Coffee-based appropriate technology implementation for community empowerment: lesson learnt from rural community in Sumba Barat Daya

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Abstract. Implementation of appropriate technology is recognized as one of the significant approaches for community empowerment. The principle of localities embedded in defined appropriateness of technology as “people mattered” has always been challenged when it is applied. This paper discussed the findings from an action-research work in the traditional coffee community in Sumba Barat Daya – East Nusa Tenggara. Coffee cultivation, post-harvest handling, processing to ground coffee, are tradition practiced to fulfill their need. The tradition is in the contest when there is a demand from the modern market requiring an increase of quality and productivity. The result of this study showed that to empower community it requires integration of technology appropriateness which is economically profitable and socially acceptable, and to ensure sustainability, maintenance of induced knowledge and practices should be strengthened by local institutional establishment based on social capital.

1. Introduction
Community empowerment is one of the development strategies. The goal of community empowerment is increasing the human resources capacity to use their resources to achieve prosperity and self-reliance. This strategy has proven to be able to solve many rural development problems, especially poverty alleviation. Thus, it becomes one of the government’s strategies for rural development.

The critical point of many community development projects is about the mindset of outsiders in their efforts to develop rural communities. Projects are subjected to get a better local condition, but only a few efforts to ensure the sustainable development [1]. In the community empowerment, transformation process will occur in the society, both in term of socio-economic and culture. Transformation is an impact of the intervention. The facilitators need to ensure that the transformation process does not have a negative impact on society.

These papers will discuss the role of Appropriate Technology (AT) for poor community empowerment in the disadvantaged regions, a case study of AT based on the coffee community in Sumba Barat Daya. This topic is relevant to Policy of Government of Indonesia and Sustainable Development Goal’s (SDGs) target to increase competitiveness, reduce poverty, and reduce the gap.

Poor people in the disadvantaged regions have all limited access to both basic and productive needs. Geographically, these regions are far from the center of growth. They lack access to infrastructure, and lack of ability to manage natural resources. If these conditions are left, then the gap among the regions of Indonesia will become wider. For the example, Sumba Barat Daya, where in national map, this region
is listing on the disadvantaged region that should be alleviated in 2019. There are ninety disadvantaged regions prioritized to alleviate. It needs an AT to optimize their resources.

Based on Statistic bureau, GDP of Sumba Barat Daya is 1.896,09 billion, which is lower than national GDP. For all East Nusa Tenggara, Sumba Barat Daya is only contributing 1.09% on the Province GDP Structure, with the level of growth is about 4.79%. From the data, Sumba Barat Daya needs a strategy to increase its economic growth, but not to widen the gap in it. Economic growth should be accompanied by justice and equality for economic access. The solution is community empowerment, which, in its method needs the active participation of community members. It is hoped, that their natural resources will be able to be processed by local people, so the added value can be returned to them.

In an attempt of community empowerment for rural development, Appropriate Technology (AT) approach will be a driver to increase human resources capacity. Inclusivity as well as providing added value, not only economically, but also socially and environmentally are the basic characters of appropriate technology [2,3]. Appropriate technology is believed as a more situated, environmentally concerned and socially just set of design and operational principles for various technology choices by involving local communities [1,4]. For a developing country like Indonesia, the essential character of technology signifies local community in need.

Through the study of technology implementation on coffee processing in Sumba Barat Daya, we unravel the challenge faced when the concept of AT is used as a reference. The research result will be beneficial for policymakers to create strategic steps of technology transfer for community empowerment. [5] Appreciate that community empowerment is an effort to brought social justice, where resources need to be distributed for those who are less fortunate.

2. Data and methods
The main issue of this study was to identify determinant factors of technology transfer by examining the process thoroughly. Therefore, action-research was selected as a methodology for community empowerment to serve the opportunity in acting while doing research. Data and information were then collected by using focus group discussion (FGD), in-depth interview and direct observation techniques.

The primary data were collected from in-depth interview to key person, focus group discussion, and direct observation when we did the research action activity. The number of respondents is 55 persons from 3 villages. In-depth interview was held with some respondents, which are entrepreneur, chief in village, and some public figures. FGD was conducted to 21 coffee farmers. Moreover, FGD was conducted to the representation of related agency, such as agriculture and plantation agency, forestry agency, BAPELITBANGDA, PMD, veterinary agency, Cooperation, and SMEs Agency, Trade and Industry Agency.

