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RESEARCH AND PROPOSE A MODEL OF AFFORESTATION COMBINING MEDICINAL PLANTS SUITABLE FOR THE NATURAL AND SOCIAL CONDITIONS OF BA BE DISTRICT, BAC KAN PROVINCE

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Abstract: *The agro-forestry system is a farming model that brings many social and economic benefits and has been implemented effectively in many forested areas of Vietnam. Bac Kan province (including Ba Be district) has a lot of potential for developing this farming system because of having the largest forested cover in Vietnam and favorable natural conditions for cultivating of many types of precious medicinal plant. The results of this investigation about models of afforestation combining medicinal plants in Bac Kan as well as in Ba Be district showed that many forestry lands have not been exploited effectively. Areas growing medicinal herbs are still small; this does not commensurate with the development potential of local and have not yet brought the maximum benefits of the agro-forestry system. On the basis of actual investigation, the current research proposed a model of growing medicinal plant (*Camellia chrysantha*) combination with afforestation (Tram tree and De van tree) in Ba Be district. These plants have been suitable for farming practices in mountainous regions and bring more incomes for the local people.*

1. INTRODUCTION

In recent years, "agroforestry farming system" has played an important role in the economic and social development of many countries around the world as well as Vietnam. This is a method of enriching the forest with agricultural trees, medicinal plants, specialty trees, shade-tolerant or shade-loving fruit trees that can be planted under the forest canopy [1].

The agroforestry system has been proven to bring many benefits such as: providing regular and annual income from intercropping trees under the forest canopy; protecting natural forests and planted forests with large and precious timber species; rational and efficient use of abundant light energy sources in the tropics; increasing water permeability and water retention, increasing the ability to prevent soil erosion of forests, especially planted forests, minimizing flood's impact in the rainy season and have water for domestic use and agricultural production in the dry season [2].

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The model of afforestation combining medicinal plants is a subsystem in agroforestry farming system, bringing dual benefits to forest growers, has been implemented in many localities of Vietnam and is considered as a biological availability of people, especially people in ethnic minority areas. The fact has proven that this model brings both immediate and long-term economic benefits to forest growers, especially in the early stages when the trees have not yet closed their canopy [3], [4], [5].

The forest cover of Vietnam reaches 42%, higher than the world average (29%) [6]. Vietnam is also a country with great potential for the development of medicinal herbs because it has many precious, rare and high-value medicinal herbs. Meanwhile, Bac Kan is a mountainous province with a large area of forest land with the highest forest coverage rate in the country (73.4%). Bac Kan province also has a lot of potential for the development of medicinal plants, but due to rampant exploitation, the area of naturally growing medicinal plants has gradually shrunk, and some precious medicinal herbs are almost eradicated. Therefore, the conservation and development of medicinal plants is a matter of concern today. Bac Kan province identifies the main strength of the province as forestry, especially the development of timber and medicinal products under the forest canopy of more than 300,000 hectares of forest land. However, the province has not been able to exploit this strength to increase people's income [7].

Ba Be district (Bac Kan province) has more than 80% of forest land, located in the tropical monsoon climate area, the annual average temperature is from 21⁰C – 23⁰C, the fertile soil is very suitable for the development of many plant species, especially medicinal plants. For example, Ba Be National Park has a system of primeval forests on limestone mountains, which preserves a rich forest habitat system, in which there are many rare indigenous medicinal species. The climate, soil and large forest area of Ba Be are very

favorable for the development of medicinal plants mixed with forest trees or medicinal plants under the forest canopy. However, at present, only a few types of forest gardens with very small scale exist in some communes in the district.

Development of forest and medicinal plant is considered an important socio-economic development orientation of Ba Be district as well as of Bac Kan province. Therefore, how to build models of afforestation combining medicinal plants for bringing overall benefits and improve production value per unit of forest land area is a very necessary and effective direction with high realism. To do this, it is necessary to have data to investigate and evaluate the existing models of afforestation with medicinal herbs or planting medicinal herbs in some localities of Bac Kan province. However, but so far, there is no adequately assessing data about this issue.

In this paper, the data on surveying and evaluating models of afforestation combining medicinal herbs/models of planting medicinal herbs in Bac Kan province was provided. These surveying and evaluating results were a basis for proposing development of a model of afforestation with medicinal herbs efficiently (both of developing multi-product forest economy and protecting the environment, responding to climate change), in line with the agro-forestry development orientation of Bac Kan province.

