

Truffles – I: An Unexploited Treasure in Pakistan – Issues and Options

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May 2011

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Motivation

Natural Resource Division of PARC has taken a special initiative during 2011 while assigning priority for research and development of natural products in the mountainous region and Spate irrigation areas. Ranging from understanding the global and domestic markets into which new products will be sold to determine which one has more commercial potential. The initial motivation was provided by a popular article published by the Spate Irrigation Network entitled “Truffle Mushrooms in Spate Areas” by Mr. Karim Nawaz, while working in D. G. Khan. He is the pioneer in presenting information about the occurrence of truffles³ in D. G. Khan. This was the major motivation to initiate an in-depth analysis of the potential of truffles in the country, as a whole.

Truffles are highly priced natural product in the international market. It is a global delicacy but an unexploited potential in Pakistan. Although, few people exploited the niche market but still it's a most valuable treasure lying unexposed in the lands of Pakistan. After having introduction of truffles, scientists in NRD were motivated to conduct a study using secondary and primary sources of information. The current study is the beginning and it is a preliminary study pointing towards the unharnessed potential of truffles in Pakistan. Moreover, the purpose of this study is to make scientists aware of truffles and its occurrence in Pakistan; it will also help in exploring refined facts from different areas. This study has largely focused on the issues that have hindered research and to document potential options that can make it a success in Pakistan. Following this Research Briefings, a companion Research Briefings will be released focusing on the “Methods for Cultivation of Truffles”. Besides, in future another study will be conducted on other species of natural mushrooms like “Morels” which is also a high value and promising species of natural mushrooms and unlike truffles it also have a commercial market value in Pakistan and it has wider prospects within the country. The dried morels are being sold by rural farmers in Murree Hills at a price of Rs. 12,800/kg to the enterprises dealing with export.

1. Background Information

1.1. Truffles in the West

Truffles are hypogeous (underground) version of mushrooms. They don't form a prominent stem and their spore-bearing surfaces are enclosed. They rely on animals eating them (mycophagy) to distribute their spores, instead of air currents like mushrooms. Truffles resemble small potatoes, and often between the size of a marble and a golf ball. There are hundreds of different kinds of truffles, while few are known to be poisonous and only a few are considered as delicacies (Oregon Garden Rediscovery Forest and Oregon Forest Resources Institute 2005).

³Truffle is a fungi fruiting body that develops underground. There are hundreds of species of truffles and some are highly priced as a food in the international market.

Truffles grow in conjunction with the roots of higher plants. Many of these are mycorrhizal⁴. Mycorrhizal mushrooms are the hardest to grow commercially, because the needs of both the fungus and the host plant must be met in order to produce a commercial crop. Also, the host plant typically must reach a certain physiological maturity before the fungus will fruit. When the host is a tree, this maturation may be measured in decades. Nevertheless, highly prized morels and truffles are mycorrhizal, and they are now being grown commercially in many countries (NCAT 2004).

Truffles belong to the order of Pezizales, widespread filamentous ascomycetes which also include species with exposed (epigeous) fruit bodies, such as the morels. The highest prized truffles belong to the genus *Tuber*, for example the white truffle, *Tuber magnatum*, and the black *Tuber*, *melanosporum* (University of Parma Italy 2000).

Truffle hunting in the desert requires substantial ecological knowledge, as truffles occur sporadically and only with adequate and properly distributed rainfall as well as the presence of necessary soil conditions and mycorrhizal hosts. Truffles are hunted by looking at cracks or humps in the soil caused by expansion of the truffles, which are then extracted with digging sticks (Trappe *et. al.* 2008).

Truffles of various kinds are found throughout Europe, Asia, America, Australia and Africa. Truffles are harvested in winter, using trained dogs and pigs. Handlers carefully dig out the truffle, which can be as much as 30 cm below the surface (Southern Woods Info Sheet 2010).

1.2. Natural Habitats of Truffles in the West

In order to complete the life cycle, truffles must enter into symbioses with the roots of trees, such as the oak, poplar and willow, via specialized nutrient-gathering organs known as mycorrhizae with dense foliage. Truffles are fungus and “ectomycorrhizal” and are found in association with plant roots, and have a symbiotic relationship with the trees they grow under. Truffles prefer oaks, beech, hazels or poplars, and like sunny, moist alkaline soils. It takes 5-8 years to start fruiting (Woodlands Company UK 2008).

