

Contemporary Farming System in the Shifting Cultivation Practiced by Arfak Tribe in Hink District, Pegunungan Arfak Regency, West Papua, Indonesia

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Abstract

Farming systems for shifting cultivation are generally carried out in dryland areas, especially in the tropics in Asia, Africa and Latin America. By enhancing local knowledge of the community in managing the land wisely, this system can still provide food sustainably. Shifting cultivation is common in Indonesia, but agricultural systems of the Arfak tribe in West Papua have not been widely reported. One of the largest dryland farms in West Papua is by the Arfak tribe through shifting cultivation system, to meet the needs of their families. Respondents for the study were purposively selected from 50% of sample villages, based on the homogeneity of the research area. This study is expected to give an overview of the agricultural system and the division of labor in shifting cultivation farming. Farming on a fairly steep slope is done by mixed cropping of food crops and vegetables. The farming activity is carried out jointly by the whole family in the clan members only at the time of land clearing, and then each member has the responsibility to maintain his/her crops. The larger role for males is in the early stages of land clearing, while the women are responsible for planting, maintenance and harvest. The largest income from all farms is obtained from potato, carrot and cabbage.

Keywords: Arfak Tribes, Dryland Farming, Farming Systems, Shifting Cultivation, Traditional Knowledge

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1. Nature of Shifting Cultivation

The history of agriculture begins with the human desire to meet their needs of food, shifting from hunting and gathering to settled farms. Farming in many countries in the tropics and subtropics are on dry land areas with shifting cultivation system. The shifting cultivation of farming systems has been practiced by many communities, especially those in tropical regions, tropical rainforest and bush areas of

Central Africa, Central America and Southeast Asia. Dove⁸ stated that shifting cultivation systems are practiced by some 240 to 300 million farmers in the tropics. It is a transitional system from hunting and gathering to a settled farm⁷. Priyadarshini¹⁷ reports that the history of shifting cultivation is as old as the history of agriculture itself. Based on archaeological evidence, the origin of shifting cultivation could be traced to 8000 BC in the Neolithic period. Shifting cultivation is also known as 'slash and burn' and 'bush

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fallow', and is known by different terms in different countries. In Indonesia it is called *Ladang*, *Caingin* in the Philippines, *Ray* in Vietnam, *Rai luan loy* in Thailand, *Jhum or Jum* in India and Bangladesh, *Milpa* in Central America and Mexico, *Conuco* in Venezuela, *Roca* in Brazil, *Masole* in Congo and Central Africa. Although the name is different, the principle of shifting cultivation is the same that is the activity of cutting down forest trees and burning to clear the land for agriculture. In addition, farmers do not utilize agricultural inputs such as fertilizers and pesticides, but use a lot of labor, specifically in the beginning of cultivation. According to Geertz¹¹ and Ruthenberg¹⁸ this type of farming involves use of simple tools and techniques, low levels of input, production and consumption.

Shifting cultivation is still widely practiced in mountainous areas of South and Southeast Asian countries, especially in Indonesia, in the islands such as Sumatra, Maluku, Kalimantan, Sulawesi and Papua. Ave and King (in Arman, 1994), suggested that the Dayak shifting cultivation or swidden cultivation in Kalimantan has been done since the time of their ancestors. Soedjito²² estimated that the Dayak farming system started two centuries ago, and Mering Ngo¹² reported the practice in various areas in Borneo is as old as 6000 BC.

In Thailand, the method of slash and burn is called "*rai luan loy*", literally meaning "drifting field", practiced by hill dwellers in mountainous areas. Since 1985, shifting cultivation in Thailand has been restricted, and government has started the resettlement with conversion of swidden agriculture into sedentary agriculture.

In the hilly areas of Northeast India, more than 86% of people living in the hills depend on shifting cultivation. In 1980, about 1.3 million ha under

Jhum rose to 1.7 million ha in 1990 and to about 2.0 million ha in 1994-1995. Areas allocated per family by tribal leaders vary from half a hectare to one hectare between different tribes, territories and states. Areas with less populations generally have longer jhum cycles (15-25 years), whereas areas with high population density have shorter jhum cycles (5-10 years). Crops grown are rice, wheat, corn, millets, tobacco, vegetables, and bananas.

