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Potentials of sustainable development of medicinal plants in Wonogiri regency of Central Java province of Indonesia

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Abstract

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Wonogiri regency is one of the widest areas with agricultural lands in Central Java. The regency is known as the center of medicinal plant production, but sustainable development has not yet been done. Fluctuation of planting width and production is highly influenced by climate and farmers behavior. The present research seeks to identify potentials of sustainable development of medicinal plants by optimizing lands in Wonogiri which have not been maximally used. Analytical descriptive method was applied in the research. The research results indicate that Wonogiri regency has relatively-high productivity of medicinal plant commodities due to intensive management of medicinal plants. Wonogori gives a big contribution as a center of medicinal plant production in Central Java and such contribution is supported by potentials of lands used for development of medicinal plants. Soil conditions and limited water availability do not dampen farmers' motivation to cultivate them.

Keywords: potentials of lands; sustainable development; production; medicinal plants; Indonesia

Introduction

In the world today, there are still a lot of people who do not have adequate access to base needs such as food, water, education, health service and clean environment among other. This is a major concern being addressed by many governments at all levels amidst the rapidly growing population on one hand and deteriorating environment on the other hand. Medicinal plant address not only the need for access to medicines as a component of health service but also to the need for increased income for farmers and as significant contribution to the national economy (Batugal et al., 2004).

The significance of medicinal plants in the traditional life of Indonesian people is high especially in the Javanese community. People use them to prepare "*jamu*" ingredients for traditional herbal medicine, usually consisting of blends of several kinds of plants or other natural materials. *Jamu* is still in great demand in Indonesia. Most Indonesian people believe that *jamu* increases health and resistance to disease. *Jamu* has long been used in the public health program to health care. The increasing demand for *jamu* for health and beauty care, medicinal treatment or as fresh beverages makes its preparation and sale highly profitable, this in turn increasing demand for sources materials most of which are forest plants. In consequence these have become rare in nature (Sangat et al., 2002).

In reference to the 2007 National Policy on Traditional Medicine, Indonesia has approximately 30,000 species of plants, 9,600 of which belong to medicinal plants and 300 of which are used by national traditional medicine industries as materials for traditional medicines. Out of the 300 species of medicinal plants recommended by the National Agency for Drug and Food Control (BPOM – Badan Pengawasan Obat dan Makanan), only 13 species were found to have been intensively cultivated by the Indonesian people. They include ginger (*jahe*), galangal (*lengkuas*), kaemferia galangal (*kencur*), turmeric (*kunyit*), bitter ginger (*lempuyang*), Curcuma zanthorrhiza (*temulawak*), pink and blue ginger (*temu ireng*), Black Face General (*keji beling*), sweet grass (*dringo*), cardamom (*kapulaga*), fingerroot (*temukunci*), cheese fruit (*mengkudu*), and king of bitters (*sambiloto*). Table 1 presents data of the biggest production of intensively-cultivated medicinal plants in Indonesia.

Central Java is one of the largest centers of medicinal plant production which contributes to substantial proportion of medicinal plant production in Indonesia. Table 2 specifies the big 5 regencies with the biggest production of such medicinal plants as ginger, kaemferia galangal, turmeric, galangal, and Curcuma zanthorrhiza.

Central Java has sufficiently big potentials of medicinal plants. Table 2 indicates that Wonogiri had the most abundant production due to its geographical conditions favorable for growth of medicinal plants (Samanhudi et al., 2014). Herbal production centers for such plants as ginger, kaemferia galangal, turmeric, and Curcuma zanthorrhiza are spread all over Semarang, Sukoharjo, Karanganyar, Purworejo, Boyolali, Banyumas, Magelang, Wonogiri, Rembang, and Jepara.

Cultivating medicinal plants is recommended considering suitable type of land and good prospect for medicinal plant business for *jamu* (traditional medicine) companies in either Central Java or outside Central Java, including fulfillment of export sales. Due to the increase in either domestic or international demands for herbal medicine, more intensive efforts can be made by optimizing potentials of a temporarily unused land to fulfill supply of medicinal plant raw materials. Wonogiri regency has a temporarily unused area of 167 ha (Central Bureau of Statistics, 2016). For that reason, the present research seeks to identify the sustainable development of medicinal plants by optimizing a temporarily unused land in Wonogiri.

Research Method

A descriptive analytical method was applied in the present research. A good descriptive research provides data to be evaluated for an analytical research. The analytical research, therefore, in the end gives more perfect description. Regency was selected using purposive sampling where a researcher chooses a sample based on what they know about the research location (Singarimbun and Effendi, 1995). Wonogiri was taken as a sample with following considerations: 1) Wonogiri gives the biggest contribution in medicinal plant subsector in Central Java province, serving as a strength in developing medicinal plants; 2) Wonogiri has a large temporarily unused land to be optimally used to grow medicinal plants, and 3) Wonogiri has geographical conditions and climate potential to support the growth of medicinal plants.

