant during the summer months for which they receive a meagre price per kg, they are not able to influence negotiations with buyers. The trade is maintained by an intricate cartel of middlemen who dispatch the merchandise to bigger lucrative markets (Montanari, 2012; Montanari & Bergh 2014). This hinders the women's ability to trade with external people, as it is considered inappropriate for women to sell their goods directly to markets in a patriarchal society in which predominantly men are charged with representing the community externally. Also, because self-employment requires contact with the public and management of other workers, women's access to opportunities are restricted; this affects their ability to make independent choices and decisions which in turn affect their personal and economic lives (Posusney & Doumato, 2003; Tzannatos & Kaur, 2003).

Land access restrictions for rural women in Morocco

Beside the factors described above that restrict rural women from entering agricultural markets, land access and land rights further jeopardise the rural women's autonomy. Mostly, the right to use customary land is limited to male heads of families running within the patrilineal link in the community. Women and especially those who are or were previously married to men but who do not belong to the lineage group, see their entitlement for land ownership automatically removed. Whether or not they benefit indirectly and temporarily from the usufruct of land acquired through their male relatives depends greatly on the goodwill of the latter (Berriane, 2016). In addition, the latest land reforms associated with the initiatives of the GMP that seek to link the economic valorisation of collective lands to human and social development through Public Private Partnership (PPP) exacerbate this situation and further reinforce inequalities (Berriane, 2017; Madhi, 2014).

Given all these constraints, enrolling in development initiatives like cooperatives seems to be the women's only option and main means of escaping the poverty experienced on a daily basis. However, because poverty affects people's mind set and psychology, immediate needs prevail over long term vision of future prospects (World Bank Report, 2015). As Berriane (2011) and Gillot (2017) have revealed in their studies, women are generally not concerned about labour law, and whether these comply or not to national or international legislations; they are ready to accept indecent working conditions in localized structures for poor remuneration. Not only do women work hard to earn a small income, they have to split their time between the cooperative and the domestic work.

The status of rural women in the cooperatives

In a working environment like cooperatives, the tasks that one does, the role and position that one holds determines to a great extent the social status and whether one is recognized or not. For instance, those who work in the administration and in the technical aspects of production are recognized whereas those who work in the labor chain, engaged in mundane manual tasks are not. In the Moroccan cooperatives, the general trend is that educated members (either men or women) of the cooperative administrative bureau tend to manage the organization as their own businesses. Thus, when women manage the cooperatives, they are promoted into the public sphere (normally reserved for men) because as the executives representing the cooperatives, their work and responsibilities also include some public appearance in national trade fairs and international conferences to access markets. They are thus able to get recognition in a patriarchal context that would not normally allow them to be part of the external representation (Damamme & Saussey, 2007; Gillot, 2017). On the other hand, the women in the labor chain who proceed to manual tasks such as harvesting or cleansing the seeds for instance are not consulted in the matters of the administrative bureau and not able to attend or participate in the decision making processes (Damamme, 2014; Montanari & Bergh, 2019; Romagny & Guyon, 2011). Although vital for the next steps of production, women's labor in the lower chains of production remains invisible while the members of the administrative bureaus are able to increase their visibility. This article deals with the issues of under-representation of working women through the lens of traditional knowledge; it questions whether women in the lower chains of production are able to upgrade their status and visibility through the recognition of traditional knowledge.

Research methods

The first author conducted field research in villages of Rhamna province between June and August 2016. Rhamna province is situated in the centre of the country, 75 km north of Marrakech, and constitutes a crossroads between the North and the South, a national road (RN 9) being the main connection from Marrakech to Casablanca. It has a population of 288.437 inhabitants and covers an area of 5856 km^2. The education system has failed to eradicate illiteracy in the province which stands at 63.4% for women compared to 43.1% for men (Haut Commissariat au Plan, 2019). Women generally seek education, work and income to secure their children's education and to provide them with a more comfortable life than their own. Men tend to migrate to the cities and abroad to gain a social status and to improve their living conditions. The province is subject to numerous development initiatives, especially those of the IGA of the Green Morocco Plan. The resources of interest for development in the cooperatives range from cheese, milk, mutton meat, rabbits, and other natural resources like the cactus or Barbary fig (*Opuntia ficus-indica*) for the extraction of oil, pomegranate (*Punica granatum*), quinoa (*Chenopodium quinoa*), cumin (*Cuminum cyminum*) and other resources in the province for which a commercial value can be added. This study focuses on the cooperatives which transform cactus, cumin, couscous, quinoa, honey and seeds (*coriander, quinoa, nigella and poppy seeds, colza*, *sesame* and *millet*) into ready-to-use ingredients which are typically used in the traditional Moroccan cuisine.

