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DIPLOMA THESIS

**Traditional Use, Management and Commercial
Potential of Lá lôt (*Piper lolot* C. DC, Piperaceae)
in Central Vietnam**

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Declaration

I hereby declare that I have worked on my diploma thesis titled “Traditional Use, Management and Commercial Potential of Lá lốt (*Piper lolot* C. DC, Piperaceae) in Central Vietnam” by myself and I have used only the sources mentioned at the end of the thesis.

In Prague on 25th April 2013

.....

Signature

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Abstract

Neglected and underutilized crops have been always acknowledged for their nutritional and/or medicinal values. Additionally, many of them have a potential to positively affect household economics in the terms of cash security as well. *Piper lolot* C. DC. (Piperaceae) is a widely spread and utilized plant among farmers in South-east Asia, particularly for culinary purposes. Any economic potential of this crop was not published yet in the literature. Thus, main aim of this thesis was to investigate traditional knowledge of selected neglected plant specie - *Piper lolot* C. DC. (Piperaceae), particularly in the terms of capacity for improving the living standards of agricultural households involved in the survey through identification of its economic potential by means of value chain was analysis. Main methodological tool utilized in this research was in-depth structured and semi-structured interviews with the stakeholders involved in the production process of *Piper lolot* C.DC. (Piperaceae). Respondents were identified at local agricultural markets. Sellers were asked whether they grow it, collect it in the wild or purchase it from other farmers. Main areas of *Piper lolot* C. DC. (Piperaceae) planting were identified and personally visited by investigator. Then, growers were selected via snowball method and interviewed as well. Multidisciplinary survey containing socioeconomic, market-access and ethno-botanical approaches was applied. Data collection was conducted in the central part of Vietnam in Hue City in the time frame from August till September 2012. Results show that *Piper lolot* C. DC. (Piperaceae) does not affect the trading activity of the Vietnamese marketers and thus cannot be considered as important cash crop, which would contribute to household income generation. However, our survey suggest not to use economic indicators only and to include those indicators, which are able to consider also wide range “externalities”, such as ecological and/or cultural value. Furthermore, other usages, such as medicinal, cultural or culinary, are extremely important for our respondents. Based on the results we can conclude that despite of promising market potential, the utilization of *Piper lolot* C. DC. (Piperaceae) will remain in the area of subsistence level with no significant impact on household cash security.

Key words: *Piper lolot*, C. DC (Piperaceae), ethnobotany, value chain, traditional medicine, commercialization, Vietnam

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List of Abbreviations

FAO	Food and Agriculture Organization of the United Nations
FDI	Foreign Direct Investment
GDP	Gross Domestic Product
HDI	Human Development Index
IFAD	International Fund for Agricultural Development
NUS	Neglected and Underutilized Plant Species
OLS	Ordinary Least Squares Method
P.Betle	<i>Piper betle</i> L. (Piperaceae)
P.Lolot	<i>Piper lolot</i> C. DC. (Piperaceae)
PPP	Purchasing Power Parity
P. sarmentosum	<i>Piper sarmentosum</i> Roxb. (Piperaceae)
UN	United Nations
UNDP	United Nations Development Program
VTM	Vietnamese traditional medicine
WB	World Bank
WTO	World Trade Organization

1. Introduction

As a consequence of globalization often connected with adaptation of modern technology importance of traditional indigenous cultures continues to disappear (see e.g. Balick and Cox, 1996). There are several recent efforts trying to conserve this traditional knowledge for future population, fighting food insecurity through crop resistance, increase community resilience through diversification of commercialization possibilities etc. Ethnobotanical research, one representative of above mentioned efforts, is often conducted due to enhancement of traditional culture and bringing significant contribution to modern science since it helps in determining possible utilization of new and/or traditional plants (Soejartho, 2005). One of the highly discussed issues in context of assuring properly functioning human society is to secure balanced food supply. Neglected and Underutilized Crop Species (NUS) that are grown especially by farmers in developing countries could play significant role. Nevertheless, despite of representing an important socio-cultural role for the local society and promising economic potential, NUS have received only little attention from the side of scientific and development community (Schmidt, 2008).

Wild vegetables, such as *Piper lolot* C. DC. (P.lolot), are typical example of NUS. P.Lolot is flowering vine which grows especially in Laos and Vietnam. This leafy dark green plant is also known under vernacular (Vietnamese) name Lá lô. The average height of the plant ranges from 30 to 80 cm (Dui can et al, 2007). P.lolot is tender perennial vine and its leaves are dark green, glossy and hart-shaped (Kuebel, Tucker, 1988). P.lolot belongs to the genus Piper, which belongs to the Piperaceae plant family, which is important in terms of both economic (commercialization) and social potential (traditional/rural medicine and traditional food use). P.lolot is widely utilized in Vietnamese folklore medicine and is especially important thanks to its socioeconomic contribution for rural people through wide possibility of utilization (Trinh et al, 2003). Generally, P.Lolot is grown for its leaves, which are further utilized for food preparation especially as a spice as well as for medical purposes. Moreover, the plant is extremely important due to its traditional values in Vietnamese culture (Vlková et al.,2011).

Low income households from developing countries often derive their livelihood from home-gardens. Additionally, commercialization of home garden products has been recognized as an important poverty alleviation strategy since it contributes to income generation of subsistence farms (Jensen and Meilby, 2010). In addition, due to overpopulation and overexploitation of

natural resources, pressure for sustainable use of natural resources have increased and for this reason understanding ecology of home gardens' products as well as their utilization has become very important (Gaoue and Ticktin, 1995).

Vietnam is country with very fast economic development. In the past, Vietnam was facing serious problems, such as 19 years of war (from the year 1955 till 1975), followed by economic failure and consequent change from socialist centrally planned economy to socialist-oriented market based economy. Additionally, during the war the country was divided into North and South more than 20 years (Awaji and Teranishi, 2003). Over last twenty years, poverty headcount ratio decreased significantly and income levels were rising. Morbidity and mortality was reduced and Vietnam made significant progress towards Millennium development Goals achievement. Market-based reforms and design of new policies, such as access to land or investments in infrastructure, unremarkably contributed to high economic growth (WB, 2012).

2. Literature Review

2.1. Traditional use of Neglected and underutilized crop species

Bermejo and León (1994) claim that the total number of worldwide cultivated plant species equal to 150. However, out of this number only twelve plant species satisfies 75% of world's food demand and three crops, including wheat, rice and maize, guarantee 50% of the total world food supply (FAO, 1996). One way how to assure global food security and to increase nutritional intake of poor people from low income households is to turn the attention toward other plant species, which remain less utilized at global and/or meso level. The research of utilization of Neglected and underutilized crop species (NUS), especially their traditional use, management and economic potential could be very relevant (Eyzaguirre et al. 1998).

NUS are grown in the place of their origin and they represent an important role particularly in subsistence farming systems. Some are distributed outside of the centre of their origin however, their occurrence remains in niches of economy. Despite of their socio-cultural importance, these species are insufficiently characterized and little attention is focused on the research and its conservation. Underutilized species has been grown in the past but currently are not used due to different reasons, including agronomic, genetic, economic and cultural matters, often due to changing taste of consumers as a result of adaptation to new food culture. They are perceived to be less competitive and thus generate less profit (Eyzaguirre et al. 1998).

2.1.1. Wild plants and vegetables

Wild plants and vegetables, usually being considered as NUS, in tropical and subtropical regions represent important role in human nutrition and its importance was emphasized by many studies. Generally, as malnutrition is often connected with lack of proper vitamins and minerals, vegetables play a crucial role in the food security of low income households. The importance of wild food in agricultural systems and its high economic value is recognized all around the world. This has to be especially considered during policy design connected to agriculture and forestry planning especially due to the high value of wild plants for the future of agricultural production and biodiversity maintenance. Above all, wild vegetables assure safe nutritional intake¹ (Ogle, 2011). Figure bellow expresses position of wild plants in food resource system of poor people

¹ Wild plants also represent key role during draught periods, civil riots or disturbance and sometimes they play crucial role in fight again malnutrition during these times.

and their multifunctional context of usage, including, social, political and cultural context. The top part of the figure represents nutritional problems, where as the bottom part outlines sources of food generation from various sources, such as home gardens, yards, dykes, common sources, forest, water sources or road sides.

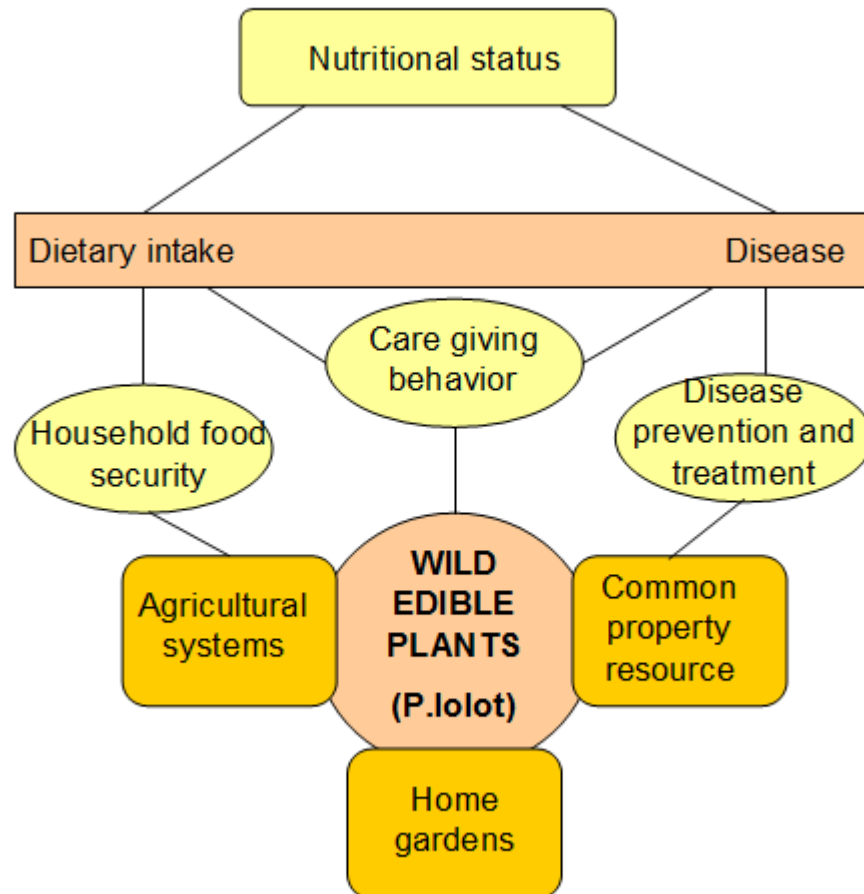


Fig 1. Multifunctional role of wild vegetables
(Based on Ogle, 2011)

Usually, major source of these plants is common property area and thus these places need to be easily accessible by the poor in order to improve their welfare, since wild vegetables represent important part of dietary intake especially for women and children. In addition, important source of wild vegetables are also home gardens and agricultural systems. Farmers in developing countries developed different strategies for their cultivation. In Vietnam, there are around 600 plant species, categorized as vegetable, which are usually grown wild, but managed, collected and utilized by farmers. P.lolot is good example of such a species (Ogle, 2011).

2.1.2. Use of Neglected and underutilized crop species in Vietnamese traditional medicine

Ethnomedicine provides explanation of health and diseases from the point of view of local culture, where as traditional medicine is medicine which does not use practices of modern Western medicine (Bannerman 1983). Utilization of herbs for disease cure and prevention by the indigenous people attracts attention of western medical companies (Pieroni, 2005). For medical treatment are responsible traditional healers, local people with knowledge about various diseases and its treatment within specific community. Such a knowledge is based on transition from generation to generation either through observations or experience (Brun and Schumacher, 1994; Chantachon, 2001).

NUS are plants occurring mainly in tropics and subtropics. These plant species contain chemical compounds, which are not only important from the pharmaceutical point of view, but also play crucial role in traditional folk medicine, particularly in Vietnamese traditional medicine (VTM)². Vietnam poses wide variety of different indigenous medicinal plants and folk medicine has long tradition especially in rural areas. In order to confirm the traditional knowledge, various studies were conducted with the purpose to verify the chemical identity of these plants (Loi et al., 1995).

VTM not only plays crucial role in disease prevention and treatment³ for Vietnamese inhabitants, but it is also important from the cultural point of view (Nguyen, 2010; O'Callaghan and Quine, 2007). It is especially vital for people living in remote rural areas of Vietnam with limited access to modern health care and for those being so poor that they cannot afford modern drugs. However in large cities, modern medicine remains major source of health care (Loi, Dung, 1991).

Vietnamese traditional medical practice is consisted of two pillars. Firstly, folk medicine, used by ethnic minorities and secondly VTM. The basic difference is in medical theory. Folk medicine is not based on any theory, where as VTM is based on medical theory. Folk medicine is

² VTM is result of many experiments over the history since wide variety of plants was used for various purposes. Herbs and plants grown in tropical rainforest are important instruments of VTM. Also, VTM was influenced by the Chinese traditional medicine. However, compared to Chinese medicine, Vietnamese one is not known abroad. Nowadays department of Traditional Medicine is part of Vietnamese hospitals and universities, which confirm its integration into people's lives. Some people even prefer VTM due to its long tradition and cultural spirit (Woerdenbag, 2012).

³ In order to cure diseases, VTM is used in form of decoction, when herbs are cooked in water for 20-40 min. Ingredients with essential oils are added afterwards. Other form of VTM can be pills, powders, medicinal wines, ointments, herbal pack or compress, and granulates (Hempfen, Fischer, 2007).

practiced without any specific causes and interaction of the herbs, people only know general effect of selected herbs. On the contrary, theory of VTM is based on principles of Oriental medicine (Woerdenbag, 2012).

Use of the traditional medicine is officially regulated and promoted by the government⁴ due to the incentives to assure accessible healthcare for all citizens (Woerdenbag, 2012). Official strategy and national policy on traditional medicine was developed by the Vietnamese government (Ministry of Health of Vietnam, 2009). Moreover it is recognized by the Vietnamese official healthcare system of Vietnam and it is widely used either alone or in combination with western medicine (O'Callaghan and Quine, 2007).

2.1.3. Ethnobotany

Traditional knowledge of indigenous people, regarding use and management of plants which is very valuable source of data is analyzed through field explorations, as a vital tool of ethnobotanic research (Soejarto, 2005). According to Harshberger (1986), ethnobotany is study of utilitarian relationship (relationship that includes use for medical purposes) between humans and the plant environment in primitive settings. Cotton (1996) claim that ethnobotany is “use of plants by aboriginal people”. Berlin (1992) points out to approaches in ethnobotany. Firstly, cognitive ethnobotany which describes human view on plants and their classification and secondly economic botany, which describes utilization of plants by people.

