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# The Eruption of Technology in Traditional Medicine: How Social Media Guides the Sale of Natural Plant Products in the Sonoran Desert Region<sup>1</sup>

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Because the adoption of technology into traditional systems has unknown effects, we examined the hypothesis that social media aids shopkeeper selection of herbs or herbal preparations that the public is exposed to. Medicinal plant shopkeepers in southern Sonora, Mexico, were interviewed about their customer base and marketing strategy. The majority, 85%, of their customers had low to middle incomes as ranked by the shopkeepers, of which seven of seventeen incorporate social media marketing into their marketing strategy. Shopkeepers preferentially selected herbal preparations over loose herbs for online marketing. The results indicate that the incorporation of social media marketing aids a shift from herbs to herbal preparations in Sonoran traditional medicine markets. In short, social media use may act as a conditioning factor used by shopkeepers to promote herbal preparations and, in doing so, may provide a critical tool for the long-term survival of traditional plant markets, but at the risk of also contributing to the loss of the culture of home remedies and traditional domestic preparation of natural products.

Porque la adquisición de tecnologías modernas en sistemas tradicionales tiene efectos desconocidos, examinamos la hipótesis que las redes sociales asisten a la población en la selección de vendedores o marchantes de hierbas y preparaciones de hierbas. Los marchantes de plantas medicinales en el sur de Sonora, México, fueron entrevistados acerca de su base de clientes y su estrategia de mercadotecnia. La mayoría, 85%, de los clientes fueron identificados como de ingreso bajo a medio por los propios marchantes, de la cuales siete de diecisiete incorporan redes sociales por medio del Internet en su estrategia de mercadotecnia. Los marchantes entrevistados seleccionaron preferencialmente preparaciones de hierbas más que hierbas sueltas para sus ventas en línea. Los resultados indican que la incorporación de redes sociales para apoyar las ventas impulsa un cambio de hierbas a preparaciones de hierbas en mercados de medicina tradicional en Sonora. En resumen, el uso de redes sociales puede funcionar como un factor condicionante usado por los marchantes para promover preparaciones de hierbas, y, al hacerlo, puede proveer una herramienta crítica para la sobrevivencia de los mercados de plantas tradicionales en el largo plazo, pero al riesgo de también contribuir a la pérdida de una cultura de remedios de hogar y de preparación tradicional domiciliar de productos naturales.

**Key Words:** Ethnobotany, selection, medicinal plants, social media, marketing, Sonora..

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## Introduction

The harvest and sale of medicinal plants is a core part of the traditions and healthcare of many people. “For many millions of people, herbal medicines, traditional treatments, and traditional practitioners

are the main source of healthcare, and sometimes the only source of care” (WHO 2002). Medicinal plant vendors are a predominant source of wild-crafted herbal medicines for traditional healers and those who prepare traditional remedies in their own homes. These medicinal plant markets have a particularly robust presence in Mexico, where the culture of traditional medicine use is strong and there is a high market demand from people seeking traditional remedies and treatments (Euromonitor International 2014; Smith 2003).

For centuries, Mexico has enjoyed a rich plaza culture where people congregate in a common area, such as a central plaza market, which creates a sense of community and provides strong networks for the distribution of locally produced food and other goods, including wild-crafted medicinal plant materials gathered from local and territorial regions near the market (Guillaumin 2010; Long Towell and Lecón 2010; Luquín 2005; Sánchez 2010; Sistema de Información Cultural 2009). While doing initial fieldwork in southern Sonora, we noted a developing trend in the use of social media networks for marketing purposes by medicinal plant shopkeepers. The use of social media marketing creates a second storefront for these vendors to supply home practitioners with products. Online social networks and smart phones offer business owners an enormous potential for engaging customers, which was not possible even a few years ago. Since Facebook introduced its Spanish language version in 2008, it has dominated the social media landscape in Mexico (eMarketer 2012) and, by doing so, is bringing the plaza culture online.