Shifting cultivation is the dominant cropping system in the highlands and mountains of Laos, involving 300,000 families (about 1.8 million people or 40% of the population), may cover up to 2-2.5 million ha, equal to about 10% of the total area of Laos. The prevalence of shifting cultivation has reduced the forests which is only about 36% in the North, compared with 52% and 58% respectively, in the central and southern regions¹⁶.

Shifting cultivation in North Vietnam was practiced by the H'Mong group. They live in the mountain areas (800-1700m), where many areas have limestone. There are two shifting cultivation types: (i) Shifting pioneer cultivation, i.e., full use of soil fertility and then abandon land without intending to reuse and (ii) Shifting cultivation rotation practiced mostly by ethnic groups. The period of fallow is usually 10-15 years depending on the soil conditions²⁰.

Primary forest management in the world has been by using shifting cultivation system. As regrowth happens, secondary forests have abundant biodiversity because the forest clearing encourages the growth of different types of plants that can attract the diversity of animals to live and breed. Thus, in addition to food crops and vegetables, game animals are also available for hunting. The main problem of shifting cultivation is that the land used for farming loses soil fertility. Therefore, farmers will look for new

fertile land or used forest land as the new farming area by cutting and burning. In addition to maintaining soil fertility, shifting cultivation for communities has a meaning to defend their communal land, since the land once used is a mark of the existing territory. In general, crops grown on fields are food crops such as rice, corn, yams, and vegetables. Before the first land is harvested, the farmers will prepare new land on the former area or open a new forest for the next crop, in order to maintain food availability.

Other crops grown on the same land are corn, potatoes, pumpkin, cabbage, and carrots. Sweet potatoes are mostly for home consumption, while most vegetables are sold to meet family needs. After harvesting, the farmer will let their animals, including pigs into the fenced gardens to graze the left over in the fields. By doing shifting cultivation, the community can continue to meet the food needs, so that food security is maintained. The process of shifting cultivation in agriculture begins with a slash and burn. Fire as a tool to clean up land has to be done wisely, as it can adversely affect the environment and also cause global warming. Negative perceptions of shifting cultivation are the significant damage to the forest and soil erosion. Besides, the adjoining forests catch fire caused by slash and burn system. Shifting cultivation systems are also judged to have low productivity with inefficient use of resources.

If the population increases, there would be competition for land for cultivation and shelter, without new land being developed. Less land causes shorter fallow periods and will lead to rapid decline in soil fertility and soil erosion.

Dryland farming lands in Hink district of West Papua Province, located in Pegunungan Arfak Regency has sloping and steep highlands. Hink is the origin of mostly Arfak Tribes and Hattam sub-tribes,

who have been traditionally practicing dryland farming. Despite its 450 sloping land, the communal land has been utilized as the farming field for food and vegetable crops. Arfak Tribes practice shifting cultivation and mixed cropping of various vegetables and foods in one area. All of the family members in one clan prepare farming land only at the initial stage. The Arfak tribes utilize the branches from cut trees as hedge around the fields, tied together with rattan and tree bark.

According to the Indonesian Agriculture Spatial Directory (2001) undulating flat land (slope < 15%) is suitable for food crops, while those with 15-30% slope land is only suited for plantations and long duration crops. However, Arfak tribes do not have access to suitable land, hence use the communal land for food, vegetables and tuber crops.

Shifting cultivation system is mostly done by Arfak tribes owning large communal land. This study is aimed at deeper understanding of the agricultural system, dominant crops, cropping systems, and traditional knowledge of Arfak Tribes about shifting cultivation and provides information on income obtained by farmers using this system.

Dryland farming in West Papua, Indonesia has huge potential as recognized by policy makers and stakeholders interested in developing the area. However, effective crop management technologies, supportive strategies and policies along with official support will help to achieve its optimal performance.

2. Data and Methods

District of Hink, Pegunungan Arfak Regency, was chosen as the study area. Fifteen of the 29 villages were purposively chosen (50% of total villages) as sample in this study, as most of the families in the village is practicing shifting cultivation system. The villages

are Kisap, Minyememut, Demunti, Ngimoubre, Humeysi, Cangoisi, Sopnyai, Hakyeibouw, Aryon, Leiheak, Pungug, Kwok1, Nungkimor, Ikimabouw, and Mbegau. The location of the Hink district within Pegunungan Arfak Regency is presented in figure 1 below.

Data used in this study included both primary and secondary data. Primary data were obtained from farming households, using semi-structured interviews using a prepared questionnaire. The farming household samples were purposively selected consisting of 110 household farmers based on the homogeneity of samples. Secondary data were obtained from related stakeholders and officials (Agriculture Office, Extension Office, Statistical Office).