During last 30 years ethnobotanical research was mainly utilized as a research tool of home gardens. So far importance of research aimed on usage of indigenous species was underestimated and investigation of this topic was rarely made (Trinh, 2003). Ethnobotanical studies are usually conducted among indigenous people in third world countries (Kumar and Nair, 2004). It is often source of valuable knowledge regarding composition, management and importance of home-gardens in terms of cash contribution to the households (Vogl et al., 2004).

⁴ For herbs trade are responsible licensed herbal stores, employing educated certified people with knowledge of traditional medicine. Trade and processing of toxic and abused herbs is regulated very strictly. In Vietnam, products of traditional medicine, including herbs and formulations, are part of official drug list (Ministry of Health of Vietnam, 2009).

2.2. Traditional use and management of P.Lolot

Piper is one of the most diverse tropical genera, which is grown especially in tropical rainforests. Piper species include wide variety of different plants, such as shrubs, climbers, and herbs. Some of them have extremely high economic value and commercial potential, in particular black and white pepper (*Piper nigrum* L.) a well known commercial commodity. Piper species are widely utilized by the indigenous populations all around the world for their anti-inflammatory, analgesic and narcotic effects. Therefore, there is enormous potential for the pharmaceutical industry (Jarmillo and Callejas, 2004; Dung et al., 1996). Moreover, plants from the genus Piper L (Piperaceae)⁵ are important especially due to its medical and culinary utilization (Raman and Galal, 2012). There are around 700 Piper species in American tropics, where as in Asian tropics there are only 300 piper species. In South Pacific only around 40 species can be found and in Africa only two piper species (Jarmillo and Callejas, 2004). In the table bellow, the most important Vietnamese piper species are described and also their utilization is emphasized.

Table 1. Overview of most common Vietnamese piper species (Piperaceae)

Latin name	Common name	Vernacular name	Part used	Purpose of use
<i>Piper lolot</i>	Lolot	Lá lô	Leaf	Spice, vegetables, medicine
<i>Piper betle</i>	Betel	Trâu không/Trau	Leaf	Medical
<i>Piper nigrum</i>	Black pepper	Tieu	Fruit	Spice

Source: Trinh et al., 2003

P.lolot is classified as neglected plant species with special importance for household food supplies in South-East Asian countries, such as Vietnam or Laos. As mentioned above, all Piper species' major utilization (including P.lolot) includes food additives and medicines. Another important category is environmental uses (Kew, 2012). Plants are crucial components of ecological systems due to their potential to become alternative to traditional insect-control agents. Self developed mechanisms tend to provide pest protection including repellent or poisonous effect. Moreover, effect on insect behaviour has been demonstrated (Wei-quan, 2010). From the ecological point of view, Piper species contributes to essential creation of forest structure in neo-tropics (Jarmillo and Callejas, 2004 and Dung et al., 1996).

⁵ Mabberley (1997) defines Piper L. Piperaceae is "a dioecious or monoecious shrubs including rheophytes, lianes and small trees often with swollen nodes, odour pungent." Extracts possess anti-fertility and insecticidal effect. P.nigrum L. is one of the most popular plants around the world and it also has hypoglycaemic effect. P.betle L. is (betle pepper is a dioecious) plant which is cultivated for fresh leaves and used as a medicine for its antiseptic essential oil. Plants from the family Piperaceae are usually grown in form of herbs or small trees (Mabberley, 1997).

2.2.1. Utilization of P.lolot in household medicine

P. lolot is very important component of folk medicine and it has been widely used among the rural people for various medical problems treatment, such as abdominal pain, cough, cold, edema, toothache, rheumatism, injuries as well as malaria⁶. Positive medical effect of the leaves has been confirmed and it was investigated that the plant possesses anti-swelling, analgesic effects with anti-inflammatory action⁷ (Loi et al., 1995). In addition according to Luger (2002) P.lolot has antibacterial activity. Its medical importance is further emphasized by Loi et al. (1995) and its utilization as a remedy against various diseases, including rheumatism, lumbago, digestive and stomach troubles as well as nausea was confirmed by the research. Moreover, it was realized that the methanolic essence of P.lolot has inhibitory activity on platelet aggregation and it has anti-platelet aggregation activity (Li et al., 2007).

In order to verify medical effect, analysis of the essential oil and its chemical components was made. According to research conducted by Dũng oil of P.lolot C. DC. contains 35 compounds. A major component was β -caryophyllene, the second bornyl acetate, which was contained in the rhizome oil (Dũng, 1996). The leaves and stem contain one of the most important essences, beta-caryophyllen. Another important essence is benzylacetate, which is contained in the root of the plant (Loi et al., 1995).

VTM is popular in Vietnam, especially because people believe that the cure is safe and efficient and it also has very long tradition in Vietnam. However number of official studies, confirming this issue are very limited (Smet, Brouwers, 1997). However, adverse effect of P.lolot needs to be considered as well while mentioning safety issues of VTM. According to Tarirai (2010), „Piperine (present in P.lolot) slows gastric emptying and increases the gastrointestinal transit time“. In addition Bhardwaj and Najjar claim that „Piperine, also inhibits P-Gps and CYP3A4, which might result in increased plasma concentrations of drugs that are substrates for these enzymes, such as rifampicine, theophylline, propranolol and phenytoin“ (Bhardwaj, 2002 and Najjar, 2010).

⁶ In order to treat malaria, Yellowdawn (2008) recommends to keep drinking for one week special drink made of mashed P.lolot mixed together with a half cup of wine and a half cup of water.

⁷ Activity against the bacteria *Bacillus pyocyaneus*, *Staphylococcus aureus* and *B. subtilis* was confirmed by research conducted by Loi (1995).

Even though traditional medicine is generally considered as safe since no harmful effect were reported some concerns regarding usage of some plants remains an issue. There are several risk connected with usage of VTM, including unsuitable cure of disease with herb or wrong identification of plant. Another safety issue is delay in visiting hospital, when people rely on traditional medicine and are afraid to visit doctor with knowledge of Western medicine. Moreover, it is believed that herbal drugs are harmless, and for this reason people often prefer them to western medicine and synthetic drugs. This statement cannot be, however, generalized and it has to be taken into account that some herbal drugs might even cause harm (De Smet, 2004). For this reason, healthcare professionals has to be aware about potential risks of VTM, such as possible toxic effects, drug-herb and herb-herb interactions, toxic effects as a result of contamination (Woerdenbag, 2012).

2.2.2. Food use of P.Lolot

The P.Lolot leaves are widely consumed and sold on the local market and further consumed as spicy vegetable. It is considered as highly demanded on the local market. Main utilization is according to Yellowdawn as a spice utilized in Asian cuisine especially for its specific aroma. Yellowdawn characterizes the taste of the plant's leaves as acrid and warm. Pepper spice can be substituted by P.Lolot plant in order to replace the pepper flavour. Piece of sliced beef can be wrapped with the leaves and grilled for a while. Also, the leaves can be used fresh as a salad with roasted beef, fish and soybean sauce. Another traditional and very popular Vietnamese receipt is P.Lolot egg omelette with minced beef. In order to guarantee the specific aroma, chopped P.lolot leaves are used for egg omelette preparation. Next, minced beef is added and the whole mixture is fried for few minutes. Major advantage of P.Lolot cuisine is beside its specific taste also its nature to cure various problems, such as fatigue, tiredness and exhaustion. In addition, especially during winter times dried P.Lolot leaves are eaten in form of beef soup in order to pre-heat the body before practicing any kind of winter sport (Yellowdawn 2008).

Kuebel and Tucker (1988) claim that leaves of P.lolot are utilized in order to assure flavour to roast beef or to a type of shish kebob. Firstly leaves are soaked in boiling water and afterwards beef is wrapped with the leaves, ensured with a toothpick.” (Kuebel, Tucker, 1988). Another extremely popular dish served in Vietnamese restaurants is Pho Phuong. Chao tom is sugar cane grilled together with pink shrimp paste. Mixture of soft beef sausage with grilled beef is wrapped into P.lolot leaves (Pataki, 2010).

2.3. *Piper sarmentosum* Roxb. (Piperaceae)

Particularly in other Asian and South East Asia regions *P. lolot*⁸ is often found under the name *Piper sarmentosum* Roxb. (Piperaceae).⁹ It is stoloniferous shrub with the average height from 300 to 800 cm. Shape and size of the leaves digger, and the size is usually 15 × 14 cm, base of the leaf is heart shaped (Raman, 2012). *P. sarmentosum* is known as a traditional medical plant utilized by the Malays in order to treat headaches, toothaches, coughs, asthma and fever (Tuntiwachwuttikul, 2006). Leaves have carminative properties. Moreover it was proved, that the plant has anti-inflammatory, expectorant and anodyne properties. Another usage of the plant is for various skin problems treatment, rheumatism, headache, diarrhoea, fever, indigestion and toothache. Moreover, roots are often utilized for cure of cough, asthma and toothache. The fruit can also be used as a spice (Raman, 2012).

In order to treat headache, the leaves and roots are attached to the forehead. Moreover, in order to treat muscle weakness and bone pain its concoction is used. In Indonesia, the roots of the plant are chewed together with betel nut. Juice of the plant is utilized for cough and asthma treatment. In order to cure pleurisy, *P. sarmentosum* is chewed together ginger. In Thailand the roots are mainly utilized to cure flatulence and stomach problems and muscle pain, where as major utilization of leaves and roots in Malaysia and Indonesia is treatment of toothache, fungoid dermatitis on the feet, cough, asthma and pleurisy (Tuntiwachwuttikul, 2006). Research conducted by Zakaria (2010) in Malaysia has confirmed anti-nociceptive (reduction of susceptibility to painful signals) and anti-inflammatory (reduces inflammation) effects of *P. sarmentosum* and results of this study have thus affirmed traditional medical utilization as remedy against pain and inflammatory-related illnesses. In addition, hypoglycemic and anti-malarial activity of the water extract of *P. sarmentosum* has been confirmed by pharmacological studies. Furthermore, antioxidant and anti-tuberculosis activities of the leaves of *P. sarmentosum* were reported (Zakaria, 2010). Additionally, studies conducted by Peungvicha (1998) have shown hypoglycemic effect of *P. sarmentosum* and confirmed traditional usage of water decoction for diabetic problems cure¹⁰ (Peungvicha, 1998).

⁸ *P. sarmentosum* can be also found under names, such as as Lolot pepper, La lot or Wild betel. Its botanical synonyms are: *Chavica hainana* C. DC.; *C. sarmentosa* (Roxb.) Miq.; *Piper albispicum* C. DC.; *P. brevicaulis* C. DC.; *P. gym-nostachyum* C. DC.; *P. lolot* C. DC.; *P. pierrei* C. DC.; *P. saigonense* C. DC (Raman, 2012).

⁹ Rukachaisirikul (2004) describes *Piper sarmentosum* as “glabrous, creeping terrestrial herbaceous plant with aromatic odour and pungent taste”.

¹⁰ Similarly according to Pongmarutai (1980), pharmacological studies have reported that crude aqueous extract of *P. rostratum* rox decreases blood glucose (Pongmarutai, 1980).

2.4. Traditional management of Neglected and underutilized crop species

Effective use, conservation and particularly management of NUS are important determinants of assuring availability of secure and balanced nutritional diet. Diversity of food crop species is closely linked human needs, preferences, and knowledge regarding to the management and use of plans (Fassil et al., 2000). Term NUS is usually used in connection to species whose potential has not been fully realized. Moreover the term can also be used for crops either abandoned by farmers or used in decline. NUS have been ignored by policy makers and researchers, thus special focus needs to be aimed on their cultivation, management, harvesting and post-harvesting (Eyzaguirre et al. 1998).

2.4.1. Home gardens

Home gardens¹¹ and subsistence farms often represent important source of NUS. Subsistence family farms can be found all around the world, usually in form of garden or backyards. Subsistence farming has very long tradition and nowadays it has very high economic value. Importance of home garden projects is recognized by government agencies as well as by NGOs. Marsh (2002) Midmore, (1991) and Ninez (1984) argue that city home gardens can be suitable solution to the poverty problem as soon as it will be adapted to local conditions and cultural traditions. Additionally according to (Ninez, 1984), higher level of sustainability is guaranteed due to the production managed directly by the family. According to them, these programs have higher potential for poverty alleviation than nutrition interventions¹². It also brings contributions to food security through regular supply of food which can be harvested any time by the family. Those without access to land are usually cultivating small free public space and use it as a garden. Moreover it is gardening is especially important during the period of draughts, failure of harvest or unemployment, unfavourable health conditions of family members or economical disturbance connected with riots and wars (Marsh 2002).

On the other hand home garden projects have been also criticized for not being sustainable and high expectation which can not be met. Moreover, it is also criticized that home gardens are suitable for families with access to land, water resources and technical resources and thus it does

¹¹ According to Mohan (2007), home gardens are divided into small with the total area less than 0.6 ha, medium (0.27-0.52 ha), large (0.53-0.78) and commercial with the size exceeding 0.79 ha.

¹² Failures in home garden projects have caused neglecting this issue by the development workers during designing development projects (Trinh, 2002).

not reach poorest of the poor. There are also several risks connected with urban agriculture including exposure to environmental problems, such as contamination of water source and potential contamination of food caused by polluted air (Marsh 2002).

According to Karim and Malik (1994), home gardens assure meaningful usage of space and at the same time through production of vegetables guarantees food security¹³ and contributes to health and nutrition of the household members. Moreover, it was analyzed, that home gardens are connected with increasing female self-esteem. Above all, it was proved supporting of home garden programs will contribute to poverty alleviation especially among rural poor. Mainly in rural areas, expansion in the vegetable sector is considered as a tool for poverty reduction. In order to implement successful home garden projects, it is necessary to know local indigenous knowledge about the traditional gardening systems (Marsh, 2002). Home garden is small scale agricultural system¹⁴ with wide variety of production¹⁵ where crops are grown on small scale with the main purpose of self consumption or for barter trade. Thus, the purpose of planting is neither commercialization nor market sale¹⁶. Moreover, home gardens represent important role in biodiversity (Ali, 2002).

Home gardens¹⁷ are managed by both men and women, however their tasks and responsibility for crops varies. It was investigated that majority of the decision related to commercial crops, such as rice, fruit are made by men. In addition, men are usually responsible for decision related to medicals, which is not considered as a cash crop (Trinh, 2002).