Table 1
Production of medicinal plants in Indonesia during 2011-2015

No	Commodity	Production Year (ton)					Growth from 2014 to 2015 (%)
		2011	2012	2013	2014	2015	
1	Ginger	94 743	114 538	155 286	226 096	313 064	38.47
2	Galangal	57 701	58 186	69 730	62 488	55 150	-11.74
3	Kaemferia galangal	34 017	42 626	41 343	37 702	35 972	-4.59
4	Turmeric	84 803	96 979	120 726	112 054	113 101	0.93
5	Curcuma zanthorrhiza	24 106	44 085	35 665	25 137	27 840	10.75
	TOTAL	295 370	356 414	422 750	463 477	545 127	33.82

Source: Central Bureau of Statistics and General Directorate of Horticulture, 2016

Table 2
Medicinal plant production in Central Java, 2015

No	Regency	Production (kg)				
		Ginger	Kaemferia galangal	Turmeric	Galangal	Curcuma zanthorrhiza
1	Wonogiri	7 579 773	1 373 130	16 647 991	4 007 142	3 215 300
2	Semarang	8 163 670	75 549	2 277 461	457 896	534 349
3	Rembang	4 764 615	1 099 646	3 527 909	1 422 399	234 537
4	Purworejo	2 508 370	350 229	400 160	116 987	3 024 783
5	Karanganyar	2 214 017	122 570	1 089 981	1 141 087	787 790

Source: Central Bureau of Statistics and General Directorate of Horticulture, 2016

Discussion

General conditions of research location

The average annual rainfall in Wonogiri is 3030 mm with 185 rain days and the elevation ranges between 141 and > 600 m above sea level (m.a.s.l.) (Central Bureau of Statistics, 2017). The soil types range from lithosol, regosol, grumusol, as well as the soil changes. The soils in fact come from such parents materials as sediments, rocks, and volcanic soils. Such soil condition leads to different uses of soils. Most areas in Indonesia are hilly or mountainous areas that create the sloping lands. Sloping lands are scattered in the tropics. Around 500 million people use them for farming. Wonogiri is one of the regions having many mountains and hills with an area of 182,236.02 ha consisting of different types of soil, among others: alluvial, lithosol, regosol, andosol, grumusol, mediterranian and latosol. Wonogiri has a harsh topography. Most of the lands are rocky and dry that is not good for agricultural purposes (Peritika et al., 2012).

The majority of the population in Wonogiri earn their living from agriculture and the area is composed of 32,539 ha (17.9%) of rice fields and 149,697 ha (82.1%) of dry lands. Department of Agriculture (2015) noted that the land is used for dry land field crops (48.7%), rice fields (17.9%), community forests (2.4%), buildings/yards (20.8%), and others (10.3%). A small part of the dry land field crops is utilized to grow medicinal plants. Below are the 2016 data of arable land and production of medicinal plants in Wonogiri.

Table 3 signifies that intensively cultivated medicinal plants have high productivity. However, such high productivity cannot fulfill demands for medicinal plant commodities due to an imbalance between demands for medicinal plants and the area of lands used for cultivation of medicinal plants, whereas in fact Wonogiri has 167 ha of unused land. The increasing demands for herbal medicine, either domestic or foreign, result in an imbalance between demands and land availability. For that reason, more intensive efforts are required to fulfill supply of raw materials of herbal medicinal products.

Mapping commodity types potential for development of medicinal plants

Medicinal plants enthuse *jamu* producers at either household, small, medium, or large scales. Raw materials of medicinal plants are generally derived from harvesting or mining and cultivating. In contrast with horticultural plants, medicinal plants require a specific planting zone to yield high active ingredients. When cultivating and developing a commodity, it is important to find out and explore potentials of land in which such commodity will be developed. Meanwhile, appropriate land cultivation techniques and land potentials depend very much on climate and soil conditions. Identifying land potentials is one of initial steps to determine attempts to develop a commodity. Below is the mapping of commodity types potential for sustainable development of medicinal plants in Wonogiri.

Ginger

Ginger is fond of well-drained, rich in humus, moderately fertile, crumbly soils. Marshlands, heavy clay soils, and soils with rough sand or gravels are not suitable for the growth of the plant. The soil textures in which ginger likes to grow are sandy clay loam, sandy clay, and silty clay. Optimum soil reaction (soil pH) ranges between 6.8 and 7.0 (Effendi, 2000). The elevation in which ginger can grow ranges 0-1,500 m.a.s.l., but the optimum one is between 300 and 900 m.a.s.l. (Bautista and Acardo, 1979). In addition optimum temperature ranges between 25 and 30°C (Murni et al., 2017) with annual rainfall of 2,500-4,000 mm.

Based on the 2016 data of ginger production, the biggest ginger production centers are located in Sidoharjo, Pracimantoro, Tirtomoyo, and Eromoko (Fig. 1). Those four subdistricts are established for ginger development centers by optimizing land functions and conversion for ginger plants. Ginger plant is perennial shrub which grows in groups, produces rhizome, and is fibrous. It is suitable for growing in Wonogiri since almost all of the areas in Wonogiri are mountain and belong to state forests with hilly areas of limestone (Suryatmojo, 2006).

