Development and Improvement of Upland Rice Productivity through Dry Land Utilization

Dedi Kusbiantoro[1], Dian Hendrawan[1], Khairunnisyah[1], Martha Adiwati Sihaloho[2], Yenni Asbur[3], Nurhayati[3], Rahmi Dwi Handayani Rambe[3], Syamsafitri[3]

[1]*Departement of Agribusiness, Faculty of Agriculture, Universitas Islam Sumatera Utara, Jalan Karya Wisata Gedung Johor, Medan 20144, Indonesia.*

[2] *Departement of Agrotechnology, Faculty of Agriculture, Universitas Amir Hamzah , Jl. Pancing Pasar V Barat, Medan Estate, Kenangan Baru, Percut Sei Tuan, Kab. Deli Serdang 20219, Sumatera Utara, Indonesia*

[3]*Departement of Agrotechnology, Faculty of Agriculture, Universitas Islam Sumatera Utara, Jalan Karya Wisata Gedung Johor, Medan 20144, Indonesia.*

Keywords: Upland Rice, Dryland, Conservation Technique.

Abstract: Development of functional rice agro industry requires simultaneous economic and socio-cultural approach. The economic approach alone will not be effective because consumption behaviour of household is influenced by tastes and socio-cultural values that shape eating habits. Land use conversion causes rice field narrow therefore it needs to be directed to dry land. Dry land cultivation is critical to meet food for increasing population while supporting food security. Multifunction of dry land farming needs to be seen in broader dimension that is, besides providing food, also having services or benefits to the environment, either biophysical, chemical or socio-economic approach. Efforts to improve productivity in dry land can be done with land use under oil palm stands, marginal land utilization, and application of soil conservation techniques.

1 INTRODUCTION

Upland rice has important role in the Indonesian people's agricultural system. Dry land can be utilized for extension of rice through cultivation. Upland rice is usually planted solely on open land/fields, watersheds, or intercropping with crops or young plantation tree. Currently, upland rice farmers are difficult to obtain high quality varieties so that farmers cannot manage their farm as expected, including applying the recommended technology.

Development of functional rice agro-industry requires simultaneous economic and socio-cultural approach. The economic approach alone will not be effective because consumption behaviour of household is influenced by tastes and socio-cultural values that shape eating habits. Land use conversion causes rice field narrow therefore it needs to be directed to dry land. On the other hand, socio-cultural approach desperately needs the support of economic approach because the motives of individual, family, or community action are heavily depending on economic considerations. In the socio-cultural approach, the tastes and eating habits are related to the perceptions of individuals, families, and society and the first step to be taken is to change such perceptions.

Land use conversion causes the narrowness of rice field so it needs to be directed to dry land. According to Puslitbangtan (Puslitbangtan, 2005), the potential of dry land in Indonesia is quite large, namely 55.6 million hectares spreading in various provinces and about 11 million ha is potential to be developed as an upland rice field. Such rice is one of the varieties in dry land. Upland rice is generally grown once a year at the beginning of the rainy season (Prasetyo. 2002).

Utilization of dry land is one of the resources that has great potential for stabilizing food self-sufficiency and for future agricultural development. Food needs have been supported by paddy fields, which in their production require characteristics of land with a high fertility rate. Characteristics of rice cultivation limit the opportunities for increased rice

Kusbiantoro, D., Hendrawan, D., Khairunnisyah, ., Sihaloho, M., Asbur, Y., Nurhayati, ., Rambe, R. and Syamsafitri, .
Development and Improvement of Upland Rice Productivity through Dry Land Utilization.
DOI: 10.5220/0008883101330137
In *Proceedings of the 7th International Conference on Multidisciplinary Research (ICMR 2018)* - , pages 133-137
ISBN: 978-989-758-437-4

production through the expansion of rice fields. This is because the narrow reserve area is suitable to be used as rice fields and the increasingly intense competition for water use with industry, mining, and households (Abdurachman et al. 2008).

Due to large potential of the land and the opportunity to develop upland rice farming, strategy that needs to be pursued is improvement of intensification and extension program. Information on agricultural technology that has not been used by farmers is also an opportunity to develop upland rice farming. On the other hand, increasing added value of agricultural products can be achieved by food diversification. Based on this, the research aims to study the utilization of dry land for the development of upland rice.