People have always been using various plants for assuring food, medicines, as well as construction materials and for manufacturing of different crafts, tools and other necessary items, such as fuel, paints and poisons. In addition, plants can also have a ritual character. (Hamilton et al, 2003). Nowadays, home gardens of low income household in developing countries are

¹³ Products are primarily used for family consumption and what remains is either sold or exchanged in form of barter trade (Marsh 2002).

¹⁴ Ali claims that size of home garden is 846 m² in South Vietnam and 138 m² in North Vietnam.

¹⁵ It has been investigated that home gardens in South Vietnam generate 11% of vegetable and 14% of fruit and in North Vietnam the percentage is 42% of fruit and 3% of vegetables. In addition, home garden is important source of nutrient and particularly micronutrient deficiency is linked to insufficient vegetable consumption (Ali, 2002).

¹⁶ Major inputs include fertilizer, manure and pesticides. Labour is usually employed in land preparation, crop management, harvesting and marketing. Threats in the vegetable sector include poor marketing infrastructure, low yields, marketing and production costs and seasonality.

¹⁷ It was observed that home gardens usually use free space in front of the house for processing and drying. Few gardens also had pond utilized mainly for fish breeding. People tend to focus rather on practical issues than ethical ones regarding to the appearance of home gardens.

utilized not only for purposes mentioned above, but also have significant socio-cultural importance especially due to their usage as food or spices, medicines, beverages, fodder and shelter. Home gardens in Vietnam are very important not only from cultural point of view¹⁸, but also due to its contribution to food security of low income households and nutritional improvements. To sum up, the major contribution is due to their socioeconomic importance, as well as valuable source of knowledge for the ethno-botanist (Trinh et al, 2003).

To understand home gardens is vital for successful economic development of the country since home gardens represent important tool how food security and income generation can be assured (Trinh, 2002). Home gardens are closely related to food security and there is significant potential in connection to gardening promotion to improve food security among the urban and rural poor. Moreover, it has been proved that 50% of food supply represents home garden products (Marsh, 1998). All in all, according to Marsh (2002) home garden projects should be integrated in the long term strategy for poverty alleviation. They generate self sufficiency of households through secure food supply. Thus these programs might be more efficient and sustainable than subsidies.

2.5. Commercialization and contribution to household cash security

Commercialization is defined as procedure of movement from subsistence farming system into semi-commercial or commercial systems. Profit is maximized through surplus generation (Pingali and Rosegrant 1995). In Subsistence farming system non traded household generated input is utilized, where as semi-subsistence and commercial systems uses rather traded inputs than household generated ones. As a result of commercialization, market increases both input and output side and also sale of product increases. Above all, commercialization of the vegetable sector might contribute to rural economy development and thus positively influence welfare of the farmers and their families (Weiberger and Genova, 2005).

¹⁸ The composition of home gardens is influenced by taste preferences of family, cultural and food habits, market, government and agricultural policy and finally by development projects. In Vietnam, there are often fruit trees which have often practical meaning as well since they provide shade. Home gardens in Vietnam is based on indigenous knowledge and often vegetable and fruit are grown there. However, many often pond and animal breeding is also integrated. Home gardens are important feature of Vietnamese culture since last 50 years they represented important tool of assuring food security. Home gardens are valuable source of vitamins, minerals and thus they mean important developmental and social services. For this reason, there is no doubt that knowledge on traditional home garden strategies has to be part of development projects (Trinh, 2002).

As a consequence of supply and demand model and increasing importance of cash crops, home gardens are commercially oriented (Vlková, 2011). In Vietnam subsistence home farms are widespread especially due to low suitability of land for rice growing. Even though subsistence food production is major reason why people maintain home gardens, recently home garden products are commercialized. Government supports this process through introduction of various policies, through facilitation of market access, private ownership of land and foreign investments. As a consequence, home gardens can earn extra income from sale of products (Trinh, 2002). Narloch (2009) points out importance of market chain development, which is achieved as a consequence of increasing competitiveness of final products.

Vegetables are more competitive than other crops however, the production is more expensive. Vegetables are often traded as a cash crop due to assurance of higher profit than other crops (Weiberger and Genova, 2005). Commercialization causes growing capital intensity, which in turn contributes to growing agricultural sector (Reardon and Barnet, 2000). Rising income and creation of employment opportunities contribute rise of real wages and commercialization further contributes to economical growth (von Braun, 1995).

Agricultural expansion results in agricultural trade which brings contribution to the market development. Finally resources are distributed to the economy. Thus agriculture influences economy through contributing to product, market and factor development. Employment and wages are direct result of the commercialization. Consequently increasing consumption positively influences local economy (Weiberger and Genova, 2005). Employment is another effect of commercialization, especially since family labour can be consequently replaced by external workforce. Moreover income of labourers is rising and new employment opportunities are created (von Braun 1995). Weiberger and Genova (2005) have investigated that commercialization contributes to well being of rural people in following ways. First of all, consumption rises, level of investment and savings are pushed up and finally children have more educational opportunities occurs and average school attendance ratio increases, which is consequently followed by better housing condition (Weiberger and Genova, 2005).

Research conducted by Vlková (2011) have confirmed that the most common utilization of home garden product from Phong My commune food (86%), medicine (32%) and firewood (32%). Home gardens in Phong My province have showed to be less market oriented than in other parts of Vietnam. However, it can be stated that plots highly contributes to socioeconomic well being of the families especially due to the importance in daily diet and nutritional intake. Subsistence

farms are primarily analyzed in order to identify wild plants, species composition, biodiversity and genetic information. Even though, majority of home garden products are usually grown for subsistence purposes, they are also important for income generation.¹⁹ Families often see home garden as source of balanced diet and recognize its socioeconomic contributions. Moreover, sale of home garden products represent source of income. However, farmers often focus on traditional species rather than focus on plants with high commercial potential. From the economic point of view, farmers have to face increasing price of inputs, volatile market prices and problems connected to market chain failure (Vlková, 2011).

2.5.1. Lesson learned from commercialization of P.betle in India

P. lolot is widely utilized in Vietnam and due to this fact it can be assumed that there is economic potential of the plant. Availability of *P.lolot* outside of Vietnam is, however, very low and it can be hardly found on foreign markets. On the contrary, *Piper betle* L. (Piperaceae) (*P.betle*) is widespread commercial crop and is sometimes called as Green Gold of India. *P.betle* has huge impact on Indian economy especially since it guarantees employment through creation of related jobs in the agricultural sector. In particular, around 20 million people in India are involved in production, processing, trade and marketing of betel. Betel leaves are exported overseas and thus generates enormous profit to the country. Commercialization of betel leaf thus generates foreign exchange (Guha, 2006). For this reason analysis of possible commercial potential of *P.lolot* was conducted and it was analyzed whether it can be commercialized in the same way as *P.betle* in India.

2.5.2. Marketing of vegetable products in Vietnam

In North Vietnam a common marketing practice is to send women in order to bring the vegetables to the wholesale market, where vegetables are sold in large bulk. The auction on the wholesale market starts at 3 a.m. and ends at 7 a.m. Retailers from city markets further buy

¹⁹ Results of study conducted by Vlková (2011) have shown that home garden products are used for extra cash generation and in addition it is also valuable source of fresh food. 52% of the research participants were supplied by additional income as a result of product sale. On the contrary, according to Trinh, 2003, around 50% of the crops are sold on the market. Moreover Vlková claims that 55% of the research participants derive additional income from the forest products.

vegetables from the wholesaler market in large quantities.²⁰ Afterwards marketers come back home prepare harvest for the next night. Average distance, people have to travel is 20 km in Hanoi. Only around 2% is sold through the agent, majority of the vegetable is sold directly on the market. Marketing strategies are very poor in North Vietnam and wholesaler marketing system is missing. Marketing is done by the farmers themselves, which is very time-consuming for them. On the contrary, In South Vietnam market infrastructure is relatively well developed. Vegetables are sold by means of marketing agents who collect the crops directly from the field. Sometimes, farmer bring crops to the wholesale market alone, however the distance they have to travel is very short, usually less than one kilometre (Ali, 2002).

2.6. Value chain

The term Value chain was invented by Michal Potter. According to Potter, value chain is „systematic way of examining all the activities a firm performs and how they interact“. Potter claims that it is basic tool in order to conduct analysis of the competitive advantage. Each link in a value chain is composed of several activities, which are executed by a firm to “design, produce, market, deliver and support its product” It is very important in terms of competitiveness, sometimes small differences in operations might be crucial to economical success. (Porter, 1988) According to Will (2008) value chain is set of activities starting from production of raw material up to its transformation into final product which will be sold to the consumer.

2.6.1. Influence of value chain on poor farmers

According to IFAD (2010), value chain is wide spectrum of activities necessary to deliver product to target consumer including way through different production phases, processing and final supply. It is also described as market based cooperation among various stakeholders involved in the production as well as market process. Market value chain analysis is crucial step for understanding of certain market and its mutual interactions of various actors, reasons of growth or limitations of production and lastly competitor analysis (Rota, 2010).

Actors of the value chain include producers - farmers, village traders, processors, retailers, wholesalers and finally consumers who consume the product either on the local market or on

²⁰ Average amount spent on food is 5,576 VND per capita in North Vietnam, where as in South Vietnam the amount spent on food equals to 6,252 VND. Around 56% of food is produced at own farms. In South Vietnam home garden products represent around 35% of food consumed (Ali, 2002).

external market. However, when it comes to the division of gains received from the sale of final products, poor receive only an extremely low share. It is thus necessary to assure better access to the markets, which might have potential of rural poverty reduction. Needs of poor, especially women, to be empowered and environment enable the poor to be able to reach the market. To exemplify, infrastructure, and sanitation needs to be improved and also business skill of poor farmers. All in all, equity needs to be achieved in particular it has to be guaranteed that economic gains will be equally distributed especially among the poor voiceless farmers (Rota, 2010).

2.6.2. Value chain of traditional herbal products

Value chain identifies standard socioeconomic and power relationship occurring during the production process, which starts from material and ends at high value end product. Value chain of herbal medicine is connected to development of product and its value from ethno-pharmacological resources. In another words, it is set of related activities that are necessary to finish end product from the input available (Booker, 2011). The analysis of value chain can be used in order to assess socioeconomic gain, loss and risks of the value chain participants. It is necessary to identify gain for primary producers in relative terms compared to other actors of the value chain since they usually get little benefit compared to other actors involved in the product (Litvinoff and Madeley, 2007).

Value chain of medical products varies from product to product, however so far, few studies about value chain of herbs are available. Despite potential treats of over-collection and depletion of the resources, medical plants represent important contribution to livelihoods of poor people from the developing countries. Demand of European consumers for high quality natural medicine with the context of ethical and social responsibility could assure secure source of income for poor people dependent on herbal medicine production.²¹ (Alam and Belt, 2009).

Vertical integration in the value chain is necessary in order to enable farmers to become its active actors. Moreover companies can easily control supply quality. It is emphasized that involvement in production of medical herbs could significantly contribute to rising welfare of poor farmers. However, it is emphasized that fair distribution of the gains is necessary (Shahidulla, Haque, 2010). Fairtrade products benefit both the farmers and consumers through delivery of high quality products. Farmers get payment above the market price and thus are

²¹ However initiative between Indian farmers, planting medical plant kutki, and European company failed and finally farmers were forced to replace kutki with apple production (Alam and Belt, 2009).

supposed to invest into high quality production. However due to its suitability for some cases only and since it is applied only to limited amount of farmers, it is also not the universal solution (Farnworth and Goodman, 2008). Also, it was investigated that Fair-trade benefits larger farms and it was realized that poor farmers does not benefit that much from it. However, fair-trade contributes to development of better working conditions and more fair distribution of gross margin along the value chain (Booker, 2011).

According to Will (2008) developing value chain of NUS might contribute to social, environmental and economic impacts due to the fact that agro-biodiversity is very often crucial to livelihood of poor people in terms of food security improvements and nutrition balance as well as income generation. Through linking supply capacities to market opportunities Value chain development can provide simple solution. So far, no studies regarding commercial potential and value chain of P.lolot are available and findings of this research might hence contribute to spread of worldwide awareness of this issue. Only little information is available about value chain of other NUS and attention has been mainly focused on value chain of traditional herbal products.

Figure bellow explains distinction between local, market, healer and national value chain of medical plants. One of example of medical plant can be P.lolot. According to Broker (2011), the simple value chain can be connection between healer, being both advisor and distributor of the medical herb and the patient as a final consumer. Healer is responsible for collection and processing of the medicine. He is also considered as expert with deep knowledge of the effects of the plant. Sometimes healers use services of local traders in order to have secure supply of the herb. Middlemen, who represent the connection between producer and either retailer or consumer can be also involved in the value chain. The structure differs depending to whether it is national or international value chain. Level of industrialization can be expressed by number of companies, such as pharmaceutical companies and retailers, involved in the supply chain.