Table 3
Land area and production of medicinal plants in Wonogiri, 2016

No	Medicinal plant	Area (m^2)	Production (kg)	Productivity (kg/m^2)
1	Ginger	2 296 438	7 802 303	3.40
2	Galangal	1 109 539	4 027 142	3.63
3	Kaemferia galangal	439 020	1 373 130	3.13
4	Turmeric	5 101 683	16 648 601	3.26
5	Curcuma zanthorrhiza	1 129 557	3 362 710	2.98

Source: Central Bureau of Statistics, 2017

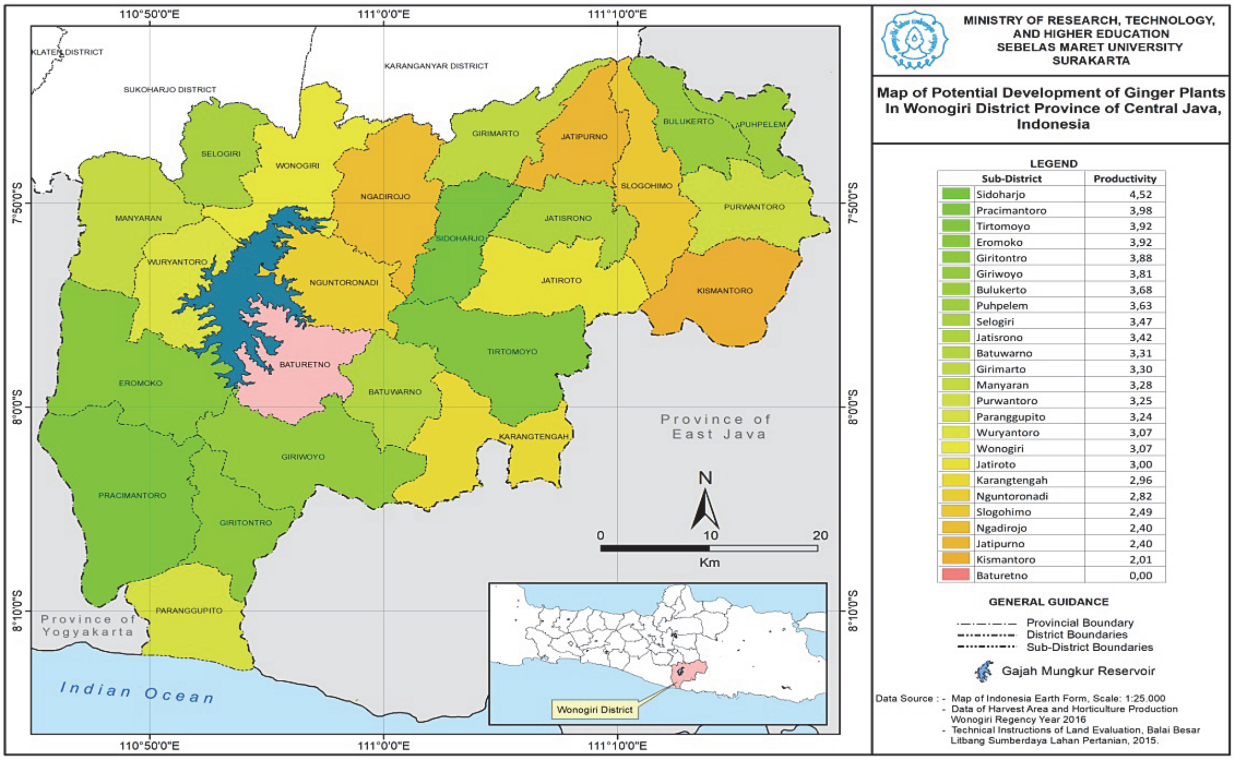

Fig. 1. Map of potentials of development of ginger plants

On the one hand, the fact obtained at field proves that agroforestry (polyculture) for ginger plants has not yet been applied thoroughly in Wonogiri since it leads to a decrease in temperature because of the existence of canopy, whereas in fact an optimum temperature for the growth of ginger plants ranges between 25°C and 30°C. On the other hand, fluctuation of land use for cultivation signifies that such lands can be maximally used for ginger cultivation. However, being an exhausting crop it is not desirable to grow ginger in the same soil year after year (Jayashree et al., 2015).

Kaemferia galangal

For optimum growth kaemferia galangal requires a land with appropriate agroclimate. The best agroclimates for kaemferia galangal cultivation are type A, type B, and type C climates (Schmidt-Ferguson), with the elevation of 50-600 m.a.s.l., and the average annual temperature of 25-30ºC. The annual rainfall to grow kaemferia galangals ranger between 2,500 and 4,000 mm with full intensity of light (100%), or the plant is shaded (25-30%) until it reaches the age of 6 months, the soil is well-drained, has texture of clay soil to sandy clay loam with slope of < 3%, soil types of latosol, regosol, associated latosol-androsol, regosol-latusol, and regosol-lithosol, soil pH of 4.5-5.0. To increase pH to 5.5-6.5. agricultural limestones (dolomite) are added. Furthermore, the land should free from diseases, particularly from bacterial wilt (Rahardjo and Rostiana, 2005).