2 MATERIALS AND METHODS

Description on upland rice development through dry land utilization is obtained from various literatures and research finding. Research methods are literature review from various sources, then analyzed and described in scientific writing.

3 RESULTS AND DISCUSSION

3.1 Opportunities and Challenges of Upland Rice Development on Dry Land

Dry land management needs to be done to meet the food needs of increasing population while supporting food security. Indonesia's population grew by 1.34% per year (BPS. 2006), while there was a change in the consumption pattern from non-rice to rice, increasing irrigated land conversion for non-agricultural purposes, and decreasing wet land productivity. In the period 1981-1999, there has been a conversion of rice land to other use as much as 1.6 million ha (Irawan et al. 2001). Assuming the productivity of rice fields is 6.0 t/ha of dry harvested grains (DHG), there has been a loss of production by 9.6 million tons of DHG/year (Agus et al. 2004). The problem of reducing food production needs to be overcome by improving rice field’s productivity, creating new rice field and management and development of other potential land including dry land.

BPS data (Kontan. 2011) shows that the area of rice fields in 2010 was around 12.87 million ha. However, according to the agriculture minister (Suswono. 2011) the area of raw rice fields is 6.7 million hectares while in order to achieve food security until 2025 requires an additional rice field of 5.875 million hectares. On the other hand, the increasing number of population will be a threat to Indonesia, where Indonesia's population growth rate currently reaches 1, 4%.

3.1.1 Water Availability

Population growth, especially in developing countries, increases domestic water consumption both for agriculture and industrial production and processing. Water pollution will be higher so that the quantitatively available water is unusable or costly to process to be used. All of these are limiting factors for production in agricultural sector (Bouwer. 2000).

Water is a physical component that is very important and needed in large quantities for plant growth and development. Water also functions as a plant temperature stabilizer (Suhartono. 2008). Ariffin (Ariffin, 2002) suggest that plants that lack water will trigger the formation of abscisic acid inhibiting hormones and inhibitors of growth stimulating hormones.

3.1.2 Poor Agricultural Practices

High pressure demand on agricultural land causes annual crop is not only to be cultivated on flat land, but also on slopes > 16%, which should be used for annual crops or forests tree. Overall, flat to rolling dry land covers a total area of 31.5 million ha (Hidayat and Mulyani. 2002), but their use is contested for agriculture, settlement, industry, mining, and other sectors. In general, farmers and dry land farming competitiveness is much lower than other sectors, so agriculture is pushed into steep slopes.

Soil erosion rates increase with the development of farming practices that are not accompanied by the conservation techniques application, such as slash and burn system in outside Java. Even in settled agricultural systems, application of land conservation techniques has not been the custom of farmers and has not yet been regarded as an important practice in agriculture.

3.2 Problems Solving

Based on the available resources, budget capabilities, risks and uncertainties such as climate change, opportunities to improve upland rice farming productivity in oil palm plantations are still very open. Without the support of infrastructure and pricing policy applied to rice, spectacularly development of harvested area and productivity of upland rice are quite difficult to achieve. Challenge of production aspect faced in this context is how to increase the production of functional upland rice to reach food security status (food sovereignty) that is the ratio of food reserve to the use is up to 20%.

3.2.1 Upland Rice Planting under Tree Stand

Expansion of planting areas towards fertile land is difficult; therefore efforts to increase national food production must utilize untapped potential land, among others under plantation tree. Role of upland rice as food stuff must be improved by increasing productivity and expanded planting (harvest) area in oil palm plantation area. According to Wasito (Wasito, 2013), intercropping of upland rice farming with oil palm plantations in District of Hinai, Langkat regency showedgood agronomic performance. Such intercropping is in rain fed land using Ciherang varieties with productivity around 2-3 tons/Ha at non rain season. In contrast, at rainy season, the productivity is 3-4 tons/Ha. The existence of rice integration program on oil palm plantations is expected to create synergism or mutually beneficial linkages. Integration of upland rice in oil palm tree in tidal area has great prospects to be developed and expected to increase food availability, farmer welfare, and reduce greenhouse gas emissions (Balittra, 2013).