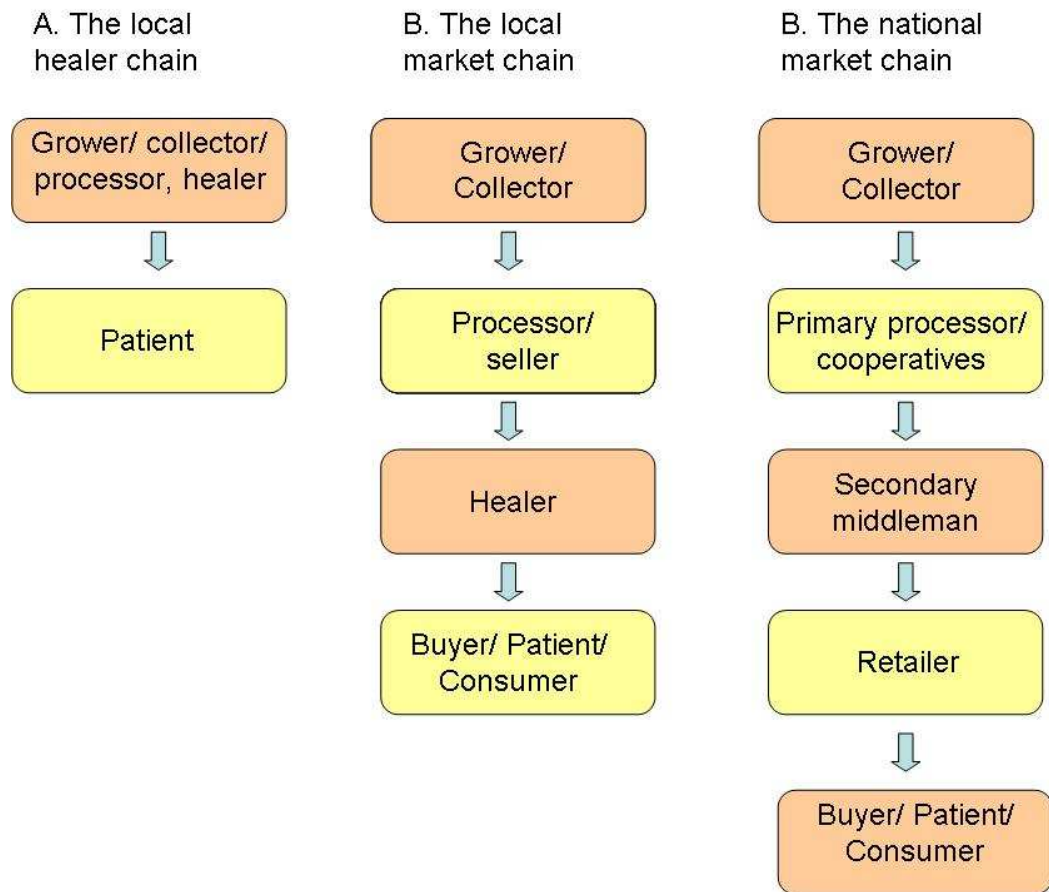


Fig 2. Different types of value chain of medical plants
(Based on Broker 2011)

2.6.3. Market analysis

According to Pindick and Rubinfeld (2005) “Market is a collection of buyers and sellers that, through their actual or potential interactions, determine the price of a product or set of products.” In order to understand real world economic conditions influencing market price and production, Supply and Demand analysis is used. Supply curve express relationship between quantity of certain good and its price. Quantity is measured on the horizontal axes, where as price is measured on the vertical axes. The supply curve is upward sloping since it expresses behaviour of seller, where with higher prices output is higher as well (Pindick and Rubinfeld, 2005).

Demand curve express relationship between quantity of good consumers are demanding and price of this good. Quantity is express on horizontal axes and price on vertical axes. Demand curve is downward-sloping showing that the lower the price is the more of this good will consumers buy. Factors influencing demand curve include income, change of consumer tastes and price of substitutes and complements. Two goods are substitutes when increase in the price

of one good causes rise of quantity demanded of other good. To exemplify, when price of beef increases more chicken meat is demanded. Where as when two goods are complements when increasing price of one good cause decreasing quantity demanded of other good. It is especially case of goods which are being used together. For example as soon as price of cars increases, quantity demanded of gasoline decreases. Equilibrium is found at the point where quantity demanded equals quantity supplied. As soon as market price is above equilibrium, as in the case bellow, there is market surplus (Pindick and Rubinfeld, 2005).

2.7. Vietnam

Vietnam is considered as a country with very fast economic development, currently experiencing economical boom. Key challenge however remains to assure equal distribution of benefits also to poor inhabitants, including farmers living in rural areas focused on traditional crop production and subsistence farming and to enable them to benefit from this economical development as well. (Ogle, 2011) According to Worldbank (2011), Vietnam is country of lower middle income level. Current GDP is 123.6 billion USD and there are 87.84 million people living in Vietnam. GDP per capita equals to 3,412 (WB, 2011).²² Human development index (HDI)²³ equals to 0.617 (UNDP, 2013) and the Gini coefficient equals to 38²⁴ (UN, 2011).

In the year 1986 Vietnam was one of the less developed countries of the world with highest poverty rate and many serious problems, such as hyperinflation, famine or trade embargo from the western countries. However, the consequent change of centrally planned economy to socialist-oriented market economy has brought remarkable changes and the Vietnamese economy, which has recently grown by 7.3% (WB, 2006 and IRD, 2012). Moreover, income has grown almost five times during last twenty years. Poverty was reduced, educational opportunities increased and also health care was improved significantly.

²² This indicator represents GDP per capita transferred to USD using purchasing power parity rates. For comparison GDP per capita in Czech Republic equals to 26,208 where as in Germany the GDP per capita is 39,491. (WB, 2011)

²³ The main focus of this indicator was measure life standard of people rather than national income. This index measures three pillars of human development including long and healthy life, knowledge and standard of living. HDI in Czech Republic 0.873 where as in Congo the value of HDI equals to 0.304.

²⁴ Gini Index expresses the equality distribution of income or consumption expenditure among individuals or households within certain economy. Gini index of 0 means perfect equality, where as an index of 100 represents perfect inequality. To exemplify, Gini index of Czech Republic was 26 (WB, 2005) where as Gini index of South Africa equals 63.1 (WB, 2009)

In the year 2004, redistribution of agricultural land together with improvement of social services enabled inhabitants to increase productivity and further improve living standards. Moreover, commercialization of agricultural products among low income rural households and small scale enterprises establishment also positively influenced economic development. Foreign investors entered the market and thousands of foreign companies were established followed by massive job creation and increase in average wage (WB, 2006).

Despite of above mentioned facts, agriculture still plays a significant role. Nowadays, Vietnam is the biggest rice exporter all around the world. Agricultural sector is responsible for 22% of GDP it represents 30% of export and employs around 52% of the population (IFAD, 2010). Opening up the market caused by accessing WTO in the year 2007 have resulted in import of foreign industrial good, which in turn caused increasing consumption levels. The Communist Party was forced to face the external influence from abroad, democracy and freedom of information (Awaji and Teranishi, 2003). However in the year 2007 due to the inflation and macro economical instability, economic growth started to slow down (WB, 2012).

Currently, there are several obstacles which are limiting investment of foreign companies, in particular scarce financial resources, limited infrastructure and insufficient access to land. Another development barrier is low education, knowledge and experience of the local labour. As a consequence, small enterprises rule the private sector. Almost all of the Vietnamese households are running small scale business and Vietnam is one of the countries with highest foreign direct investment (FDI). Business sector is expanding and growth is higher in foreign companies (WB, 2006).

Recently, various macroeconomic problems appeared, including inflation, currency depreciation or loss of international reserves. In addition not only environmental problems, such as pollution, but also social problems, particularly increasing vulnerability or problems of ethnical minorities have created future challenges in order to become industrialized country by the year 2020 (WB, 2011). One of the possible causes might be according to WB (2012) incomplete transition to market economy. Even though lot of people has been lifted above the poverty line, many of them remained extremely vulnerable to shocks including unemployment, accident, death or natural disasters. In addition, many of the poor have to deal with several issues, such as limited access to resources, isolation, poor educational health care opportunities. However, business development have caused dramatic fall in poverty rates in Vietnam (IFAD, 2012).

Household income increased as a result of agricultural growth. However, the poorest of the poor usually do not have access to land and also the off farm employment opportunities are missing. Poorest of the poor, living in the remote areas, have limited access to infrastructure, basic financial services, like credit and savings. Also unexpected events, such as disease significantly contributes to household income level reduction. Also children and women are more likely to be poor. Other group, often affected by poverty are ethnic minorities often rely on forest products and people living in remote areas with no natural resources. Also people living in coastal areas are more likely to be influenced by climatic disaster.

After accessing WTO, new opportunities as a result of global market access have arisen and agricultural products, for instance rice, coffee, tea, rubber, cashews, black pepper and fish started to represent significant portion of export to various countries all around the world. However despite of economical progress it is expected that rural population will remain poor in next 10 years. The core issues according to IFAD is improving access to market, promotion of private sector growth, support of services and market oriented approaches. Moreover, it is also important to develop pro poor rural program. To increase income of rural people is possible through assuring access to labour, finance, commodities and service market. Majority of these people are dependent on subsistence farming and for this reason creation of off-farm employment opportunities is also important (IFAD, 2010).

Another serious issue is ethnic minority poverty. There are 53 ethnic minority groups, being 47% of the poor. Despite of growing urbanization, structural changes and movement towards market economy poverty reduction remains still major challenge, especially due to the fact that for some of the poor it is very hard to reach the markets. Thus agriculture is important for this target group in terms of income generation (WB, 2012). The agricultural sector was especially developing thanks to increasing rice production in the 1990s. Economic development also brought contribution to small scale farmers especially through increasing production opportunities (Ogle, 2001).

3. Objectives

It is assumed that P.lolot is important medical plant, widely utilized also in Vietnamese cuisine. Its commercialization can contribute to economic security and economic success of Vietnamese subsistence farms through contribution to increasing welfare and living standards of low income Vietnamese households.

So far only few researchers conducted study about P.Lolot and thus only little information are available, in particular about the medical effects, usage and commercialization. Neither studies about commercial potential of P.lolot nor about its value chain were published so far. This has been major incentive for conducting this study.

The main objective of the thesis is to (i) to document traditional knowledge on specie use and management, (ii) to identify market potential of the plant and detect possible ways how to contribute to household cash security, and, (iii) to analyze market value chain and possible commercial potential of P. lolot, e.g. to detect whether P.lolot can be commercialized.

4. Methodology

4.1. Study area

The ethno-botanic research was conducted in Hue City, which is located in Thua Thien Hue Province in Vietnam. Thua Thien Hue Province is consisted of nine districts and one of these districts is Hue City, which is made of 25 communes. The total area of Hue city equals to 71.87 km² and the city is located on the bank of Perfume River. Hue city is considered as one of the most popular Vietnamese tourist destination, thousands of tourists are attracted by the historical city-centre, which is under the UNESCO cultural heritage (Ali et al., 2006). Hue city is located in the area of tropical monsoon climate with wet and dry seasons. The dry season is from March to August and the rainy season is from August to January. The average temperatures ranges from 35–40 °C during the dry season and from 9 °C up to 20 °C during the rainy season. Floods are very common during the wet season (Ishizawa, 1988). Average temperature is around 25°C and humidity is approximately 86% (Trai, 2001). The geographical location is 16° 28' 0" N, 107° 34' 45" E (Geohack, 2013). In addition, rural areas in Thua Thien Hue province were visited including Phú Hậu village and Dạ Lê village. Study area was affected by several conflicts especially during the Second Indochina War (Cu and Vy, 2006). Not only as a consequence this war, but also natural disaster, such as floods have caused lost of biodiversity and many plants species (Tuan, 2003). Effectivity of agriculture was very low which has resulted in low yield. This might be not only cause of limited access to arable land, but also by little capital and unfavourable terrain for irrigation. Furthermore, bad agricultural practices are not only result of state intervention and policies, but also by the post-conflict problems (Vlková, 2011).

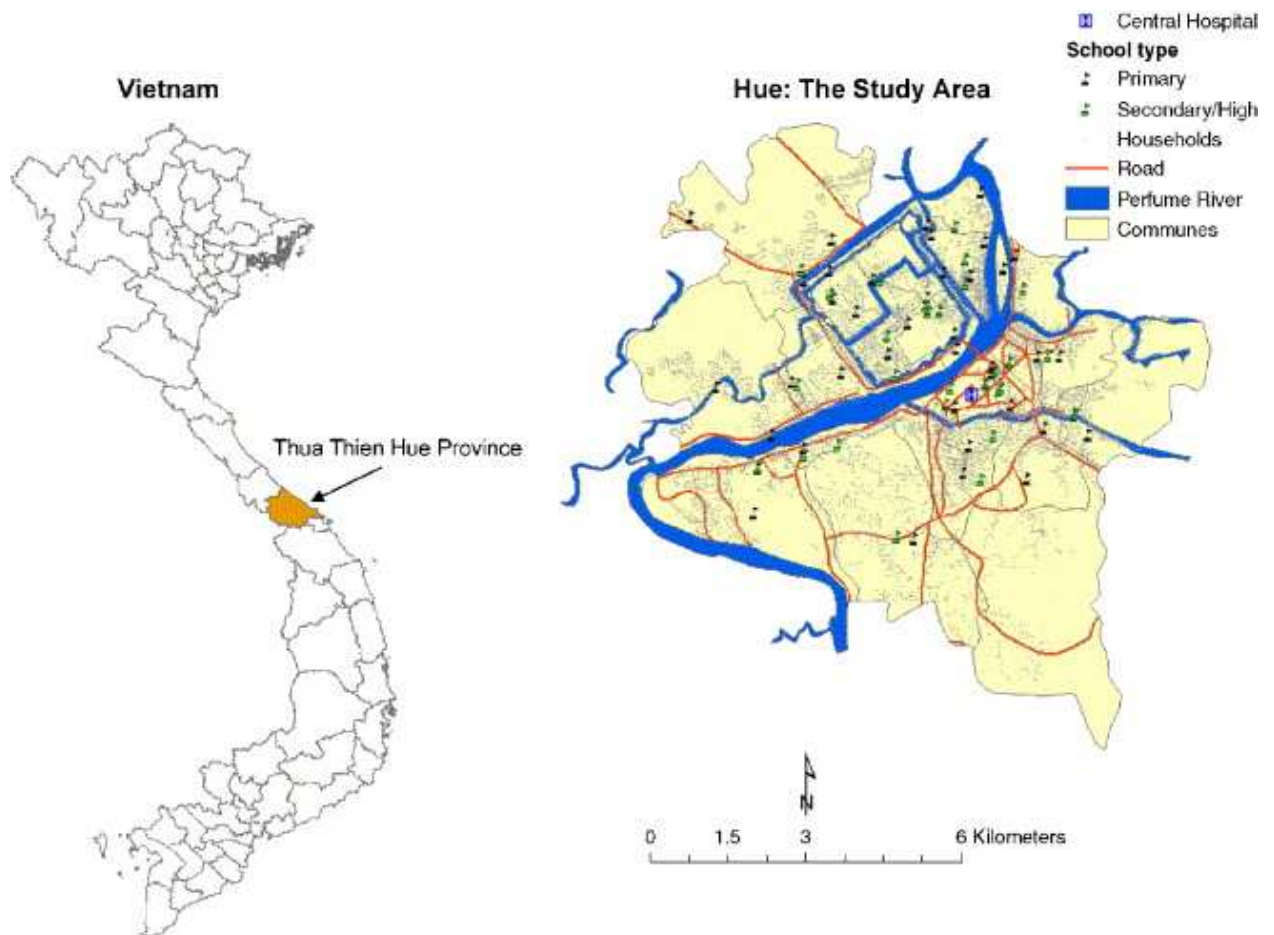


Fig 3. The geographical features of study area

Source: Ali et al, 2007

4.2. Data collection

Main methodological tool is in-depth descriptive analysis of randomly selected community members involved in the supply value chain of *P.lolot*. In addition, primary data were compared and supported by the secondary data and background regarding the issue was gathered based on information from scientific articles journals and reports. The ethno-botanical survey was conducted in the central part of Vietnam in Hue province in August and September 2012 personally by the author. Rapid ethno-botanical appraisal (Martin 1995) was utilized and author utilized mainly primary data, which were collected through interviews conducted with key actors participating in value chain of *P.lolot* in Thua Thien Hue province. Consequently, primary data were compared with secondary data gained throughout literature review.

