

PROBLEMS AND PROSPECTS FOR SUSTAINABLE AGRICULTURAL DEVELOPMENT IN SOLOK DISTRICT, WEST SUMATRA, INDONESIA

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Abstract: *This paper studies the implementation of “green revolution” in Indonesia, that has been the main policy for Indonesia’s agricultural modernization and food security. The revolution has significantly increased rice production, but the sustainability is under question because of its negative effect both to environment and to income distribution. This paper also finds the strategies for sustainable development of agriculture by learning the case of agricultural development in Solok District of West Sumatra. Intensive use of agrochemical inputs in upland polluted both water and soil in lowland eventually harms human health. Both spatial disparities and income inequality had been raised during last three decades when rice farming zone and activities have been gotten huge investment and subsidies while the non-rice farming zone and activities were ignored. To bring sustainable development, three policies are recommended; promoting organic farming, developing and empowering local agricultural institution and reforming development planning and decision making for wider local people participation.*

Kata Kunci: agro-ecological zone, sustainable agricultural development, green revolution, West Sumatra, development strategy

INTRODUCTION

Indonesia has been implementing “green revolution” to modernize its agricultural sector. The revolution started by the end of 1960s as a national development focus. Self sufficient of rice production was chosen as a main target. Almost all rural development activities were focused on rice production. Therefore, the target was achieved in 1984. On the other hand, non rice agricultural commodities were gotten lack of government attention. These commodities development have been grown by most of demand push. Upland horticulture farming in the areas where infrastructures available, for example, is using intensive chemical fertilizer and pesticide that are introduced by private

agricultural inputs enterprises’ sales workers rather than by government extension workers.

However, both of lowland and upland as well as highland Indonesia’s agricultural developments are facing many problems. Aggressive chemical external input has been given main contribution to environmental problems. Ultimately, it produced economic and social problems. Yield trend decreases and production cost increases. Moreover, population growth is still continuing that force high pressure to natural resources. Income inequality among farmers is to be worse during last decade. Those problems are Indonesia’s sustainable agricultural development

challenges that are forcing us to find out new strategies for future development.

This paper discusses the problems and potentials of Indonesia's sustainable agricultural development which Solok district, West Sumatra, is chosen as a case. It is selected because it could represent Indonesia's agricultural development. This district was a target of green revolution due to its lowland rice field potential. Its upland area is Sumatra's horticultural production centre that supplies vegetables and fruits to surrounding cities. In addition, its highland has tea plantation, modern form of agricultural enterprise, and shifting cultivation, traditional agriculture, as well as protected forest in mountainous areas. Studying Solok agricultural development could mirror Indonesia's agricultural development as well because of its agricultural zone diversity.

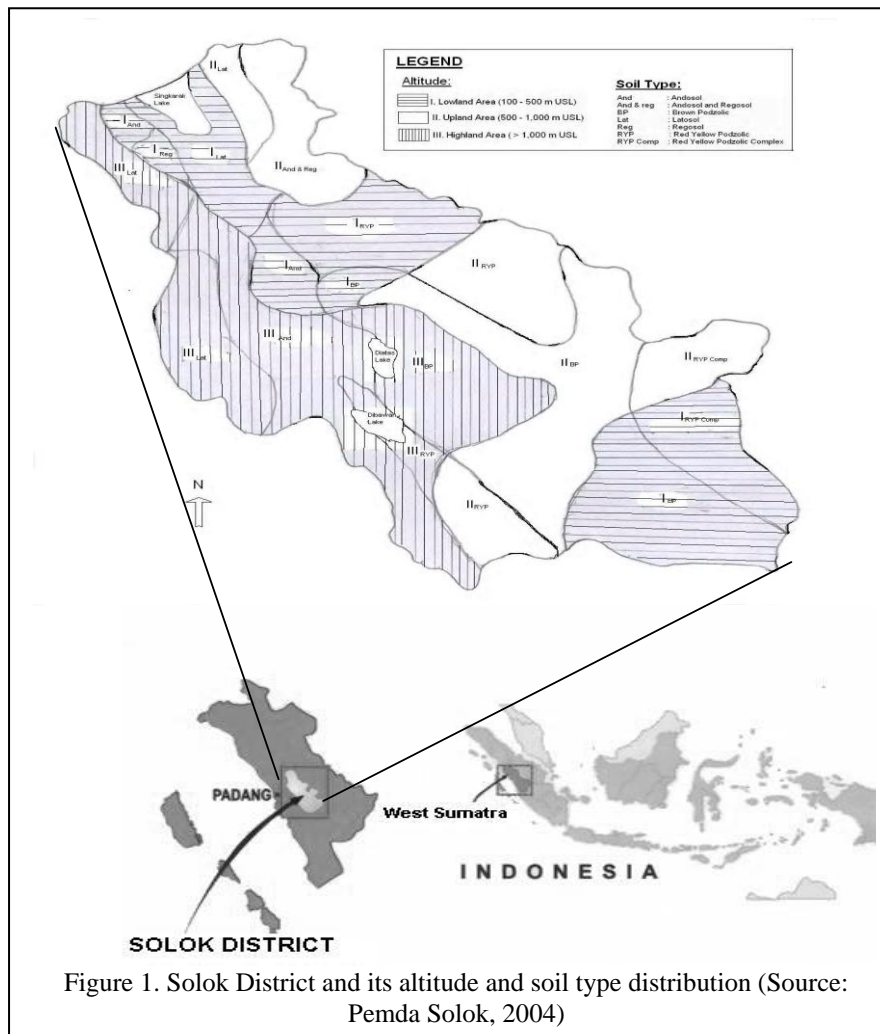
The paper is written mostly by using of author knowledge about the district where author had done research and was involved in many local government agricultural development projects. Biophysical and demographic data are taken from official local government report and planning documents.