1.3. Review of Truffle Prices in the West

Price of truffle mushrooms varies from region to region and species to species, thus there is wide range of prices for different species. Temporal variation in the availability of truffles also affects the price in the market. Truffles in the natural system are commonly having a seasonality character. High price of truffles is due to unpredictable growth habits. Retail prices typically range from hundreds to thousands of dollars per Kg. The common range of truffle price is between \$ 5000 to 6000 per kg. The huge variation in truffle prices in different countries and for different species is difficult to justify and same is depicted as under:

- ➔ In Italy, the price of white truffles (*Tuber Magnatum*) during the year 2010 was US\$ 250,000/kg (Anakin 2010). According to the National Geographic News, the price of white truffles in Italy was US\$ 2600-5000/kg during 2005.
- ➔ In Miami USA, the price of White truffles was US\$ 13500-22500/kg in the year 2008 depending upon the quality (CNN News 2008).

⁴ *Mycorrhizae is a symbiotic (mutually beneficial) association between some kinds of fungi and plants.*

- Ministry of Agriculture in France reported that in 2006-07, the production of French black truffles was around 13 tons and average prices ranged from US\$ 900 to 1000/kg. The price of black truffles is much less than white truffles.
- Australian industry members, during a visit to France, observed wholesale prices in the range of Euros 800 to 1500 per kg (approximately AU\$ 1350 to 2500 per kg) and confirmed that French growers expect that the price to remain on the higher side, for at least a decade while supply is low and demand is high (Lee 2008).
- The major export market opportunities for Australia include Europe, Asia and North America due to the counter-seasonal supply advantage. However, prices for Australian exported truffles from the Hazel Hill truffière have been reported as achieving wholesale prices of US\$ 1,500-3,000 per kg (Malajczuk and Amaranthus 2007).
- In USA during 2006, prices of summer truffles were US\$ 825 per kg and Fresh Perigord Truffles was US\$ 4,752 per kg. These are retail prices, and include 100% tariff on imported truffles imposed by the US Government (Marky 2006).

2. Prospects of Truffles in Pakistan

Truffles in Pakistan are mostly found in the spate irrigated areas of Pakistan (D. I. Khan, D.G. Khan, Barkhan, Musa Khel, Thana Bula Khan). **Farmers are of the opinion that rain water on desert lands, fallow lands, and fields free from pesticides and fertilizer provide the best medium for the growth of wild mushrooms in the country (Figure 1).** Spate water is equally good. Spate irrigation fields and adjacent sites, where floodwater has spread once, are particularly suitable for truffles. The Kachhi region (Balochistan) is considered among the best grounds for natural mushrooms in the country (The Pakistan Spate Irrigation Network 2011).

In Pakistan, some of the varieties (probably white) of truffles have been identified. These are mostly Spate irrigated areas (D. I. Khan, D. G. Khan, Thana Bula Khan, Barkhan), Naran and Kaghan, Murree hills, AJK, etc.

Some of these areas were visited by the NRD Survey Team, and some instances of underground mushrooms were found out. People at these places were interviewed to get information about the usage of natural mushrooms. The local names of natural mushrooms vary from place to place. In Ghora Gali of Murree Hills, local name is called Gandair. In D.I.Khan it is called Zami Zung but local people in Muree Hills are unaware of the value of truffles and domestic markets. People in Muree Hills prefer to eat natural mushrooms i.e. Morels. They eat morels in combination with meat, eggs, etc. Some people sell the morels in the nearby city. Some people at different places got some awareness about truffles being an expensive food in the foreign countries; people who are aware of its value are reluctant to share the information so they can get maximum benefit out of its sale. But those who tried to make it a business are facing difficulty for the identification of species, market identification, meeting export standards, shipment process, etc. It is not a success up till now as a business as there is lack of research on truffles. As far as local consumption is concerned usually people don't have any awareness of this mushroom being a food and due to its strange aroma they usually through it and/or unable to identify it. Throughout the world the reported host trees are mostly oak, pines and hazel nuts but as far as Pakistan case is concerned truffles are found mostly in the crop fields (i.e. sorghum and millets in D. I. Khan, D. G. Khan and other Spate areas; **Figures 2 and 3**). Rest of the areas is not fully explored.