The proliferation of low-cost Internet access has opened up opportunities for businesses to deal directly with individual customers and with a larger customer base in a way that was previously unimaginable. Social media marketing is considered a hybrid aggregate of the promotional mix of advertising, the Internet, direct marketing, and e-commerce (Mangold and Faulds 2009). Compared to traditional media, which uses one-way company-to-consumer marketing messages such as advertisements, social media is interactive, allowing customers to talk to businesses and to each other. While there are no generally accepted classifications of social media, they are considered to be those “activities, practices, and behaviors among communities of people who gather online to share

information, knowledge, and opinions using conversational media” (Safko and Brake 2009). Probably the best known social media are *social networks* such as Facebook. A site like Facebook.com allows one person to communicate with hundreds, even thousands of people about his or her products. Today it is recognized that “a sound social media strategy combines engagement through social networks like Facebook with building social capabilities into a brand’s own sites” (Foux 2010). This move to use social media provides Mexican shop owners with a low-cost way to incorporate online tools to help sell their traditional medicinal plants. By creating and cultivating an online community of customers, traditional plant vendors can develop trust that leads to more sales. When social media is used to market ancestral medicinal plants, these products become available for sale to a larger customer base than ever before.

Vendors and customers have traded online since the inception of ARPANET, a precursor to the Internet. Some of these trades involved marijuana (*Cannabis sativa* L.) exchanged between students in Silicon Valley who had access to such networks (Walsh 2011). Later, people started purchasing psychoactive plants such as *Salvia divinorum* Epling & Játiva and plants used for *ayahuasca*, namely *Banisteriopsis caapi* (Spruce ex Griseb.) Morton and *Psychotria viridis* Ruiz & Pav. from online companies (Walsh 2011). As Internet penetration increases (Internet World Stats 2015; Pew Research Center 2015), we find traditional herbalists moving online. This brings up many questions about the future of marketing herbs online around the world. Bussmann has found that confusion between species in local physical markets can pose serious risks to customers, especially pregnant women. His team identifies the need for vendor education and deeper studies on the supply chain of herbs in local and potential online markets (Bussmann et al. 2013; Bussmann et al. 2015). In addition to human health, the health of a species’ habitat may be affected as vendors reach out to wider markets. Lee found that local market demand may decrease the ecological health of popular species in Southwest China (Lee et al. 2008). Yet at the same time, Monteiro asserts that healthy, prosperous physical markets can keep the persistence and prevalence of traditional knowledge systems active in markets of Brazil (Monteiro et al. 2010). There are scores of questions regarding habitat, harvest,

sale, and traditional knowledge preservation that can and should be studied as traditional herb vendors move online.

This move to online sales illustrates the union of modern technology with the time-honored use of medicinal plant resources from the natural environment. The interplay between human and natural systems, known as social-ecological systems, evolves through multiple factors (Folke 2006; Vervoort et al. 2014). On one hand, it has been proposed that the assumption that western technology can help or save a culture is insulting and detrimental (Escobar 2011; López 2012); on the other hand, some traditional practitioners seek to preserve their ancestral practices and knowledge using modern technology such as websites and social media (Cowan et al. 2012; Owiny et al. 2014). Still others suggest that rather than stagnating in tradition or assimilating in modern society, many traditional practitioners have a dynamic approach where they mix old and new ways (Berkes 2012). Despite various ideas on the best way to respect, preserve, and value traditional practices, the understanding of this interplay between traditional and technological societies remains unclear.

One important factor that may contribute to the shift in the current dynamics between local tradition and technology is the recent adoption of social media marketing by herbal medicine vendors. Around the world, 15% of mobile device users seek health and medical advice online, in addition to speaking with a health practitioner (Pew Research Center 2014). Consumers are tapping into a new source of health information by going online, suggesting that the mixing of tradition and technology may have a profound effect on both the marketing of herbal medicines and the product availability of those medicines.

The present study was designed to test the general hypothesis that social media aids herbal product placement and that availability to consumers varies between the physical and online storefronts. For this study, we interviewed medicinal plant vendors in the cradle of the Green Revolution in southern Sonora, Mexico, where the intermixing of tradition and technology is particularly strong. To observe the placement of products, we measured both the physical and cyber shelf space given to herbs and herbal preparations. This

approach enabled a direct assessment of the effect of new marketing strategies on shelf space and availability of local medicinal herbs and herbal preparations.