The paper objectives are: (1) to explain agricultural development in Solok district and its farmers management practices both in lowland and in upland as well as in highland areas; (2) to discuss the problems, issues and prospects of Solok district's sustainable agricultural development; (3) to formulate strategies for sustainable agricultural development according to agricultural development potentials in lowland, upland and highland areas.

OVERVIEW OF BIOPHYSICAL AND DEMOGRAPHIC OF SOLOK

Solok district covers an area of 3,738 km² and is divided administratively into 14 sub districts. It is located between 0°32' - 1°45' south latitude and

100°27' - 101°41' east longitude (Figure 1). It has variation of topography, climate and soil type (Pemda Solok, 2004). Agro-ecological zone in local government planning document is mostly based on altitude, because this district has extreme variation of altitude between low-land and highland mountainous areas (Pemda Solok, 2000).



The altitudes are grouped into three categories. First is the area with 100 – 500 m upper sea level (USL) in its central through northern and small portion in southern part which is categorized as lowland areas. Second group is the area with 500 – 1000 m USL in its central through southern and small portion in northern part which is categorized as upland areas. Third altitude group is the area with more than 1000 m USL in western part of district across north through south which is categorized as highland area.

Land in lowland areas is mostly plain, according Solok district statistical office. Land slope ranges between 0 – 10%. Its southern part has two soil types, brown podzolic and red yellow podzolic complex. While its northern part's soil type are red yellow podzolic, brown podzolic, latosol, andosol and regosol. Irrigation infrastructures are available at most of area with sufficient water supply throughout years. The sources of irrigation water are from rivers. There are seven rivers flowing through this zone and four of them were dammed for irrigation. In addition, southern part of this zone is also part of upland areas that the water flows from

upland through it. Roads are also available in good condition to support agricultural activities.

Northern part of upland areas soil type is andosol and regosol and small portion is latosol. The other part, the biggest, has three soil types, red yellow podzolic, brown podzolic and red yellow podzolic complex. Slope here is higher than lowland areas and its topography are quite varies which most of them are slope land and small portion is plain. The irrigation infrastructures are not quite good in this zone, while sufficient water supply from many small rivers. There are two lakes, Diatas lake and Dibawah lake, in highland zone that their

outflows are the main source of irrigation water of this area. Road infrastructures were also developed with hotmix to local market and between rural areas are connected by relatively good condition of rural roads.

Highland areas have also varied soil type, latosol, andosol, brown podzolic and small portion of red yellow podzolic. This zone is dominated by steep slope mountainous areas in the most western part. Most of area is covered by forest. This area has poor infrastructure.

With wide range of altitude, it, consequently, has wide range microclimate that is categorized into C, D and E climate, according Aldemen classification, with 7,768 mm average rainfall and 34 – 212 rainy days a year. Its northern gets lower rainfall than central and southern part. The lowest rainfall is usually recorded in July, while November to February has higher ones. Temperature is varies and influenced most by altitude. Temperature range in lowland areas are between 28.5°C to 31.30°C and in upland and highland areas are between 12.5°C to 24.60°C (Pemda Solok, 2000).

In 2003, according Solok district statistical bureau, it is inhabited by 330,507 number of population. The recent density is 88.42 per sq km in average, but lowland area has higher density than upland and highland areas. Population growth rate was 0.97% during last five years. About 46% of the populations are in working age (20-59 years old) and most of them, about 69.62%, are working in agricultural sector.