3.2.2 Utilization of Marginal Land

Main constraint on dry land is low intensity of light due to shade factor, high soil acidity and drought threats. Increasing production on marginal land, including land under annual crop stands, can be achieved through improvements: (1) potential yields, (2) rates of crop adaptation to abiotic and biotic stress, and (3) cultivation techniques based on physiology or eco-physiology knowledge (Sopandi and Trikoesoemaningtyas. 2011).

Unlike rice fields with relatively high fertility, uniform, and often flooded, generally dry land has low fertility rate, low organic matter content, and difficult to maintain so that productivity is rapidly declining, and farmers choose to leave it as idle/critical land. On sloped land and no adequate conservation measures, the land is easily degraded, both chemically and physically. In addition, water supply is also inconsistent, as it depends on rainfall.

Currently, the productivity of dry land is relatively low or not yet optimal (Mulyani. 2005; Dariah and Las. 2010; Mulyani and Sarwani. 2013). The fertile dry land area is also increasingly limited, so the choice falls on the suboptimal dry land, i.e. land that has low productivity due to internal (intrinsic) factors such as parent material, physical, chemical and biological soil properties, and external factors such as extreme rainfall and temperatures (Mulyani. 2013). Therefore, technological innovation is required to overcome these limiting factors to be utilized for agricultural development. Such suboptimal land needs rehabilitation efforts to increase its productivity.

Multifunction of dry land farming needs to be seen in the context of a broader dimension, that is, besides as food provider, it also has services or benefits to the environment, either biophysical, chemical and socio-economic environments (Agus et al. 2003). As agricultural producers, dry land contributes to food security, economic buffer, social and cultural value (Irawan et al. 2004). As an environmental service provider, dry land functions in erosion control, flood mitigation, biodiversity and recyclers of organic materials (Notohadinegoro. 2000; Agus et al. 2004). The soil is capable to clean the waste from substances or pollutants by filtering, absorbing, and/or disentangling. Thus the land is able to act as an environmental sanitation factor (Notohadinegoro. 2000).

3.2.3 Utilization of Conservation Techniques

Vegetative soil conservation techniques are the use of crops and plant residues as soil protector medium from erosion, inhibition of runoff, improve moisture content, and improve soil physical, chemical and biological properties. Soil chemical conservation technique is the use of chemicals, both organic and inorganic, which aims to improve soil properties in suppressing the rate of erosion. This technique is rarely used because it is quite expensive and the result is almost the same as the use of natural materials. Chemicals included in this category are soil conditioners.

Water scarcity is often a major limitation in dry land management. Therefore, technological innovations in water and climate management are needed, including water harvesting techniques, supplementary irrigation, climate prediction, and determination of planting time and land management techniques. Harvesting can be done by harvesting rainwater or surface runoff at temporary or permanent shelters, to be used for irrigating crops (Subagyono et al. 2004).

Besides the water availability, other things that become obstacles in dry land farming are low nutrients and organic material availability. Efforts are made is fertilizer application, both inorganic and organic fertilizer. According to Norsalis (2011), fertilizer used in upland rice framing should be combined between inorganic and organic fertilizer. Provision of organic fertilizer (manure, compost and green) can improve physical, chemical and biological properties. Meanwhile, inorganic fertilizer can provide nutrients in quick time.

The simple land resource technology to control erosion and improve dry land productivity is the use of organic materials. Mulch, organic waste, compost and manure (organic matter) are able to control soil erosion, improve soil physical and chemical properties and increase crop production. Mulch from various materials, among others, residue of crops on dry land farm are intended to protect soil from external forces such as rainfall splash that reduce soil fertility and rooting. The role of crop residues used as mulch in agricultural lands, especially on dry land has been quite widely. Organic mulch includes all agricultural waste materials that are economically less useful such as rice straw, corn stalks, peanut stalks, banana leaf leaves and midribs, sugarcane leaves, reeds, kirinyu leaves and sawdust. With the presence of mulch material above the soil surface, the rainwater energy will be retained by the mulch material so that the soil aggregate remains stable and avoids the process of destruction and erosion. The use of mulch will also maintain the condition of the soil's microclimate such as temperature and soil moisture so that the soil does not dry quickly and is not easily cracked (Jajang, 2009).