Structured and semi-structured in-depth interviews containing open ended, closed, indirect and direct questions were utilized in order to gain qualitative data, which were further quantified by

means of decoding in order to estimate the econometric model. The research design is provided in Appendix 5 together with detailed overview of research questions. Important source of ethno-medical research is participant observation, which requires participation of the researcher within the community by means of observing the daily life of the local people (Alexiades, 1996). Field survey was executed with help of participant observation techniques and market surveys. As a sample size for this research, 31 in-depth face to face in depth qualitative interviews with key participants of the value chain, including three farmers involved in the production of P.lolot, four farmers not involved in the production process of P.lolot, 12 small scale marketers involved in the sale of P.lolot, three marketers involved in the wholesaling of P.lolot, seven consumers and four pharmaceutical workers. In addition to this sample size, in order to increase reliability of tested data, 12 others retailers and 3 additional wholesalers were shortly interviewed to gain quantitative information. Systematic approach of going back-forwards in the value chain was utilized and snowball method was applied in order to identify more participants (Gaoue and Ticktin, 2009, Bernard 1995). In order to verify medical effect of the plant received from the users, interviews in local pharmacies and hospital were conducted.

Table 2 and 3 provide detailed information about the respondents involved in the survey. Table 2 represents overview of the respondents according to their occupation/relationship to P.lolot and its preferred usage of P.lolot, where as table 3 provides information about gender, farming system type, information whether they produce P.lolot or not and source where from they get the plant. Majority of the respondents were retailers and second largest category were consumers. From the gender perspective, women represented the majority of our respondents (28 out of 31) representing 90% of the research participants.

Table 2. Research participants according to their employment and preferential use of P.lolot

Employment	%	Consumer use	%
Wholesaler	10	Food use	21
Retailer	38	Commercial	52
Farmer	13	Medical	18
Consumer	23	Barter	9
Pharmacy	16	Other	0

Table 3. Overview of the research participants according to socioeconomic indicators and attitudes towards producing and purchasing of P.Lolot

Sex	%	Farm type	%	P.lolot production	%	P.lolot Source	%
Female	90	Subsistence	57	Producing	43	Own farm	27
Male	10	Commercial	43	Not producing	57	Wholesaler	73

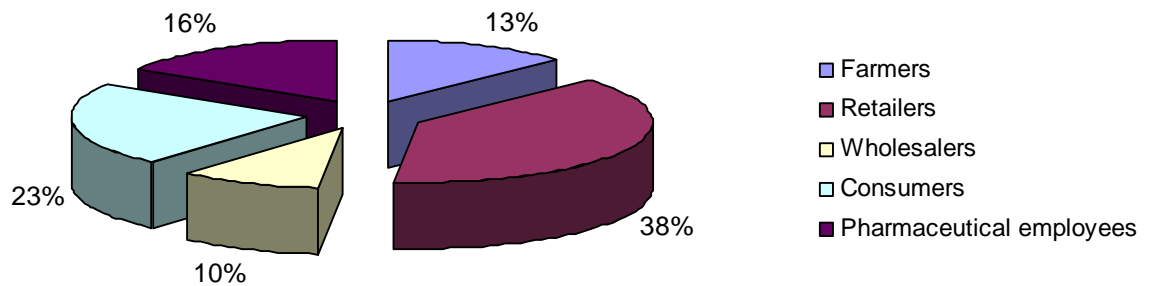


Fig 4. Respondents involved in particular level of value chain.

All of the participants of the value chain of P.lolot, including producers, consumers, wholesalers and small scale marketers were interviewed in order to analyze entire value chain and identify market potential, followed by opportunities for possible commercialization of the plant. Hue city was selected as initial research site due to the assumption, that the farmers close to the Hue city have high potential of commercialization due to the availability of markets (Weinberger and Genova, 2005). In addition, market places is important source of ethno-botanical knowledge is due to the interaction between both consumers and producers or plants and people. For this reason, it is often source of valuable data (Alexiades, 1996). Firstly interviews with wholesalers were conducted and one major trading point in Bai dau was identified. Consequently it was followed by interviews with small scale marketers, consumers and farmers.

The research was not only conducted in urban marketplaces, but also rural areas were investigated and farmers in Phú Hậu village and Dạ Lê village in Thua Thien - Hue province, Vietnam were visited. Collaboration with government officials was necessary prior to the ethno-botanical research since it was necessary to obtain official permit (Gaoue and Ticktin, 2009, Bernard 1995). Since prerequisite for successful ethno-botanical research is usage of native language for data collection Vietnamese translator was hired and all of the interviews were

translated directly from Vietnamese to English on the place. In order to document the data, notes were taken during the interviews and photographs were used for plant documentation.

Finally, data were analyzed through standard ethno-botanical and econometrics methods and for interpretation of result regression analysis as well as correlation analysis is used. In order to analyze consumer preferences regarding consumption of P.lolot, data were interpreted through standard Economic Botany methods based on Economic Botany Data Standards published by Kew (2013). In addition, results are explained on the basis of standard econometric model estimated through statistical software Gretl 1.9.12²⁵. Parameters were estimated using Ordinary Least Squares (OLS) Method. Dependence of nine explanatory variables was tested. Core issue examined in this section was to examine impact of several selected variables upon net profit²⁶. Total sample size was 30 marketers, including both retailer and wholesalers. Initially all of the parameters were tested to estimate the equation of dependence, however due to low reliability of the model significant parameters were tested separately in order to increase accuracy. In our study concept employed in study by Jensen and Meilby (2010) was applied.

$$Y = b_0 + b_1X_1t + b_2X_2t + b_3X_3t + b_4X_4t + b_5X_5t + b_6X_6t + b_7X_7t + ut$$

Y – endogenous variable (Net profit of traders)

X – exogenous variables

ut – random error

b₀, b₁, ...b₉ – parameters

$$b = \frac{\sum(X_i - \bar{X})(Y_i - \bar{Y})}{\sum(X_i - \bar{X})^2}$$

It is assumed that P.Lolot affects trading activity of the traders involved in the sale and particularly income of traders. Moreover it is expected that traders have higher income than wholesalers and with increasing competition the net profit decreases. In addition, availability substitutes and complements affects net profit as well and it is assumed that traders with own source of the plant have higher income due to savings which would be otherwise spent for purchase of the plant from external source. Furthermore, market price is expected to have negative impact on net profit, the higher the price is, the lower is the net profit. Additionally, it is

²⁵ Free statistical software inventored for Windows produced by Allin Cottrell and Riccardo “Jack” Luchetti, 2013.

²⁶ Net profit is calculated as total revenue minus total expense, where as family income represents total farm cash inflow.

expected that the older the trader is the higher the profit will be due to such a person being more experienced.

This study also examined availability of substitutes and complements on the market and it was expected that they have impact on the net profit. It has been assumed that as soon there are substitutes on the market, net profit decreases due to higher competition. On the contrary it has been expected that availability of complements contributes to higher net profit since it pushes consumers to buy more of P.lolot. It was observed, that in every case, there were at least one substitute and one complement present on the market. For the purpose of our survey as substitutes were mainly considered vegetables not used in connection with P.Lolot, such as morning glory (Rau Muong), Cabbage (Bap Cai), Bamboo shoots (Mang), Chayote (Su su), Ceylon spinach (Rau Mung Toi) or Cucumber (Dua Chuot). As complements were classified items, which are necessarily utilized for preparation of Vietnamese traditional dishes together with P.Lolot, including Beef, Shrimps, Lemon grass, Buffalo, Pork or Jackfruit.

5. Results and discussion

5.1. Traditional knowledge on P.lolot use and management

5.1.1. Planting and harvesting

According to our results, there are three most important ways of P.Lolot harvesting. Firstly, collection of wild plants around the fences and/or under the bamboo or banana trees. This is typical for subsistence farming systems where harvest is not commercialized. Secondly, common property area, such as forest, is another important source of P.Lolot, mainly typical for low income village households located in areas with unsuitable climatic condition for P.lolot planting. Thirdly P.Lolot is collected in the mountainous area, which is especially common for wholesalers with the major aim of commercialization.

Furthermore, our study showed that P.Lolot is not intensively grown plant in majority of the home gardens as other crops, such as vegetables or fruit. On the contrary, P.Lolot is grown as a wild vegetable near to the fence or under the shade of bamboo or banana tree. According to the respondents cultivation is very easy and no special maintenance is required since it is usually grown widely. However, as soon as P.lolot needed for commercial sale, when more of the plant is needed they have to plant it by putting root to the soil, which is either bought on the market or from other farmer. For commercial purposes, the plant is grown from February till April, in the area 500 m² around the fence, where as small scale subsistence farm plant it on the area of one till five m². In order to grow P.lolot, moisture is needed and the plant can only be grown in areas with high occurrence of precipitation. In addition, some of the research participants have reported source of P.lolot common property area, particularly forest and have confirmed that the plant grows in forest of high density due to the availability of most suitable land (damp soil).

According to the farmers plant is harvested in a time frame ranging from every two weeks up to every month. Majority of the farmers harvest the plant every one or two months, depending on the actual needs. They always harvest only half of the tree by means of cutting with the knife. Another opportunity is to remove plant from the soil with the root. Major harvesting season is in December after the flood season however P.lolot can be harvested all the year. The plant does not need to be stored due to immediate consumption.

Majority of the consumers buy fresh leaves in the city market in Hue city together with other food and in the village people grow P.Lolot either in their home garden or get it from the neighbour.

5.1.2. P.Lolot and nutrition

P.Lolot is important spicy vegetable which plays significant role in Vietnamese cuisine and it is necessary ingredient used for preparation of traditional Vietnamese dishes. The plant is mainly utilized for its unique flavour and it is used in several different ways, such as grilling, frying and cooking. Consumption of P.Lolot is very popular and in average it is consumed three times per week together with other vegetables. According to research participants, P.lolot is considered as extremely healthy and tasty part of Vietnamese diet and it represents important role in Vietnamese cultural dishes preparation. Moreover, it has high nutritional value. Firstly, it can be used for preparation of different kind of meat, such as beef, buffalo or pork, which is wrapped into the leaf and afterwards fried or grilled. Another traditional meal, containing this vegetable is Vietnamese soup. Pieces of P.lolot leave are boiled together with jack fruit and beef. Also, “Bó Lá lốt” is extremely popular and traditional Vietnamese dish. Beef is firstly fried on a pan and afterwards P.Lolot leaves are added. Leaves of the young plant are used for human consumption and cooking time is usually around 15 minutes.

Compared to other published studies, major utilization of P.lolot was for preparation of beef, shrimp, buffalo, pork meat and jackfruit soup. This was confirmed by Yellowdawn, Pataki (2010) and Kuebel and Tucker (1988). Research participants have also reported usage of P.lolot together with shrimp, which was confirmed by Kuebel and Tucker (1988). On the contrary Yellowdawn (2008) have reported usage of P.lolot for preparation of fish, egg omelet and soybean sauce. No such a usage was recorded throughout the research.

5.1.3. P.Lolot and medicine

P.lolot is widely utilized in VTM. Spice vegetables have often medical effects and leaf of the plant is considered as useful medical component. Utilization of P.lolot was confirmed by scientific studies by various researchers including for example Loi et al.1995, Luger (2002), Li et al. (2007), Dũng (1996), Loi et al. (1995), Tarirai (2010), Bhardwaj, (2002) and Najar, (2010). Even though medical effect of P.lolot are well-known and it has been considered as important medical plant, based on our respondents especially nowadays majority of the young people

living in the city do not trust traditional medicine and rather prefer modern western medicine, which was confirmed by Woerdenbag (2012).

Pharmaceutical workers participated in the research have claimed, that major advantage of the traditional medicine is the fact that in comparison with drugs herbs do not have any side effects, due to whole plant being extracted. For this reason people tend to prefer VTM, which is additionally less expensive and easily accessible through i.e. self-collection. Based on household interviews, P.lolot is mainly used for curing stomach or intestinal illnesses and respiratory illnesses or for haemostatic, particularly to stop nose bleeding. In addition, it is also used to cure recurring pain in the case of breasts, bones or tooth.

Traditional medicine also develops special systems of P.lolot preparation for healing purposes. For example in the case of arthritis and osteoarthritis cure, the plant is boiled for 20 minutes and the patient has to drink this decoction three times per day until the disease disappears. Another usage is against muscle ache. The plant is also used for massage in order to treat musculoskeletal pains²⁷. Furthermore, decoction is consumed whenever people start to feel ill, weak or tired. Moreover, P.lolot is also utilized to cure fever. Also, inhalation of the steam is used for treatment of the respiratory illnesses. Another medical effect is against hand or feet sweating. In the evening, hands or feet are soaked into water, which has been boiled together with salt and 30 g P.lolot for 20 minutes.

In addition, P.lolot is also utilized for stomach and intestinal problems treatment. Dry Piper lolot is mashed, cold water is added and it drunk against diarrhoea. Another possible usage is boiling fresh plant and drunk three times per day. Furthermore, it has been confirmed that the steam has positive medical effect in terms of treating the joint pain, against allergy and itching. Additionally, respondents have confirmed positive effect of P.lolot against hiccup as well and toothache. Against toothache root of the plant is crushed up with salt, and the juice is used as a palliative drug, which is attached directly to the infected place. In addition, it can also be used as a painkiller against bone or joint pain, especially during change of weather, when people start to experience joint pain and bone pain. Some of the female respondents have stated that the plant mixed with other herbs can be used for treatment of menopause, menstrual and gynaecological problems.

²⁷ It is however necessary to combine P.lolot with other herbs, the receipt described in the book Can and Vien (2007) recommends following receipt: la lot 10 g + Than xa 20 g Bac than 20 g, Ké huyet dang 16 g + co xuoc 20 g. All ingredients are boiled together

The average daily amount used in order to treat diseases listed above is either eight grams of dry leaves or 50-100 g of fresh leaf which is further boiled or crushed in order to cure these medical problems. Very often P.lolot is combined with other herbs such as lemon leaf. Finally, P.lolot in combination with other herbs (Star fruit and peanut leaf) is also utilized by the indigenous population as a treatment against snake bites. All of the ingredients are crushed, water added and the compound is drunk.