AGRICULTURAL PRACTICES

Agriculture is main livelihood and mostly contributes to local income. In

2003, agricultural sector contributes 42.08% of Solok district Gross Domestic Income. The rate of agricultural sector was higher than average. In 2000, it contributed 41.28% to total regional income (Solok Statistical Office, 2004). Farmers practice both crops monocultures and crops diversification, livestock and fish raising. Therefore, a lot of kinds of crops can be found within the district that have been practiced since long term ago. However, specific commodity can be found in one zone and not in others. The following part explains agricultural practice by farmers, input and technology use, and land and crops management in each agricultural zone. Because of huge number of commodities, the explanation will be limited on three major commodities in each zone; those are mostly cultivated and given highest contribution to the local economy.

Lowland areas

The three major kind of agricultural practices in lowland areas are rice cultivation in wetland, fish raising in suitable location and horticulture cultivation in dry land. Farmers practice either monoculture or diversify for both commercial and subsistence.

Rice cultivation is main Solok district agricultural production and most of its rice field is in lowland areas. Rice that produced here supplies not only in West Sumatra province but also in its three neighbors provinces, Jambi, Bengkulu and Riau province. In 2003, Solok district produced about 420,000 ton of rice and about 65% was produced in this zone (Solok Statistical Bureau, 2004). Paddy fields are cultivated twice or three times a year because of sufficient water supply and good irrigation facilities. Almost all of farmers here are using “green revolution” technologie.

Modern high yield rice varieties, chemical fertilizer and toxic pesticide are common inputs, meanwhile in many spots, Integrated Pest Management (IPM) has been introduced. Mechanic tools are also used to ease particular heavy work. Hand tractor is used widely for land tillage and threshers are worked for harvesting. Most of production is marketed.

Fish raising is also practiced by farmers in favorable places, wherever water is available. There are three kinds of fish raising in this zone, raising fish in private pond, in common water canals – either in irrigation channel or in rivers stream as well as in lakes, and fishing in open water. Raising fish in private pond has been practiced since long period ago either for commercial or subsistence purposes. Commercial fish raising usually applies modern input such as processed feed and high yield fish. Meanwhile, subsistence fish raising usually practices traditional techniques without modern input and it is developed mostly by small farmers as a source of household protein. Raising fish in common water canal (*keramba*) is a new technology that have been raised since last fifteen years for most market purposes, where farmers drown trellis boxes or float nets in water surface to grow fish, and the processed feed is sowed regularly, twice a day. Open water fishing is usually practiced by most of landless small farmers using fishing tools or/and net and small manual boat. This practicing can be found only in lakes and slow stream rivers and one of important source of income for poor household.

Horticulture crops, such as chili, tomato, cassava, sweet potato, etc, are also cultivated by farmers in particular dry land within this zone, including backyard. Usually, it is one of farmer

diversified income either for commercial or for subsistence. Modern inputs, particularly inorganic fertilizer and chemical pesticide, are also commonly used.

Briefly, in three kinds of agricultural practices, modern inputs have been implemented widely in Solok district lowland agriculture. They have been contributed to people income both for large and small farmers.

Upland areas

In upland zone, rice, horticulture cultivation and small plantation are three major agricultural practices. In addition, small portion of secondary forest can be seen here.

Unlike lowland area, rice fields here are in hill waist with relative high slope and were constructed likely big terraces. Rice cultivation here also uses hugely external inputs. Most of paddy fields are cultivated intensively twice or three times a year both for commercial and subsistence purposes.

Horticulture crops are major commodity particularly at plain area in southern part of this zone and have been supplying many surrounding cities demand. Onion, lettuce, tomato, broccoli are kinds of vegetables that always produced here. Production motives are purely commercial and have been practiced since long period ago. Farmers rotate the commodity depend on their market price prediction. Lettuce, for example, is grown when trend of it price in nearby market increase, after harvesting, when others commodities have good price farmers will choose those commodities for next seasons. Modern inputs are used intensively by farmers with a profit motive by improving yields. Pesticides, for example, are sprayed regularly and sometimes in

the high volume. This behavior are encouraged by privates agricultural inputs industries sales, who sales progressively their products to farmers, while extension workers do not give enough advices to them.

Farmers here also produce plantation commodities. Small rubber (*Hevea braziliensis*) plantation and orange are grown in small portion of northern part of this zone, while they are not a main source of income, these plantation have been practiced traditionally since long period ago. Cinnamon and coffee are two major plantation crops in southern part that planted in relatively high diversity with others, such as *jengkol*, jack fruit, durian, and others perennial crops. Most of the land that allocated for these practices is in hill waist where water is not sufficient to irrigate the land. Meanwhile their yields are low, farmers in this upland area get better benefit because they is required relatively little external inputs and save labor.

Indeed, agricultural practices in this upland zone vary both in commodities and in way. Rice and horticultures are grown in using high modern external input. and on the other hand, plantation crops are also developed by many farmers in traditional way.