The paper focuses on six villages with operational cooperatives. The villages were selected from a list of villages located in the northern, central and southern parts of the province suggested by the regional director of the Office National de Conseil Agricole (ONCA). The ONCA was keen to understand the factors that facilitated the enrollment of women in cooperatives in certain villages and not in others. In this article, we focus on the six “successful” cooperatives that represent half of the total sample. Table 1 below gives an overview of the cooperatives

Table 1
Resources exploited in the cooperatives for income generating activities (IGA).

Cooperatives	Resources	Elements of Traditional Knowledge
A1	Seeds: Coriander, quinoa, fenugreek, nigella, poppy seeds, colza, sesame, millet	Traditional handpicking harvest, traditional hand cleaning
A2	Cumin	Traditional handpicking harvest, traditional basket cleaning
A3	Couscous	Traditional culinary practice
A4	Honey	Traditional bee hives and honey collection
A5	Quinoa	Home grown & traditional basket cleaning
A6	Cactus	Traditional culinary, cosmetic & ethno-medicinal knowledge

studied in this article, which we refer to as A1-A6 in order to protect the respondents. A total of 48 women participated in the focus groups and eight in depth interviews with women aged between 52 and 60 were conducted in the presence of the female or male managers of the cooperatives. The interviews and focus group discussions were conducted in Arabic with the support of a local research assistant and then translated into French. Women in these villages seldom encounter foreigners and gaining their trust was essential. For this reason, recording the interviews was not appropriate but detailed notes were taken, and respondents were anonymized. Trust was gained by explaining to the women that the study aimed to understand the factors that would improve their employment. The managers of the cooperatives were also interviewed. The discussions sought to elicit how the women perceived the role of traditional practices in product development and to what extent the managers recognized this contribution.

Results

Managing the cooperatives

In the visited villages, women are eager to earn money to escape the daily burden of poverty. Strongly influenced by women who have left the villages and moved to the cities and are perceived as "successful", because they have readily access to modernized commodities that reduce their daily workloads, thereby allowing them to benefit from a certain degree of autonomy (Hoffman, 2007); women in the villages are keen to become financially independent from their husbands. However, given the prevalent illiteracy and poverty among the women and the administrative burden required for the creation of a cooperative, women are often not able to initiate the administrative process. The general trend is that only educated women and men are able to do so (*see Montanari & Bergh 2019 for the mechanisms that promote the creation of cooperatives)*. As a labor force however, the women working in the lower chains of production for harvesting, cleaning the seeds, making couscous and packaging the goods are typically recruited from the close surrounding villages, usually working in shifts and teams of eight and supervised by a local woman with basic education. The findings presented in the next section show that while the members of the administrative bureaus (the cooperative's management) are able to benefit from the cooperative's achievements, those who work in the labor chain remain unseen and do not receive any credit for their contribution to natural product development.

Women's traditional knowledge applied in cooperatives

In the province of Rhamna as with other rural regions of the country, women's traditional knowledge is widespread and practised in the household whether in the culinary and ethno-medicinal areas, or in external settings like agricultural activities, animal husbandry, and fodder collection. Traditional knowledge then is irrefutably an integral part of the women's contribution to the daily subsistence and maintenance of the household. It is vital for ensuring food availability and the sustainable management of natural resources. It is also within these settings that the transmission to the younger generations occur (Montanari, 2014). In addition, the women's input in agricultural activities (harvest, transformation and transport) and the care of livestock at home (fodder, treatment, cleaning), nonetheless represent an important contribution to the informal economy, although not acknowledged. Because of the invisible nature of this work, numerous traditional knowledge and associated skills within these activities remain largely dismissed and viewed as backward practices by Moroccan society.