Data collected from respondents consisted of some observed variables. Qualitative and quantitative data were gathered and suitable analysis method used. The qualitative analysis was used to identify and explain the issues involved. A tabulated analysis was used to organize the quantitative data obtained from the respondents.

3. Results and Discussion

3.1 General Farming System in West Papua

Agriculture is one of the important sectors for the development in West Papua, in addition to mining. This state has 140,376 km² of total land area. Approximately 48.71% labor is in agriculture, but its contribution to GDP is only 10.82%, and decreasing

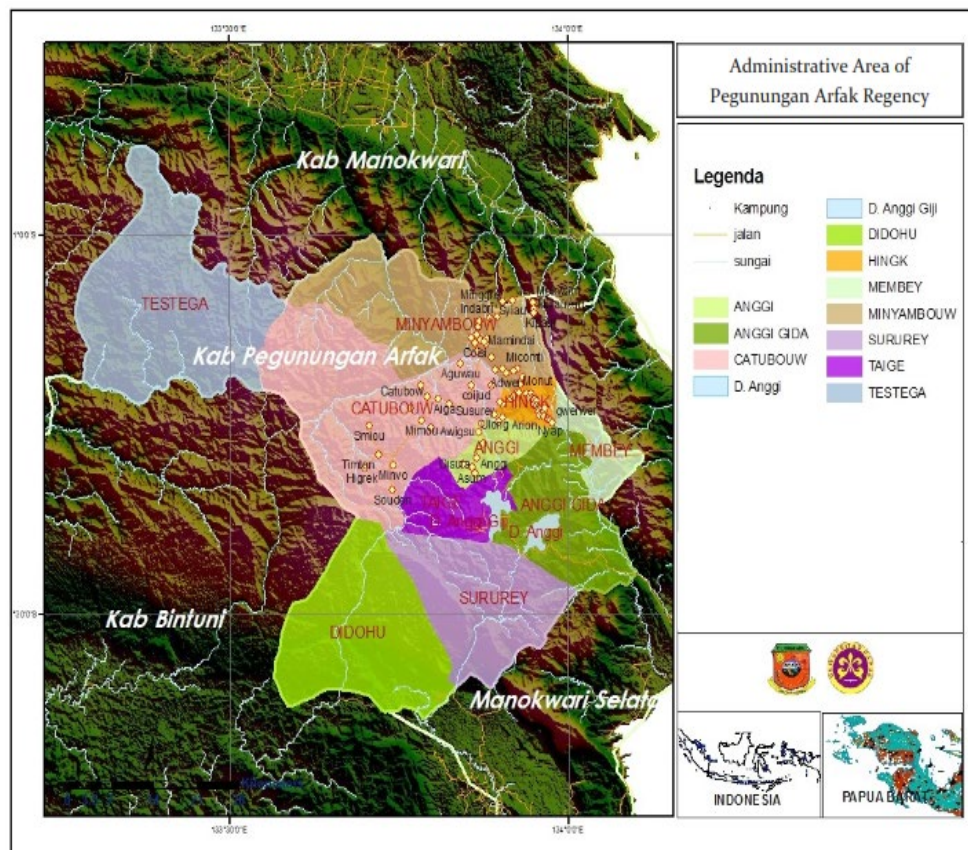


Figure 1. Map of Pegunungan Arfak Regency Administrative region
 Source: Report on the development of food crops, plantations, livestock, forestry And fisheries agribusiness-oriented in Pegunungan Arfak Regency, 2015

annually. It shows that farmers in West Papua mostly depend on agriculture and have low income. Pegunungan Arfak Regency (as an extension of Manokwari Regency) has 415.678 ha of shifting cultivation which is 62.71% of total cultivated field in West Papua province. After separating from Manokwari Regency, the areas became accessible and open to the outside world. Indigenous population has a low level of education. About 80% farmers follow shifting cultivation with limited agriculture technology, while the rest have adopted permanent cultivation, although the technology is still limited.