## Materials and Methods

### LOCATION AND STUDY SITE

In and around Mexican municipal markets, medicinal plant vendors are found alongside vendors of staple food items (like meat, produce, and grains) and alongside artisanal craft and clothing vendors. The municipal markets in southern Sonora (Fig. 1) are illustrative of Mexico's centuries-old plaza culture where people come together to buy and sell, and this includes medicinal plants (Guillaumin 2010; Long Towell and Lecón 2010; Luquín 2005; Sánchez 2010; Sistema de Información Cultural 2009). The government constructs these markets in city centers to house small shops, and numerous stores open for business all around them (Long Towell and Lecón 2010; Luquín 2005; Sistema de Información Cultural 2009). Markets in the cities of Ciudad Obregón, Navojoa, and Hermosillo offer ideal research sites as they provide access to investigate the flow of wild plants from the natural environment to consumers, as well as the circumstances of this interchange.

The habitats supplying these markets are dominated by Sonoran Desert communities, thorny tropical deciduous forests, and scrub (Arizona Desert Museum 2014; Yetman et al. 1995). These areas have an arid climate from Hermosillo southwards to Ciudad Obregón, gradually transitioning southeast of Navojoa into a semi-arid one (INEGI 2010a). The mean annual rainfall is 390 mm in Navojoa, 299 mm in Ciudad Obregón, and between 200 and 300 mm in Hermosillo with the heaviest rains occurring in late summer in all areas (Ayuntamiento de Cajeme 2010; Ayuntamiento de Hermosillo 2010; Ayuntamiento de Navojoa 2010).

Vendor shops are usually stands (about 25 m<sup>2</sup>) within large, covered municipal buildings, although sometimes larger one-room stores are located nearby (Fig. 2). The herbal products are typically displayed as loose herbs piled in open containers, placed in clear containers with lids, or packed in clear plastic bags. Herbal preparations are



**Fig. 1.** Map showing the study site locations in relation to Mexico and the state of Sonora. The enlarged region shows cities surveyed for medicinal plant shops (GIS data from CONABIO 2010).

typically placed in bags, bottles, or plastic jars and displayed on a shelf or in small boxes (Fig. 3).

We selected three study sites based on the presence of medicinal plant vendors in the markets. Ciudad Obregón is the principal city in the Municipality of Cajeme, which has ca. 410,000 inhabitants (INEGI 2010b). This city lies in the Yaqui Valley where it grew during the agricultural development of the Green Revolution (Hewitt de Alcántara 1973). Navojoa is the principal city in the Municipality of Navojoa, which has some 158,000 inhabitants (INEGI 2010b). The city of Navojoa is surrounded by agricultural fields cleared out of the original thornscrub (Yetman et al. 1995). Hermosillo is the principal city in the Municipality of Hermosillo, which has around 785,000 inhabitants (INEGI 2010b). The city is

surrounded by Sonoran Desert scrub, and the main agricultural activities are ranching and some cultivated field crops in irrigated areas (Encyclopaedia Britannica 2014).

#### INFORMANT INTERVIEWS

Medicinal plant shopkeepers were asked to participate in a plant products survey. The shopkeepers were asked questions verbally in Spanish, which is the dominant language in the markets, and answers were written down by the investigator. All interviews and surveys used in the present study were approved by the University of California Riverside Human Research Review Board (Protocol Number HS-14-103) and followed the International



**Fig. 2.** Representative photographs of the medicinal plant shops typical in the study area with (A) side view and (B) front view.



**Fig. 3.** Representative samples of herbs and herbal preparations from medicinal plant shops in the study region. (A) Herbs, (B) herbal preparations.

Society for Ethnobiology Code of Ethics for the facilitation of ethical conduct and equitable relationships (International Society of Ethnobiology 2006). The Spanish and English versions are available as Appendix 1—Electronic Supplementary Material, *ESM*.

