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### *Improving Marketing and Sustaining Natural Resource Systems in Latin America and the Caribbean*

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Editor**

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## *Towards a Sustainable Medicinal Plant Industry in Trinidad and Tobago*

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### *Abstract*

*A vast number of over the counter drugs produced by pharmaceutical companies are derived from plants and animals. In 2005, 753 990 kg of medicinal pharmacy products worth 45,574,343 TT dollars were imported (C.I.F) into Trinidad and Tobago, while 16,724 kg worth 2,008,228 TT dollars were exported (F.O.B.). In the Caribbean, there has been a long tradition of preparing 'bush teas' using indigenous and exotic plants for medicine. The Chemistry/ Food and Drugs Division, Ministry of Health, Trinidad and Tobago is responsible for monitoring and regulating the control, manufacture, importation, storage and disposal of drugs (pharmaceuticals) and herbal preparations. Establishing a sustainable medicinal plant industry in Trinidad and Tobago (T&T) could stimulate agricultural diversification and enhance socio-economic development. This paper provides an overview of the status of agriculture in T&T, some global and traditional trends vis-à-vis medicinal plant usage. It identifies some key elements in the development of a medicinal plant industry, such as identification of medicinal plants, Good Agricultural and Good Manufacturing Practices, identification of active health ingredients and intellectual property rights.*

**Keywords:** medicinal plants, 'bush medicine', agricultural diversification, regulation, herbal remedies, herbal therapy

### **1. Introduction**

This paper highlights the status of agriculture in T&T and offers some suggestions for the development of a medicinal plant industry on the

islands. Some of the global trends in the use of medicinal plants and the prevalence of its use locally, based on local research findings, are examined. Major challenges for transforming the now defunct sugar industry into a

viable and sustainable medicinal plant industry are outlined. Some of the opportunities for innovative research and development in the selection and breeding of suitable medicinal plant materials are identified. The effort for updating and /or revising the Chemistry/Food and Drug Act of the Division of the Ministry of Health, Trinidad and Tobago is rationalised. Issues governing Intellectual Property Rights (IPR), with respect to the breeding of new plant varieties, and patents have been included.

## **2. Status of Agriculture in Trinidad and Tobago**

'In the nineteenth century Trinidad's economy was overwhelmingly agricultural, with the major export crops of sugar and cocoa accounting for the bulk of the colony's revenues and employing most of the labour force. But in the present century, oil has increasingly dominated the economy. More than any other factor, it is the development of the oil industry that made twentieth-century Trinidad relatively prosperous.' (Brereton, 1989). In 2005, the energy sector continued to be the main driver of growth in the economy expanding by 10.9%, while the non-energy sector grew by 4% (Central Bank of Trinidad and Tobago, 2007). Table 1 shows the contribution to the various industrial sectors to the Gross Domestic Product (% contribution) of Trinidad and Tobago, 2002-2006. The percentage contribution of agriculture to the Gross Domestic product declined from 1.4% in 2002 to 0.7% to 2006, while the

contribution of the petroleum industry increased from 33.3% in 2002 to 41.2% in 2006 (CSO, 2007a). In this context, agriculture continues to face considerable challenges to compete for productive resources, such as arable lands, affordable labour, and investment capital. This is compounded by praedial larceny, which operates as a disincentive for supporting a thriving agriculture sector.

Trinidad and Tobago is heavily dependent on imported food because of the historical legacy of sugar monoculture (Pemberton, 1990). Plantation owners were reluctant to diversify from sugar and lose the social and political privileges, which were linked to sugar monoculture. Sugar production has declined from 136.7 thousand tonnes in 1997 to 84.5 thousand tonnes in 2004, and exports declined from 109.3 thousand tonnes in 1997 to 43.8 thousand tonnes in 2004. The recent demise of the sugar industry is reflected by a decline in the GDP from 0.5 in 2002 to 0.2 in 2006 (CSO, 2007b). This should be an opportunity for government and the private sector to consider diversifying into a thriving medicinal plant industry.

