The use of specifically adapted genetic resources for regional economic development

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Abstract. Genetic resources are essential sources for further varietal improvement as well as directly used of their products due to their prime quality product in a particular region but not in other regions. Genetic resources grown for some time in a region probably have been improved their adaptability to the environment. The resourses could be used to develop new varieties adapted to a specific location. If every region has that kind of variety, it will, in turn, improve national productivity of that commodity. Besides, genetic resources having specific adaptability to a specific location and producing a prime quality needed by the consumer may also be useful to boost the economy of that particular region. This kind of products is generally known as the Geographical Indication (GI) products. A GI must identify a product as originating in a given place. Examples of products protected with GI that improve the local economy are: (1) GI Kintamani arabica coffee which before the protection involving 40 groups of farmers (1,750 workers), the price of coffee IDR 25,000.00/kg. After the protection, the farmers' groups become 60 involving 2,640 workers and the price increase to IDR 75,000.00/kg, (2) Muntok white pepper, the price after protection is IDR 170,000.00/kg, whereas the price before protection was IDR 40,000.00/kg. The use of genetic resources in varieties improvement required a tremendous amount of effort and funds, while GI required effort in maintaining quality of products and funds for the promotion of product.

Keywords: genetic resources, plant breeding, geographical indications.

1. Introduction

Genetic resources are essential components for the development of new plant varieties to meet the growing population's demand on their need. However, in the era of globalization, the availability of plant genetic resources is getting scarce due to the fact that the reduction of fertile agriculture land is getting greater than the population increase.

The International Treaty on Plant Genetic Resources for Food and Agriculture (IT PGRFA) is an international legally binding agreement, in harmony with the Convention on Biological Diversity, to guarantee food security through the conservation, exchange and sustainable use of plant genetic resources for food and agriculture (PGRFA), as well as the fair and equitable sharing of benefit arising from its use. The Treaty also recognizes the right of farmers to get protection on their traditional knowledge relevant to plant genetic resources for food and agriculture; participate in sharing benefit-sharing arising from the use of plant genetic resources for food and agriculture; in making decisions, on matters related to the conservation and sustainable use of plant genetic resources for food and agriculture. The Treaty establishes a Multilateral System (MLS) of Access and Benefit-Sharing (ABS)

to facilitate plant genetic resources exchanges and benefit-sharing through a Standard Material Transfer Agreement (SMTA). Besides, there are available genetic resources found in specific location producing products of premium quality resulting in high price can also be used to improve farmers' income due to high demand.

2. Genetic resources

Genetic resources refer to the genetic material of actual or potential value. Genetic material is any material of plant, microbial or other origin containing functional units of heredity. PGRFA are plant genetic materials of actual or potential value for human livelihood, and may include the entire generative and vegetative reproductive material of species with economic and, or social value, especially for the present and future of agriculture, with special emphasis on nutritional plants. It may also be defined as the diversity of material contained in traditional varieties and modern cultivar as well as crop wild relatives and other wild plant spesies that can be used now or in the future for food and agriculture.

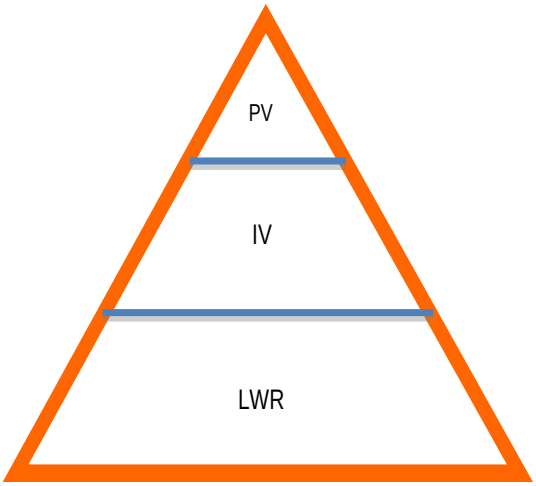

Figure 1. Forms of Plant Genetic Resources: protected varieties, improved varieties, and landraces and wild relatives.

Genetic resources can be grouped into:

1) Protected varieties
   Genetic resources belong to this group consisting new plant varieties eligible for protection. The plant variety must be distinct, i.e. should be distinguishable by at least one essential characteristic from existing or commonly known varieties in any country at the time of filing of the application. It also must be sufficiently uniform in its essential characteristics; which must be stable after repeated propagation.
2) Improved varieties
   Improved varieties or cultivated variety, refers to an assemblage of plants selected for desirable characters that are maintained during propagation. Most cultivars arose in cultivation, but a few are unique selections from the wild. In the International Code of Nomenclature for cultivated plant, cultivar is the most basic catgory.
3) Landraces and wild relatives
   Landraces crop cultivar or animal breed that has been developed through traditional farming practices for many years in aparticular locale without influence from modern agricultural science. A crop wild relative (CWR) is a wild ancestor of the domesticated plant, or another closely related taxon.