#### SAMPLING

In this study, three central markets were sampled in the southern region of Sonora: Navojoa, Ciudad Obregón, and Hermosillo. Within each city, interviews were conducted at markets where local people use, exchange, and sell locally sourced medicinal plants. Shopkeeper informants participated and provided information on a voluntary basis. Surveys were conducted among nine female and eight male shopkeepers selected on the basis of the prevalence of medicinal herbs or herbal products on display. All shops in and around central municipal markets participated with the exception of one vendor in Ciudad Obregón. Surveys were attempted in both Etchojoa and Álamos, but there were no stands or shops selling herbal medicines in these towns.

#### SHOP COMPARISON

To compare the shelf space of physical and cyber storefronts, shelf product display areas were measured. The resulting display zones were normalized to total storefront area. As for online shelf spaces, product displays were considered as photos and product display quantities were normalized to the total number of product display photos. Interviewees were also asked about the socioeconomic level of their customer base (classified as Low, Middle, and High), and their responses were ranked.

#### DATA ANALYSIS

Product data were grouped into three storefront categories according to whether they were from (a) an online storefront, (b) physical storefront of a shop that also markets online, or (c) from a physical storefront of a shop that does not market online. Products also were classified into two categories: (i) bulk and (ii) prepared products. Our data analysis design was planned to test whether the proportion of prepared products compared to that of bulk-sale products was different in traditional stores that do not market online compared to those stores that use online marketing. Because our dependent variable,

the proportion of prepared products in each store, is a ratio of two counts, we first used a Generalized Linear Model for proportions (also known as a logit model for binomial data). The residuals in the models were tested for over-dispersion, and the model parameters were corrected if necessary using “quasi-binomial” modeling (R Core team 2015). The significance of the differences between the three types of stores was calculated by means of a *t*-test on the model’s parameters (in order to further confirm our results, we also calculated the proportion of processed products offered in each different storefront as a simple continuous variate, and tested these proportions across the different types of stores using one-way ANOVA, with similar results to the more complex logit model).

For the analysis of customers ranked into socioeconomic groups, we first counted the number of stores that declared receiving customers from (a) low-income social groups, (b) middle-class customers, and (c) high-income customers. We then compared the proportion of stores that declared receiving customers from each social group relative to the total number of stores, also using a logit model. If, overall, the proportions differed significantly, we calculated for each group its binomial mean and standard error, and compared each social group against the others using a *t*-test. All statistical analyses were scripted and run in the R programming language (R Core Team 2015). Both original data and computer code are available from the authors.

## Results

We encountered 11 medicinal plant shops in Ciudad Obregón, 4 in Navojoa, and 3 in Hermosillo, 17 of which agreed to participate, with one in Ciudad Obregón declining. Shops generally consisted of stands set up in a larger municipal marketplace. Of the 17 participating shops, 5 were outside the municipal marketplace on nearby streets. Seven of the 17 shops incorporated social media marketing into their marketing mix, 6 used Facebook pages, and 1 used a blog. Figure 4 demonstrates a representative image of products marketed online with informant information blurred out. All of the businesses rely on local suppliers, and these suppliers make biweekly rounds offering bulk material gathered from wild areas in the countryside. Correspondingly, shop owners resell bulk plant material as loose herbs, and/or