There has been a decline in the number of persons employed in agriculture in 2004 (26,000 persons) compared to 1997 (43,700 persons) (Central Bank of Trinidad and Tobago, 2005). The total number of agricultural land holders enumerated in Trinidad and Tobago during the 2004 Agricultural Census was 19,143 of which 18,169 (94.9%) were recorded

in Trinidad and 974 (5.1%) in Tobago (CSO, 2005). There was a decline of 11,423 holders or approximately 37.4% when compared to the total number of holders (30,566) recorded in the 1982 Agricultural Census. In Trinidad, 74.3%, 15.3%, and 9.7% of the holders were engaged in crop, mixed and livestock activities, respectively. However, in Tobago, although the majority of holders, 38.9%, were engaged in crop activity, mixed and livestock activities were also significant. Individual/household/sole proprietor and joint partnerships accounted for 99.5% of all holders. Forty percent (40.0%) of the private holders were registered as farmers. Ninety six percent (96.0%) of all holdings were less than ten (10) hectares in area. The average size of a private holder's household was 4.2 persons. The male/female ratio of holders was found to be 5.9:1 (CSO, 2005).

### 3. Traditional Medicine

It is estimated that over 80% of the developing world relies on medicinal plants as a major form of healthcare therapy (Vincent and Furnham, 1997). 'Scientists have only been able to exhaustively examine one half of one percent of the higher plants on this planet for their chemical composition and pharmaceutical potential. Yet these species have yielded about one-quarter of all the drugs on the pharmacist's shelf,' (Mack, 1997). It is noteworthy that approximately 62% of Americans use some form of alternative and complementary medicine, and prefer

to self-diagnose and self-treat for a variety of acute and chronic maladies (Barnes *et al.*, 2002).

In 2005, 753 990 kg of medicinal pharmacy products worth 45,574,343 TT dollars (6.3 TT dollars = 1US dollar) were imported (C.I.F) into Trinidad and Tobago, while 16, 724 kg worth 2,008,228 TT dollars were exported (F.O.B.) (CSO, 2007b). In Trinidad and Tobago, there is a well established tradition of the acceptance of specific medicinal plants or preparations for use as colon and blood cleansers or laxatives, e.g. the product branded as "Tisane de Durbon" manufactured in Barbados under licence of Stella Pharmaceutical, Ontario, Canada, and sold by local distributors.

There is a growing demand for manufactured herbal products in the form of herbal 'teas', health drinks, essential oils, phyto-medicinals, nutraceuticals and cosmeceuticals. These commodities are value-added plant-based preparations. Medicinal plants may be traded as plant parts, extracts or isolated active constituents (Seaforth and Tikasingh, 2006). The term 'nutraceuticals' was coined by the Foundation for Innovation in Medicine, and is defined as 'any substance that may be considered a food or part of a food and provides medical or health benefits, including the prevention and treatment of disease' (DeFelice, 1989). Hence there is a product, which is dual purpose serving as both food and medicine.

Trinidad and Tobago, like other Caribbean countries, has evolved its

own unique medicinal plant tradition. This tradition is a complex fusion of Amerindian, European, African and Asian traditions, which has incorporated well known exotic species such as garlic (*Allium cepa*), aloes (*Aloe vera*), ginger (*Zingiber officinale*), turmeric (*Curcuma longa*), neem (*Azadirachta indica*), with indigenous plant materials such as shadobeni (*Eryngium foetidum*) or Spanish thyme (*Lippia micromera*) to produce new blends of infusions or 'teas'.

The most recent addition to the growing literature supporting the use of traditional herbs is the Caribbean Herbal Pharmacopoeia (Germosén-Robineau, 2007), which contains a list of medicinal plants along with their effects and directions for use.