In order to verify information received throughout interviews, pharmacies in Hue City were visited and it the survey result has proved that there are two medicines which contain P.Lolot. First of all, “Thieu doc pu” medicament used for allergy treatment and itching and secondly “Hoa Han Linh” with the main effect of sweat and palpitations reduction, immune system support and tiredness alleviation.

Our survey has proved that especially older people are aware of its medical effect and claim that it is considered as a part of traditional Vietnamese medicine, used in the daily life for disease cure as well as illness prevention. This statement was also emphasized in study by Loi and Dung (1991) who confirmed that traditional herbal medicine is vital for people living in remote rural areas of Vietnam with lack of access to modern health. Similarly, Woerdenbag (2012) claim, that herbs are usually used also for long term cure of old people. Results of our survey further shows that younger people living in Hue city are not familiar with utilization of P.lolot as medical remedy, which was confirmed by study executed by Loi, Dung, (1991), who confirmed that in large cities, western medicine is rather utilized as medical remedy. According to our respondents, the plant was widely used as alternative medicine during wars due to scarcity of western drugs, which is in correspondence with other published studies. For example, according to Traditional Medicine in Union of Myanmar (2013) during war times people in Myanmar tend to rely on traditional medicine in order to maintain healthy life.

In conclusion based on the result of the study, major utilization for medical purposes include Rheumatic pain, Arthritis, Osteoarthritis, toothache, stomach problems and diarrhoea cure. Moreover, it is also utilized as a palliative drug against recurring pain, including muscle pain, bone paint, join paint. In addition, it is used for weakness, tiredness alleviation and immune system support. This was also confirmed by the study conducted by Loi et al. (1995) Utilization of P.lolot for fatigue, tiredness and exhaustion cure was also emphasized by Yellowdawn (2008). Anti-swelling and analgesic effects were confirmed by Loi et al (1995), which also corresponds

to result of the study and confirm utilization against recurring pain. Results of our survey have shown utilization of P.lolot against inflammation, which was confirmed by research conducted by Loi (1995), according to which Piper lolot C. DC. has the activity against the bacteria *Bacillus pyocyaneus*, a bacterium causing inflammation.

Cure of stomach problems was confirmed by Tairirai (2010), who reported slowing of gastric emptying and increases the gastrointestinal transit time of P.lolot. Similarly, utilization of P.lolot as a remedy against nausea and diarrhoea was confirmed in study by Loi et al (1995). Loi (1995) also points out activity of P.lolot against *Staphylococcus aureus* a major cause of skin infections, respiratory disease and food poisoning. Results of our study also confirmed utilization of P.lolot as a remedy against these problems. Our study has further confirmed utilization against hand sweating, allergy and itching, however, no such records were however mentioned in published studies.

Results of the research have shown, wide variety of utilization to cure cold and flu, and this was confirmed by the study conducted by Luger (2002), who investigated antibacterial activity of P.lolot. However, no literature sources have confirmed use of P.lolot as a remedy against hiccup, and for treatment of gynaecological diseases. Also official sources reported utilization of P.lolot as a remedy against malaria however no such utilization was investigated throughout the research. Respondents have also reported use against snake bites, which has not been confirmed by official studies. Respondents have further confirmed usage of P.lolot against nose bleeding, which was confirmed by research conducted by Li et al. (2007), who reported inhibitory activity on platelet aggregation. Compared to study conducted by Woerdenbag (2012), major utilization of herbs is used for cure of medical problems including fever, cold, cough, digestion problems, diarrhoea, dysmenorrhoea, rheumatism, hepatitis, diabetes or immune system support. All in all, the positive effects of P.lolot have confirmed its utilization in VTM.

5.1.4. Other

P.lolot not only symbolized important cultural role in Vietnamese society but is also associated with mythology. It is believed, that consumption of P.lolot contributes to balance of Jing and Jang (cool god and heat god) in the body. However, no official records have confirmed this statement. Moreover, according to Vietnamese tradition, neither beef nor banana soup can be prepared without P.lolot. There was additional usage of the plant investigated during the research, where respondents have confirmed security purposes of the plant, which is planted near

to the fence as a protection against snakes. These findings can be compared to results of study conducted by Weiquan, (2010), which indentified P.lolot as alternative to traditional insect-control agents. He also states that the plant can be utilized as against pest due to its repellent or poisonous effect.

5.2. Analysis of market value chain of P.lolot

Neither commercial potential nor value chain of P.lolot was investigated so far and thus findings of our study might enrich current scientific knowledge. It was investigated that P.lolot is collected in the remote mountainous rural areas and afterwards brought to wholesaler market, where from it is distributed to retailer markets in Hue city. The primary collector collects the plant in the rural area 70 km far away from the city and afterwards it is sold at the wholesaler market. Primary collector collects P.lolot in the afternoon and further sells it on the wholesaler market from 2 a.m. till 6 a.m., where retailers come to purchase P.lolot. Finally, end consumers buy it on the small scale market in Hue city from 6 a.m. till 11 a.m. Marketing is done by females and sometimes middleman is involved in the process. Similar trend was observed by Ali (2002). In North Vietnam wholesaler market starts at 3 a.m. and ends at 7 a.m. Women are selling vegetables on the market and marketing is done by farmers themselves, where as in South Vietnam goods are sold through marketing agents.

Our study has shown that only small portion is sold due to the demand being very low. People do not sell it with the aim to earn profit and it does not affect the trading activity of the marketers. Thus P.lolot is not sold as a commercial good but it is rather sold as a complementary good. Majority of the respondents were retailers and only 20% of the research participants were wholesalers.

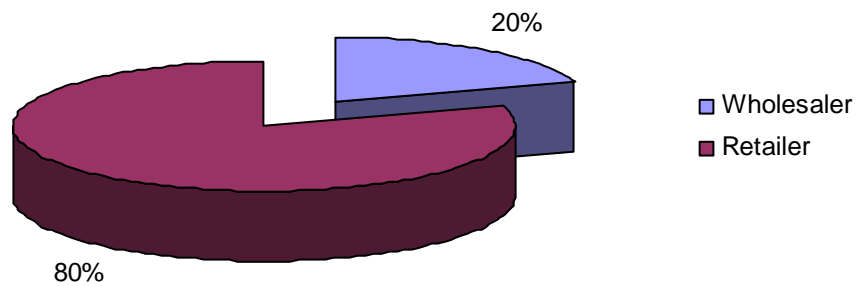


Fig 5. Respondents according to type of business

Figure below graphically describes value chain of P.lolot in Hue city and expresses mutual linkages between the stakeholders. First major source of P.lolot are subsistence farmers, who grow P.lolot not only for subsistence purposes and barter trade, but also for commercialization. Secondly, temporary source of P.lolot can be also primary collector, who is responsible for collection of P.lolot in the mountainous area. P.lolot is further distributed to the wholesaler market in Bai dau, where from it is further distributed to the retailers to the Local urban city market, where consumers can buy it. Regarding method of sale, 80% of the research participants were retailers. Similar concept was described by IFAD (2010).

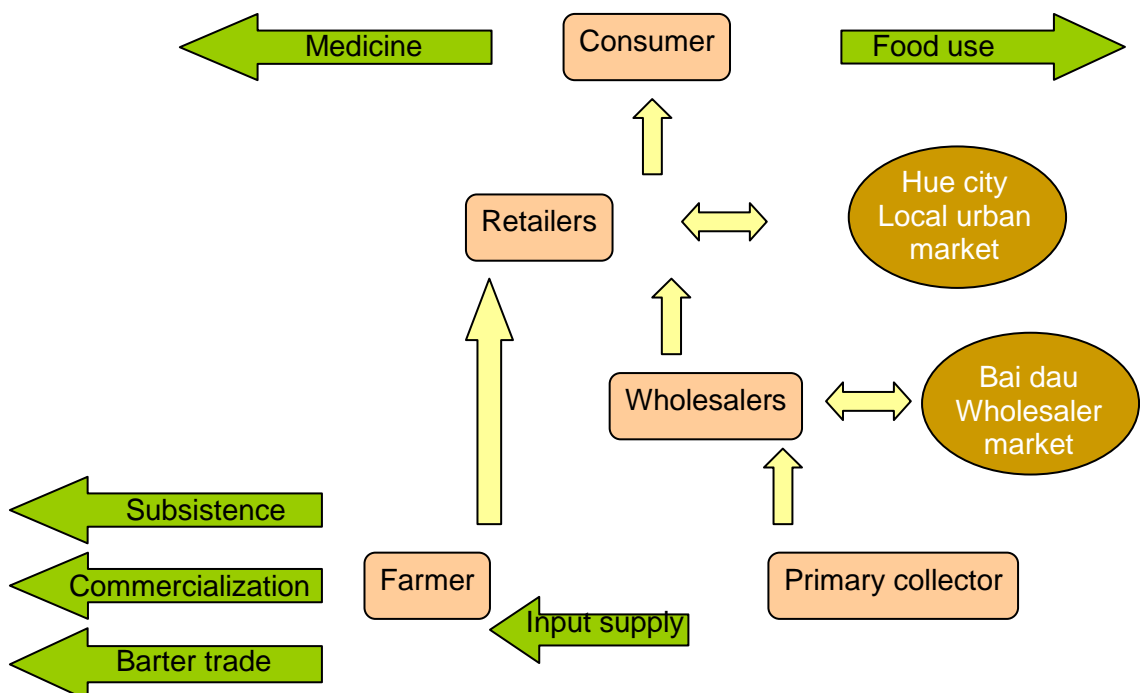


Fig 6. Value chain of P.lolot in Hue city, Vietnam

5.2.1. Wholesaling

Agricultural products are often distributed through wholesaling. The product dedicated for domestic consumption remains in the fresh form. Due to the fact that cooling systems is missing, P.lolot has to be sold as soon as possible after harvest and for this reason transportation system is essential link in the value chain. Majority of the food sold on the city markets or in supermarkets are not yet fully integrated into the marketing channels. There are two supermarkets in Hue city, however not fully involved in P.lolot sale. Major actors of the value chain are thus wholesalers and retailers. However, some of the marketers sell the product directly in the city market, which is in correspondence with other studies (Weiberger and Genova, 2005).

The price at the wholesaler market ranges from 8,000 up till 10,000 VND per kg. During the research period price was high because of the dry season. However, after the rainy season (February till March) price drops to 1,000 or even 500 VND. Total amount of P.lolot sold in one day in Hue city is 30 kg, which means that one marketer sells on average from three till five kg per day. Thus P.lolot does not significantly contribute to cash generation of the marketers. Research shows that demand was very low due to the high prices. According to the wholesaler marketers, despite of price decrease, demand for P.lolot remains low. Even though this statement is in contrary to economic theory of supply and demand, it might be explained by the fact that P.lolot is not market commodity. P.lolot is only sold complementary good and majority of consumers prefer self-collection and/or they plant P.lolot for their own subsistence. P.Lolot is only sold for special events, such as wedding or celebrations, when large bulks are required. The net profit of the wholesaler marketer from P.Lolot sale ranges from 5,000 till 6,000 VND per day.

5.2.2. Retailers

The majority of the retailer purchase P.lolot on the wholesaler market (73%) and the rest collects P.lolot from their own home gardens. According to the research participants, it is very easy to grow P.lolot and majority of the consumers can plant it themselves. However, it is demanded by the urban inhabitants, who do not have access to land. Only small amount of P.lolot is required and for this reason it represent only small share of the market space. This is reason why it is not intensively grown in large commercial areas. On the contrary, only little amount is grown in for cooking purposes in subsistence farms.

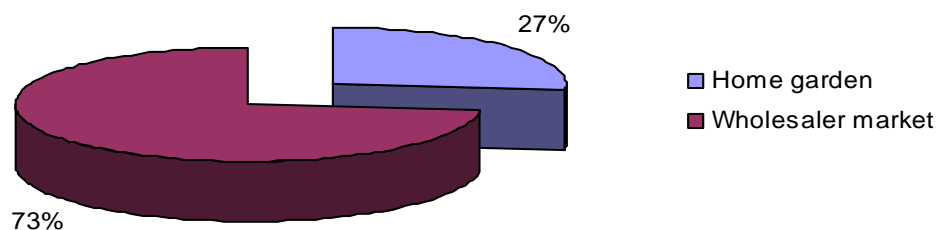


Fig 7. Source of P.lolot for retailers

Study has document the current market price on urban market for P.lolot in Hue city ranges between 8,000 VND and 20,000 VND. The net profit of small scale traders ranges between 4,000 VND and 20,000 VND. The average family income²⁸ is between 20,000 VND and 40,000 VND per day. Table 4 shows average market price and Net profit of the small scale traders and in figure 8 the situation is expressed graphically.

Table 4. Market price of P.lolot on Hue city market and Net profit of the traders

	Market price per kg	Net profit per kg
Average	13,666.67	7,933.33
Median	13,000.00	6,500.00

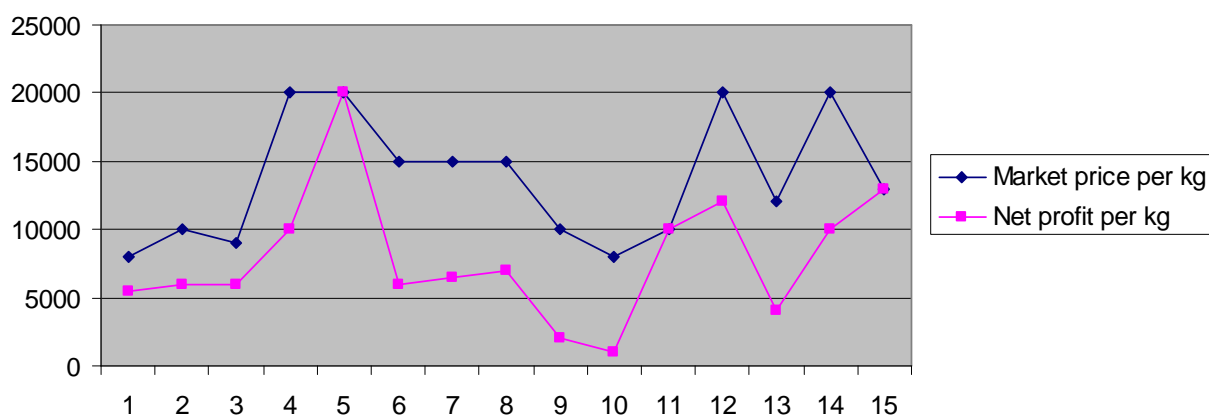


Fig 8. Market price and net profit of retailers in Hue city, Vietnam

²⁸ Family income represents total family cash inflow.