2. OBJECTIVES AND METHODS

2.1. Research objectives

- Investigate and evaluate some models of growing medicinal plant models in Bac Kan province.
- Proposing a model of afforestation combined with medicinal plants suitable to natural and social conditions in Ba Be district, Bac Kan province.

2.2. Research methods

- Inherit scientific documents and related research results.

- Conduct field survey and investigation of relevant farming models.
- Conduct questionnaires (or in-depth-interview) with contents suitable for local residents and businesses/cooperatives, satisfying enough information to serve the evaluation and analysis of models.
- Consult with experts on silviculture, herbal medicine at research institutes and pharmaceutical enterprises.

3. RESULT AND DISCUSSION

3.1. Assessing medicinal herbs growing models in Bac Kan province

According to the survey results, in Bac Kan province, although there are policies to promote the development of afforestation model combining with medicinal plants, this model has not been widely disseminated. The main models focus on growing indigenous medicinal plants or imported medicinal plants at household scale, cooperative scale or household association scale

within the framework of the current project.

3.1.1. Model of growing medicinal herbs at household scale

The model of growing medicinal herbs at household scale has been scatteredly developed in some localities of Bac Kan province. These patterns appeared because many people realized the practical role of certain types of medicinal herbs in the health care of their family members, or because there is a need to buy medicinal herbs from some people and healer. This has created supply and demand. However, this supply and demand is not really sustainable. Besides, many localities of Bac Kan have sources of indigenous medicinal herbs that grow naturally in people's gardens. Knowing the benefits of medicinal herbs that have both health care value and improved family economy, many households have zoned and taken care of those natural medicinal gardens for using and commerce purposes.

Table 1: Some models of growing medicinal herbs at household scale in Bac Kan province

Model	Combining with other plants	Item/ distribution	Project	Productivity (dry tons/year)
<i>Celastrus hindsii</i> ("Xạ Đền" in Vietnamese)	Fruit trees	Dried branches/ Free	3PAD*	0,5
<i>Gynostemma pentaphyllum</i> ("Giảo Cổ Lam" in Vietnamese)	Mixed trees	Dried branches/ free	None	0,5
<i>Illicium verum</i> ("Hôi" in Vietnamese)	None	Fresh flower/ Free	PAM5327**	6,7
<i>Camellia chrysantha</i> ("Trà Hoa Vàng" in Vietnamese)	Mixed trees	Fresh flower/free	None	unharvested

* Partnership project for the poor in agroforestry development in Bac Kan province (3PAD project) is funded by the International Fund for Agricultural Development (IFAD).

** Planting forests with funding from the World Food Program (PAM)

Through investigating the model of growing household level, the households all realized some medicinal species according at the the role and economic value of medicinal

plants much higher than traditional plants such as rice. However, the scale of planting was also located in the garden of the households, not in combination with intercropping with forest trees on forestry land. The difficulty for these households was output stage for products, leading to limitations in investment to expand the farming scale. Although some models of growing medicinal herbs of individual households had been originated from a certain project, but after the end of the project, to continue planting and tending, people had to find the output for products by themselves. There had not been a link between one household and another in expanding production and consumption and had not been linked with cooperative models and businesses, so input and output productivity was unstable. People are mainly self-

collecting, self-sufficient, self-sufficient, small-scale consumption at fairs by selling fresh or preliminary processing by drying. There is no orientation to invest in processing system, develop into licensed products on the market. Therefore, the effectiveness of these medicinal plants had not really been promoted.

3.1.2. Model of growing medicinal herbs at cooperative scale

The cooperative model of growing medicinal herbs is quite popular and is being replicated in localities of Bac Kan province. With the strategy of one commune – one product, Bac Kan province has contributed many OCOP-standard medicinal products such as Giao Co Lam (*Gynostemma pentaphyllum*), Tra Hoa Vang (*Camellia chrysantha*), Ca Gai Leo (*Solanum hainanense*), etc.