### 1. Prevalence of 'Bush' Medicine Usage

In the Caribbean, there has been the long established tradition of using a range of plants for making 'bush' teas or as spices and flavourings in culinary preparations. The use of 'bush' medicine is inextricably linked to one's belief system about illness. However, its application and use may often conflict with the recommendations of some professionals in the modern health care system (Morgan and Watkins, 1988). A study to determine the levels of acceptance and knowledge of medicinal herbs by physicians at six major public hospitals in Trinidad, it was revealed, that contrary to popular belief, 60.2% of physicians believed that the herbs were beneficial to

health. This correlated to 'average' to 'excellent' acceptance scores in 56.8% of the sample (Khan *et al.*, 2005). Fifty percent (50%) of the physicians could identify at least two Caribbean herbs or their uses.

Two studies were conducted by Meritt-Charles *et al.* (2003) to investigate the use of herbal medicine by surgical out patients in Trinidad. One study involving 97 adult patients attending a surgical outpatient clinic at Eric Williams Medical Sciences Complex, Trinidad, West Indies revealed that over 93% had used alternative therapies, 49% used prescription medication and 23% did not inform their physician prior to their surgery (Meritt-Charles *et al.*, 2003). Also, 86% of the respondents also used some form of herbal therapy with garlic (45%) and ginseng (34%) being the most popular herbs. Among the herbal therapy users, it was found that 40% used herbal remedies in the form of tablets, powdered products or drinks bought from a herbalist or pharmacy, 51% used 'bush' teas in the form of a decoction or infusion made at home from plants e.g. soursop leaf (*Annona muricata*), vervine (*Stachytarpheta jamaicensis*) or lime bud (*Citrus aurantifolia*) and 44% of the home-made 'bush' medicine included garlic.

In the second study, which sampled 303 adult patients attending the surgical outpatient clinics at Port-of-Spain General Hospital, San Fernando General Hospital and Eric Williams Medical Complex, Trinidad, West Indies, it was revealed that the most popular herbal remedies were

garlic (75%), aloe vera (31%) and ginseng (24%). The most commonly ingested 'bush' teas were orange peel tea (47%), fever grass tea (39%) and soursop leaf tea (23%) (Merritt-Charles *et al.*, 2003).

In a specific study, which investigated 622 persons with diabetes mellitus in Trinidad and Tobago, herbal medicines were used by 42% of the patients with 24% using them specifically for diabetes (Mahabir and Gulliford, 1997). The findings also showed that 'bush' medicine was most frequently used by the Afro-Trinidadians (52%) compared to mixed race (48%) and Indo-Trinidadian (36%). Most of the subjects (81%) reported gathering the plants themselves and 41% took them more frequently than once a week. Table 2 shows the use of 12 most frequently mentioned plants for diabetes or for other indications (Mahabir and Gulliford, 1997).

##### 5. Uses of some common medicinal plants

Several medicinal plants have been used as dietary adjunct and in the treatment of numerous diseases without proper knowledge of their function. Although phyto-therapy continues to be used in several countries, few plants have received scientific or medical scrutiny. Moreover, a large number of medicinal plants possess some degree of toxicity (Marles and Farnsworth, 1994).

A review of ten years of herbal medicine research (1990-2000) with potential anti-diabetic activity was

conducted by Bnouham *et al.* (2006). The large number of plants described in this review (176 species belonging to 84 families) clearly demonstrated the importance of herbal plants in the treatment of diabetes. It also showed the effort to isolate new potential anti-diabetic agents. The plant families, including the number of species most studied for their confirmed hypoglycaemic effects include: Leguminosae (11), Lamiaceae (7), Liliaceae (8), Cucurbitaceae (7), Asteraceae (6), Moraceae (6), Rosaceae (6), Euphorbiaceae (5) and Araliaceae (5). The most studied species were: *Citrullus colocynthis* (Cucurbitaceae), *Opuntia streptacantha* (Cactaceae), *Trigonella foenu-greacum* (Leguminosae), *Momordica charantia* (Cucurbitaceae), *Ficus bengalensis* (Moraceae), *Polygala senega* (Polygalaceae), and *Gymnema sylvestre* (Asclepiadaceae).