Highland area

There are two main kinds of agricultural practices in highland area, modern tea plantation and small plantation, although rice field and horticulture also exist, but they are relative small in size and are fragmented. Those agricultural lands are small portion because most of this zone is still covered by protected forest. In addition, poor

farmers household pick up timber and non timber forest product as one of important source of income.

Modern tea plantation here is Dutch colonial era heritages. It was located at fertile and relatively plain in highland area. It is now managed by PT. Perkebunan Nusantara VI, Indonesian Government owned Plantation Enterprise, in very modern way, and most of its workers are came in from outside.

Like in upland areas, main small plantation crops that grown in highland area are cinnamon, rubber and coffee. These plantations have also been practiced traditionally since long period ago and diversified with other commodities. Most of farmers do not intake inputs in this style of agriculture and land that allocated for these practices is hill waist with step slope. In early time, when perennial crops have not covered soil yet, farmers grown vegetables as sources of cash income and after two or three years, when perennial crops have covered soil, farmers sometimes look for other portion of land and start to open the new one. This practice need more land and sometimes they slash the primary forest.

Many small and landless farmers harvest forest product as their important income both timber and non timber. Pick up honey from wild forest bee is an example of non forest timber product that practiced popularly by local people here. Timber is still harvested by local people while almost all of forest areas have been included in protected areas according national laws.

In conclusion, very modern and very traditional ways of agricultural practice are exist in Solok district highland areas. Tea plantation is very modern and small plantation, many western

experts called shifting cultivation, is very traditional agricultural practice. Pressure to forest protected areas is still occur-ing.

ENVIRONMENTAL, ECONOMIC AND SOCIAL PROBLEMS

Above agricultural practices were emerged environmental, economic and social problems in every zone. Those problems make sustainable agricultural development is under question. Following are description of those problems by areas.

Lowland areas

Figure 2 summarizes the problems and their causes that grouped into four categories, health, environmental, economic and social problems. The problem in a category can cause problem to others categories. Biodiversity loses, soil degradation and water pollution are environmental problem that have been

concerned since last several years. Biodiversity loses is impact of destruction of quality soil and water. The pollutions are caused by aggressive use of agro-chemical inputs. Soil pollution gives impact on diminishing of soil fertility that ultimately decreases crops yield. Yields trend is decreasing or can be maintain with higher volume of fertilizer than that before. Local government agricultural report shown that using of inorganic per hectare of land has increased during last five years from 300 kg/ha in average in 1998 to 325 kg/ha in 2003. Besides, surface water pollution caused by both residue of chemical fertilizers and pesticides and residue of fish raising feeding. In 2002, local newspaper reported that reduction of wild fish population in Singkarak lake, in its northern part, that fish catcher income was dropped. Fish risers, likewise, are facing yield diminishing.

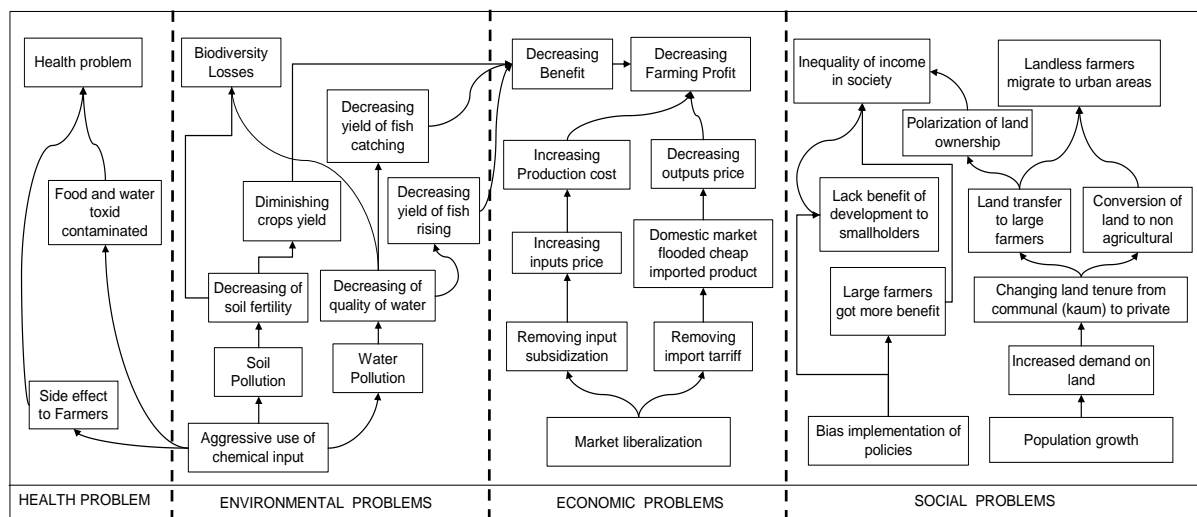


Figure 2. Agricultural development problems and their causes in lowland Solok district, West Sumatra province, Indonesia.