It is clear from Fig. 2 that the most kaemferia galangal plants are spread in green color areas such as Girimarto, Jatipurno, Jatisono and Slogohimo (Department of Agriculture, 2015). Due to productivity of kaemferia galangal, the four subdstricts are suitable to develop the plant. Kaemferia galangal is used commercially as a basic material of kaemferia galangal oil and of jamu to fulfill the needs of local people. For that reason, production of kaemferia galangal should correspond to planting requirements to maximize the production. The findings of the research indicate that soil conditions, weather, climate, temperature, and canopy exert an influence.

Kaempferia galanga L. (family *Zingiberaceae*) is an endangered medicinal plant with potent medicinal activities. The plant is economically important and is over exploited to the extent that there is always scarcity of propagating material (rhizomes) which is the consumable part too. As it is vegetative propagating, its conservation via conventional and non-conventional means is very much crucial (Preetha et al.,

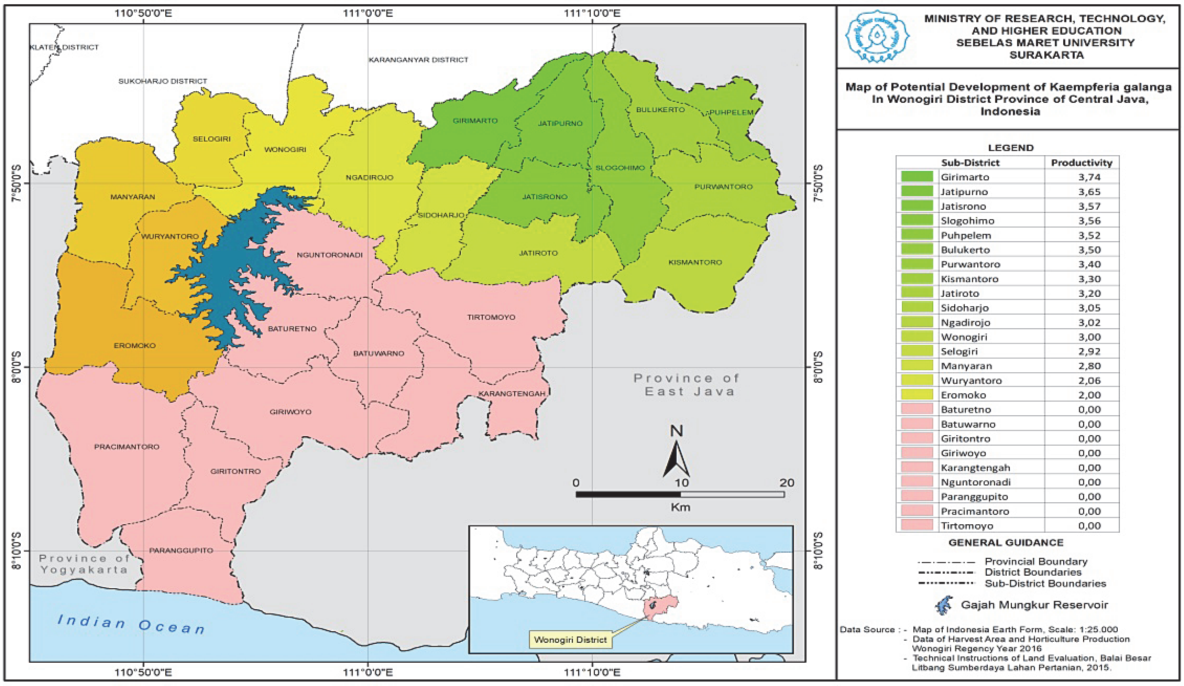

Fig. 2. Map of potentials of development of kaemferia galangal plants

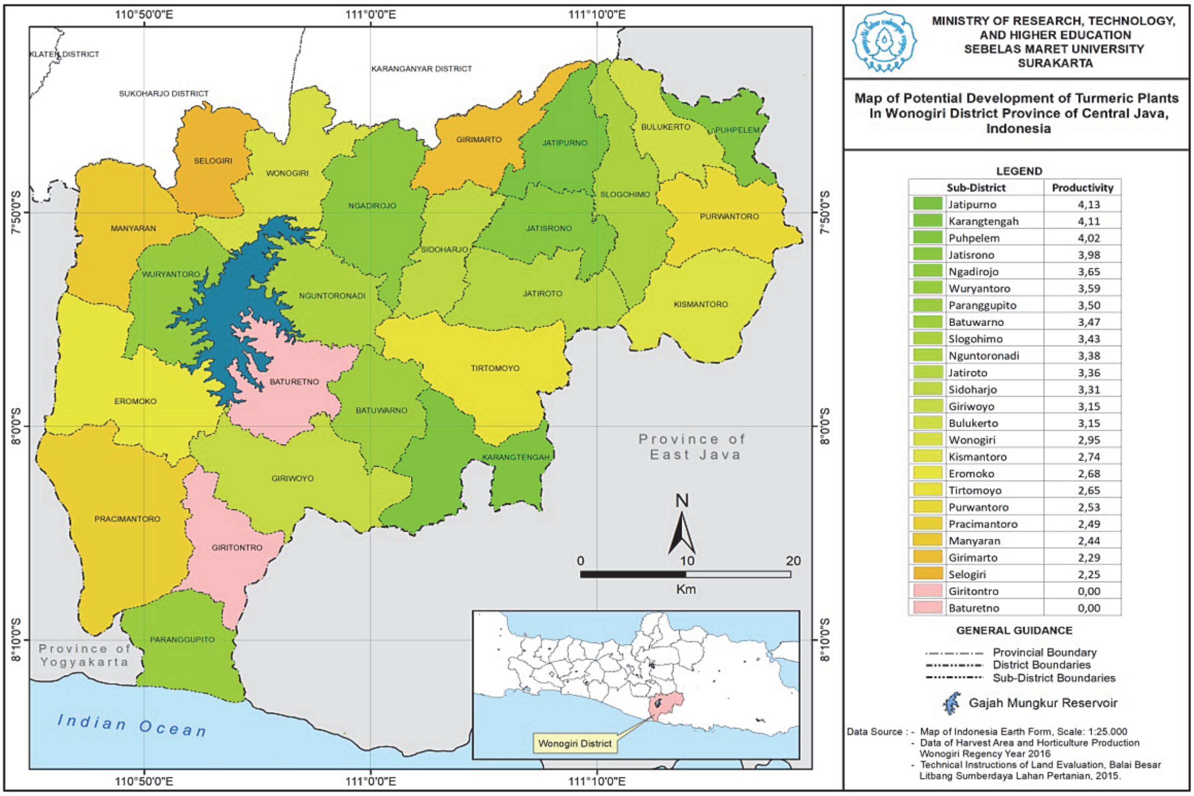

Fig. 3. Map of potentials of development of turmeric plants

2016). Conventional propagation is via rhizomes, which remains dormant during drought, sprouting in spring. Though few seeds were obtained after cross pollination, the resultant seeds are non-viable. About 840-1700 kg of rhizome is needed to plant one hectare.

Turmeric