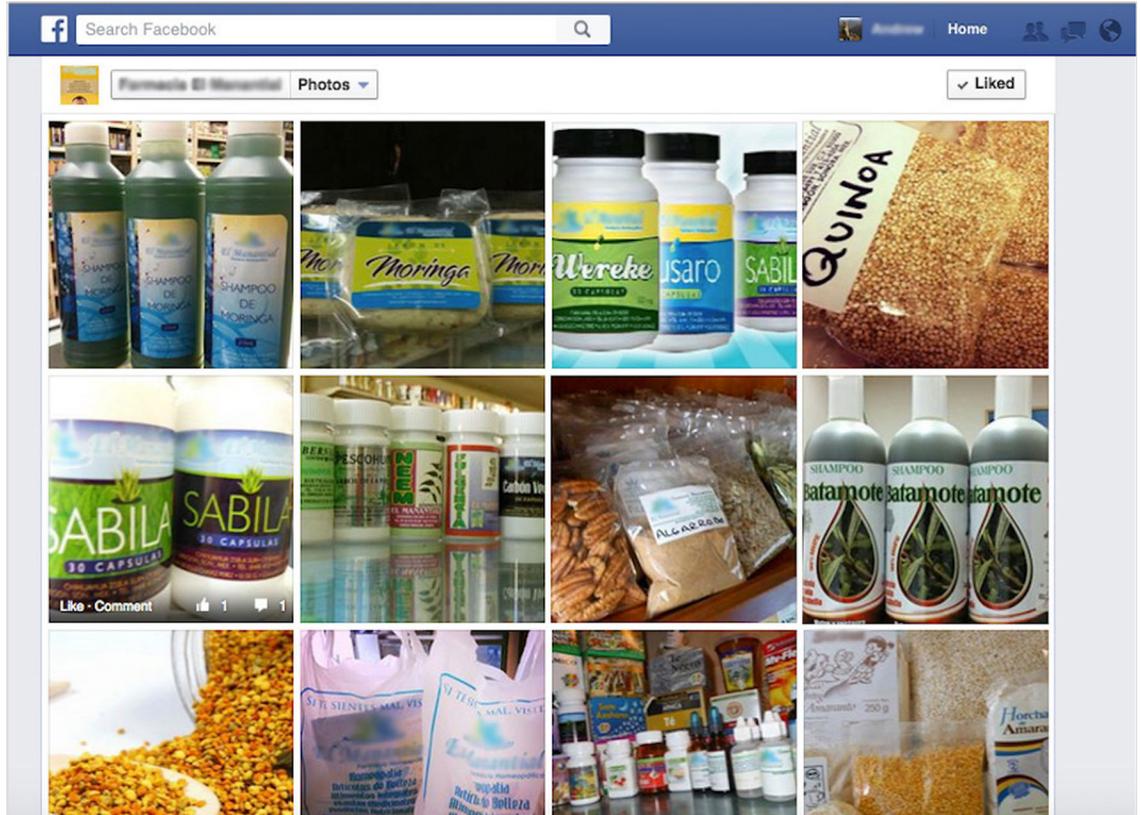


Fig. 4. Representative image of products marketed online using social media.

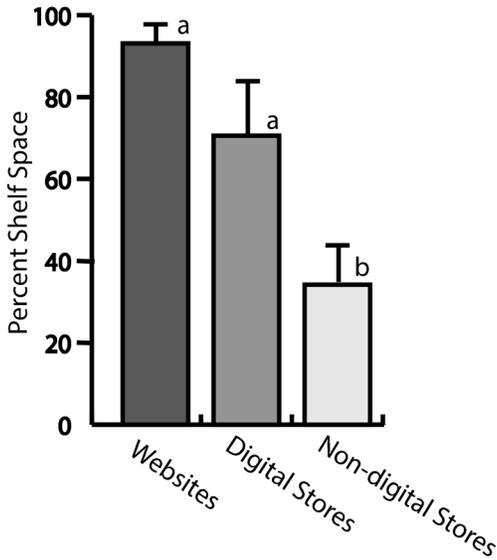
process it and sell their herbal preparations. They reported that the major customer base, 85% on average, is made up of low- to middle-income people who seek natural remedies to treat health ailments. All stores reported receiving low- and middle-income customers but only 42% of the stores reported receiving high-income customers. That is, higher-income customers were perceived as being significantly less frequent ( $t = 5.1$ ;  $p < 0.0001$ ).

Product sales can be influenced by promotion and marketing. Social media marketing brings information and products closer to the consumer (Bernhardt et al. 2012). To determine the potential influence of shopkeeper marketing strategies, we examined the relationship between Internet marketing and the product availability of herbs and herbal preparations. There was a marked and highly significant difference in the proportion of prepared and bulk products sold by the different shopkeepers, according to their type of store ( $X^2 =$

113.7, d.f. 2,  $p < 0.0001$ ). Online shelf space exhibited almost all herbal preparations, whereas shopkeepers who did not use Internet marketing filled their shelf space with mainly bulk herbs. This significant difference ( $t = 2.7$ ,  $p = 0.001$ ; Fig. 5) reveals a starkly different product availability via these two marketing methods. Further, physical storefronts of shopkeepers who also market online showed a trend to less herbal preparations compared to their own online storefronts and more bulk herbs, but the difference was not significant ( $t = 1.7$ ,  $p = 0.1$ ; Fig. 5). Taken together, these shifts in shelf space demonstrate a trend toward turning herbs into herbal preparations as shopkeepers move their marketing strategies online.