The above mentioned environmental problems ultimately lead to economic problem. Decreasing soil fertility, of course, means decreasing of farmers' benefit and on the other hand, cost production increased in result of market liberalization that force to

remove modern agricultural input subsidization, though farmers dependency on those inputs are so high. Farming profit is ultimately falling down. The problem is to be worse when agricultural product prices fall down as an effect cheap agricultural product

import flooding Indonesia's market as an impact of removing import barrier as an important point of agreement in letter of intend that signed by Indonesian government and International Monetary Fund (IMF) as a requirement to get helping from IMF after economic crises in the mid of 1997. Water pollution cause reduction of fish raising yields as well as reduction of wild fish population that affected decreasing of fish riser benefit and income of fish catcher in open water.

Social problems are also emerged as impact of past aggressive agricultural development in this lowland area. Green revolution technology and institutional introduction gave more benefit to big farmers than to small farmers. Using of subsidized input, access to credit are more in big farmers. This condition forces to increase inequality among rural people. Otherwise, agricultural employment decreases in result of using of mechanical machines in particular paddy field, while the number of worker are still increasing because of high population growth in the last decade. Moreover, water pollution, that reduce wild fish population in open water, make poor fish catcher trapped into deeper poverty. In addition, high population growth in this area increases land demand both for agricultural and non agricultural purposes. Increasing land price leads small farmers to sell their communal land. This trend is forcing the changing land tenure from most of communal to private. Polarization of land ownership is appeared that leads to make inequality of income in society. Furthermore, land is conversed to non agricultural often occurs in this area because of urbanization process and high population growth in particular near urban areas. Therefore, small farmers

are trapped into landless farmers and sometimes move to urban and work in informal sectors.

Aggressive use of agro-chemical inputs also leads to health problem both within areas and in outside. Farmers may have higher risk due to contact to toxid pesticide. Consuming contaminated the residue of food and water could make health problems in others areas far from here.

Upland areas

Biodiversity loses, soil erosion, reduction of soil fertility, land and water pollution are the environmental problems that emerged in upland areas (figure 3). Small plantation in steep slope of hill waist is under water erosion threat and it has been occurred. Reduction of soil fertility also hit this zone because of aggressive use of inorganic fertilizer in the past. In addition, land and water are polluted by toxid pesticides that have been sprayed regularly by farmers. Polluted waters from this zone flows to lowland area and add the water pollution problem in that zone.

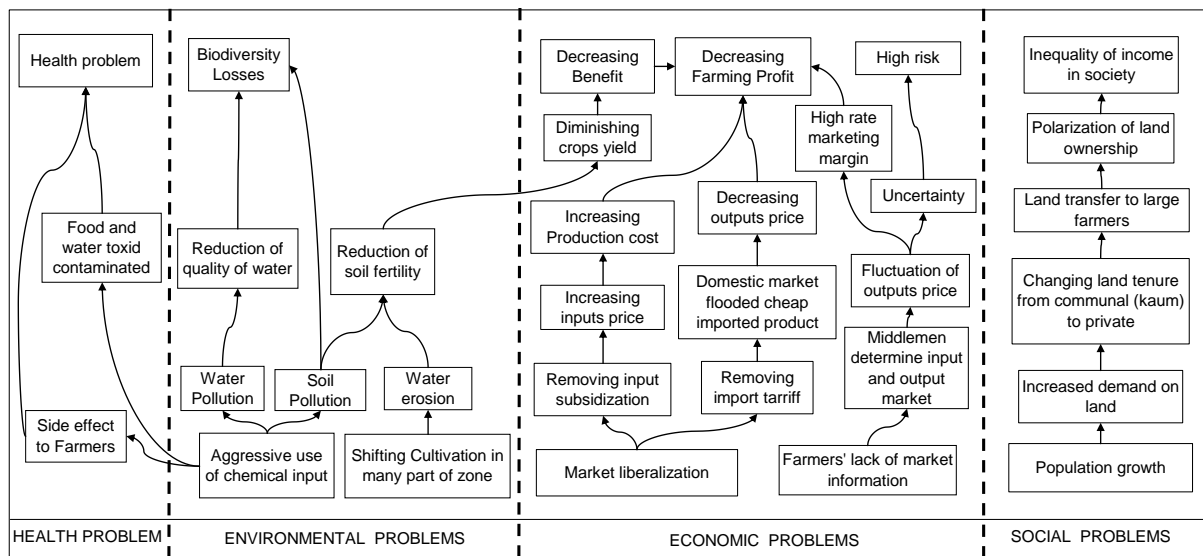


Figure 3. Agricultural development problems and their causes in upland Solok district, West Sumatra province, Indonesia.