A turmeric plant grows best at soil types of latosol, alluvial, and regosol with elevation of 240-1200 m.a.s.l. and annual rainfall of 2000-4000 mm/year. It can also grow under stands of hardy plants such as sengon, 3-4 year old teak with canopy level of less than 30% (Rahardjo and Rostiana, 2005). For optimum growth, the appropriate elevation is 45 m.a.s.l. A turmeric plant is fond of an area having full or medium light, particularly an open space, or an area with canopy level of less than 30%, with rainfall of 1000-4000 mm/year and optimum temperature of between 19-30°C (Anggun, 2012).

Turmeric production is different from one area to another. Such difference depends on climate and difference in soil nutrients. Turmeric produced at Wonogiri is found to contain the highest percentage of curcuminoids than those produced by Ciemas, Sukabumi, and Balito (Setiawan et al., 2017). The highest turmeric productivity (4.13 kg/m^2) is found in Jatipurno subdistrict. It is interesting because Jatipurno has elevation of more than 300 m.a.s.l. and Karangtengah and Puhpelem have higher elevation, indicating that turmeric grows well in plateau of Wonogiri.

Use of mother rhizome as planting material resulted in better emergence, taller plants with more number of leaves and leaf area index, and weight (136.96 and 227.66 g) of total rhizomes per plant^{-1}. Planting of mother rhizomes produced highest fresh (207.7 q ha^{-1}), dry (46.0 q ha^{-1}) and processed (44.1 q ha^{-1}) turmeric yield and it decreased significantly with decrease in seed size. Curcumin content did not change due to different planting methods, plant densities and planting materials (Kumar and Gill, 2010).

Galangal

Galangal grows in lowland and plateau with elevation of 1,200 m.a.s.l., rainfall of 2500-4000 mm/year, temperature of 29-25°C, moderate moisture, and high intensity of