The twelve (12) most frequently mentioned plants used in 'bush' medicine by vernacular names as reported by patients in a Trinidad and Tobago survey were vervine (*Stachytarpheta jamaicensis*), soursop leaf (*Annona muricata*), chandilay or ball bush (*Leonotis nepetifolia*), fever grass (*Cymbopogon citrates*), caraili (*Momordica charantia*), orange peel (*Citrus sinensis*), senna (*Senna alata*), zebapique (*Neurolaena lobata*), aloes (*Aloe vera*), black sage (*Cordia curassavica*), olive-bush (*Bontia daphnoides*) and seed-under-leaf (*Phyllanthus amarus*) (Mahabir and Gulliford, 1997).

A survey was conducted of the

most commonly used medicinal plants which are used for herbal preparations in Tobago (Seaforth *et al.* 1998). From this study, sixty plant species were identified as being used for treating about 12 different ailments. Among them *Chromolaena odorata*, *Cordia curassavica*, *Cecropia peltata*, *Cymbopogon citratus*, *Lantana camara* and *Neurolaena lobata* are the most commonly used.

One of the most significant developments emerging from the use of Caribbean 'bush medicine' is the widespread use of 'shado-beni'/culantro / fit weed, (*Eryngium foetidum*) as acceptable food flavouring. Its pungent unique aroma gives the characteristic flavour to dishes, in which it is incorporated, and this is responsible for its increasing demand among ethnic populations resident in western developed countries (Ramcharan, 1999). The leaves are eaten in the form of chutney, as an appetite stimulant (Mahabir, 1991). But in traditional folk medicine, its use extends to the "leaf teas" for fever, flu, diabetes, leaf baths for coughs, heat, urinary infusion baths for fever, flu, and pneumonia, as well as root decoctions for fever, coughs, cold, pneumonia, malarial fever and constipation (Wong, 1976). Clearly, its long established traditional use has proven to be safe for human consumption without the formal endorsement of scientific testing.

## 6. Identification of medicinal plants and formal nomenclature

The use of common or vernacular names is unreliable as a form of plant

identification particularly when involved in scientific investigation or for labelling approved plant-based products. Common names are often variable as numerous names can be applied to the same species or the same common name can be applied to many different species. For example, at least three different species of marine macro algae from the genera *Gracilaria* and *Hydropuntia* which grow in south-eastern Caribbean are known as 'sea weed' or 'seamoss' (Baksh-Comeau, 2006). The 'sorrel' (*Hibiscus sabdariffa*) grown in Trinidad and Tobago is a different plant from 'sorrel' (*Rumex acetosa*) in North America and Europe. Similarly, a 'lime tree' (*Citrus aurantifolia*) in the Caribbean is different from a 'lime tree' (*Tilia x europeae*) in Europe (Baksh-Comeau, 2003). On the other hand, the species *Eryngium foetidum* mentioned earlier is known by a plethora of common names such as; 'bhandania' (Trinidad and Tobago), 'chadron benee' (Dominica), 'coulante' or 'culantro' (Haiti), 'recao' (Puerto Rico), and 'fit weed' (Guyana) (Seaforth *et al.*, 1983; Seaforth, 1988). There are also names derived from different languages: 'langer koriander' (German); 'ketumbar java' (Malay); 'pak chi farang' (Thai); 'ngo gai' (Vietnamese); 'culantro', 'racao', 'recao' (Spanish); 'bhandhanya' (Hindi), and 'spiny coriander' (Spanish) (Ramcharan, 1999). It is therefore critical that plants are identified correctly by their scientific name or Latin binomial, which is comprised of the generic followed by the specific

epithet. The danger of misidentification of a medicinal plant could thus lead to accessing incorrect published information about the putative species. In Trinidad and Tobago, the National Herbarium of Trinidad & Tobago provides a professional plant identification and information service.