The soil temperature in the root area is important for plant growth and development because it affects physiological processes in plant roots such as taking water and mineral nutrients from the soil (Diaz-Perez and Batal, 2002). Soil that is given platinum mulch and organic mulch, is able to increase the soil temperature between 1.20 - 4.19 ºC higher than soil without mulch. Soil temperature is one of the important micro-soil environmental factors because it influences: soil moisture, soil aeration, soil structure, activity of microorganisms, enzymes, and availability of nutrients. Soil moisture is available to plants in rice straw mulch higher than other mulch and controls. Soil moisture that is sufficiently available in the rhizosphere stimulates plant growth and yield.

4 CONCLUSIONS

Efforts to improve productivity of upland rice in dry land can be done with land use under oil palm stands, marginal land utilization, and application of soil conservation techniques using organic mulch.

REFERENCES

Abdurachman A, Dariah A, Mulyani A. 2008. Strategi dan teknologi pengelolaan lahan kering mendukung pengadaan pangan nasional. J Litbang Pert 27(2): 43-49.

Agus, F., Surmaini, E., Sutrisno, N., 2005. Teknologi Hemat Air dan Irigasi Suplemen. Hlm. 223−245. Dalam Teknologi Pengelolaan Lahan Kering: Menuju Pertanian Produktif Dan Ramah Lingkungan. Pusat Penelitian Dan Pengembangan Tanah Dan Agroklimat, Bogor.

Ariffin. 2002. Cekaman Air dan Kehidupan Tanaman. Fakultas Pertanian Universitas Brawijaya. Malang. hal. 1- 12

Balittra (Balai Penelitian Tanaman Rawa), 2013. Prospek Pengembangan Padi Dan Sapi Diantara Tanaman Kelapa Sawit Pada Lahan Rawa Pasang Surut. Balittra Banjarbaru, Kalimantan Selatan.

Bouwer, H., 2000. Integrated water management: emerging issues and Water Management 45(3):217-228.

Badan Pusat Statistik. 2006. Sensus Pertanian (ST) 2006. Badan Pusat Statistik Indonesia. Jakarta.

Constantinensco, I., 1976. Soil Conservation for Developing Countries. FAO Soil Buletin No. 30.

Dariah, A., Las, I., 2010. Ekosistem lahan kering sebagai Pendukung Pembangunan Pertanian. Hlm. 46-66 dalam Membalik Kecenderungan Degradasi Sumberdaya Lahan dan Air. Badan Litbang Pertanian. IPB-Press.

Diaz-Perez, J.C., K. D. Batal, 2002. Colored plastic fill mulches affect tomato growth and yield via changes in root-zone temperature. J. Amer. Soc. Hort. Sci. 127 (1): 127-136

Hidayat, A., Mulyani, A., 2002. Lahan kering untuk pertanian. hlm. 1−34. Dalam A. Abdurachman, Mappaona, dan Saleh (Ed.). Pengelolaan Lahan Kering Menuju Pertanian Produktif dan Ramah Lingkungan. Pusat Penelitian dan Pengembangan Tanah dan Agroklimat, Bogor.

Irawan, B., Friyatno, S., Supriyatna, A., Anugrah, I.S., Kirom, N.A., Rachmanto, B., Wiryono, B., 2001. Perumusan Model Kelembagaan Reservasi Lahan Pertanian. Laporan Hasil Penelitian. Pusat Penelitian Sosial Ekonomi Pertanian. Badan Penelitian dan Pengembangan. Bogor.

Jajang S.H. 2009. Pengaruh Jenis Mulsa Terhadap Pertumbuhan dan Hasil Tiga Kultivar Kentang

(Solanum tuberosum L.) yang Ditanam di Dateran Medium. Jurnal Agronomi Indonesia 37(1):14-20.