3. The use of genetic resources

As shown in Figure 1 three forms of genetic resources that may be used directly or indirectly to develop new plant variety, which, in turn, provide a source of income not only to the developer but also regional economy.

The Convention on Biological Diversity (CBD), which under certain circumstances refers to genetic resources, recognizes the need for equitable sharing of benefits arising from the use of traditional knowledge, innovations and practices relevant to the conservation of biodiversity/genetic resources and the sustainable use of its components.

Access to genetic resources, therefore, should be coupled with equitable benefit-sharing in order to realized the objective of the CBD. Adoption of valid prior informed consent (PIC, Figure 2) procedures in both provider and user countries have a crucial role to play in achieving realization of the CBD's objective of ensuring equity and fairness in benefit-sharing; and in consolidating international ABS governance.

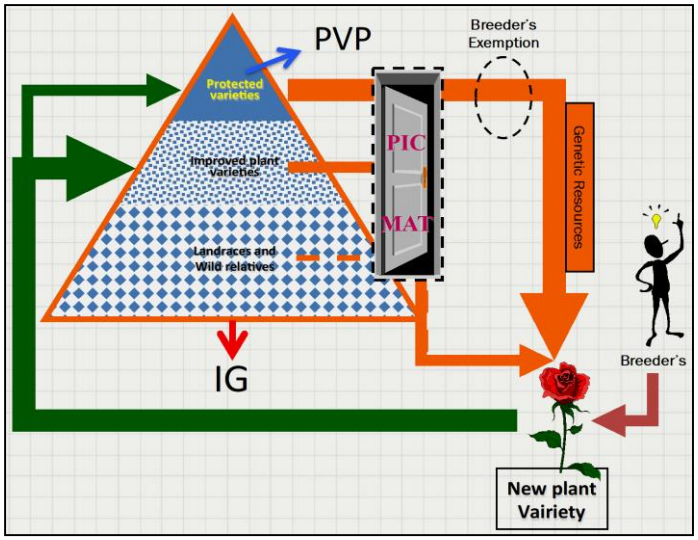

Figure 2. Genetic resources cycles.

PIC is at the very heart of the CBD's compact on ABS. Stakeholders had developed procedures for different purposes (e.g. in MTAs, in patent applications, or the process of product approval for commercialization). Any system should be designed to avoid unnecessary impacts on trade to circumvent any conflicts with World Trade Organization agreements. Any regime has to be developed with the full participation of all stakeholders; only then can it protect the interests of resource providers, in particular concerning traditional knowledge, without being restrictive and preventing desired exchanges of genetic resources.

Under the CBD [1], the concept of Mutually Agreed Terms (MAT) means that a contractual agreement must regulate the access to genetic resources and the sharing of resulting benefits among the parties (the contracting country, as represented by its competent authority, and the party using the genetic resources).

4. Classical plant breeding

The main objective of plant breeding is to improve crop productivity, quality of products (harvested materials), ability to adapt to climate and soil conditions and tolerance or resistance to pests and diseases. Plant breeders use the genetic variations between plants to attain these objectives. Successful adaptation to environmental conditions and success in plant breeding are bounded by the range of the genetic base, as measured by genetic diversity. Genetic variation is needed to address many problems in plant breeding, and is obtained from the biodiversity within the plant genetic resources as shown in

Figure 1 consisted as breeding lines, landraces, primitive forms, wilds and wild relatives, weed races, etc.

In plant breeding, the use of genetic resources is to manipulate plant species in order to create desired genotypes and phenotypes for specific purposes. This manipulation is done, either through controlled pollination, genetic engineering, or both, followed by artificial selection of progeny. Classical plant breeding crosses closely or distantly related individuals to produce new crop varieties or lines with desirable properties. Plants are cross-bred to introduce traits/genes from one variety or line into a new genetic background. For example, rice accession resistant to bacterial leaf blight crossed to high-yielding variety. The goal of the cross being to introduce bacterial leaf blight resistance without losing the high-yield characteristic.

Progeny from the cross would then be backcrossed with the high-yielding parent to ensure that the progeny was most like the high-yielding parent. The progeny from the backcrossing then be tested for yield and bacterial leaf blight resistance and high-yielding resistant plants would be further developed. In crossed pollinated crops, such as corn, plants may also be crossed with themselves to produce inbred lines for breeding. Inbred lines were then used to develop single, double, or three- way cross hybrids.

Plant breeding often, but not always, leads to plant domestication. Plant breeding has been practised for milenia, since the beginning of human civilization. Government institutions and commercial enterprises are alo practicing. International development agencies recognize that crop improvement through plant breeding and development of crops suitable for their environment are vital for ensuring food security.