While, secondary data was collected from related agency such as agriculture and plantation agency, BPS, and others. The analysis method was qualitative and statistical descriptive analysis. The parameters were built in this research based on the concept of key indicator on AT by [6–8], transformed into four measurements of appropriateness, which are:

1. Technology appropriateness
2. Socio-economic appropriateness
3. Environment appropriateness
4. AT Institutional appropriateness

Assessment of these parameters was based on the result of surveys, FGD, in-depth interviews and direct observation in the field. The data were processed as descriptive qualitative to be analyzed and generate the conclusion.

3. Results and discussion
3.1. Identification of potency
Based on the result of the assessment of local natural resources potency, coffee is one of the potential commodities that have an important social and economic role. Coffee is usually used as family
communicators because most people in Sumba have a habit of drinking local coffee. Drinking a local coffee is a pride for them. Coffee also has a role to be an income generating source for the family.

Figure 1. Plant area and production of commodity in Sumba Barat Daya.

Coffee is the third biggest commodity in Sumba Barat Daya. Coffee is not the biggest, but coffee has an important social value. In Sumba, Coffee is usually used to be one of donating tools in the traditional event such as in funeral ceremony. The coffee bean has a shift of value, from economic to social value. Hence, the view of a narrow the economic perspectives needs to be widened to move beyond a sole focus on self-interested preferences, to detect the nature of social value and to explore ways to capture those values [9]. With the widen perspectives, in the potency identification process, coffee is chosen because it has wide value, not only economic but also the social value in the local’s community. These will help to determine the subject and object of community empowerment.

Even coffee has been a daily drink for five decades, but the quality of the coffee is still substandard. It is because the post-harvest handling of coffee is not standard. The farmer’s knowledge of coffee processing comes from their previous generations. The traditional coffee processing they do can be drawn in the picture below:

Figure 2. The traditional method of coffee postharvest processing.

The traditional processing of locals is close to honey methods coffee processing. The farmers were pulping the coffee cherries an drying it on the ground. The dried coffee cherries were hulled with traditional mortar and pestles. This method can break the coffee bean, which can make the prices fall.

The post-harvest treatment of coffee cherries is a significant but variable impact on volatile and aroma profiles of roasted coffee [10]. Coffee has many techniques to process Each technique results a different taste and flavor. It is relatively complex steps, including fruit harvesting, depulping, drying, and storage. Fruit harvesting is the first step in postharvest coffee processing. After the coffee cherries are harvested, the coffee processing should begin as quickly as possible to prevent fruit spoilage by unfavorable fermentation or mold formation [11]. Generally, coffee processing has three methods, they are wet process, dry process, and semi-wet process. In the dry processing, seeds are exposed to the sun or air dryers until the moisture content is approximately 10%–12%. After drying, the fruits are cleaned and dehulled, and then the dried skin and pulp are removed. Wet processing, in contrast, involves a relatively complex series of steps, including mechanical removal of the coffee skin and pulp, microbial degradation (fermentation) of the mucilage layer and, finally, water removal by sun-drying. This process...
reduces the time (from 3 to 5 weeks to 8–10 days) and the area required for drying the beans in relation to dry processing. Finally, the natural process presents stages of both dry and wet methods, where the coffee fruits are mechanically depulped and then submitted to sun-drying [12].

To process green bean to be ground coffee is something usual for local people. They usually roast their coffee. The roasted coffee they like is “dark to dead charcoal” roast. So, they always add some sugar to their cup while drinking coffee to reduce the bitterness. Moreover, ANg as one of respondents said “I should provide my own roasted coffee, prepare for the guest. If the guest is served with instant coffee, it means we do not respect them”. Based on a survey in 2017, the data showed that 100% of respondents choose to roast their coffee. The local people revealed verbally that they are proud of producing coffee by themselves. However, they do not refuse to buy local coffee roasted, as long as they are sure that the coffee is original from Sumba. That social value of coffee has a strategic role, to be promoted as a viable economic commodity. In other reason, some market segments (non-locals) like medium or light type for roasted coffee.