Table 2: Some models of growing medicinal herbs at cooperative scale

Cooperative/ location	Area/herbal type	Products	Origin of participating projects	Mode of Operation
Hoang Huynh/ Khang Ninh commune, Ba Be district	1 ha/ <i>Gynostemma pentaphyllum</i>	<i>Gynostemma pentaphyllum</i> OCOP3*	New rural program	Planting, caring, harvesting, purchasing, processing, developing products into commodities and consuming
Hoa Thinh/ Nghia Ta commune, Cho Don district	3.5ha/ <i>Camellia chrysantha</i>	<i>Camellia chrysantha</i> OCOP3*	None	Seed supply, technical support, purchasing, processing, product development and consumption
Thien An/ Vi Huong commune, Bach Thong district	10ha/ <i>Cinnamomum cassia</i> , <i>Illicium verum</i> , <i>Gleditsia australis</i>	Products for bathing from traditional medicinal herbs of the Dao people/OCOP3*	The joint project of growing and processing medicinal herbs and the project of deep processing of local medicinal products	Cultivation medicinal herbs; Support for seed and fertilizer for associating households, purchasing, processing, developing into commodity products and consumption
Bao Chau/ Lang San commune, Na Ri district	20ha/ <i>Morinda officinalis</i> <i>Fallopia multiflora</i> , <i>Solanum procumbens</i> , <i>Gynostemma pentaphyllum</i> , <i>Ampelopsis cantoniensis</i> , <i>Ardisia silvestris</i> , <i>Lonicera japonica</i>	Herbal extract, tea bag filter, <i>Solanum procumbens</i> extract /OCOP 3*	-The project is coordinated by TRAFFIC and the Provincial Forest Protection Department on strengthening management and fair benefit sharing for natural medicinal product chains in Vietnam. -The standard FairWild 2.0 project for harvesting wild plants	Growing and processing products for the market; medical examination and treatment according to traditional medicine methods

Cooperative/ location	Area/herbal type	Products	Origin of participating projects	Mode of Operation
Van Lang HT/ Van Lang commune, Na Ri district	12ha/ <i>Morinda officinalis, Milletia speciosa, Solanum procumbens, Celastrus hindsii, Ardisia silvestris</i>	<i>Solanum procumbens</i>	Joint project for the production and consumption of products from medicinal plants (<i>Solanum procumbens, Celastrus hindsii</i>)	Seed supply, planting, harvesting and supplying raw materials to pharmaceutical product manufacturers, product development
Thang Lợi/Binh Van commune, Cho Moi district	2.2 ha/ <i>Morinda officinalis</i> 2.03 ha/ <i>Fallopia multiflora</i>	None	The project for researching and development medicinal plants in Bac Kan province	Growing and processing medicinal herbs; Mining of stone, sand, gravel for construction, petroleum
Đông Nam Duoc/Ha Vi commune, Bach Thong district	0.5 ha/ <i>Hypericum sampsonii</i>	<i>Hypericum sampsonii</i>	None	Planting, harvesting and consuming, using for traditional medicine clinic of cooperative

Table 2 presents some models of cooperatives operating in the field of planting, processing and consuming medicinal herbs in some localities of Bac Kan province. In general, these models are derived from different projects and programs for the development of medicinal herbs. Most of the activities are involved in the chain of planting, tending, harvesting, processing and developing commodity products. Cooperatives have received the attention and support of local government and bringing positive effects for the economy - society. However, most of the models have difficulties of budget for expanding the farming area into material zone

and purchasing equipment for processing and preserving products. Thus, the products are still not diversified, mainly still processed in raw form. These models have not been implemented on local large forest land.

3.1.3 Model of growing medicinal herbs according to other projects

Along with the province's policies on the development of forests and medicinal plants, Bac Kan province has implemented scientific projects to develop medicinal herbs. Table 3 presents some information on some projects for developing medicinal herbs in Bac Kan province.

Table 3: Some projects to develop medicinal herbs in Bac Kan province

Project	Funding source	Executed in
Researching, evaluating, plant breeding and cultivation techniques <i>Zingiber purpureum</i> Roscoe in Bac Kan	Department of Science and Technology of Bac Kan province	Liem Thuy commune, Na Ri district
Researching on biological characteristics and technology for planting <i>Anoectochilus setaceus</i>	Department of Science and Technology of Bac Kan province	Bach Thong district, Cho Don district
Management and fair benefit sharing for natural medicinal product chains in Vietnam	Traffic International Organization in Viet Nam	Cho Don, Ba Be, Ngan Son, Na Ri
Building a model of growing medicinal plants associated with product consumption in some northern provinces of Vietnam	National Agricultural Extension Center	Huong Ne commune, Ngan Son commune Phuong Vien, commune Yen Thinh, Cho Don district
Model of growing medicinal plants and support growing	Project 3PAD	Khang Ninh commune, Ba Be district Duong Son commune, Na Ri district