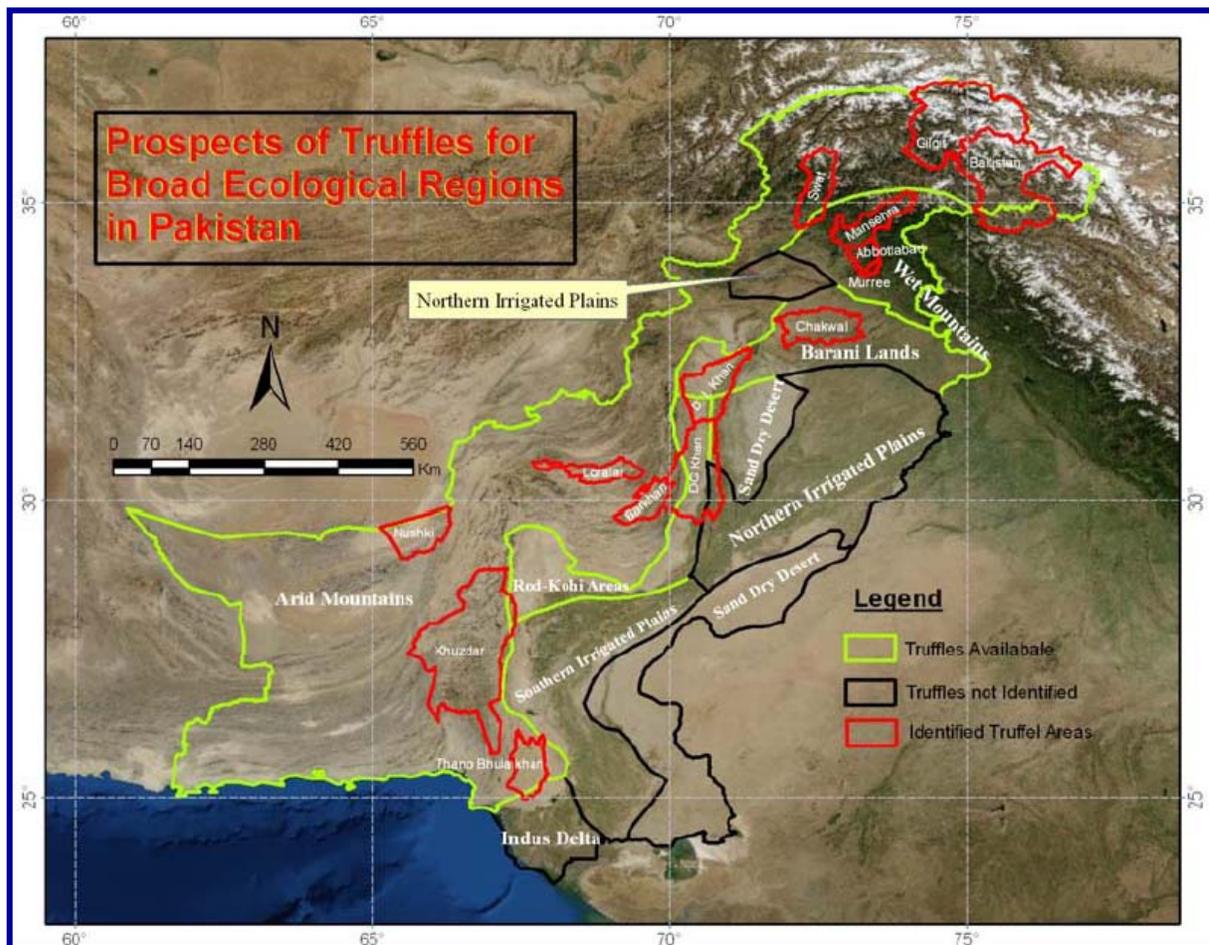


Figure 1. Regions identified for naturally grown Truffle mushrooms



Figures 2 and 3. Truffles harvesting in sorghum and millets fields in D. G. Khan

Natural Resources Division, Pakistan Agricultural Research Council, Islamabad, Pakistan

- ➔ ***Potential areas identified in Pakistan:*** In D. I. Khan district of KPK truffles are found in areas of Saggi, Kohawar, Shero-Kohna and Gundi Umar Khan. Presence of truffles is also reported from Spate irrigation areas of D. G. Khan, Thana Bula Khan, Barkhan, Noshki, Narran, Kaghan and Murree hills. There might be more areas, which are not yet identified, as a comprehensive survey is required.
- ➔ ***Ecologies for truffles:*** They are usually found in Barani, Spate irrigated areas, arid and wet mountains of Pakistan. Truffles are normally found in sandy-loam soils.
- ➔ ***Seasons for truffles:*** Season for truffles varies from area to area; they appear when the micro-climatic requirements are fulfilled. In D.I. Khan Truffles are found in September-October, or during the growing season of sorghum and millets. In Murree hills, it is usually found during the rainy season of March, when lightening caused by clouds helped truffles to grow – local perception of rural people.
- ➔ ***Truffle species:*** There is wide variety of truffle species throughout the world. In Pakistan, there are many evidences for the presence of truffles in different areas but till now there is no identification of species. In D. I. Khan, it is commonly known as ‘*Zami Zung*’, light brown in colour, good in taste and smell like muddy ginger. It was also found in off-white colour. It is also found in white colour which resembles Italian white truffles. There is a need to initiate nation-wide surveys to identify species available in different regions.
- ➔ ***Host plants:*** In D. G. Khan and D.I. Khan districts, white truffles are found in large quantity in the fields of sorghum and millets. In the Murree hills, they were found in the roots of pine trees but the quantity information is not yet available.
- ➔ ***Harvest methods:*** The soil bulges out showing their presence and then people pull them out. As per local knowledge they (mushrooms) appear in the morning following the night having maximum suffocation (humidity with no wind). While moving out early in the morning these can be collected from the fields. The principle of ‘first come-first take’ is the normal custom.