## Discussion

The present study offers two new findings. First, shopkeepers in southern Sonora who sell wild



**Fig. 5.** Proportion of shelf space occupied by herbal preparations as opposed to unprocessed natural products for Internet websites (Websites), storefronts in shops that also advertise using digital media (Digital Stores), and storefronts in shops that do not advertise in digital media (Non-digital Stores). While Internet sites market almost exclusively prepared products, in traditional market stores prepared products show a minority presentation. Different letters indicate significant ( $p < 0.05$ ) differences in the proportion of processed/unprocessed natural products according to Student's  $t$ -test. Bars labeled "a" differ significantly from bars labeled "b". The error intervals above each bar indicate  $\pm$  standard error (see text for statistical details).

medicinal plants are incorporating social media marketing into their marketing plans. Second, herbal preparations are preferentially marketed online, more so than bulk herbs.

Through social media marketing, individuals can promote their products using online social channels and tap into a much larger community of potential buyers. With more than one thousand million users (Facebook Newsroom 2014), Facebook is the largest social networking site in the world. A growing number of small businesses use Facebook to engage with, share deals, and seek feedback from consumers and fans. Mexican medicinal plant vendors in this study used social media, predominantly Facebook, to talk to their customers and advertise their products. Because Facebook relies on members adding friends, who add their friends to create a network of trusted allies, marketers have the

potential of reaching groups of consumers with similar interests. Humans are social by nature, and the conversational marketing that is such a striking feature of social media brings the plaza culture of Mexico to the online environment. So while the term "social media" might be relatively new, the experience is not (Wenger et al. 2009). Social media facilitates information sharing and knowledge distribution. With social media, information in the form of words, images, pictures, videos, and audio tracks is easily shared. David Meerman Scott (2013) said, "Social media differ from so-called mainstream media in that anyone can create, comment on, and add to social media content."

Mexico has a strong tradition of herbal and natural medicinal plant use. A large percentage of the population seeks herbal and traditional remedies (Euromonitor International 2014). Cost savings are an important reason for people to use traditional medicine, which is easily available and affordable in low-income countries (WHO 2002). Information supplied by the shop owners in this study also showed that low- to middle-income people make up their main customer base.

Our concern is that the affordability of wild plants combined with a broader marketing approach may lead to the over-harvesting of wild plants. Krigas et al. (2014) recently showed that endemic and endangered flora of Greece are marketed and sold online to a large multinational customer base. This may affect the survival of endemic flora promoted online. Additionally, the predominance of herbal preparations over bulk sale in Internet-marketed products leads to a narrowed assortment of options for Internet customers, who buy prepared products instead of preparing them at home using a much wider array of recipes, processes, and uses. In future work we aim to assess the risk of this selection of specific species of plants harvested within the region and marketed online.

## Conclusions

The sale of local traditional plants in city centers connects modern society with natural resources, and it also increases the awareness of traditional medicinal knowledge. While some purport the benefits, and some cite the harm of combining traditional and modern systems, our study finds that traditional plant markets are highly resilient and can survive in the middle of one of the most technologically intense agricultural areas of Latin America, evolving

and adapting to take advantage of digital media marketing strategies and social networks.

However, our study also shows that the offer and supply of traditional resources changes as shopkeepers move online, because digital media pushes human selection away from bulk sale of unprepared natural products onto herbal preparations. In short, social media use may act as a conditioning factor used by shopkeepers to promote herbal preparations, and in doing so may provide a critical tool for the long-term survival of traditional plant markets, but at the risk of also contributing to the loss of the culture of home remedies and traditional domestic preparation of natural products.