### 7. Selection of medicinal plants

At the outset, the selection of medicinal plants for industrial development should be limited to those species known to be safe for human consumption, including traditional food crop with known phyto-medicines. Documentation and preliminary evaluation of medicinal plants is a necessary step for establishing whether remedies could be provided for health needs. In general, it was found that information about the processing technology, market trends and trade of selected medicinal plants was scarce. It would be necessary to compile profiles or monographs of selected medicinal plants. This will inform and encourage agriculturalists, farmers, extension personnel, processors and distributors to make the right selection of species suitable for cultivation and agro-processing to deliver value-added products, such as herbal teas or essential oils. In the development of a medicinal plant industry, it is vital that information on the identification, propagation, harvesting, storage and processing of selected Caribbean plants must be established. Already some traditional medicinal plants are in cultivation for commercial use such

as aloe (*Aloe vera*), fitweed/shado beni (*Eryngium foetidum*) while others such as carailli (*Momordica charantia*) grown commercially as a food plant and wild senna (*Senna alata*), harvested from the wild, have the potential for adding value as medicinal products. It was found that while farmers treasure their marginal and small-scale holdings of these crops, the application of good agricultural practices (GAP) and good manufacturing practices (GMP) is required to produce herbals of uniformly good quality (Palevitch, 1998). Aloe and ginger emerged as the best documented, but are highly competitive on the global market. *Hibiscus sabdariffa* (sorrel), *Senna alata* (wild senna) were well documented as nutraceuticals and phyto-medicinals with potential. The popular food plants, *Eryngium foetidum* (shado beni) and *Momordica charantia* (carailli), need further research for their essential oil and potential anti-diabetic extract (Seaforth, 2006) to be developed into medicines.

### 8. Agronomy

The early selection, screening and breeding of suitable plant cultivars from the wild must be undertaken by agronomists and plant breeders. This would be followed by intensive laboratory screening of the various cultivars to determine the best quality material yielding the highest quality natural product, with the desired agronomic traits, suitable for commercial production by farmers. This will ultimately guarantee the

economic returns for farmers' investments by producing the highest quality planting material acceptable for the market.

Agronomic studies testing an alley-cropping system in the United States Virgin Islands, using a tree crop in combination with medicinal and culinary herbs, showed promising results. It was undertaken to evaluate the tree crop *Moringa oleifera* growing together with medicinal plants ('inflammation bush') (*Verbesina alata*), 'worrywine' (*Stachytarpheta jamaicensis*) and the aromatic and culinary herbs 'basil' (*Ocimum basilicum*), 'lemongrass' (*Cymbopogon citratus*), 'thyme' (*Thymus vulgaris*), 'mint' (*Mentha piperita*), 'cilantro' (*Coriandrum sativum*) and 'chive' (*Allium schoenoprasum*). The results indicated that the initial yield of intercropped medicinal plants with culinary herbs was not significantly affected by the tree crop (Palada *et al.*, 2003). However, long-term studies are required to investigate the effects of different tree crops' interactions on the productivity of other medicinal plant species.

### **9. Good Agricultural Practices (GAPs) and Good Manufacturing Practices (GMPs)**

The move towards a medicinal plant industry will demand that Good Agricultural Practices (GAPs) and Good Manufacturing Practices (GMPs) be followed by farmers and manufacturers in order to access preferential markets where high

quality medicinal products are in demand by consumers. Over the years, GMPs have been undergoing significant changes, making them more compatible with international standards, regulations and guidelines. These include International Standard Organisation (ISO) ISO 9001, ISO22000-2005, Hazard Analysis and Critical Control Points (HACCP), Food and Drug Administration (USA) – Current Good Manufacturing Practices 21CFR Part 110, Codex Alimentarius Recommended International Code of Practice – General Principles of Food Hygiene.

A proper GAPs / GMPs programme will include *inter alia* the accurate identification of the plant by its scientific name, the selection of appropriate plant materials, testing for chemical residues in soils, recommended fertility practices, particularly if manure is used, weed control, irrigation water quality, worker hygiene and safety, facility sanitation, pest control, trace back and trace forward records and appropriate documentation of all activities at all levels.

To illustrate the importance of GAPs/GMPs, in a South Carolina study on the marketability of medicinal plants grown by commercial growers, the following factors, which prohibited saleability were; (a) excessive foreign matter, primarily weeds (b) excessive ash content due to contamination from sandy soils (c) presence of moulds resulting from processing with excessive moisture content and (d) infestation with insects during storage (Rushing *et al.*, 2003).