Shifting cultivation at the area of Pegunungan Arfak, can be a serious problem if indigenous do not cultivate the land properly. Although the area is designated as conserved forest, it can be damaged due to shifting cultivation. On the other hand, to Arfak people, shifting cultivation is done to revitalize and enhance soil fertility. The level of soil fertility in the Arfak is categorized as low (less fertile), thus after two or three harvest, the land becomes less fertile rapidly. Through the traditional wisdom of fallows, the fertility of soil can be improved for the next cycle of farming, as the land is marked with the planting of wooden trees such as *Arwop* (*Dodonaea viscosa*) in Hattam language is called *Damur*, and *Pasang* (*Lithocarpus rivoifillosus*) in the abandoned land.

The land preparation in shifting cultivation system needs longer time than in permanent system. The land opening requires extra time and effort, thus all family members play an important role. It starts by cutting down the trees, cleaning, and burning the logs, and building the fence to avoid animals that can damage the field. They will then start planting, nurturing, and harvesting. Land preparation is usually done by male family members and helped by other members of one clan. The land cleaning, planting, and nurturing are done by the family

members, which is mostly women, while harvesting is done by both men and women. There is no such wage system, because the activities are done by the group in the same clan.

3.2 Status of Farmers at Hink District

Generally, the agriculture sector is the primary source of income for Arfak ethnic household living in District Hink. They tend to plant vegetable crops such as carrot, cabbage, Chinese cabbage, spring onion, and potato as the main crops, as horticultural crops are harvested early, and provide the economic benefit.

There are 110 farmers in Hink District, originally from Hatam sub-tribes, and 90% of are male and 10% female. The average farmers' age is 33.7 years, and most of the family members are in productive age between 20 to 50 years. The range of education level varies from uneducated to college degree holders. Three of six farmers with a university degree work as government officials while the rest work as farmers, as there is no job opportunities in the government or the private sector. The average family has 3.96 persons/family. To Arfak Tribes, more the family members better is the productivity of their farms. The number of family members in one clan could help them to initiate a land opening and do shifting cultivation faster. Sometimes, the hard work, such as tree cutting and land cleaning are usually also done by outsourcing labours from non-family members, but from the same clan. Almost all the farmers sell their surplus agricultural produce directly to the market during harvest time.

3.3. Land Ownership for Farming

Land ownership in Papua Island is still collective or clan/family based ownership, but its land can be cultivated by other clans/families under the same name. The higher social status members within the clan/family will possess larger area than the lower

social status members. Every plot of farming land owned by Arfak tribes is a type of communal land in which every family is assigned particular land by their ancestors. They are responsible to develop and maintain the field.

Nearly 60% of farmer own up to 2 plots of land, and 38% own 3-4 plots, and only 2% have more than 4 plots of land. In terms of land size, majority (nearly 88%) own 200 to 3000 sqm of gardens, and about 52% is self owned and 42% is leased land.

3.4. Cropping Systems and Cropping Patterns

Shifting cultivation is one of the methods for small-scale subsistence farming in the tropical forests. The system being practiced for more than thousand years⁹. Although modern technology and intensive farming methods are common in other parts, shifting cultivation is still followed by Arfak tribes since there are plenty of fertile lands surrounding the area.

Located in between the village and primary or secondary forest in the hill, Arfak tribes have to work hard to maintain their land that is 45° steep, and farmers walk for more than 5km a day to cultivate

land which is located on another side of the hill. Arfak tribes cultivate mixed cropping of sweet potato and/or taro with potatoes. Tubers are consumed as staple food by indigenous people, although most of them also consume rice purchased from selling surplus tubers. Crops cultivated by Arfak tribes are shown in table 1.

Farmers use >50% of their land to plant tuber crops such as sweet potato and potato. Mixed cropping allows farmers to raise different commodities in the same field. Arfak tribes use both strip cropping or rows of crops, or the crops can be mixed in the field and in the same row. Mixed cropping is used to optimize the land use and increase the crop productivity per unit of land. Mixed cropping can be implemented for seasonal crops with similar duration and time of planting¹⁵. For those farmers who have a limited farm area, mixed cropping is best suited. But, the Arfak tribes have large fields, but follow mixed cropping due to their desires to fulfill the basic need for the family. According to Santoso²¹ mixed cropping offers many benefits: (i) to reduce the risk of unstable price of commodities, (ii) reduce the operating cost such as labour cost and crop management, and (iii) increase land productivity as well as soil fertility.