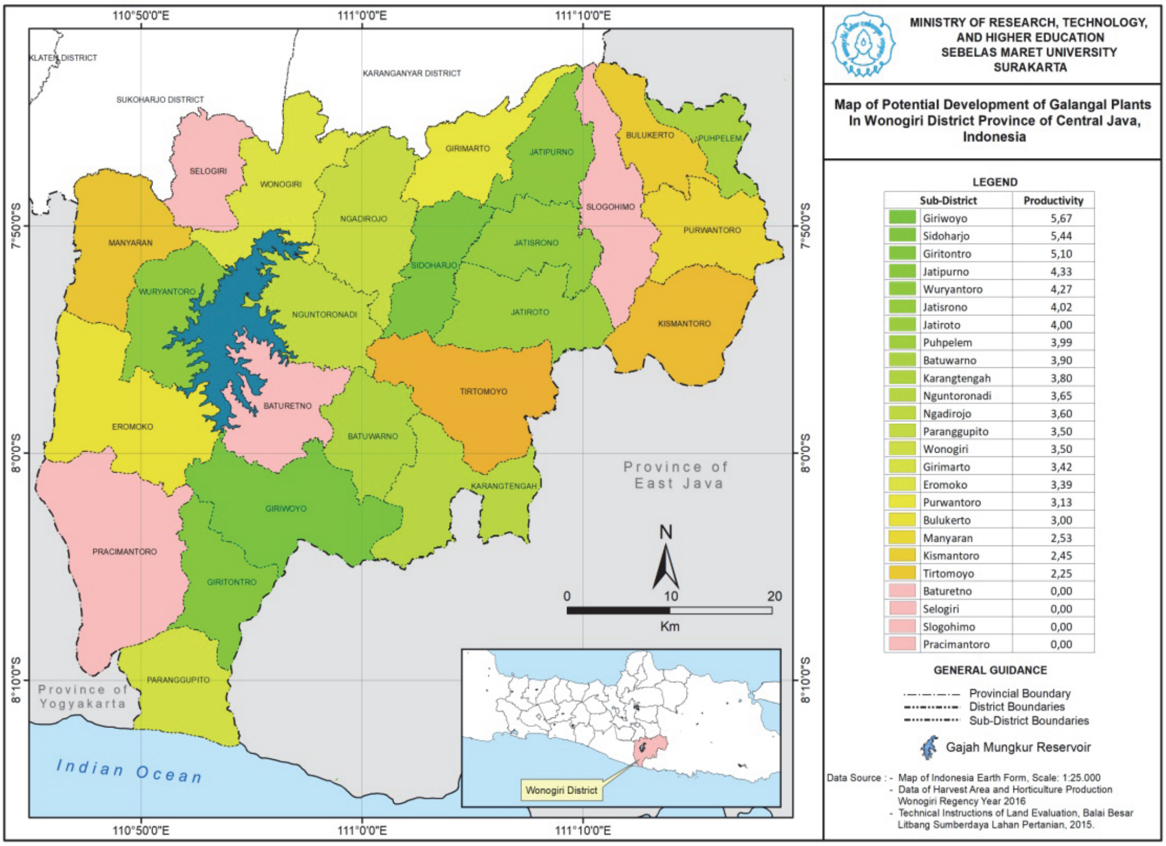

Fig. 4. Map of potentials of development of galangal plants

light. Types of soils suitable for such plant are red latosol, brown latosol, andosol, alluvial with textures of clay loam, sand clay, red clay, and lateristic soils. Galangal plant grows well in an open space exposed with full intensity of light, but requires mild canopy for optimum growth. This can be seen from galangal plants grown in monoculture: their leaves fold inward (close in the afternoon). However, galangal plants planted in protected areas will only produce leaves (Pangerang, 2013).

Regions considered to be potential for development of galangal plants involve Giriwoyo, Sidoarjo, Giritontro, and Jatipurno subdistricts (Fig. 4). At present, high productivity has been achieved. If more intensive attempts are made, the productivity will be getting higher.

Curcuma zanthorrhiza

Production location belongs to one of determining factors of the success in good and appropriate production. Curcuma zanthorrhiza grows well in soil types of latosol, andosol, podsolic soils, and regosol with textures of sandy clay, crumbly, fertile soils with much organic matter, soil pH of 5.0-6.5. In addition, it can grow at type B and C climates (Oldeman, 1975) with rainfall of 1,500 mm/year, dry months of 3-4 months/year, average annual temperature of 19-30°C, air moisture of 70-90%. It can also be planted under stands with maximum canopy level of 25% (Hasanah and Rahardjo, 2008) and grow at elevation of 5-1,500 m.a.s.l. It is suggested for an optimum cultivation to grow at elevation of 100-600 m.a.s.l. There has been a reverse comparison between contents of xanthorrhizol and curcuminoids in Curcuma zanthorrhiza grown at elevation of locations of development (Rahardjo, 2001).

Table 2 presents different results from results of a research conducted by Wiryani et al. (2012) pointing out that Semarang city is a regency with the biggest production of Curcuma zanthorrhiza. Other regencies with the biggest production include Karanganyar regency, Semarang regency, Boyolali regency, Sukoharjo regency, and Wonogiri regency. This finding indicates that for 3 years, Wonogiri has shown a significant increase in production of Curcuma zanthorrhiza. Most of farmers in Wonogiri prefer tamarinds and Curcuma zanthorrhiza as plants for polyculture (Hudiyani et al., 2017).