Project	Funding source	Executed in
Model of growing medicinal plants	UN-REDD program of the Norwegian government	My Phuong commune, Ba Be district Quang Phong commune, Na Ri district
Research on planting and processing <i>Gynostemma pentaphyllum</i>	Department of Science and Technology of Bac Kan province	Nam Mau commune, Ba Be district
The model of growing <i>Solanum procumbens</i>	Youth Union of Ha Hieu Commune and Youth Union of Bac Kan province	Ha Hieu commune, Ba Be district
Model planting of <i>Polyscias fruticosa</i>	The Department of Agriculture cooperates with Center for Application of Science and Technology Advancement of Bac Kan province	Ha Hieu and Cao Tri communes, Ba Be district

All models of growing medicinal herbs according to the programs and projects achieved the targets of the projects. However, the effectiveness of the projects should be assessed not only when the project finished but also the maintenance and development of the post-project models. In fact, many medicinal models without the project's seed funding could not be maintained. The cause may be subjective and objective: Many households only participated in the projects in moderation, according to their commitments, but do not intend to develop for long-term; Many households wanted to develop but cannot afford to invest in developing the model. The models that could be maintained and developed mostly cooperative models due to related to the interests of the cooperative members. This showed that when the project finished, still need supporting about capital, techniques for cultivation, harvesting, processing, and output for medicinal products by local authorities, related departments and agencies and the project leader.

3.2. Proposing an appropriate model of afforestation combining medicinal herbs in Ba Be district

Although with the largest forest area in the country, with the terrain, soil and climate are very suitable for the growth and development of many species of indigenous medicinal plants as well as medicinal plants imported

from the other localities. However, the model of growing medicinal herbs in combination with forests in Bac Kan province in general and Ba Be district in particular has not been expanded. According to the survey, Ba Be district has quite large area of primary and plantation forest, but it has still large forestry land area that has not been effectively exploited or has a lot of areas with only naturally regenerated trees. This showed that Ba Be district has still many potentials and advantages to develop the forestry economy. Based on the level of forest cover, forestry land that has not been effectively exploited and the advantages of climatic and soil conditions, the model of planting medicinal herbs under the available forestry canopy or planting forests with medicinal herbs is a solution bringing many benefits: both preserving and developing forests, preserving and developing medicinal herbs in accordance with the orientation of Ba Be district as well as of Bac Kan province.

3.2.1 Proposing forestry and medicinal plants in the model of afforestation combining medicinal plants in Ba Be district

Forestry is identified as one of the key orientations, playing an important role in the socio-economic development of Bac Kan province. For that reason, the project on restructuring the agricultural sector in Bac Kan province towards increasing value and

sustainable development in the period of 2020-2025, with a vision to 2035, is affirmed: it is necessary to research and select forest trees that have high economic value, focusing on indigenous forest tree and valuable multi-purpose trees on the market, research and innovate planting methods, business cycles according to production of goods [8].

To response to that target, in the past few years, people have invested themselves in planting *Castanea mollissima* (Dẻ Ván – Vietnamese name) and *Canarium tramdenum* or *Canarium album* (Trám - Vietnamese name, including Trám Đen and Trám Trắng) to harvest chestnuts, and sell Tram fruit to the market, bringing high income for people. However, the cultivation *Castanea mollissima* is still mainly spontaneous and tends to increase, using seed sources that are self-seeded, planting and care techniques have not been guided by professional agencies. Therefore, there may be many risks such as poor seed quality, resulting in after many years of planting the tree has low yield, poor quality.

In fact, when planting Dẻ Ván and Trám, that were made by grafted technique, can be harvested after 2-3 years of planting, the rate of trees for harvesting seeds is high. For the grafted Trám Đen tree can be harvested after 3-4 years of planting. Therefore, the expansion of the area of these trees will come with a lot of profit for economy and society. Based on the, policies and orientations of local government for the development of multi-purpose forest economy, based on the benefits and the actual situation of the planting of Dẻ Ván and Trám Đen in Bac Kan, the model of mixed forest plantation, multi-purpose forest was proposed on inefficient forestry land in Ba Be district, includes grafted Trám Đen and Dẻ Ván. Both species are multi-valued trees: timber, seeds or resin harvesting. The height and dispersion of these two types of trees are different. Trám Đen is higher and larger canopy than Dẻ Ván,