Seeds (A1)

Within the context of the income generating activities of the GMP, natural resources are increasingly incorporated in the development of natural products (culinary and ethno-medicinal products), and other locally produced consumable products (cheese, meat, milk) for which cooperative managers are increasingly encouraged to apply for the label "geographic indicator" (GI). Given Morocco's rich cultural heritage, traditional practices are encountered not only in Rhamna Province but throughout the country and particularly in rural communities. Women are employed for basic cleaning, sorting or processing of the natural resources in the cooperatives for which traditional knowledge is required. Unlike Argan oil which has transited from a traditional manual process to an entirely mechanised one in recent years (Simenel et al., 2009), women's traditional knowledge is still needed in the processing of all the products such as seeds, couscous, and quinoa, honey, and cactus in the visited cooperatives (Table 1). Seeds for instance, are increasingly sold as packaged natural culinary products as people tend to buy already packed products due to time constraints. Because the collection of seeds in the field is a non-mechanised process, the harvest contains a lot of small wooden debris and small dust particles. The women harvest the seeds by hand. This not only requires knowledge of the optimum time for collecting but to recognise the ripe seeds from those which are not. They then proceed to the cleaning by hand using hand woven baskets or trays if baskets are not available. This is the case of women in cooperative A1 who proceed to the cleaning of seeds using traditional baskets. Working in shifts of three teams with eight women per group, they handle the cleaning of *coriander, quinoa, fenugreek, nigella and poppy seeds, colza*, *sesame* and *millet* in the traditional way before proceeding to packaging (Fig. 1). When asked whether they were using the seeds at home, a woman in the focus group discussion replied: "*Yes, we used mostly nigella, coriander, but quinoa is new for us. But we also frequently use fenugreek in cooking, and also in traditional medicine for general health and also diabetes. We do the same here as we do at home*". Given the expansion of natural health products now widely found on the Moroccan market, the finished products are sold in a popular boutique/ restaurant in Marrakech that promotes holistic well-being.

Cumin (A2)

A similar process is happening with cumin (*Cuminum cyminum*) in

Fig. 1. Women proceeding to the manual cleaning of fenugreek seeds. Source: © B. Montanari 2016.

Fig. 2. The various stages of processing cumin. a) Bulk cumin; b) first step using machinery to refine the bulk; c) 2nd spreading out seeds for drying in a dryer; d) dried cumin seeds; e) traditional baskets to refine the seed cleaning; f) woman proceeding with the final cleaning; g) finished product. Source: ©B Montanari 2016.

cooperative A2. Although the main steps for conditioning the cumin after harvesting and packaging (either in glass containers for powdered cumin and packaged seeds) is done with technical machinery, the cleansing of small debris from the cumin seeds is a manual process. The women in this cooperative do not harvest the seeds. They only proceed to a thorough cleaning using traditional baskets, a process that cannot be done with a machine. The first cleansing therefore is done mechanically to rid the seeds of the main dust, the second sieving is done with a machine to refine the process; the third process dries the seeds, the fourth process refines the calibre of seeds using a grading machine and the fourth one is done traditionally with baskets to refine the prior processes (Fig. 2). It involves a dexterous and agile tossing of the seeds back and forth in the baskets inclined to a specific degree, to allow the seeds to separate from the dust. The movement is repeated until the entire debris lie at the lower edge of the baskets. The final touch is picking the remaining dust that may still be found in the manually cleansed seeds. When asked about why the cleansing was done by hand during the focus group discussion, an older woman of the group replied: "*The thorough cleaning of the seeds before packaging as we do it with the baskets cannot be done by a machine. There is no machine so far that replaces the human eye and the dexterous hand movements that allow for dust particles and debris to be separated from the seeds*". And the president of the cooperative added: "*I employ these women especially because they have these skills. The younger women do not know how to do this anymore. They would rather go to the shop to buy already packaged cumin*". The cumin is then packed into glass containers or sealed in plastic bags. Besides selling it to local shops and at trade fairs at around 1.50 Euros, the manager also supplies a retailer in Germany where cumin is sold at 3 Euros per unit.