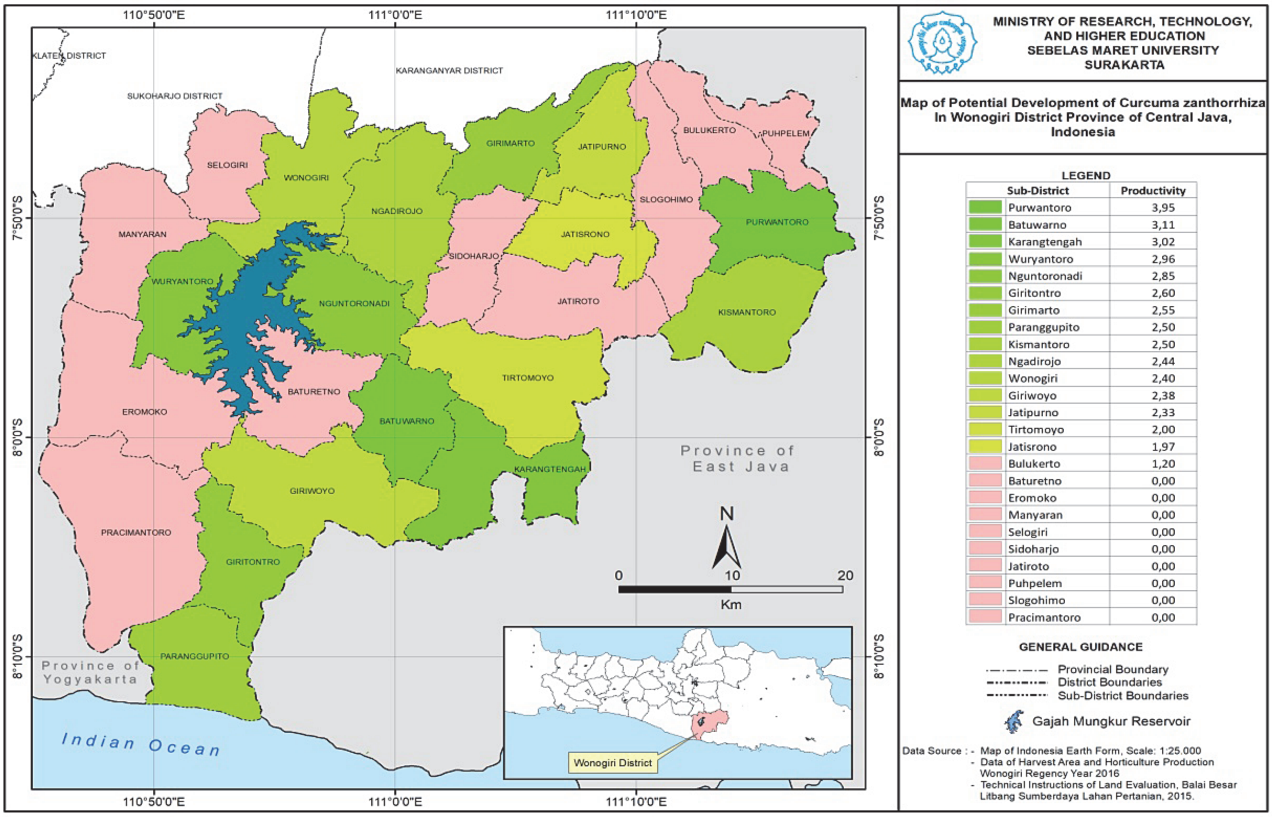

Fig. 5. Map of potentials of development of curcuma zanthorrhiza plants

Regions where curcuma zanthorrhiza is developed are Purwantoro, Batuwarno, and Karangtengah (Fig. 5). The optimum dose NPK fertilizer of 6.25 g N/plant, 6.25 g P_2O_5/plant, 7.5 g K_2O/plant increased Curcuma zanthorrhiza rhizome dry weight. Combination of 4.5 g N + 2.8 g K per plant increased dry weight of Curcuma zanthorrhiza rhizome by 33% and 220% compared to application of N and K of single application which were harvested at 6 months after planting (Nihayati et al., 2013).

Conclusion

Medicinal plant development in Wonogiri is based on an aspect of high productivity and agroecological suitability. An increase in production is achieved by expanding planting areas and making use of yards in selected subdistricts. Another strategy is by using dry land to apply polyculture of food plants and medicinal plants. However, the problem encountered is the use of chemical substances in producing food plants.

References

Anggun, C. (2012). *Budidaya tanaman kunyit (Curcuma domestica Val) dan khasiatnya sebagai obat tradisional di PT*. Indmira Citra Tani Nusantara, Yogyakarta. Perpustakaan. Uns. Ac. Id. Fakultas Pertanian, Universitas Sebelas Maret.

Batugal, P. A., Kanniah, J., Sy, L., & Oliver, J. T. (eds) (2004). *Medicinal Plants Research in Asia. Volume I: The Framework and Project Workplans*. Bioversity International.