3. Issues

The issues and constraints identified for the assessment of potential, extent, value and marketing of natural truffles available in various ecologies of Pakistan and their production enhancement through provision of inoculums for the treatment of crop seeds and plant roots under natural systems are:

3.1. Lack of Awareness

Consumers and collectors of truffle mushrooms in Pakistan are generally not familiar with value and uses of natural truffles. While many chefs throughout the world have an appreciation of their value, many consumers are unfamiliar with truffles and are unable to appreciate them as a valuable food item having premium price in the global markets. The collectors or farmers in rural areas who are not aware of these natural products usually throw these away being ignorant of this premium priced natural food product due to its sharp and pungent aroma.

Lack of awareness is a major hindrance in tapping the potential of natural truffles in Pakistan. Hardly any article in newspapers and popular magazines are published for the knowledge and awareness of civil society at large. Hardly any scientist has ever worked on truffles in Pakistan in a systematic manner. There is complete lack of information regarding any research done on truffles in Pakistan both under natural and cultivated conditions. Some of the mushroom experts are aware of truffles but

they never worked on it. Even protocols for the identification of fungus and isolation of pure strains of truffle spores are not available in the national research institutions.

3.2. Lack of Support Systems

There is complete lack of support systems in having access to information, knowledge and capacity building. The details of the support systems needed for harnessing the potential of natural truffles in Pakistan are:

- ➔ ***Lack of Information and Technical Support Systems:*** Currently people in rural Pakistan are collecting truffles at their own without any information or support from any public-sector institutions or NGOs. Nevertheless, there is limited information and technical expertise available to the Pakistani truffle collectors as a whole. The need for provision of information and technical support to the collectors of truffles has been identified as one of the basic issue for limited development of this niche. The provision of information and development of technical support system would certainly help to support the development of local or regional networks and enable communities to become more capable in identification, harvesting and value addition of truffles.
- ➔ ***Access to Market Information and Market Research:*** In order to promote the production/cultivation of truffles, export markets will need to be identified. Truffles have a shelf-life of approximately 2-3 weeks and protocols may need to be developed to support the integrity and value for truffles from the field to export. There is hardly any research on truffles. It is highly priced natural food product in many countries. Pakistan R&D environment is not supportive for research in natural products therefore there is a need for technical assistance from foreign countries involved in truffle identification and processing. Furthermore, local capacity has to be developed for developing export markets for Pakistani truffles. The local marketing enterprises have to be linked with the international institutions dealing with marketing and trading of truffles.
- ➔ ***Lack of Capacity Building and Linkages:*** In Pakistan those who are aware of truffles and their high value in the world market don't let this fact to be exposed to other people so that others may not receive any benefits out of it. They won't let their benefits to be shared by others, for this reason there is lack of communication and linkages in this area and the other stakeholders are facing difficulty in getting access to information. In Pakistan, the production of truffles is natural. There are ways that can be used to cultivate it. In order to make it happen there is a need to get collectors trained and let them to have access to technical support and knowledge for the establishment of truffières and the production of truffles.

3.3. Lack of R&D System

There is a complete lack of R&D system in the identification and standardization of natural species of truffles and facilities and support for inoculation of host plants for production enhancement of natural truffles. The details of the R&D systems needed for harnessing the potential of natural truffles in Pakistan are:

- ➔ ***Identification and Standardization of Truffle Species:*** Truffle industry is highly flourished throughout the world but yet many species are not yet identified. Another serious issue is the identification of species in Pakistan which is a complex task. Currently, there is no research being done in the country related to mycology. The basic question for the exporters is that from where they can get these truffles identified and standardized?