Like in lowland area, the economic problem in the upland area is increasing production cost as an impact of removing subsidization. Moreover, production prices fluctuation is another farmer problem. Therefore, they face uncertainties and high economic risk, particularly for vegetables commodities. This problem is occurred because farmers have lack access to market information. Middlemen still have power to control marketing of most of horticultural products. Although local extension office has provided many price information boards in many places, but the information updating was scare.

Income inequality is the main social problem in upland areas. Large farmers get more benefit than small farmers in new external technologies implementation. Profit motive oriented leads large farmers to extent their land and small farmers are attracted to sell their land, so, polarization of land ownerships is also occurring here. This trend also mirror the changing of land tenure system from most communal to private ownership

Highland areas

Figure 4 shows the problems and their causes in Solok district highland area. Like many highland areas in Indonesia, the zone was neglected in major past national agricultural development. Poor infrastructures and support services are appearing that mirror regional disparities to lowland and upland areas.

Deforestation and forest degradation and soil erosion are three major environmental problems. Practicing of shifting cultivation by most of farmers is blamed as source of these problems. Besides that, biodiversity loses is another problem that concern by particular scientists and government officials. This is further impact of forest degradation. In monsoon season, landslide here often makes news in local media. In addition, it also leads to flood in lowland areas because most of forest here is lowland catchments areas.

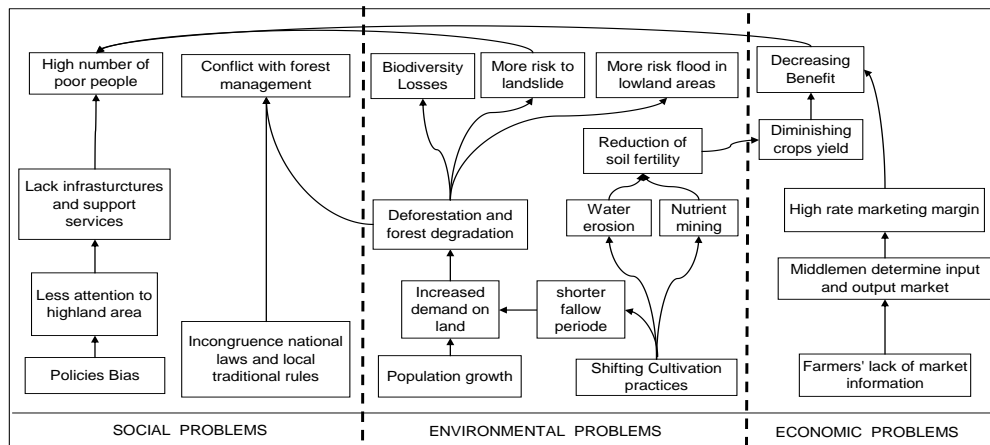


Figure 4. Agricultural development problems and their causes in highland Solok district, West Sumatra province, Indonesia.

Shifting cultivators are facing diminishing crops yield due to reduction of soil fertility. Reduction of soil fertility is caused by water erosion and nutrient mining in shifting cultivation activities itself. Therefore, decreasing farming benefit and lack of infrastructures and support services are expected a main source of high number of poor people here. Fallow period is to be shorter due to high demand of land in result of population growth.

In social dimension, conflict between protected forest management boards and local people emerge in result of differences point of view over forest resources management. Shifting cultivation and harvesting forest product are prohibited by national forestry laws, but local people do not accept and they still refer local customary laws that give them chance to pick up particular forest product for non commercial. Local people, for example, feel the forest areas are still under their local customary management, where they allowed harvesting timber from forest area for non commercial purposes. On the other hand, protected forest management boards refer to national laws that strictly prohibited all activities in forest areas. Another source of conflict is land tenure that imposed by local people in shifting

cultivation does not also sequence to national forest laws. Decentralization efforts in Indonesia now have not touch forestry sector yet. Shifting cultivators face uncertainty over their land tenure.

Those problems, sometimes, could not localize in a zone only, but they could interact each others over zone and social boundaries. Water pollution problem in lowland, for instance, also caused by agricultural input residue that flow to water bodies both in highland and upland areas. Vegetables that are contaminated with toxid pesticides, another example, could make health problems to urban people whom consume them.

ISSUES IN AGRICULTURAL SUSTAINABILITY AND PROSPECTS

Aggressiveness of “Green Revolution” implementation

Indonesia has been implemented green revolution aggressively. The revolution started by the end of 1960s, that was called “Program Bimbingan Massal (BIMAS/mass guiding program), when growth of agricultural sector was chosen as a priority of national economic development and self sufficient of rice production was selected as a target, at

that time, Indonesia was the biggest rice importer country.