Couscous (A3)

As with other countries in the Maghreb, Morocco also has a long tradition of *couscous making*. *Couscous* is a traditional dish that is usually made and served on Fridays, the day of prayer at the mosque in both rural and urban settings. Traditionally, women gather at someone's house and prepare it together, using large bowls to mix the flour and water, moving their hands in a circular motion that contributes to the formation of the small couscous lumps. A small amount of water is further added to the mixture if it is too dry and clumpy and the circular firm hand movement is repeated until the couscous mixture becomes more consistent. The women then pass the grains through a sieve to refine and calibre the final couscous grains. This process is witnessed in cooperative A3. The novelty of this particular product is the flavouring

Fig. 3. Women making couscous the traditional way. a) addition of water to the flour; b) mixing the grain with added cactus flour or quinoa; c) dried couscous mixture packed ready for sale. Source: ©B Montanari 2016.

with cactus flour and quinoa added manually to the couscous mixtures. The women employed in the cooperative therefore proceed in the same manner to what they do at home for making traditional couscous and then add the extra ingredients. The couscous mixtures are then put through a dryer before packaging (Fig. 3). The finished products are sold locally and some on the international market. This is facilitated by the cooperative's secretary's family connections in Germany.

Quinoa (A4)

Originally from Bolivia and Peru, quinoa is a flowering plant from the amaranth family, an herbaceous annual plant grown as a grain crop primarily for its edible seeds; it has become widely popular for its nutritive value. Quinoa is cultivated in Rhamna province and managed by a small family-based cooperative of a man and his wife. They cultivate quinoa on a small scale, on one and a half hectare of land that belongs to his wife. The quinoa seeds are supplied by the Institut Agronomique et Veterinaire Hassan II from Rabat. As well as growing their own, the president of this small cooperative also buys it from around 50 growers for which he pays 40 Dh (approx 3.5 to 4 Euros) per kg. The quinoa is then resold at 75 Dh per kg to three main companies which in turn sell in Casablanca, Marrakech and Benguerir. It is the wife who harvests the *quinoa* by hand and she occasionally employs other women from the village if needed during the harvesting season. As with the seeds in cooperative A1, the wife knows the right time to harvest and how to pick the seeds from the plant without crushing them as the seeds are gathered in clusters on the stem. Once harvested and dried in the sun, the quinoa is then cleansed of debris using traditional baskets. As in cooperative A1, the quinoa is tossed back and forth in the basket to separate the seeds from the dust until the content is cleaned of all debris and transferred into a sieve and finally into the basin (Fig. 4). When interviewed, the woman replied: "*The use of a basket and sieve is the only way to rid the quinoa of debris, dust and other particles. It is a long thorough and painstaking job but it is one that gives the best result*". For the small cooperative, growing quinoa has proved to be more lucrative than wheat as the small cooperative earns Dh 4000 for one ton whereas it used to earn Dh 3000 for one ton of wheat.

Honey (A5)

Bee hiving and honey producing are traditional activities in rural Morocco. Traditionally, the hives are made of woven baskets and shaped as a cylinder where the bees gather to produce honey (Fig. 5). The bees usually forage on the flowering plants that are available within a given location. However, the lack of rain affects the availability of flowers in many regions of the country, and bee owners are increasingly constrained to move their hives to other locations where flowers are more abundant. Honey is produced from cactus, orange and pomegranate flowers in cooperative A5. Run like a small family business, this cooperative is managed by the son of the family as president, the mother as secretary and treasurer (at least on paper) and three daughters in law who are responsible for the collection of honey. The ancient practice associated with this activity, has however evolved from traditional to technical because of the centrifuge equipment provided by the "*Initiative Nationale de Developpement Humain*" (INDH), a national social development program started in 2005. Once the honey clumps have been scraped off the hives by hand, they are transferred to the centrifuge. However, the traditional knowledge associated with the gathering and the quality control of the product remains kept in the family setting. When interviewed about the honey collection and processing, the mother said: "*I have done the collecting of honey all my life. I hold this knowledge from my father…he is the one who taught me. I know exactly when it is the right time to collect, if it is good or poor quality honey. I am able to advise others throughout all the stages of production*". Although the lumpy collected honey needs further refining, the transferred traditional knowledge associated with the provided equipment has allowed the small cooperative to process honey more effectively. With the upgraded centrifugal processes, the small cooperative can produce up to one ton of honey on a good year that they sell to a small clientele gradually built through family connections and relatives in Casablanca