3.2. Appropriate technology selection

Before the technologies were implemented, the assessment was carried out to ensure the appropriateness of technology towards the problem to be resolved. In this case, coffee in Sumba Barat Daya has many problems from upstream (Plantation) to downstream (roasted coffee). On the locals farming activities, they do not do periodic maintenance. The plants in their “Kalio” grow naturally. On the post-harvest processing, they have inadequate knowledge, so the quality of green bean is low. Whereas, naturally, Sumba’s coffee has a unique taste and flavor.

The criteria for AT assessment were built with paying attention to some aspects that are in accordance with AT principal. The aspects are economical aspect, social-cultural aspect, environment aspect, and technology aspects. The explanation of each aspect can be seen on the table below.

| No. | Criteria                      | Assessment                                                                                                                                 |
|-----|-------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------|
| 1.  | Technology Appropriateness    | The technology needed for locals is kerosene and gasoline-fueled technology. We avoid technology based on gas or electricity because both are difficult to find. The capacity of the device is adjusted to each coffee farmer’s productivity.
|     |                               | Water availability is limited.                                                                                                               |
| 2.  | Social-Economic Appropriateness | Coffee has high social value for locals. Besides, it has an obvious market. Kinship system in Sumba, in many ways, helps the program to reach the target. It also helps us to form coffee farmers group.
|     |                               | The most livelihood comes from agriculture activity. Sumbanesse have land named “Kalio” for perennial crops, and they have “uma” for food crops |
| 3.  | Environmental Appropriateness | Robusta coffee is cultivated in a polyculture pattern in an agroforestry system with at least 17 species of plants to fulfill ecological, economic and social roles. Although managed with minimal intervention, the ecosystem resilience is relatively balanced. An important indication is the low incidence of pest and diseases infestation, while productivity reaches 396 kg/ha or about 54 percent from the average national productivity [13]. |
| 4.  | Institution Appropriateness   | There is a pioneer of cooperation. But, it is not active since three years ago. The existing farmer group is only formality, not really active. |
Based on an assessment conducted prior to implementation stage, it concludes that serial of technology which suitable for Sumba Barat Daya’s condition is:

1. Technology (Equipments) was implemented using huller, pulplier, grader, and roaster. All machines are kerosene and benzene based. The capacity of pulplier is 300kgs/hour, huller has capacity 100kgs/hour, and the capacity of the grader is 300kgs/hour. Some devices are electrical, such as scales and sack sewing machine. The capacity of the machines adjusts to the productivity of farmers whenever picking coffee.

2. Drying technology uses a wood frame, with a dome made from Plastic UV. Wood frame is affordable and easy to get. It is also simple in its construction.

3. Processing technology of coffee beans uses the honey method. This method was chosen because of the limitation of water availability in Sumba Barat Daya.

All technology packages were designed according to condition and capability of locals in Sumba Barat Daya.

3.3. Appropriate technology implementation

AT implementation based on the coffee agro-industry in Sumba Barat Daya started in the period of the year 2015, by building a microenterprise, which process grounded coffee. It is used as a stimulant on the behavior changes of coffee community in Sumba Barat Daya. When the demand for ground coffee increases, the microenterprise should find an alternative for green bean supplier. From the series discussion with coffee farmers, they agreed to build village coffee business. Its function is processing coffee from red cherry to green bean. In 2018, after the farmers institutions were formed, technology was introduced. The technology was introduced to improve the quality of Sumba’s coffee.

All the implemented technology used appropriate technology approach. Whereas, the process of choosing technology are considers to the social economic and environmental aspect. The three aspects are corresponding to AT definitions, the technology that is affordable, easily exploited, eco-friendly, and not contrary to social-cultural value (INPRES No.3 2010).

Despite the lower level of sophistication and complexity of these solutions, the transfer process is often problematic for the context in which the transfer tends to take place, a context that is frequently characterized by similarly low levels of sophistication and development [14].

Post-harvest technology of coffee processing for Sumba people is not a new thing. They have got cultivation knowledge from the extension service. But, to implement on their daily life, it needs a huge motivation and an intensive mentoring. Sumba’s coffee farmers know that they should pick only red cherry of coffee. In point of fact, they pick both green and red cherry. It is because there are no price differences and it is faster to be done.

With AT implementation, coffee farmers are trained to pick red cherry only, shortages, and peel coffee skin by machine so that the coffee has a good quality. They are introduced to coffee which has a higher quality. The market for a high quality of coffee is introduced to them so that they can choose an alternative process of coffee. From the mentoring of coffee processing, the locals change their method of picking red coffee.