New paddy cultivation technology, that was called “Panca Usahatani” (five farming technologies packet) – using high yield varieties, intensive land tillage, intensive pest control, irrigation, and post harvesting treatment-, was introduced. Subsidized modern seed, fertilizer and pesticide were supplied in particular areas in Java, Sumatra and many part of Sulawesi islands. Agricultural cooperatives were established at both national, provincial, district and village level as a channel input distribution. Rural infrastructure, such as irrigations, roads, schools, and health services center, were developed throughout country. Agricultural credit and its institutions were established and their sub branches were opened at sub district level (kecamatan), and then collaboratively with agricultural cooperative, the credit was distributed to farmers at village level. Extension service was provided freely to encourage and guide farmers to implement the new technologies. Many research centers were established and talented young researchers were trained. To stabilized rice price, floor and ceiling price policy were adopted and Badan Urusan Logistik (BULOG/logistics distribution authority) was introduced as a technical institution that will buy the rice when its price go down over floor price and will flood the market when its price trend increase over ceiling price.

This aggressiveness produced five implications. First, dependency of farmer to government program, particularly in lowland areas, was high. Previously, farmers arranged their agricultural activities independently. For instance, farmers have institution to manage irrigation system locally and independently to outside intervention,

but after technical irrigation system replaced local irrigation, farmers were highly depended irrigation management to government institution, local initiative was dried. Second, farmers highly depended on external input in their agricultural practice. Chemical fertilizer and pesticide, for instance, are using widely and highly in result of past aggressive extension to implement them. Many program to reduce these dependencies such as integrated pest management (IPM), and organic farming had launched, but its progress is running slowly. While subsidization of those input were cut, farmers have no others inputs alternative and its cause decreasing of productivities. Third, environmental problems, as mentioned above, emerge to surface as new challenges as an impact of high intake of chemical inputs. Fourth, inequality of income distribution was grown up during last three decades because local elite got larger benefit from “green revolution” programs. Fifth, disparities between favored and less-favored areas in term of income distribution, infrastructures, support services also increased.

Market liberalization

Market liberalization has been given three impacts on sustainability of agricultural development here. First, agricultural outputs price is fall in average because foreign substituted product flooded Indonesia’s market as import barriers were removed. Second, Indonesia government is under pressure by international trading communities to remove subsidization of agricultural inputs. The removing increased inputs price and ultimately increased pro-

duction cost. Of course, farmers' competitiveness falls down. On the other hand, third impact, market liberalization gives more opportunities to Indonesia's farmers to compete in international level. Assigned free trade agreement in ASEAN (AFTA) and Asia Pacific (APEC) region are increasing market demand of qualified product from everywhere, including from Indonesia.

Decentralization and "Reformasi" agendas

After Asian economic crisis in mid 1997, Indonesia has been changed its political systems, governmental institution, decision making process, and economic and social development strategy. All of these are called "Reformasi" agendas.

Indonesia's political system has been changed dramatically from authoritarian military rule to more democratic system, where Indonesia has arranged successfully three times election after "Soeharto regime" step down. The latest was successful direct presidential election. Governmental institutions also are changed, along with decentralization, where district governments have larger authority to manage their territorial including agricultural activities. In Solok district, like others district in West Sumatra province, decentralization is translated to give power not only to district level but also to local level, nagari level. Nagari is the lowest level of administration that is developed based on local culture. This changing give broader chance to local people to participate in decision making process, particularly related on agricultural development decision making process.

In addition, Indonesian government's economic and social development strategy is emphasized on improving

equality of income distribution and sustainable economic development, according Indonesia's five years development plan (Program pembangunan nasional/PROPENAS). Economic growth, including agricultural growth, is pursued equally among society. Its meaning is agricultural development in local level to pursue equality is congruent with national strategy.

Role of Agricultural Sector in Solok's Economy

Solok district's economy highly depends on agricultural sector. Most of its workforces are working in this sector and most of district domestic income is also contributed by this sector. High population growth, environmental degradation, and market liberalization make its economic sustainability problem under question.

Solok District's agricultural potentials

On the other hand, Solok district has huge agricultural potential. Most of its lowland and upland areas has well infrastructure. Roads are available to reach all of lowland and upland as well as most of highland villages, modern irrigation systems are available for most of lowland and upland areas. Water is also available throughout years. Three regional agricultural research centre, regional rice, fruits crops, and spicy crops research center, are situated here. Previous development, both positive and negative, added all of agricultural stakeholders' experience. Besides that, demand for agricultural product still increase because of population growth and free trade among particular ASEAN countries. All of those are the prospects of Solok district agricultural sustainable development

STRATEGY FOR SUSTAINABLE AGRICULTURAL DEVELOPMENT

To avoid or to minimize negative impact of agricultural development in future and to give better and equal benefits to whole society, we should develop new strategies for sustainable agricultural development. They have to tackle properly those of problems and should avoid carefully emergence of new problems. Following are five strategies that are formulated to remedy those problems and develop sustainable agriculture.