Fig. 4. a) Quinoa plant; b) drying quinoa and c) seed cleaning process. Source: ©B Montanari 2016.

Fig. 5. Honey upgraded to a technical process. a) Traditional bee hive; b) modern hive; c) centrifuge; d) non refined honey. Source: ©B Montanari 2016.

and Rabat. They are able to able to earn a small income of approximate 4000 Dh per year (approx. 360 Euros).

Cactus (A6)

An important women's traditional ethnobotanical knowledge that is transferred to the development of a product is related to cactus (*Opuntia ficus-indica*). Cactus, commonly known as Barbary fig is extensively cultivated in the province of Rhamna, both for personal consumption and care, for feeding animals and for commercial pursuits. The cactus fruit are extensively consumed not only in the region but throughout the country, as a source of fibre, vitamin C, radical scavenging[1] and also for its laxative properties, among many others (Fernández-López, Almela, Obón, & Castella, 2010; Jana, 2012; Shetty, Rana, & Pretham, 2012). In rural Morocco, the women traditionally use the dried cactus flowers to prepare tea for relieving gastrointestinal and sleeping disorders. Typically, the flowers are left to dry in a place free of dust and sunlight and small amounts are used for preparing herbal infusion. The flowers known for their anti-inflammatory properties, are also made into a jam in certain regions of the country. The young cactus leaves (rackets) are traditionally conditioned as a condiment that can be eaten either a side dish or on its own. Cooperative A6 proceeds to the transformation of cactus and its derivatives and replicates these culinary and ethnobotanical traditions. The women's main activities in this cooperative are the collection of the fruit and seeds and the young leaves (rackets) when in season. Because the fruit and young cactus leaves are prickly, the harvest is traditionally hand-picked. It involves a careful handling of the fruit and young leaves, usually picking from the upper part of the plant to ensure that only fresh flowers and tender leaves are collected. Once harvested, the fruit and the young leaves are deposited on a large table at the cooperative where women sit together to separate the best fruit and leaves for the next steps of technical conditioning. The cooperative has developed a range of cosmetic products (shampoo and shower gel with added cactus oil) for which the main processing is done with machines. The latest addition to the range of products however, is the reproduction of a traditional ethnobotanical knowledge into a food supplement. It uses the young leaves rendered into flour or a powder that can be taken for its anti-cholesterol and anti-diabetic properties (Bellakhdar, 1996; Sijelmassi, 1993). While the young rackets are collected traditionally by hand, the drying processes of the “new supplement product” are using ventilating machines (Fig. 6) to dry the leaves before rendering them into flour. This is a typical transfer of technology, i.e., the transfer of a traditional ethnobotanical knowledge to a commercial product sold for its therapeutic properties.

Regulatory issues around products involving women's traditional knowledge

Because of bio-piracy concerns, herbal products made from traditional ethnobotanical knowledge held by indigenous communities and for which active molecules are isolated by pharmaceutical companies (see for instance Jayawardane (2011) for the case of the *Hoodia gordonii* Cactus)[2] to develop allopathic medicine increasingly fall into the realm

[1] Radical scavengers are substances that acts as antioxidant and help protect cells from the damage caused by free radicals (https://www.britannica.com/science/radical-scavenger)

[2] Jayawardane N. 2011.The Hoodia Cactus (*Hoodia gordinii*) is a typical example of a technology transfer from an ethnobotanical remedy to a manufactured herbal product. Pharmaceutical companies isolated the active ingredients from the extract to synthesize them for use as an appétit suppressant for weight loss. https://doi.org/10.1080/15405702.2011.562102