Table 1. The Distribution of Farmers Based on Type of Crops that Planted and the Planted Area of Various Commodities in District Hink, West Papua

Type of Crops	Number of farmers based on percentage of planted area (people)					
	>50%	30%-<50%	20%-<30%	10%-<20%	5%-<10%	<5%
Sweet potato	54	26	18	12	0	0
Potato	56	33	10	6	0	5
Taro	4	15	6	7	4	74
Cabbage/Chinese Cabbage	24	52	28	6	0	0
Beans and nut	6	22	32	29	13	8
Carrot	33	29	30	9	0	9
Peanut	1	6	5	0	0	98
Pumpkin	0	9	23	36	11	31
Corn	4	8	34	22	8	34
Spring Onion	33	24	22	8	0	23

Number observation: 110 farmers

Source: primary data analysis, 2015

3.5 Division of the Labor in Shifting Cultivation

Arfak tribes are still adopting shifting cultivation. This method allows farmers to have more than one field as a consequence of opening two or more lands in one time. The land-opening is done before the crops are ready to harvest in one field. After opening a new field for farming, they abandon the existing field for a fallow period. Table 2 shows the various activities of shifting cultivation system by the farmers.

According to FAO, shifting cultivation is detrimental for tropical forest ecosystem conservation (Mertz et al., 2009). A different notion proposed by Namgyel et al.¹⁴ report prohibition on the shifting cultivation practice in Bhutan to conserve the forestry needed for local flora and fauna.

Arfak tribes cultivate food crops and vegetables in this order: cabbage, Chinese cabbage, potato, pumpkin, corn, beans, peanut, taro, and sweet potatoes. The duration of planting season is approximately up to

two months. Thus the vegetables are harvested first and provide food until other crops are harvested. Sweet potato is the last crop harvested after all crops. The harvest process is gradual according the needs, as it is both a staple food of Arfak community, and also feed to pigs. Finally, the farmers allow their livestock to graze in their farms which has fencing all around.

Farming operation season by Arfak tribes in shifting cultivation system is calculated based on the dry season, which is most suitable condition to clearing the bushes and logging the trees to open the land. Three planting seasons practiced by the tribes are small season, medium season, and big season. The small season starts in March, when there are few rains for a couple of weeks. The medium season starts in May, when there is no rain the whole month. The big season is during August to October. For Sururey and Sough sub-tribes of Arfak, the sound of cicada (locally called as *Areijkn*) marks the beginning of the dry season¹⁹.

Table 2. The Process of Shifting Cultivation System in the District of Hink.

Farming Process / stages	Workers*	Time period	Description
<ul style="list-style-type: none"> - Land opening - logging - burning - cleaning up - hedging 	<ul style="list-style-type: none"> M M M + F M 	3 months	<ul style="list-style-type: none"> - Performed together by all of the family members - Part of the festive (cooking and eating in the pre-opening field of farm)
<ul style="list-style-type: none"> Planting - Seeds harvested from the previous crop for next season - Sowing in the crevices of the burnt tree - Planting 	<ul style="list-style-type: none"> M/F M/F F 	2 months	<ul style="list-style-type: none"> - Gradually done by farmers - Mix crop planting. - Mix cropping in one field.
<ul style="list-style-type: none"> Harvesting - Gradual harvest as per family needs - Surplus produce to be traded 	M / F	1 year	<ul style="list-style-type: none"> - Performed by the family members - Limited trading due to costly transportation fee
<ul style="list-style-type: none"> Idle field (bera) - The seed of harvested crops to be used for next planting - Reopening land - Farming field is reopened as secondary forest - Continue as in the initial cycles. 	<ul style="list-style-type: none"> F F + M 	<ul style="list-style-type: none"> >3 years After 5-10 years 	<ul style="list-style-type: none"> - Used as hunting area (trapping for the prey) - The reopening is not as hard as the first opening. - Member of the family as laborer

* M=Male; F=Female

The farms maintained by Arfak tribes are unique since they have hedge around the field to avoid animals that could destroy the crops. The process of preparing and opening land are done under mutual help system known as “*gotong royong*”. People or family who join the group working will be given enough compensation²⁴. *Gotong royong*, which is originally Javanese, is called “*Kerjan Ijai Noyam*” by Arfak tribes meaning to ask for group working. Although the practices are only done by a clan of family, it proves that the system is quite good and helpful to be implemented everywhere.

3.6 The Farming System

Agriculture production system by Arfak ethnic in District Hink is still traditional. Farmers do not use fertilizer and chemicals for crop production. Sowing and harvesting are dependant on the climate, which is a proof that agriculture in the area is still traditional. The harvested crops are either consumed by family, surplus is traded and/or saved as stock and supplies.