Bautista, O. K., & Acardo, H. B. (1979). *Ginger: Its production, handling, processing and marketing with emphasis on export.* Departement of Horticulture College of Agriculture. University of the Phillipines at Los Banos (No. 633.83/B352).

Central Bureau of Statistics and General Directorate of Horticulture (2016).

Central Bureau of Statistics (2017). Badan Pusat Statistik: Kabupaten Wonogiri dalam angka 2017.

Department of Agriculture (2015).

Effendi, D. S. (2000). Identifikasi lahan bagi pengembangan tanaman jahe (Zingiber offlcinale Rose.) dan melinjo (Gnetum gnemon L.) [Land Identification for Developing Ginger {Zingiber offlcinale Rose.) and Melinjo {Gnetum gnemon L.) plants]. *Berita Biologi*, *5*(2).

Hasanah, M. & Rahardjo, M. (2008). Javanes turmeric cultivation. In: *Proceeding of the first international symposium on temulawak*. Biopharmaca Research Center Bogor Agricultural University, pp. 207-212.

Hudiyani, I., Ninuk, P., Pang, S. A. & Hardjanto (2017). An analysis of stakeholders in Agroforestry Community Forest Management in Wonogiri regency, Central Java Province, Republic of Indonesia. *International Journal of Sciences Basic and Applied Research*, *32*(3),164-185.

Jayashree, E., Kandiannan, K., Prasath, D., Rashid, P., Sasikumar, B., Senthil Kumar, C. M., Srinivasan , V., Suseela Bhai R. & Thankamani, C. K. (2015). *Ginger*. ICAR-Indian Institute of Spices Research.

Kumar, B., & Gill, B. S. (2010). Growth, yield and quality of turmeric (Curcuma longa L.) as influenced by planting method, plant density and planting material. *Journal of Spices and Aromatic Crops*, *19*(1&2), 42-49.

Murni, S., Pujiastuti, S. S., & Octoria, D. (2017). Improving the Production Quality of Atsiri Oil Industry Through the Introduction of Equipment and Diversification of Raw Materials. *Review of Integrative Business and Economics Research*, *6*(Suppl. 1), 32-41.

Nihayati, E., Wardiyati, T., Sumarno, S., & Retnowati, R. (2013). Rhizome yield of temulawak (Curcuma xanthorrhiza Roxb.) at N, P, K various level and N, K combination. *Agrivita, 35*(1), 73-80.

Oldeman, L. R. (1975). *Agro-climatic map of Java*. Central Research Institute for Agriculture.

Pangerang (2013)). *Budidaya tanaman lengkuas*. Cultivation of Agri Economy of Agriculture.

Peritika, M. Z., Sugiyarto & Sunarto (2012). Diversity of soil macrofauna on different pattern of sloping land agroforestry in Wonogiri, Central Java. *Biodiversitas Journal of Biological Diversity*, *13*(3), 140-144.

Preetha, T. S., Hemanthakumar, A. S., & Krishnan, P. N. (2016). A comprehensive review of Kaempferia galanga L.(Zingiberaceae): A high sought medicinal plant in Tropical Asia. *Journal of Medicinal Plants*, *4*(3), 270-276.

Rahardjo, M. 2001. Karakteristik beberapa bahan tanaman obat keluarga zingiberaceae. *Buletin Plasma Nutfah. 7*(2), 25-30. Badan litbang Pertanian (Agency for Agricultural Research and Development).

Rahardjo, M., & Rostiana, O. (2005). Budidaya Tanaman Kunyit. Balai Penelitian Tanaman Obat dan Aromatika. *Sirkuler No. 11*.

Samanhudi, A. Y., Pujiasmanto, B., & Rahayu, M. (2014). Effect of organic manure and arbuscular mycorrhizal fungi on growth and yield of young ginger (Zingiber officinale Rosc.). *IOSR Journal of Agriculture and veterinary Science*, *7*(5), 1-5.

Sangat, H. M., & Larashati, I. (2002). Some ethnophytomedical aspects and conservation strategy of several medicinal plants in Java, Indonesia. *Biodiversitas*, *3*(2), 231-235.

Setiawan, T. L., Ambarsari, T. & Ibnu, S. (2017). Anticancer study of Wonogiri's Curcuma xanthorhiza ethanol fraction as jamu by flexible docking methods. *International Journal of Hybrid Information Technology*, *10*(1), 277-288.

Singarimbun, M., & Effendi, S. (1995). Metode Penelitian Survei; Cetakan ke II, PT. Pustaka LP3ES, Jakarta, Indonesia.

Suryatmojo, H. (2006). Konsep Dasar Hidrologi Hutan. *Jurusan Konservasi Sumber Daya Hutan, Fakultas Kehutanan UGM, Yogyakarta*.

Wiryani, E., Perwati, L. K., & Murningsih (2012). Study of Ethnobotany for Bioconservation Medical Plant (Zingiberaceae). In: Proceding iSNPiNSA "Science for Enviromental Sustainability and Public Health, 113-117.