Fig. 6. a) Cactus border with fruit; b) young leaves (rackets) used as cattle fodder; c) newly acquired drying shelves for new powdered food supplement; d) range of cactus products.
(Source: ©B Montanari 2016)

of international conventions and legislations (Liang, 2011). Thus, the herbal supplement product based on cactus for the development of an anti-cholesterol supplement is subject to article 8 (j) of the Convention on Biological Diversity (CBD) that states:

Each contracting Party shall, as far as possible and as appropriate: "*Subject to national legislation, respect, preserve and maintain knowledge, innovations and practices of indigenous and local communities embodying traditional lifestyles relevant for the conservation and sustainable use of biological diversity and promote their wider application with the approval and involvement of the holders of such knowledge, innovations and practices and encourage the* ***equitable sharing of the benefits*** *(emphasis added) arising from the utilization of such knowledge innovations and practices*".[3]

The production issued from the activities in the cooperatives described in this article do not match the scale of commoditised resources like Argan oil[4] for which the international market is currently predicted to be worth USD 676.51 million by the end of 2024 (Market Reseach Future, 2018), and for which cactus oil is set to follow. However, the above examples illustrate several regulatory issues around the use of women's traditional knowledge for the development of natural products. First of all, the Ministry of Agriculture has widely promoted the concept of "Territory Product"[5] (*Produit du terroir)* for products made locally; however, the notion of "territory product" is questionable as the traditional knowledge associated with the development of these products in the cooperatives is not acknowledged. As Ilbert and Petit (2009) have pointed out, a "Territory Product" (*Produit du terroir)* or other nomination of a product like Geographical Indicator (GI) for instance cannot be acknowledged without referring to the traditional knowledge associated with the cultural context; a product made according to *local know-how* is emblematic of the local culture. Most importantly, it raises the issue of access to benefit sharing (ABS) and benefits returning to the communities in a lucrative market.

While the application of the ABS legislation remains a complex process and individual countries apply it in different measures to fit their national agendas, the cores values of the CBD nonetheless apply to all, i.e. that the local people's knowledge be respected, that conservation and the sustainable use of resources of biological diversity be achieved and that socio-economic incentives fulfil the current CBD legislation. Although Morocco has ratified the Biosafety of the Convention on Biological Diversity,[6] has signed the CBD and according to the Access to Benefit Sharing Clearing House (ABSCH, 2017), has recently passed a pre-bill No. 56–17 for the access to genetic resources and equitable and fair sharing of benefits arising out of their use, it remains a non-party to the Nagoya Protocol and has yet to ratify the treaty on genetic resources or traditional knowledge.

It is useful to briefly compare Morocco to India here as India illustrates well the application of ABS. The country signed the CBD in 1992 and ratified it in 1994, signed and ratified the Nagoya Protocol in 2001 and enacted the Biological Diversity Act (BDA) in 2003. It also enacted the Geographical Indications of Goods (Registration and Protection) in 1999 and amended the 1970 Indian Patents Act in 1974, 1985, 1999, 2002, 2005 in compliance with various international agreements,

[3] https://www.cbd.int/traditional
[4] https://www.marketresearchfuture.com/reports/argan-oil-market-3752
[5] *http://www.agriculture.gov.ma/pages/acces-fillieres/produits-du-terroir*

[6] The *Cartagena Protocol on Biosafety to the Convention on Biological Diversity* is an international agreement which aims to ensure the safe handling, transport and use of living modified organisms (LMOs) resulting from modern biotechnology that may have adverse effects on biological diversity, taking also into account risks to human health. It was adopted on 29 January 2000 and entered into force on 11 September 2003. https://bch.cbd.int/protocol/

considering the country's own needs. The issues related to Intellectual Property Rights (IPR) and the procedures for transferring accessed biological resource and associated knowledge to third parties for research and commercial utilisation have also been included.