Lowland Area

Four strategies can be offered to tackle the issues in agricultural sustainability in lowland areas. First, implementation of organic farming can remedy environmental degradation issues and health problem as well as economic issues. Organic farming uses as minimum as chemical inputs, such as chemical fertilizer, and pesticides, and replaced them with organic inputs such as compost and integrated pest management (IPM). Sometimes, organic farming have higher production cost than that inorganic farming that makes their competitiveness are low. To solve this obstacle, two side ways could be used simultaneously, impose tax on agro-chemical inputs and or promote consumption of IPM and organic product. The former way will increase production cost of inorganic farming that reduction of its competitiveness over organic farming. The later way purpose is to improve demand of organic product in particular middle and high class consumers.

Second, improve farmers competitiveness is a strategy to help farmer counter act over market liberalization problem. Besides policies that have

mentioned above, two more ways can be added to improve farmers' competitiveness, strengthen farmers' institution and improve farming technologies. Farmers' institution such as farming cooperative could be coordinated agricultural inputs and outputs trading activities, so that, it will give more benefit to the farmers both by reducing input prices and by increasing outputs prices at farmer level. Strengthening farming cooperatives can be done by giving certain legal status and training to its official. In addition, Farming cheaper environmentally sound technologies should be found to reduce production cost on one hand and increase productivities on the other hand, so, farmers' competitiveness will be improved. Research activities must be arranged continuously.

Third, participatory approach on development planning and its implementation process is a strategy that could be solved the problem related on inequality incomes distribution. Participatory approach here means involving all stakeholders at local level in decision making process that hopefully will hinder bias. What are development objectives in which location?, who are the targets?, what are development focuses?, how will it be implemented and by whom? are the questions that will be answered by all of stakeholder equally. This approach is possible because Indonesia has been implemented decentralization of governmental systems not only to district level but also to local level.

Fourth, population growth control is also needed to avoid increasing number of land less and pressure of population to natural resources. Indonesia's family planning was cut after 1997 economic crises and increasing

population growth is appeared. Indeed, formulation and implementation of this policy are decided by local government.

Upland Area

In upland areas, four strategies that have been formulated in lowland areas can also implemented here, but unlike lowland areas, farming cooperatives here could play role not only on agricultural trading activities but also on market information finding. Local government should help them to organize market information finding by providing information technology equipment and training to use it in effort to find horticultural market information such as outputs and inputs prices, volume of demand of each crops, volume of supply of each crops from others agricultural zone and etc. these activities can reduce role of middlemen in this area as well as mitigate economic risk.

However, one more strategy is needed in upland area. It is research and extension related on shifting cultivation, because shifting cultivation is blamed as a source of erosion problems. Many research activities to find the environmentally sound technologies for sloping land have been done. For instance, International Centre for Integrated Mountain Development (ICIMOD) has found and implemented sloping agricultural land technology (SALT) (Partap and Watson, 1994) and/or International Centre for Agroforestry (ICRAF) also has been done to tackle the issue of shifting cultivation. However, those technologies have not introduced in this areas yet. Research activities to adapt and adopt as well as to search locally environmentally sound technologies is needed and then disseminate by extension activities.

Highland Area

Five strategies could be offers to tackle the issues in highland area. They are population growth control, research and extension on shifting cultivation, improvement of farmers' competitiveness, participatory approach on agricultural development planning and its implementation, and congruent national laws and local customary rule. The three first of those strategies are explained above and those explanation are same to highland area. However, participatory approach for highland area, fourth strategy, is related on not only how decision making process is arranged in agricultural development planning but also how development activities will be done equally among region within Solok district. It also means that participatory of highland people on political process in district level should be improve to avoid disparities of development among region.

Fifth strategy, congruent national laws and local customary rule is a way to avoid conflict between farmers and protected forest management. Congruency of those rules could be done by developing district rule as close as possible to local customary rule. In addition, in many spots where local communities can participate on forest management, community based forest management (CBFM) should be implemented. For this purpose, CBFM that have been implemented successfully in Nepal (Gautam and Shivakoti, 2005) could be adapted in this area.

CONCLUSION

Indonesia's agricultural sustainability is facing heavy challenges environmentally, economically, socially as figured in Solok district. Each zone has many problems and related each other.

Strategies are formulated to make agriculture development is to be sustainable.

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