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### Literature Cited

- Arizona Desert Museum. 2014. The Sonoran Desert region and its subdivisions. <https://www.desertmuseum.org/desert/sonora.php> (5 August 2014).
- Ayuntamiento de Cajeme. 2010. Enciclopedia de los Municipios y Delegaciones de México—Cajeme. <http://www.inafed.gob.mx/work/enciclopedia/EMM26sonora/municipios/26018a.html> (25 November, 2014).
- Ayuntamiento de Hermosillo. 2010. Enciclopedia de los Municipios y Delegaciones de México—Hermosillo. <http://www.inafed.gob.mx/work/enciclopedia/EMM26sonora/index.html> (25 November 2014).
- Ayuntamiento de Navojoa. 2010. Enciclopedia de los Municipios y Delegaciones de México—Navojoa. <http://www.inafed.gob.mx/work/enciclopedia/EMM26sonora/index.html> (25 November 2014).
- Berkes, F. 2012. *Sacred ecology*. New York: Taylor & Francis.
- Bernhardt, J. M., D. Mays, and A. K. Hall. 2012. Social marketing at the right place and right time with new media. *Journal of Social Marketing* 2(2):130–137.
- Bussmann, R. W., N. Y. Paniagua–Zambrana, and A. L. M. Huanca. 2015. Dangerous confusion—“cola de caballo”—horsetail, in the markets of La Paz, Bolivia. *Economic Botany* 69(1):89–93.
- , N. Paniagua–Zambrana, M. Rivas Chamorro, N. Molina Moreira, M. Cuadros Negri, and J. Olivera. 2013. Peril in the market—classification and dosage of species used as anti-diabetics in Lima, Peru. *Journal of Ethnobiology and Ethnomedicine* 9(37).
- CONABIO. 2010. Portal de geoinformación. <http://www.conabio.gob.mx/informacion/gis> (10 December 2014).
- Cowan, D., F. McGarry, H. Moran, D. McCarthy, and C. King. 2012. Dreamcatcher: IT to support indigenous people. *IT Professional* 14(4): 0039–0047.
- eMarketer. 2012. Facebook dominates social media in Mexico. <http://www.emarketer.com/Article/Facebook-Dominates-Social-Media-Mexico/1009255> (20 May 2013).
- Encyclopaedia Britannica. 2014. Hermosillo. <http://global.britannica.com/EBchecked/topic/263335/Hermosillo> (14 November 2014).
- Escobar, A. 2011. *Encountering development: The making and unmaking of the third world*. Princeton, New Jersey: Princeton University Press.
- Euromonitor International. 2014. *Herbal/traditional products in Mexico*. London: Euromonitor Country Reports.
- Facebook Newsroom. 2014. <http://newsroom.fb.com/company-info/> (1 October 2014).
- Folke, C. 2006. Resilience: The emergence of a perspective for social–ecological systems analyses. *Global Environmental Change* 16(3):253–267.
- Foux, G. 2010. Integrating social into your business. *Journal of Direct, Data and Digital Marketing Practice* 12(2):128–136.
- Guillaumin, M. D. 2010. Un breve comentario sobre la historia de los tianguis y los mercados de México. <http://www.historiacocina.com/paises/articulos/mexico/tianguis.htm> (6 November 2014).
- Hewitt de Alcántara, C. 1973. The ‘Green Revolution’ as history: A Mexican experience. *Development and Change* 5(2):25–44.
- INEGI (Instituto Nacional de Estadística y Geografía). 2010a. *Información por entidad:*