5. Modern plant breeding

In modern plant breeding or genetic engineering, the DNA in an organism's genome is altered by changing one of the base pair (A-T or C-G). The breeding process may also include the deletion of the whole region of DNA, introduction an additional copy of a gene, or extraction DNA from another organism's genome and combining it with the DNA of that individual. Genetic engineering can be used to enhance or modify the characteristics of an individual organism, e.g. to produce plants that have a higher nutritional value or can tolerate exposure to herbicides. Scientists in a laboratory were able to slow the ripening of tomato by introducing a reverse-orientation copy of an "antisense" gene in a tomato, i.e taking out a gene in the chromosome and putting it back in backwards. This slow ripening tomato increased it shelf life dramatically and was the first genetic engineering crop. In 1994, this genetic engineering tomato was commercialized under the name of FLAVR SAVR tomato and released to the public. However, consumers and retailers in the United States and the United Kingdom resist to Calgene, the company marketing this tomato and tomato paste products, and soon after the tomato project was stopped; since it was no longer profitable.

Studies showed the continued social, environmental and economic benefits of the global adoption of biotechnology in agriculture. The International Service for the Acquisition of Agribiotech Application (ISAAA) [2] report that the global biotech crop area increased in 2017 by 3% or 4.7 million hectares. This increase was primarily due to greater profitability stemming from higher commodity prices, increased market demand both domestically and internationally, and the presence of available seed technologies. As more developing countries increased their biotechnological crop area and continue to allow farmers to adopt biotechnology in food production. With such adoption smallholder farmers see the direct improvements in their crop production; allowing them to provide better lives for themselves and their families. In fact, developing countries now account for 53% of the global biotech area planted.

6. Geographical indication

A sign used on products that have a specific geographical origin and possess qualities or a reputation that are due to that origin is called A Geographical Indication (GI). To function as a GI, a sign must identify a product as originating in a given place, and the qualities, characteristics or reputation of the

product should be essentially due to that place of origin. Since the qualities depend on the geographical place of production, there is a clear link between the product and its original place of production.

Currently, there are various national and international instruments to protect GI from being used by unauthorized parties. Development knowledge base by any society for a period of time owes its origin to the geographical environment and human interactions, the knowledge base becomes the integral part of their economy and tradition. In a globalized society, the knowledges are vulnerable to misuse; hence, the process of preserving the knowledge and heritage is essensial. GIs have intellectual property status since the product gets more value commercially by its mere association with a particular place. GI helps in the identification of a source of a good, which in turn, is related to the quality of good. The laws related to GI apply to a wide variety of goods varying from natural, agricultural to manufactured products. If an area has indicative power then any name related to that area can get legal protection under GI.

In Indonesia, GI have been implemented since the enactment of the Government Regulation Number 51 [3]. One of the most essential requirements in filing for GI protection is that the applicant must submit a book of requirements, under the Law of the Republic of Indonesia Number 20 [4] on Mark and GI refers to Description Document. The description should contain the name of the GI the goods to be protected, the characteristics and qualities of the produced goods, the environmental impact in terms of geography and nature as well as human factors on the characteristics and qualities of goods, the area boundary or area map that is protected by the GI, history and tradition relating to the use of the GI to mark the goods produced by the area, including testimonials from the community on the GI; the production process, processing process and making process which are being applied to enable every producer in that area to produce, process, or make the concerned goods; the methods used for quality testing of the concerned goods; and the labels of the concerned goods showing the GI.

Once the GI registered, the product will be protected indefinitely as long as the specific characteristics and qualities which form the basis of protection remain to exist. GIs can have enormous economic value and are especially useful as marketing tools in emerging markets. So far, there are 65 GI products registered at the Ministry of Law and Human Rights, consisting of fifty-nine domestic GI products, out of which twenty-two products are coffee. Six are foreign products: Champagne, Pisco, Parmigiano Reggiano, Lamphun Brocade, Grana Padano and Tequila.

Farmers' income improvement examples: Kintamani Bali arabica coffee price before GI protection was only IDR 25,000.00/kg, and after the protection become IDR 75,000.00/kg, Muntok white pepper price before GI protection was only IDR 40,000.00/kg, and after the protection become IDR 175,000.00/kg, and Meranti liberica coffee price before GI protection was only IDR 48,000.00/kg, and after the protection become IDR 200,000.00/kg.

Those specially adapted genetic resources having a high reputation in the high producing quality of their products, proof their ability too boost the price through GI. This is not only for the betterment of the farmers, but also for the regional economy.

7. Concluding remarks

Genetic resources is anessential component for varietal improvement in developing high-yielding varieties with the addition of resistance to pest(s), disease(s) or environmental stress. Adapted varieties or landraces capable of producing premium quality products in a specific region known as GI products. Those genetic resources may, eventually, boost the regional economy due to limited growing area with the high demand for the product.

8. References

[1] CBD 1992 *Convention on Biological Diversity* (Rio de Janeiro)
[2] ISAAA 2017 *Global Status of Commercialized Biotech/GM Crops in 2017: Biotech Crop Adoption Surges as Economic Benefits Accumulate in 22 years*
[3] Indonesian Government 2007 *Law of the Republic Indonesia Number 51 of 2007 on*

Geographical Indication
[4] Indonesian Government 20016 *Law of the Republic Indonesia Number 20 of 2016 on Marks and Geographical Indications*