➔ ***Inoculation for Production Enhancement:*** The occurrence of truffles in Pakistan is confirmed in many areas that mean the ecological advantages for truffles are available. Methodology and technology associated with the inoculation of crop seeds and roots of trees are usually confidential and subject to commercial patents and/or license in many parts of the world. There is a need for the establishment of inoculation development systems for seed, trees with tubers or tuber mycorrhizae and then distribute these seeds and plants to the growers. Furthermore, the production of truffles in Spate irrigation areas of all the provinces is never studied for the identification of production system and development of inoculation system or provision of spores to the farmers in truffle ecologies.

4. Way Forward

4.1. Creating Mass Awareness

The society as a whole is not aware regarding the potential of natural truffles in Pakistan and its export at premium prices. Initially awareness is needed at the intellectual levels so that intelligentsia in the country is aware regarding the prospects of utilizing the natural truffles grown in various ecologies of the country.

This would require preparation of popular articles, video clips, news files and communication materials regarding the current state of truffles in Pakistan, its potential for export and prospects for enhancing production of truffles in the country.

Radio broadcastings and newspaper articles in local languages would have larger impacts on the rural segment of the country who will be involved in collection, identification and grading of mushrooms for domestic and export markets.

PARC may take a lead in developing materials for creating mass awareness based on available information and knowledge in the country and abroad.

4.2. Developing Effective Support Systems

Development of effective support systems for provision of knowledge, information and training is essential for supporting export of natural truffles to international markets. This would require establishment of institutions for provision of knowledge, skills and processes for identification of truffle species, quality control, grading and packing, storage and export. Knowledge, skills and processes are required by the people involved in the business of truffles so that they can fetch best markets of the world and premium price for Pakistani truffles.

The support system has to be developed to meet the expectations of the clients and in this case it includes: truffle traders, truffle collectors, truffles producers, etc.

Market information regarding markets and market prices both domestic and export markets are also essential for the Pakistan enterprises for export of truffles, which are grown naturally in different ecologies.

4.3. Developing Effective R&D Systems

The country with minor modifications and changes can develop R&D system for truffles mushrooms. PARC being an apex research body can initiate the process of establishing a programme for the identification and standardization of truffles as natural products. The research output will be used to develop protocols for the identification, grading and standardization of truffle mushrooms as per international standards. The protocols developed by PARC can be used by provincial agriculture departments for providing services to the farmers. Similarly, the private sector enterprises will be provided processes and trainings for establishing their capacity.

PARC may also take a lead in developing research programme for the production of inoculums for treating the seeds and host plants so that farmers can enhance the process of production of natural truffles in their fields. The private sector ultimately can take up the technology for the preparation and marketing of inoculums for sale to the farmers.

4.4. Development of Strategy for Research and Development

There is a need to develop R&D Strategy to underpin future prospects for Pakistani truffle. This strategy may include identification of areas and species, methods for collection of truffles, inoculation of seeds and host plants for production enhancement and development of support systems. In addition, research is also needed regarding market system and marketing of truffles especially export to western countries including value addition in terms of grading, packing and storages.

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Acknowledgements

This study was conducted with the help of various scientists of PARC and beyond. Survey was conducted in Ghora Gali of Murree Hills with the help of Mr. Akhlaq Khan Kakar and Mr. Rasheed Nasir, experts from the private sector. Survey Team included Mr. Irfan Ali, Ms. Shaista Kookab, Ms. Sidra Majeed and Ms. Sumia Bint Zaman. In D. I. Khan Mr. Noman Latif, Head Water Programme, AZRI collected and provided the desired information. Team is highly indebted to all for their cooperation in conducting this study.

The NRD Research Briefings is a Series of Issues, which are being prepared and circulated to the policy and decision makers, research and development experts, NGOs and private sector in the country with an objective to synthesize and disseminate the research outputs related to natural resources management research conducted by the establishments of the Natural Resources Division of PARC.

The NRD Research Briefings was started during February 2009 to present outputs of studies undertaken by the Natural Resources Division of PARC and its research establishments including the MARC-Gilgit, AZRC-Quetta, AZRIs at D. I. Khan, Bahawalpur and Umerkot and national research institutes at NARC. The comments and suggestions can be sent at the following email address:

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The scientists and engineers of NRD and its establishments interested to get their papers published in these Briefings can send their files through email.

Reference: Majeed, S. and S. Ahmad. 2011. Truffles – I: An Unexploited Treasure in Pakistan – Issues and Options. Vol. (3), No. (19), NRD, PARC, Islamabad, Pakistan.