Most farmers of Arfak in District Hink produce sweet potato and potato, because potato is the main food for local people. Surplus potato is sold to get

income for the family. Sweet potato is consumed by the family and also used to feed their livestock, especially pig. The production for taro is also substantial (31% farmers).

Peanut is only planted by ten farmers (9%), and is mostly sold with small amount left for the next farming. For farmers of Arfak, seed is obtained from the previous harvest. For some crops such as cabbage, Chinese cabbage, and carrot seeds are purchased from the suppliers in Manokwari.

3.7. The Revenue of Farming Crops

The agricultural produce is the main source of income of most people in District Hink. In addition to contributing to household revenue, the agriculture sector is able to supply real wage for the people. The revenue of farming or production value of farming of various products sold by the farmers last year is shown in table 3 below.

The highest income comes from potato and lower from other plants such as pumpkin and corn because the harvest is for home consumption and not for sale. About 21% of farmers receive their income

Table 3. The Revenue of Various Cultivated Plants in the District of Hink

Type of Crops	Number of farmers based on amount of revenue ('000IDR)						Average (IDR)
	< 250	>250 – 500	>500 – 1,000	>1,000 – 1,500	>1,500 – 2,500	>2,500	
Sweet potato	34	28	41	5	0	2	581,421.00
Potato	13	11	50	21	12	3	1,202,703.00
Taro	16	6	11	2	0	0	333,377.70
Cabbage/Chinese cabbage	28	13	27	9	3	2	762,654.00
Beans	36	22	19	8	0	0	571,389.00
Carrot	19	23	26	14	3	10	823,111.00
Peanut	0	6	0	4	0	0	690,000.00
Pumpkin	35	39	5	0	0	0	265,561.00
Corn	28	22	26	0	0	0	358,439.00
Spring Onions	17	29	28	9	4	0	504,060.00

Source: primary data analysis, 2015

Note : IDR=Indonesian Rupiah

from various crops between 500,000 to one million of IDR. Income of farmers in District Hink is low, as price offered for the produce is low since the traders have to transport the produce to Manokwari town which is very expensive.

4. Conclusions

Farming system of shifting cultivation of Arfak tribe in Arfak mountain area is similar to shifting cultivation in other areas, which is cutting and burning. Activities are carried out jointly on individually owned land based on the ancestral ownership of land. The decision of crop to be planted is determined by landowners who hold the land rights, and get help from clan members to clear land, based on mutual agreement. Land clearing in the past was preceded by a traditional feast, but togetherness in the farming operations is still maintained.

The production of tuber crops is major as compared to other commodities. However, it only generates low income due to the high fluctuation in price of those commodities at harvest, and the transportation cost is also high. The highest income for Arfak tribes farmers comes from potato.

At present, the shifting cultivation is moving fast in Arfak mountain area due to increasing population and demand for food. This compels the community to open large number of primary forests which may cause natural disaster, such as flood, forest fire, and landslide. The gradual introduction of intensive settled agriculture is one of the solutions that local governments should develop.

5. References

1. Abdurachman A, Dariah A, and Mulyani A. Strategi daan Teknologi Pengelolaan Lahan Kering Mendukung Pengadaan Pangan Nasional. 2008. Available from:

<http://www.pustaka.litbang.pertanian.go.id/publikasi/p3272081.pdf>.