Processing of coffee technology that was introduced by improves the traditional system into honey system. This effort is to ensure that in the process, coffee beans do not rot during the drying process. So, it does not make the tastes dan aroma of coffee beans stinky. Besides, the process aims to avoid contamination.

3.4. Challenges to empower rural community

Transfer of technology requires a change of behavior, both from technology provider and from technology receiver. That change becomes the starting point of the acceptance of technology adoption system. Change of behavior needs to be institutionalized, so that it becomes group behavior. The transformation process of personal behavior to institution behavior is a part of community development [15]. Change of behavior takes a long time with the prerequisite of consistent mentoring.
AT in principle involves productive mindset to each member group, who was initially farming to agriculture business unit, selling random coffee bean to only selling good quality of coffee beans. To get good quality of coffee beans, the farmers should change their cultivation behavior.

Mistrust on transfer of technology process is one of the things that should be considered. Something new definitely invites lots of questions. There are 2 type mistrust based on the subject, there are; Mistrust of technology performance and mistrust to disseminator of technology. Mistrust happens not only to external sources but also on how to transfer the technology. So, people prefer choosing locals to non-locals as a network [16].

The dialogue between external knowledge sources and small and medium-sized enterprises may render difficulty by relational-type barriers generated by a distance that may be cognitive, traceable to sets of basic values, norms, and mindsets, or of an emotional nature, traceable to sensations of apprehension and confidentiality [17]. The dialogue should be done systematically and measurable so that the trust will rise.

Quadra Helix is one of right ideas to build a community empowerment concept with the AT approach. ABGC (Academician, Business, Government, and Community) concept becomes a tool to empower traditional microenterprise to be an efficient and productive business. Government plays as an infrastructure provider for the A B C. Academician plays as a technology provider, and community has a role as supporters in micro enterprise’s supply chain.

Transfer of technology is carried out to technology dissemination as an effort to build a competitive nation. Local government and local bank help to provide initial investment with the prerequisite of a soft loan, low interests, and long grass period adjusted to micro enterprises capability. Coffee farmers community as a supplier of raw materials has roles in providing a consistent and good quality of the coffee bean.

One of the scenarios to build SME’s is by building its community. Building community loyalties to local products, building awareness of environmental sustainability are accompanied by increasing their purchasing power. Social engineering begins to build an awareness of the locals natural resource’s potency, such as coffee. If coffee is maintained and processed, it can be a decent source of income. Therefore, a coffee farmers association is formed where coffee farmers and ground coffee micro enterprises become one in an integrated agribusiness system.

Of course, all actions cannot be done individually. Building awareness should be done in groups with collaboration principle. Collaboration with others will simplify the goal achievement. To make the system function as desired, interaction across all the parties is compulsory [15]. Coordination is one way to build interaction among these parties. The character of small-scale enterprise in rural area is traditional in which the natural resource base activity heavily depends on raw material availability and local market system. In the globalization era, holding to that principle will place coffee farmers in Sumba Barat Daya into a vulnerable position. It is important to strengthen them with relevant entrepreneurial skill and knowledge to help them survive by increasing their competitiveness. It will require collective action and institutional approach to shift the paradigm from traditionally managed small-scale enterprise to collaborative network [18]. Although it is not a new concept, networking could be the most appropriate strategy for small scale industries to develop strong business capable of competing. Collaboration allows business to manage risk through sharing scheme, provide access to resources so that the improvement of business performance can be achieved [19]. The collaboration will enable them to strengthen their bargaining position, the solve problem collectively, which at the end creating a more efficient and effective marketing system [20].

4. Conclusion

Community empowerment is needed for rural development in disadvantaged region such as Sumba Barat Daya. Appropriate Technology could be a driver for empowering the community to prosperity and self-reliance. An Appropriate Technology is a technology that is still needed for local people, especially people in the low-level income. In this level, technology is not impartial. If technology wants to bring impact to welfare, there is a need to mentor the system in the context of community development. An AT embraces inclusivity. So, in the AT implementation, people participation is needed. More people to participate, it means the goals of AT implementation are achieved. Community
empowerment is needed to justice and equality of technology access for everyone. With the equality principle, it is hoped that equitable economic growth will be achieved, and the gap can be reduced.

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