In order to analyze, whether there is any relationship between market price and net profit of the small scale traders, correlation analysis was applied on the sample size of 15 retailers. It can be concluded that there is a positive relationship existing between market price and net profit of the market commodity, thus the higher the market price the higher the profit of the marketers will be. However due to coefficient of determination being extremely low, the result can not be concluded as statistically significant and for this reason it can not be assumed that there is relationship between market price of P.Lolot and net profit of marketers. However, income does not fully reflect well-being of research participants and thus can not be considered as an indicator of household welfare.

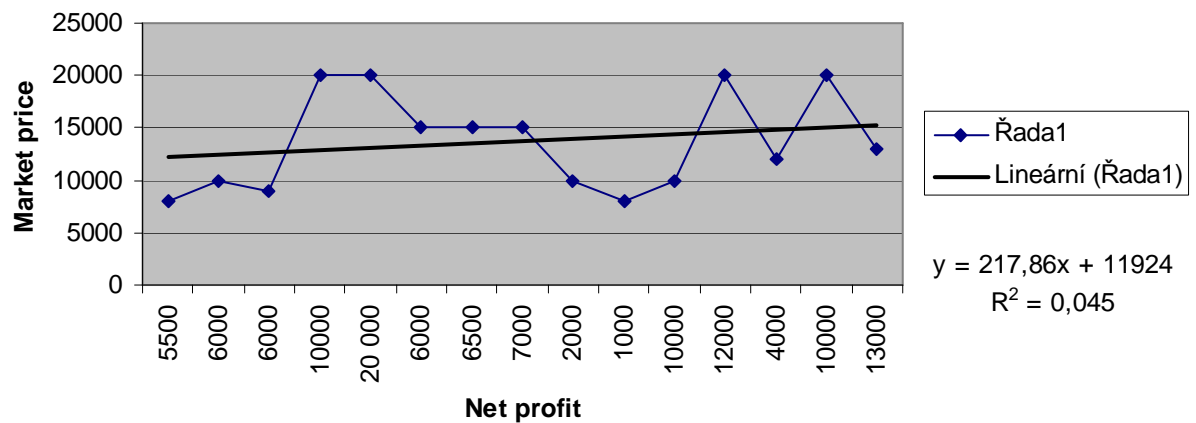


Fig 9. Impact of market price on net profit of retailers

5.2.3. Farmers

Majority of our respondents were not involved in production process of P.lolot. Major reasons for that, according to our the survey results is low awareness about planting techniques and low soil quality or, more probably, because they abandon its cultivation because of low profitability and they turned their attention towards other more economically promising crops in order to increase household cash security. Figure 10 shows that more than half of our respondents were not involved in the production process of P.lolot.

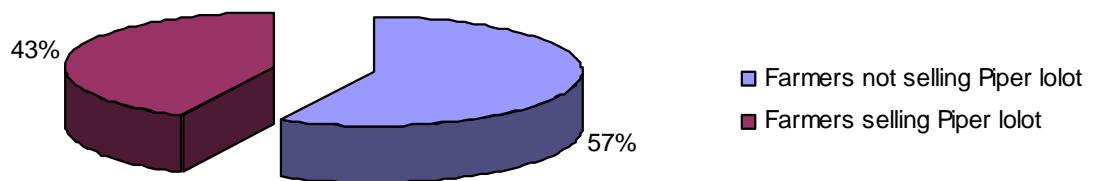


Fig 10. Farmers involved in production of P.lolot

For example one respondent reported that planting P.lolot generated only 2,000 VND of net profit per kg in the case that P.lolot is sold through middlemen. Therefore, P.lolot was consequently removed from the crop rotation system and replaced by cash-crops, such as flowers which generate three times higher profit.

Currently no study about P.lolot was published and few researches about value chain of herbs are available. Compared to study of value chain of traditional herbal products conducted by Broker (2011), major actors of the value chain include farmers, village traders, processors, retailers, wholesalers and consumers. Unless P.lolot, which is only consumed on the local market, traditional herbal product described by Broker (2011) reaches external market. Value chain for vegetable products in Vietnam was analyzed by Ali (2002), who concludes similar approaches and trends as used in our study.

5.2.4. Major utilization of P.Lolot among subsistence farmers

Based on our results major utilization of P.lolot can be divided into four categories: (i) subsistence agriculture, (ii) commercialization, (iii) medicinal purposes, and (iv) barter trade. Farmers were interviewed in order to investigate major purposes of planting P.Lolot. Primarily, 52% of the respondents used P.lolot for cash generation and/or subsistence purposes. P.Lolot is commercialized and the plant is distributed as a market good either directly or through the middle man to the wholesaler market. Second major category was food use (21%) under which respondents mainly used P.lolot for food purposes in order to assure balanced diet and for high

nutritional value of the plant. 18% of farmers have reported medical usage of the plant and 9% of the respondents use the plant for barter trade. Under the condition of barter trade, P.lolot is exchanged within the village community members for another good.

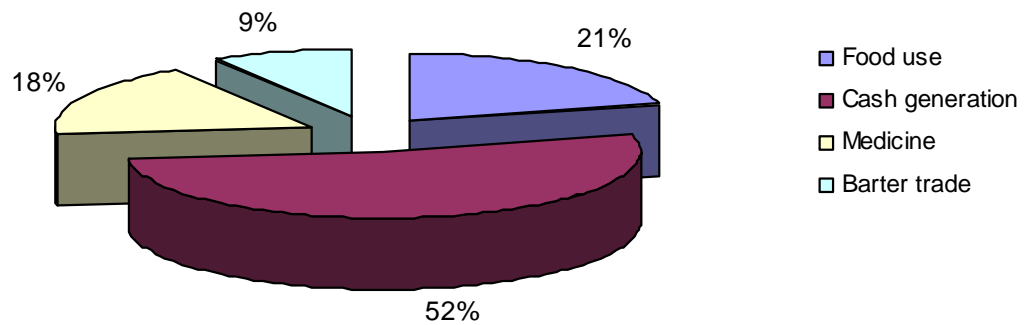


Fig. 11. Categorical usage P.lolot into major categories according to farmers

5.2.5. Consumer preferences/attitudes

Our study documented that there are six major categories of P.lolot use, including food additives, social use, vertebrate poisons, non-vertebrate poisons, medicines and environmental uses. The largest category was food additives – leaves, which represents P.lolot as a major ingredient for preparation of traditional Vietnamese dishes. The category social use – miscellaneous social use represents especially mythological association of P.lolot in terms of balance of Jing and Jang. Under category vertebrate poisons is usage of P.lolot as a protection against insect, particularly snakes, which according to research participants keeps the insect far away from the house. It is also used for various diseases treatment and prevention, which is represented under the category non-vertebrate poisons – viruses. Under the category medicine were recorded blood, digestive, genitourinary, immune systems, muscular-skeletal and respiratory systems disorders. P.lolot is further used within category medicine also for inflammation, pain, poisonings and mental disorders. Last category is environmental use of P.lolot, including boundaries, barriers and aesthetical issues (Kew, 2012)

Table 5. P.lolot consumer preferences according to Economic Botany Data Standards, level 2, based on Kew (2012)

CATHEGORY	Number of respondents	Percentual share
FOOD ADDITIVES - Leaves	19	28,36%
SOCIAL USE - Miscellaneous social use	1	1,49%
VERTEBRATE POISONS - Reptiles	1	1,49%
NON-VERTEBRATE POISONS - Viruses	9	13,43%
MEDICINES - Blood System Disorders	1	1,49%
MEDICINES - Digestive Systems Disorders	5	7,46%
MEDICINES - Genitourinary System Disorders	1	1,49%
MEDICINES - Immune System Disorders	3	4,48%
MEDICINES - Inflammation	2	2,99%
MEDICINES - Muscular-Skeletal System Disorders	9	13,43%
MEDICINES - Pain	4	5,97%
MEDICINES - Poisonings	1	1,49%
MEDICINES - Respiratory System Disorders	9	13,43%
MEDICINE – Mental Disorders	1	1,49%
ENVIRONMENTAL USES - Boundaries/Barriers/Supports	1	1,49%

Detailed usage²⁹ of P.lolot was monitored consequently sorted into 26 categories including:

- i) food use – preparation of beef, shrimp, buffalo, pork meat and jackfruit soup
- ii) medical purposes – inhalation in form of steam and drinking decoction for various diseases treatment, including rheumatic pain, arthritis, osteoarthritis, stomach problems and diarrhoea, as a palliative drug against recurring pain, including muscle, bone and joint paint, toothache, for weakness and tiredness alleviation and respiratory system disorders, hand sweating, allergy, itching, immune system support, hiccup, for treatment of gynaecological diseases, inflammation, to stop nose bleeding and to cure snake bites
- iii) other – protection against snakes as a barrier and for balancing of Jing and Jang

All in all, our survey has showed that the highest utilization was documented for food purposes, especially for preparation of beef. Secondly, research participants have confirmed that it is

²⁹ Detailed overview regarding usage of P.lolot and in-depth consumer's preferences is recorded in Appendix 1 and 2.

widely used for preparation of jackfruit soup and third most popular usage was as a steam for inhalation against various medical problems.

Figure below represents major consumer preferences and attitudes and the source of P.lolot. The lower part of the figure represent major source of P.lolot, where as the upper part indicates consumer preferences. P.lolot is usually obtained from homegardens, city market, neighbours or common property resources and it is further utilized to assure nutritional intake, for subsistence farming and common property resources and it is further utilized to assure nutritional intake, for subsistence farming and household food security, disease cure and prevention and barter trade.

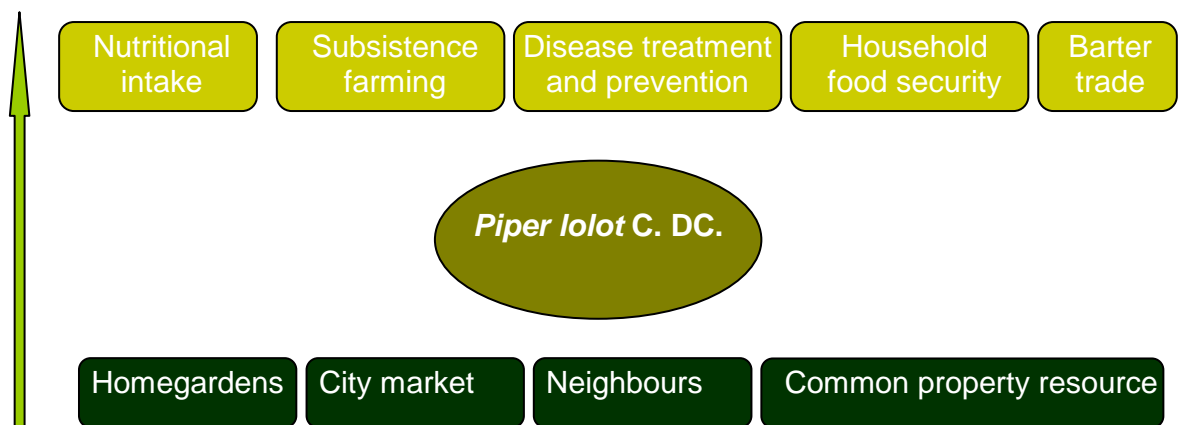


Fig 12. Consumers' preferences and the source of P.lolot

5.3. Identification of market and commercial potential

Unlike in other developing countries, such as in India, where commercialization of P. betle contributes to national economy through generation of job opportunities in the agricultural sector and international export (Guha, 2006), our research has not confirmed that commercialization of P.lolot would benefit neither Vietnamese national economy nor local farmers involved in the production of P.lolot.

Results showed that P.lolot is grown for subsistence purposes only, due to the fact that it does not contribute to income generation. It can be concluded that the highest income earn the retailers. Generally, our survey documented that P.Lolot is not considered as an important cash crop compared to the other neglected and underutilized crops and thus, market potential is extremely low and hence it is not market commodity. According to research participants, plant is grown on small peace of land and thus it brings a little contribution to income generation of the families. This could be explained through low profitability and absence of economic benefits

from P.Lolot production. Due to everyday utilization, subsistence farms are preferred by local markets as a source of P.lolot. Generally, there is very low potential of P.lolot becoming marketable vegetable or cash crop, since supply exceeds demand. However, the plant still remains important especially for its high cultural and traditional value. Survey result shows that P.lolot is not sold as a main market commodity, such as onion, or chilli. In addition, the survey proves low contribution P.lolot to income generation on the contrary the role on the market is rather as complement to other market commodities. In depth study of the market situation is conducted in the following chapter.

5.3.1. Market Analysis

Figure bellow applies principles of economic law of supply and demand on the domestic market for P.lolot in Vietnam. Vertical axis represents quantity of P.lolot demanded, where as horizontal axis represent price of P.lolot. Initially, market equilibrium is found at intersection of supply and demand curve, where consumers are demanding Q^* amount P^* of P.lolot. However, due to current situation on the market, supply exceeds demand and demand curve thus moves to D_1 . Now here is market surplus and equilibrium moves to upwards. Consumers are now demanding Q_1 at price P_1 . Under current market conditions, P_1 equals to 13,667 VND per kg and Q_1 equals to 30 kg. Red triangle represents ability of the poor households to pay for the good. Blue triangle graphs missing income which is needed in order to buy the good. Green triangle is consumer surplus.