Kontan. 2011. Peringatan Krisis Pangan dating Lagi. Harian Bisnis dan Investasi kontan Rabu 26 januari 2011. m-padi-di-polibag-1632 Pertanian.

Las, I., Purba, S., Sugiharto, B., Hamdani, A., 2000. Proyeksi kebutuhan dan pasokan pangan tahun 2000−2020. Pusat Penelitian Tanah dan Agroklimat, Bogor.

Mulyani, A., 2005. Potensi Lahan Kering Masam untuk Pengembangan Pertanian. Warta Penelitian dan Pengembangan Pertanian vol 28 no 2.

Mulyani, A. 2013. Karakteristik dan potensi lahan kering beriklim kering untuk pengembangan pertanian di Nusa Tenggara Timur. Hlm. 593-600 dalam Prosiding Seminar Nasional Inovasi Pertanian Lahan Kering. Kupang 4-5 September 2012. Balai Besar Pengkajian dan Pengembangan Teknologi Pertanian. Badan Penelitian dan Pengembangan Pertanian. Kementrian Pertanian.

Mulyani, A., Sarwani, M., 2013. Karakteristik dan potensi lahan suboptimal untuk pengembangan pertanian di Indonesia. Jurnal Sumberdaya Lahan 7(1): 47-58.

Norsalis, E., 2011. Padi Gogo dan Padi Sawah. Melaluihttp://skp.unair.ac.id/repository/GuruIndonesia /Padigogodansawah_ekonorsalis_17170.pdf [07/05/15].

Notohadinegoro, T., 2000. Diagnostik Fisik Kimia dan Hayati Kerusakan Lahan. Makalah pada Seminar Pengusutan Kriteria Kerusakan Tanah/Lahan, Asmendep I LH/Bapedal. 1-3 Juli 1999. Yogyakarta. Hlm. 54-61.

Prasetyo, Y.T., 2002. Bertanam Padi Gogo Tanpa Olah Tanah. Penebar Swadaya, Jakarta.

Puslitbangtan., 2005. Peluang menuju swasembada beras berkelanjutan. Warta Penelitian dan Pengembangan Pertanian 27(5):12-14.

Samsudin, E., Karama, A.S., 1966. Budidaya hemat air dan panen hujan dalam pertanian. Hal.69 – 76. Dalam Prosiding Seminar Nasional Gerakan Hemat Air.

Sopandi, D., Trikoesoemaningtyas, 2011. Pengembangan Tanaman Sela di Bawah Tegakan Tanaman Tahunan. Iptek Tanaman Pangan 6(2): 168 – 182.

Subagyono, K., Haryati, U., Talao'ohu, S.H., 2004. Teknologi konservasi air pada pertanian lahan kering. hlm. 151−188. Dalam Konservasi Tanah pada Lahan Kering Berlereng. Pusat Penelitian dan Pengembangan Tanah dan Agroklimat, Bogor.

Suhartono. 2008. Pengaruh Interval Pemberian Air Terhadap Pertumbuhan dan Hasil Tanaman Kedelai (Glycine max (L) Merril) Pada Berbagai Jenis Tanah. Jurnal Embryo. Vol, 5 (1).

Suswono. 2011. Pernyataan Menteri Pertanian pada pembukaan Kongres kehutanan Indonesia ke 5 tanggal 22 Nopember 2011. Harian Kompas 23 Nopember.

Suwardjo, H., 1981. Peranan Sisa-Sisa Tanaman dalam Konservasi Tanah dan Air pada Usahatani Tanaman Semusim. Disertasi Fakultas Pasca Sarjana IPB. Bogor.

Wasito. 2013. Diversifikasi Pangan Berbasis Pemanfaatan Lahan Sela Perkebunan Kelapa Sawit Dengan Tanaman Pangan di Kabupaten Langkat Sumatera Utara. p. 527 – 545. dalam M. Ariani, K. Suradisastra, N. Sutrisno, R. Hendayana, H. Soeparno, dan E. Pasandaran (editor) Diversifikasi Pangan dan Transformasi Pembangunan Pertanian. 2013. Badan Penelitian dan Pengembangan Pertanian, Kementerian Pertanian. IAARD Press. Jakarta.