2. Arman S. Analisa Budaya Dayak. In: Florus DP, editor. *Kebudayaan Dayak: Aktualisasi Dan Transformasi*, Jakarta: Grashindo Utama; 1994.
3. Badan Penelitian dan Pengembangan Pertanian. *Prospek dan Arah Pengembangan Agribisnis: Tinjauan Aspek Kesesuaian Lahan*. 2001. Available from: <http://www.litbang.pertanian.go.id/special/komoditas/files/0105-Lahan.pdf>.
4. BPS Kabupaten Manokwari. *Manokwari Dalam Angka*. BPS Kabupaten Manokwari. 2011.
5. BPS Provinsi Papua Barat. *Statistik Daerah Provinsi Papua Barat 2016*. BPS Provinsi Papua Barat. 2016.
6. Conklin, HC. *Hanunoo Agriculture: A Report an Integral System of shifting Cultivation in the Philippines* Food and Agriculture Organization Rome. 1957.
7. Dobby EHG. *Southeast Asia*. University of London Press: London; 1950.
8. Dove MR. Theories of Swidden agriculture and the political economy of ignorance. *Agroforestry Syst*. 1983; 1:85–99. <https://doi.org/10.1007/BF00596351>
9. Filho Alexandre AR, Adams C, and Murrieta RSS. The impacts of shifting cultivation on tropical forest soil: a review. I Universidade de São Paulo. São Paulo, Brasil. 2013. Available from: <http://www.scielo.br/pdf/bgoeldi/v8n3/13.pdf>.
10. Gandhiv K. 2011, An Overview of Shifting Cultivation with Reference to Nepal. *International Journal of Biodiversity and Conservation*. 2011 May; 3(5): 147-154. Available from: <http://www.academicjournals.org/ijbc> ISSN 2141-243X©2011 Academic Journals.
11. Geertz C. *Agricultural Involution: The Processes of Ecological Change in Indonesia*. University of California Press: Berkeley, CA; 1963.
12. Mering Ngo. *Inilah Peladang*, dalam: *Prospek*; 3(1). Available from 13 Oct 1999.
13. Mertz O, Padoch C, Fox J, Cramb RA, Leisz S, Nguyen TL, and Tran TD. Swidden Change in Southeast Asia: Understanding Causes and Consequences. *Hum. Ecol*. 2009; 37:259-264. <https://doi.org/10.1007/s10745-009-9245-2>
14. Namgyel U, Siebert SF, and Wang S. Shifting Cultivation and Biodiversity Conservation in Bhutan *Conserv. Bio*. 2008; 22:1349-1351. <https://doi.org/10.1111/j.1523-1739.2008.01019.x>

15. Nazarudin. *Budidaya dan Pengaturan Panen Sayuran Dataran Rendah*. Penebar Swadaya. Jakarta; 1994.
16. NOFIP (National Office of Forest Inventory and Planning). *Forest Cover and Land Use in Lao P.D.R. - Final Report on the National Reconnaissance Survey*. Department of Forestry, Ministry of Agriculture and Forestry. 1992; 71 + appendices.
17. Priyadarshni. *Shifting Cultivation: Cropping Patterns, Jhum Cycle and Problems*. 2009. Available from: <http://www.yourarticlelibrary.com/cultivation/shifting-cultivation-cropping-patterns-jhum-cycle-and-problems>.
18. Ruthenberg H. *Farming Systems in the Tropics* 2nd edn. Clarendon Press: Oxford; 1976.
19. Rochani A, and Luhulima F. *Pengembangan Agribisnis Hortikultura Dataran Tinggi Pegunungan Arfak Kabupaten Manokwari*, P3FED Unipa Manokwari. 2012.
20. Sam DD. *Shifting Cultivation in Vietnam: its social, economic and environmental values relative to alternative land use*. IIED Forestry and land use Series No. 3. Working Group and Forest Science Institute Ministry of Forestry Vietnam. 1994; 3-15. PMID:12222412
21. Santoso. *Klasifikasi Usahatani Jurnal Lahan Sub Optimal*. Kabupaten Lombok Timur. 1990. ISSN 2302-2015
22. Soedjito H. *Masyarakat Dayak: Peladang Berpindah dan Pelestarian Plasma Nutfah, Dalam Kusnaka Adimihardja (editor), Petani, Merajut Tradisi Era Globalisasi, Pendayagunaan Sistem Pengetahuan Lokal Dalam Pembangunan*, Bandung: Humaniora Utama Press; 1999.
23. Spencer JE. *Shifting cultivation in Southeastern Asia*. Berkeley, University of California Press; 1966.
24. Subejo and Matsumoto T. *Transformation of Labor Exchange Arrangement in an Agrarian Community of Rural Java, Indonesia*. *Journal of Applied Sciences*. 2009; 9 (22): 3932-3946. ISSN 1812-5654.
25. Yusran J. *Belajar Dari Adaptasi Petani Ladang Berpindah Di Nagari Silayang Kecamatan Mapattunggul Selatan Kabupaten Pasaman Provinsi Sumatera Barat*. *Prosiding Seminar Nasional Pelestarian Lingkungan & Mitigasi Bencana Pekanbaru*. 2016. Available from 28 May 2016.

“A door is much smaller compared to the house, a lock is much smaller compared to the door, and a key is the smallest of all. But, a key can open entire house. Thus, a small, thoughtful solution can solve major problems”
- APJ Abdul Kalam