- Clima. <http://cuentame.inegi.org.mx/monografias/informacion/son/territorio/clima.aspx?tema=me&ce=26> (10 September 2014).
- . 2010b. Censo de Población. <http://www3.inegi.org.mx/sistemas/mexicocifras/default.aspx?src=487&ce=26> (15 November 2014).
- International Society of Ethnobiology. 2006. International Society of Ethnobiology Code of Ethics (with 2008 additions). <http://ethnobiology.net/code-of-ethics> (1 February 2012).
- Internet World Stats. 2015. World Internet users and population statistics. Miniwatts Marketing Group. <http://www.internetworldstats.com/stats.htm> (22 October 2015).
- Krigas, N., V. Menteli, and D. Vokou. 2014. The electronic trade in Greek endemic plants: Biodiversity, commercial and legal aspects. *Economic Botany* 68(1):85–95.
- Lee, S., C. Xiao, and S. Pei, 2008. Ethnobotanical survey of medicinal plants at periodic markets of Honghe Prefecture in Yunnan Province, SW China. *Journal of Ethnopharmacology* 117(2): 362–377.
- Long Towell, J. and A. A. Lecón. 2010. Caminos y mercados de México. Mexico City: Universidad Nacional Autónoma de México Instituto Nacional de Antropología e Historia.
- López, A. 2012. The media ecosystem: What ecology can teach us about responsible media practice. Berkeley, California: North Atlantic Books.
- Luquín, L. H. 2005. Origen y evolución de los mercados públicos en la zona metropolitana de Guadalajara.  *Mercados Municipales en Guadalajara – 1era parte*. Guadalajara, Mexico: Instituto Tecnológico y de Estudios Superiores de Occidente. [http://www.mktglobal.iteso.mx/index.php?option=com\\_content&view=article&id=310&Itemid=121](http://www.mktglobal.iteso.mx/index.php?option=com_content&view=article&id=310&Itemid=121) (24 September 2014).
- Mangold, W. G. and D. J. Faulds. 2009. Social media: The new hybrid element of the promotion mix. *Business Horizons* 52(4):357–365.
- Monteiro, J. M., E. de Lima Araújo, E. L. C. Amorim, and U. P. de Albuquerque. 2010. Local markets and medicinal plant commerce: A review with emphasis on Brazil. *Economic Botany* 64(4):352–366.
- Owiny, S. A., K. Mehta, and A. N. Maretzki. 2014. The use of social media technologies to create, preserve, and disseminate indigenous knowledge and skills to communities in East Africa. *International Journal of Communication* 8:14.
- Pew Research Center. 2014. Emerging nations embrace Internet, mobile technology: Cell phones nearly ubiquitous in many countries. <http://www.pewglobal.org/2014/02/13/emerging-nations-embrace-internet-mobile-technology> (20 May 2014).
- . 2015. Internet use over time. *Data Trends*. <http://www.pewinternet.org/data-trend/internet-use/internet-use-over-time/> (22 October 2015).
- R Core Team. 2015. R: A language and environment for statistical computing. Vienna: R Foundation for Statistical Computing. (available at <https://www.R-project.org>)
- Safko, L. and Brake. 2009. *The social media bible*. Hoboken, New Jersey: John Wiley and Sons.
- Sánchez, V., 2010. Mercados Mexicanos, síntesis y germen de cultura. <http://www.inah.gob.mx/index.php/especiales/34-mercados-mexicanos-sintesis-y-germen-de-cultura> (11 November 2010).
- Scott, D. M. 2013. *The new rules of marketing & PR: How to use social media, online video, mobile applications, blogs, news releases, and viral marketing to reach buyers directly*. Hoboken, New Jersey: John Wiley & Sons.
- Sistema de Información Cultural. 2009. Historia de los mercados en México. [http://sic.conaculta.gob.mx/ficha.php?table=gastronomia&table\\_id=106](http://sic.conaculta.gob.mx/ficha.php?table=gastronomia&table_id=106) (5 November 2014).
- Smith, A. 2003. Mexican cultural profile. <http://ethnomed.org/culture/hispanic-latino/mexican-cultural-profile> (1 November 2014).
- Vervoort, J., M. Hoogstra, K. Kok, R. van Lammeren, A. Bregt, and R. Janssen. 2014. Visualizing stakeholder perspectives for reflection and dialogue on scale dynamics in social-ecological systems. *Human Ecology Review* 20(2):157.
- Walsh, C. 2011. Drugs, the Internet and change. *Journal of psychoactive drugs* 43(1):55–63.
- Wenger, E., N. White, and J. D. Smith. 2009. *Digital habitats: Stewarding technology for communities*. Portland, Oregon: CPsquare.
- WHO (World Health Organization). 2002. WHO traditional medicine strategy 2002–2005. Geneva: World Health Organization.
- Yetman, D., T. R. Van Devender, P. Jenkins, and M. Fishbein. 1995. The Río Mayo: A history of studies. *Journal of the Southwest* 37(2):294–345.