## 10. Regulation

Some issues, which relate to the use and sale of medicinal plant products are safety, efficacy and quality. The market demand is for good quality medicinal plant products, which must comply with national and international specifications and regulations. The regulatory agencies are the ones expected to provide the guidelines to safeguard consumers. In the USA, current laws and regulations prohibit the development and marketing of nutraceuticals without having *Generally Regarded as Safe* (GRAS) status (Childs, 1997). In Trinidad and Tobago, the regulation of herbal products is under the jurisdiction of the Chemistry/Food and Drug Division of the Ministry of Health, Food and Drugs Act: Chapter 30:01 and its amendments (Teemul, 2003). In Trinidad & Tobago, The National Drug Policy was approved in 1998. It was the result of collaboration between the Ministry of Health and the Pan American Health Organisation (PAHO) involving inputs from the private sector and university academics. The document outlines broad policies for the several areas related to drugs, drug use, drug supply and its management in Trinidad and Tobago. In this policy, Section 16.0 deals with complementary medicine. Section 16.0.2 indicates that the "Ministry shall regulate herbal medicines in the same way as are allopathic (conventional) drugs used in 'orthodox' medicine". The National Drug Policy document identifies the major stakeholders such

as the Ministry of Health, Chemistry, Food and Drugs Division and the Customs and Excise Division, the Ministry of Finance, private sector, health care providers, the public and the Ministry of Agriculture as having important roles in drug regulation for public safety and improved health and well being. (Seaforth and Tikasingh, 2006).

## 11. Intellectual Property (TRIPs)

Intellectual property laws allow the creators to prevent others from using their creations for specific times to enable them to recoup their research and development expenses, enjoy some returns and encourage further innovation. The rules and norms of those IP systems contained in the treaties developed and administered by the World Intellectual Property Organization (WIPO) and the agreement on the Trade Related Aspects of Intellectual Property Rights (TRIPs) of the World Trade Organization.

In Trinidad and Tobago, a new variety of plant can be protected by giving the breeder the legal right to exclude anyone for the purpose of marketing, offering for resale or market. The Plant Breeders' Right legislation in force in Trinidad and Tobago is the 'Protection of New Varieties Act, 1997' (2007). To qualify for protection, a variety must be new, distinct, uniform, stable and have an original variety denomination (IPO, 2007a). Patent legislation is in force in Trinidad and Tobago: 'The Patents Act, 1996 (Act No. 21 of 1996)'. The Patents Rules, 1996. Ideas and

discoveries (of things already existing in nature) could be patented (IPO, 2007b). The rules and norms of intellectual property are embedded in the treaties developed and administered by the World Intellectual Property Organization (WIPO) and the agreement on the Trade Related Aspects of Intellectual Property Rights (TRIPS) of the World Trade Organization.

## 12. Conclusions and Recommendations

The following recommendations are not exhaustive, but offer suggestions on paths to developing a viable and sustainable medicinal plant industry with the potential for improving the quality of life for the nation. The following recommendations take into account the need to reduce the high import of herbal /medicinal products through import substitution using mainly indigenous medicinal plants:

1. The Caribbean Pharmacopoeia (2007) is an existing guide to the selection of well-researched and validated Caribbean medicinal plants as suitable substitutes for householders and farmers to cultivate.
2. In mid 2005, St. Kitts and Nevis ceased commercial sugar production after 350 years. In response to this, the European Union has signed a grant agreement of EC\$9 million to support economic transformation. The strategies include fiscal sustainability, retraining of former sugar workers and communities and the creation of job opportunities (e.g. medicinal industry) (European Union - Press Release, 2007). A parallel situation now exists in Trinidad, where sugar production ceased in 2007 and therefore one possible strategy would be for local sugar workers to cultivate medicinal plants.
3. The need to shift from a monoculture crop like sugar-cane and diversify into multi-cropping medicinal plant production will take some time. This would require the support of new goods and services including but not limited to: accurate plant identification, analytical laboratories, clinical testing facilities, biotechnology laboratories and diagnostic laboratories to support this industry and its farmers.
4. Systems should be in place to support farmers to produce organically-grown medicinal plants. Therefore, access to environmentally friendly chemicals to replace the traditional inorganic synthetics must be made readily available and affordable.
5. The development of a local Caribbean-GAP system specifically targeted to local medicinal plants, which will meet international standards. This system will facilitate monitoring at the distributor level where significant intermingling of produce occurs and procedures designed to trace-back individual farms and scrutinize record-