so it can be planted simultaneously in the same forestry land. These two types of trees are also in line with the province's policy on restructuring crops, promoting forestry economic development by planting forest trees with high economic value, focusing on indigenous forest trees, multi-purpose trees with value on the market [9]. For medicinal plants, *Camellia chrysantha* (Trà Hoa Vàng in Vietnamese), that is used to make special tea, are proposed in this model. Trà Hoa Vàng is a small tree, shade-tolerant, likes scattered light, not suitable for direct light, very suitable for cool climates, grows under forest canopy. Therefore, they can be planted as a lower plant layer for protective forest belts to nourish water sources and prevent erosion. They have many leaves, have the effect of retaining water and improving soil [10], [11]. Trà Hoa Vàng are grown naturally in some localities in Bac Kan province such as Cho Don, Ba Be,... Comparing with other crops, Trà Hoa Vàng bring high incomes to people, contribute positively to economic growth. Therefore, Trà Hoa Vàng is increasingly focused on developing in many districts and communes in the province. This is also a key medicinal plant in development projects linked to the value chain, associated with the consumption of medicinal herbs [2].

3.2.2 Proposing a model of afforestation combining with medicinal herbs

According to the survey results, some villages around Ba Be Lake have still many areas of unexploited forest land, where only regenerated mixed wood species exist. Therefore, in these areas, if the mentioned model is applied, (mixed afforestation between Dẻ Ván, Trám Đen and Trà Hoa Vàng), it will be very suitable, increasing the production value per unit area of forest land, taking advantage of the forestry land that is being abandoned or inefficiently exploited. The diagram of mixed afforestation including Trám Đen - Dẻ Ván - Trà Hoa Vàng is proposed as follows:

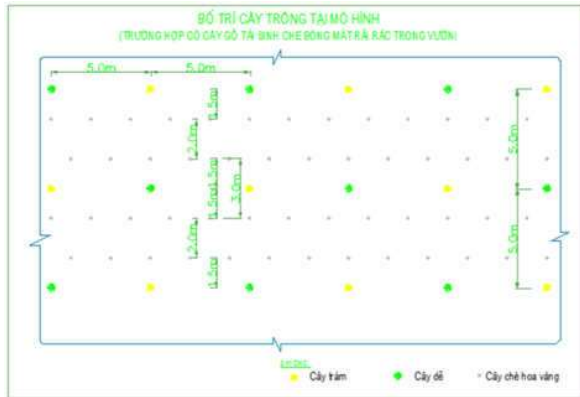


Figure 1: Diagram of mixed forest planting with medicinal plants (In case there is shading by regenerated trees)

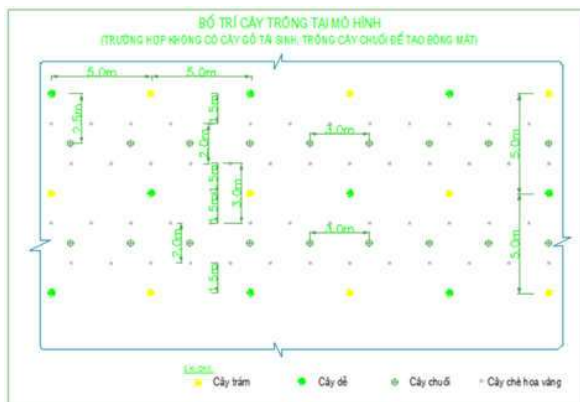


Figure 2: Diagram of mixed forest planting with medicinal plants (In case there is no shading of regenerated trees)

Figure 1 showed the forest land areas with regenerated timber trees that can create shade for growing of Trà Hoa Vàng, especially in the early stages when the timber trees are not yet mature. However, there are also some areas where there are no regenerative trees, so if the above plantations are applied, it will be

difficult to create shade for Trà Hoa Vàng in the early stages, so in these areas, the banana trees can be intercropped. Because banana has fast growth rate, the large and spreading foliage will create shade and keep moisture for Trà Hoa Vàng growing with a high survival rate. Besides, the bananas also bring good income for growers (Figure 2).

4. CONCLUSION

Bac Kan province currently exists most of the models of growing medicinal herbs according to household scale, cooperative scale. Through the investigation and survey of medicinal plant cultivation models as well as the actual situation of forestry land exploitation in Bac Kan province, including Ba Be district, it showed the potential for the development of medicinal plants on local forestry land still very large. In order to promote the effectiveness of the agro-forestry system in Ba Be district, the model of growing medicinal herbs in combination with afforestation with plant species including Trám Đen – Dẻ Ván and Trà Hoa Vàng has been proposed on the basis of the actual situation: the forestry land has not been effectively exploited and suitable to local natural conditions.

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