India is the first country in the world to have granted over 1500 ABS applications since the ratification of the CBD (Arkalgud, 2017). The country has enacted several measures and mechanisms to ensure that access to biological resources and equitable sharing of benefits arising out of the use of biological resources be implemented, and that the associated knowledge relating to biological resources be regulated in the respect and protection of the local communities' knowledge and biodiversity (Kumar, Singh, & Shilpa Gautam, 2017). As a result, by-products are shared with the knowledge holders whether on a small individual level or bigger scale of natural resource development/production, and the information related to the traditional use of the biological resources, the innovations and practices associated with the uses and application of the resources are acknowledged (Pisupati, 2015). Most importantly, the country has set forth a vision that by 2020 all traditional knowledge, innovations and practices of indigenous and local communities relevant for the conservation and sustainable use of biodiversity and their customary use of biological resources, be respected and fully integrated, reflected and implemented in the CBD with full and effective participation of indigenous and local communities, at all relevant levels (Arkalgud, 2017).

In Morocco and the rest of the Maghreb, organisations like the German development cooperation (GIZ)[7] are increasing pressure on the government to implement some legislation that promulgate the access to benefit sharing (ABS) for the utilisation of genetic resources; this would imply that the traditional knowledge associated with the transformation of natural resources into commercial product be recognized.

Conclusion

This study has shown that women's traditional knowledge activities applied in the cooperatives (seed collecting, cleaning, sorting, couscous and honey making, cactus collection and processing) permit the knowledge transfer towards product development and are key to the production process itself. Without the different processes pertaining to this knowledge, however insignificant they may seem to the cooperatives' managers or outsiders, the quality of the products would not be possible to attain. For instance, in the case of cooperative A1, without the preliminary stage of careful picking and handling at the appropriate time and the keen eye to remove all dust and particles in the final stages of cleaning the seeds by hand using traditional baskets, the final product would be gritty, rough and compromised, and unsuitable to satisfy customers' desires. Similarly, the final couscous product would not be suitable for sale without the traditional culinary knowledge of knowing when to add water, the precise hand movement that uses either the fingers of the palm of the hand to form the couscous grains, and the final refining to ensure that the calibre and texture contribute to the quality of the finished product. On the other hand, while the honey currently produced with a centrifuge requires further refining, the precise traditional knowledge of collection, and the discernment of knowing whether the quality of the honey is suitable or not would not be possible without the knowledge passed on through generations. As for the cactus products, without the knowledge of knowing the appropriate time to pick the flowers and rackets in a suitable manner that does not damage the leaves, and the other empirical ethnobotanical knowledge, rendering the powdered leaves into a therapeutic remedy for relieving anti-cholesterol and anti-diabetic conditions would not be possible.

Recognising the women's traditional knowledge in the different stages of production would reverse the current invisibility of women and promote their status within the cooperative management, perhaps even enabling them to demand better wages and more decent working conditions. This would counterbalance the current visibility of women (and men) involved in the administrative bureau who benefit from exposure and recognition, e.g. by exhibiting the products at trade fairs. Applying some ABS mechanisms would help to ensure this recognition and change the current reality in which women's labour is cheap and unprotected.

As the application of ABS in Morocco is currently closely scrutinised by the authorities, recognising that technical means cannot substitute the applied traditional knowledge that contributes to the finished products is vital. Given the exponential growth of cooperatives that develop natural products in the country, implementing some ABS mechanisms would truly contribute to the socio-economic development of rural women in the isolated parts of the country.

The question of ABS implementation in this context is an area of study which has yet to be explored more fully. For example, ABS mechanisms (or other compensation mechanisms that the government needs to establish) in theory should encourage conservation initiatives. This implies that cooperatives set forth some conservation strategies and initiatives, and develop the women's awareness of the ecological and conservation aspects of the resources they are using. It also implies that the concept of ABS would be fully integrated in the priorities of the cooperatives and their management. At present, this seems a remote possibility as rural women are only starting to emerge into a realm of “emancipation” in a patriarchal society. Regardless of a present or future application of ABS legislation, women's traditional knowledge in the development of products within the IGAs of the Green Morocco Plan matters, and the perpetuation of traditional knowledge transmission to future generations is vital for the survival of rural communities.

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Declaration of competing interest

None.

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[7] http://www.abs-initiative.info/fr/countries-and-regions/africa/algeria/abs-workshop-mena-region/

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