- keeping for quality control. In addition, compliance with the 2006 Trinidad and Tobago Occupational Safety and Health Act (TT OSH) is critical for such an industry.
6. The need for educational programmes and projects designed to target schools and community groups to create medicinal plant gardens and training manuals. This will build awareness of the importance of conservation of wild genetic resources.
  7. The development of stronger policies with stricter law enforcement to eradicate the scourge of praedial larceny and formulate a national campaign to sensitize the population to help protect farmers from this social menace.
  8. The development of a regulatory framework for the registration, establishment of conditions of sale and monitoring of plant medicines in the context of public safety and legislative imperatives. A safe and cohesive system is needed for the registration, classification and monitoring of medicinal plant preparations.
  9. The fostering of alliances with NGO's like the Caribbean Association of Researchers and Herbal Practitioners (CARAPA) and the Caribbean Agri-Business Association (CABA) for purposes of networking and information sharing.
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**Table 1: Contribution of Gross Domestic Product of Trinidad and Tobago, 2002-2006 (at constant (2000) prices (Percentage Contribution))**

| Industry                       | 2002 | 2003 | 2004 | 2005 | 2006 |
|--------------------------------|------|------|------|------|------|
| Petroleum industry             | 33.3 | 38.3 | 38.1 | 38.2 | 41.2 |
| Non-petroleum industry         | 66.2 | 61.8 | 61.3 | 61.7 | 58.7 |
| - Export Agriculture           | 1.4  | 1.1  | 0.7  | 0.7  | 0.7  |
| - Domestic Agriculture         | 0.7  | 0.6  | 0.5  | 0.6  | 0.5  |
| - Cane farming and cultivation | 0.4  | 0.2  | 0.1  | 0.1  | 0.1  |
| Manufacturing <sup>1</sup>     | 7.2  | 7.0  | 7.0  | 7.2  | 7.2  |
| Services <sup>2</sup>          | 57.7 | 53.7 | 53.6 | 53.7 | 50.8 |

<sup>1</sup> Excludes oil refining and petrochemical industries (See 'Petroleum Sector')

<sup>2</sup> Excludes distribution of petroleum products (See 'Petroleum Sector')

Source: CSO (2007).

**Table 2: Use of 12 most frequently mentioned plants for diabetes or for other indications**

| Botanical Name                    | Common Name     | % of persons using bush medicine for diabetes | % of persons using bush medicine, but not for diabetes |
|-----------------------------------|-----------------|---|--|
| <i>Momordica charantia</i>        | Carailli        | 28  | 11   |
| <i>Stachytarpheta jamaicensis</i> | Vervine         | 8   | 28   |
| <i>Aloe vera</i>                  | Aloes           | 15  | 5  |
| <i>Neurolaena lobata</i>          | Zebapique       | 13  | 6  |
| <i>Leonotis nepetifolia</i>       | Chandilay       | 5   | 13   |
| <i>Annona muricata</i>            | Soursop leaf    | 3   | 14   |
| <i>Bontia daphnoides</i>          | Olive-bush,     | 10  | 3  |
| <i>Cymbopogon citrates</i>        | Fever grass     | 2   | 13   |
| <i>Senna alata</i>                | Senna           | 5   | 7  |
| <i>Citrus sinensis</i>            | Orange peel     | 1   | 10   |
| <i>Phyllanthus amarus</i>         | Seed-under-leaf | 7   | 1  |
| <i>Cordia curassavica</i>         | Black sage      | 3   | 5  |

Source: Mahabir and Gulliford (1997)