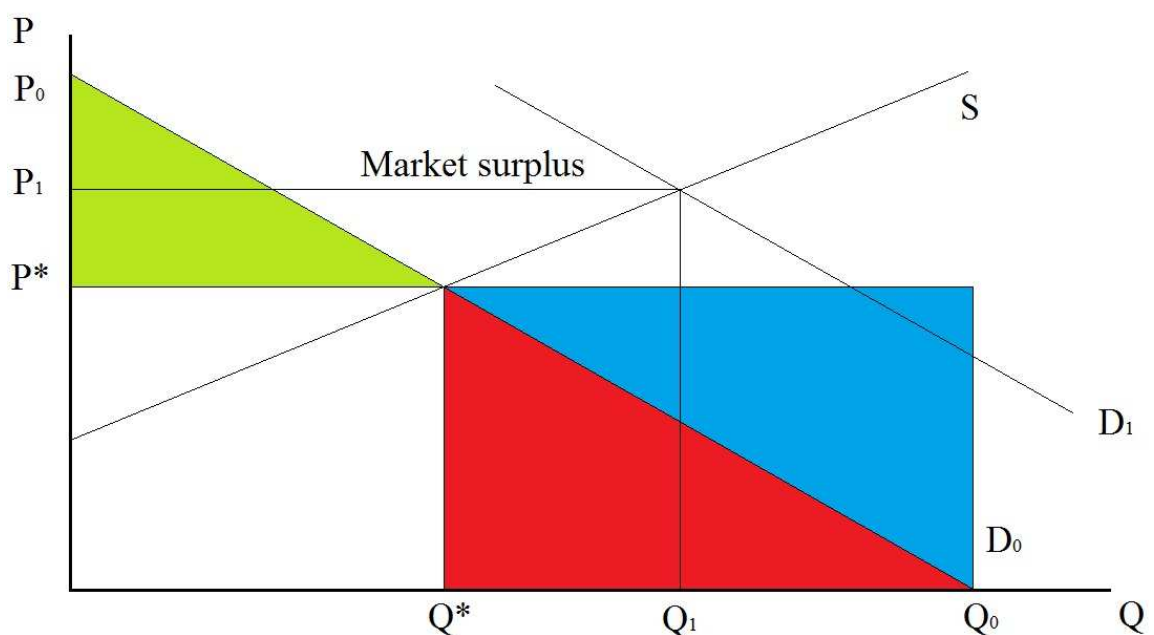


Fig 13. Analysis of urban market for P. lolot in Hue city, Vietnam

Note: $P_1 = 13,667$ VND per kg, $Q_1 = 30$ kg

Under these conditions, good of some producers remains unsold. This situation presses the marketers to push down prices to be competitive. As soon as market prices are pushed down, overall market price of the good decreases as well. As a result, consumers will consequently start to demand more of the good and market finally moves toward an equilibrium price and quantity. In this case, excess supply caused downward pressure on the price. P.lolot is a normal good, which means that with rising income consumers tend to demand more of given good (Pindick and Rubinfeld, 2005)³⁰. Graphical description of P.lolot as a normal good is explained on the basis of figure bellow.

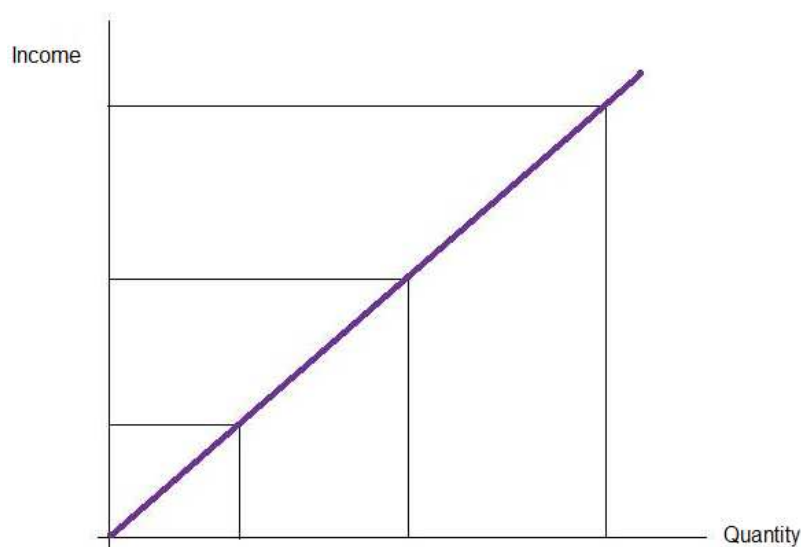


Fig 14. Piper lolot as a Normal Good

5.3.2. Net profit analysis

Analysis of net profit of traders was conducted and it was examined which factors have impact upon this issue. To sum up two parameters were significant (own source and market price) on alfa level 0.01. Two parameters (Substitutes availability and complements availability) were omitted due to exact collinearity. The rest of the variables were proven to be non significant and thus did not influence the net profit of the marketers. Table below shows detailed overview of variables utilized in the research. The middle column indicates whether variable was significant (S) or non significant (N) and in the right column is indicated p-value. NETPROF is endogenous variable expressed by the 9 exogenous variables.

³⁰ On the contrary, demand for inferior good decreases with rising consumer income (Pindick and Rubinfeld, 2005).

Table 6. Overview of significant and non-significant variables

Var.	Variable	S/N	p-value
NETPROF	Net profit of the traders		
CONST	Constant	S	0.0215
LAL	P.Lolot sold	N	0.2944
TYPT	Type of trader	N	0.4626
COMP	Number of competitors	N	0.5657
SUBA	Substitutes availability	omitted	
COMA	Complements availability	omitted	
OWNS	Source of P.lolot	S	0.0046
MAPR	Market price per kg	S	8.67e-05
SEX	Sex	N	0.4939
AGE	Age	N	0.9986

There is positive relationship between own source and net profit, which has confirmed the initial assumption that traders with own source to have higher profit. This might be explained by savings, which could be otherwise necessary in order to purchase the good. Moreover there is positive relationship between market price and net profit, the higher the price the higher the net profit is. However, the model is not very reliable, since R-squared equals to 0.54, which means that only 54% of the variables can be explained by this model. In order to increase reliability of the model, significant parameters were tested separately and R-squared increased to 0.59. The equation of dependence is stated bellow.

$$\text{NETPROF} = -1.40103 + 0.897 \text{ OWNS} + 0.827 \text{ MARPRI}$$

Adjusted R-squared =0.587

5.4. Research limitations

Firstly, research might be in a certain level influenced by cultural bias of researcher, when results are wrongly interpreted based on cultural expectations of the researcher. Furthermore, subjectivity might be another issue, when result is influenced by projection of own ideas, approaches and attitudes of the investigator. In addition, language barrier can also negatively influence the result especially when results are wrongly interpreted as a consequence of

misunderstanding during translation. Another problem is possible seasonality, when utilization of certain plant can be influenced by seasonal phenomena (Alexiades, 1996). Limitations of regression analysis include possible spurious regression, omitted variables or insufficient sample size. Moreover, another limitation of the study might be possible misinterpretation of the final results, especially due to the fact, that income does not necessarily need to be only indicator of well being of research participants and thus can not be perceived as the only indicator of household welfare.

6. Conclusion

Based on documentation of traditional indigenous knowledge it can be concluded that P.lolot is important wild plant especially due to its contributions to human nutrition (traditional cuisine) and health care (traditional Vietnamese medicine). The plant is commonly grown in subsistence agricultural system and it is especially important for its high traditional as well as cultural value. P.lolot is widely utilized in Asian cuisine for preparation of traditional dishes together with beef, shrimp, buffalo, pork meat and jackfruit soup. Medical effect of P.lolot was documented through the survey and confirmed by published studies. Survey results have proven that P.lolot is important component of VTM used for various diseases treatment, including Rheumatic pain, Arthritis or Osteoarthritis. In addition P.lolot is also utilized as a remedy for recurring pain treatment, cure of stomach or intestinal illness and fever. Furthermore, the study has also confirmed usage for immunity and regeneration support, head of chest cold, skin problems as a consequences of allergic reaction and finally for gynaecological problems treatment.

Commercialization of home garden products brings contributions to rural economy through increasing welfare of the farmers and their families. For this reason, commercial potential of the plant was examined and it can be concluded that market potential of the plant is extremely low. Research had shown that P.lolot can not be commercialized and can not contribute to economic success and security of the subsistence farms in Hue city. It can be summarized that there is market surplus and for this reason P.lolot can not be sold as market commodity due to very low demand. In addition, people prefer alternative sources rather than the market, such as subsistence farms, barter trade or common property resource. Results of our survey have confirmed that P.lolot brings a little contribution to income generation of the families due to low profitability and absence of economic benefits from its production.

Market value chain in Hue city was examined and it was investigated that P.lolot is collected in the remote rural areas by the primary collector and afterwards through Bai Dau to wholesale market, where from it is distributed to other small markets in Hue city. Correlation analysis has shown that there is no relationship between market price of P.lolot and net profit of marketers and it can be thus generalized that neither retailers not wholesaler marketers are not selling P.lolot with the aim to earn profit and it does not affect the trading activity of the marketers. This is especially due to the fact that majority of people plant P.lolot on subsistence farms. Profit generated through sale of P.lolot is extremely low and it is rather sold as complementary good.

Moreover, it can be concluded that P.lolot is normal good. Dependence of several variables was statistically tested and the results have confirmed that only a few parameters were significant. Traders with own source of P.lolot, such as home garden were showed to have higher profit and it was confirmed that market price influences the net profit of the marketers as well, the higher the net profit is. However due to low statistical significance, the results are not very reliable.

To sum up, result of our survey have confirmed that P.lolot is important medical plant, widely utilized also in Vietnamese cuisine however its commercialization can not contribute to economic security and economic success of Vietnamese subsistence farms due to its low commercial potential. In conclusion, our study has not confirmed commercial potential of P.lolot in Vietnam. However, the plant still remains important especially for its high cultural and traditional value. Thus, it is recommended to conduct additional studies, especially focused on current opportunities of commercialization in the area of household decision making process, institutional framework or policy making rather than on ethnobotanical issues, which was deeply examined by our research.

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Appendix

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Appendix i: Detailed overview of *Piper lolot*, C. DC. (Piperaceae) utilization

Interview number	With shrimp	With beef	With buffalo	With pork	Jackfruit soup	Protection against snakes	Steam (viruses poisons)	Decoction (viruses poisons)	Rheumatic pain	To stop bleeding	Osteoarthritis Arthritis	Stomach problems	Snake bites cure
1		1	1	1	1		1						
2					1		1						
3		1			1		1	1			1		
4		1		1	1		1		1				
5		1			1						1		
6	1	1										1	
7						1		1					
8		1									1		1
9													
10		1			1							1	
11							1	1					
12		1			1		1						
13													
14													
15												1	
16													
Total	1	8	1	2	7	1	6	3	1	1	3	3	1

Appendix ii: Detailed overview of *Piper lolot*, C. DC. (Piperaceae) utilization (cont.)

Interview number	Immune system support	Hand sweating	Diarrhea	Jing and Jang balance	Join Bone Muscle pain	Allergy Itching	Blood System Disorders	Inflammation	Hiccup	Palliative drug	Fence	Toothache	Gynecological diseases treatment
1													
2													
3											1		
4								1					
5													
6					1		1						
7					1								
8	1				1								
9		1						1					
10		1	1	1									
11					1								
12					1	1							
13		1				1							
14	1	1											
15		1	1		1				1	1		1	1
16					1								
Total	2	5	2	1	7	2	1	2	1	1	1	1	1

Appendix iii: Parameter estimation

Model 1: OLS, using observations 1-30

Dependent variable: Net_profit

Omitted due to exact collinearity: Substitutes_ava Complements_ava

	coefficient	std. error	t-ratio	p-value	
const	-1.03797	1.67881	-0.6183	0.5427	
Selling_la_lot	-0.245275	0.228355	-1.074	0.2944	
Type_of_trader	-0.332374	0.444606	-0.7476	0.4626	
Competitors	-0.0978317	0.167740	-0.5832	0.5657	
Own_source	0.896735	0.283888	3.159	0.0046	***
Market_price	0.892898	0.186232	4.795	8.67e-05	***
Sex	0.341703	0.491189	0.6957	0.4939	
Age	0.000218940	0.127421	0.001718	0.9986	
Mean dependent var	2.300000	S.D. dependent var	0.915386		
Sum squared resid	8.299358	S.E. of regression	0.614202		
R-squared	0.658463	Adjusted R-squared	0.549792		
F(7, 22)	6.059231	P-value(F)	0.000504		
Log-likelihood	-23.29287	Akaike criterion	62.58574		
Schwarz criterion	73.79532	Hannan-Quinn	66.17178		

Excluding the constant, p-value was highest for variable 10 (Age)

Appendix iv: Parameter estimation (second processing)

Model 1: OLS, using observations 1-30

Dependent variable: Net_profit

	coefficient	std. error	t-ratio	p-value	
const	-1.40103	0.573840	-2.441	0.0215	**
Own_source	0.896918	0.243562	3.683	0.0010	***
Market_price	0.827397	0.144360	5.731	4.30e-06	***
Mean dependent var	2.300000	S.D. dependent var	0.915386		
Sum squared resid	9.335274	S.E. of regression	0.588006		
R-squared	0.615832	Adjusted R-squared	0.587375		
F(2, 27)	21.64091	P-value(F)	2.46e-06		
Log-likelihood	-25.05720	Akaike criterion	56.11439		
Schwarz criterion	60.31799	Hannan-Quinn	57.45916		

Appendix v: Research framework and interview design

What is your sex (Male, female)

Location

What is your professional occupation (Subsistence farmer, commercial farmer, wholesaler, retailer, other)

Do you plant P.lolot?

Please state the major reason of P.lolot planting?

Please state the major reason why you do not plant P.lolot?

State the share of division of planting purpose of P.lolot (Subsistence, commercial purposes, barter trade)

Please state major categories of P.lolot consumption when using P.lolot for subsistence purposes (Food, medicine, other)

What is the state of land ownership (Own, rented)

How do you perceive soil quality? (Extremelly good, very suitable for P.lolot planting, good, average, extremelly bad, not suitable for P.lolot planting)

What the approximate area of P.lolot field?

Can please describe in details, how is P.lolot utilized or possibly describe the way how is it used.

In which time period do you grow P.lolot?

How often do you harvest P.lolot?

How is P.lolot harvested?

How often is P.lolot planted?

Does the plant need to be stored or is it consumed immediatly. If yes, how do you store it?

Please describe the planting procedure.

Which channels do you use for plant distribution in order to reach the final consumer? (Through middleman, wholesaler market, sell directly at the small scale market) Please also state the % of division representing each distributor.

Can you kindly describe the price fluctuation and price development in various seasons of the year?

How many man days do you spent with P.lolot planting?

How many man days do you spent with P.lolot sale?

Under market what price do you currently sell the P.lolot

What is your average Gross income per month?

What is the average cost associated with P.lolot planting per month?

What is your monthly net profit?

Where is the market located?

Do you sell P.lolot?

What is the market price per punch?

Where from do you get P.lolot? (Wholesaler market, own garden)

How would you evaluate the importance of P.lolot in terms of income generation compared to other market commodities?

How many competitors are available on the market?

Are there any substitutes currently present on the market?

Are there any complements currently present on the market?

Are you aware of any medicine containing P.lolot extracts?

Are you aware of any medical effects of P.lolot?



Appendix vi: Socio-cultural importance of *Piper lolot* C. DC. (Piperaceae)



Appendix vii: *Piper lolot* C. DC. (Piperaceae)



Appendix viii: *Piper lolot* C. DC. (Piperaceae) in subsistence farming system



Appendix ix: Retailer market, Hue city, Vietnam



Appendix x: Traditional Vietnamese dish (beef wrapped in P.lolot leaves)



Appendix xi: Field visit, Phu Hau village, Vietnam