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Harnessing Indigenous and External Agricultural Knowledge Systems Toward an Indonesian Economic Corridor

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HARNESSING INDIGENOUS AND EXTERNAL AGRICULTURAL KNOWLEDGE SYSTEMS TOWARD AN INDONESIAN ECONOMIC CORRIDOR

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CHAPTER 1. INTRODUCTION

1.1. Research Background and Issues

Indonesia has abundant natural resources, including agriculture, the main source of income of the majority of its people. Ironically, data show that Indonesia cannot fulfill its demand for food because it lacks supply. Data also show that Indonesia is a net importer of food commodities such as rice, maize, soybeans, sorghum, wheat, peanut vegetables, and fruits. Export per capita, both in volume and value for food commodities, remains constant, while the import per capita tends to fluctuate. This shows an inadequate food supply and high dependency on food imports.

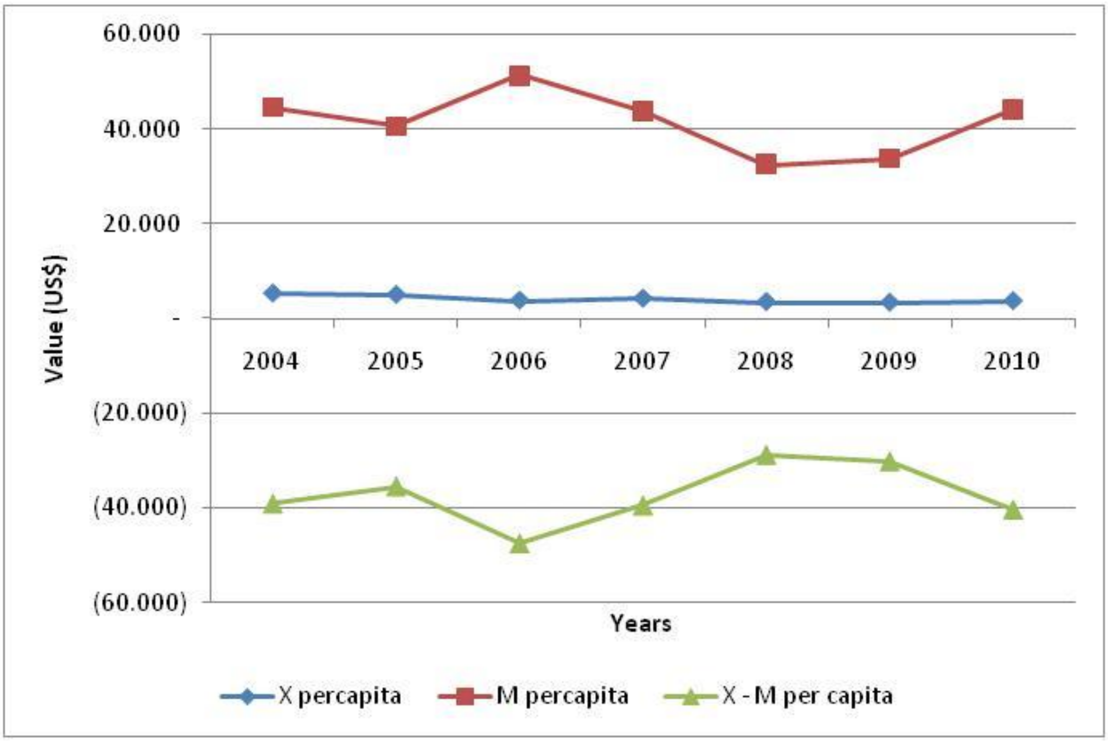
Table 1.1 Volume and Value of Exports and Imports of Food Commodities 2004-2010

Years		Export	Impor	X - M	X percapita	M percapita	X - M per capita
2004	Vol (KG)	1,170,247,442	9,670,604,316	(8,500,356,874)	5.397	44.601	(39.204)
	Value (US $)	274,497,239	2,423,417,775	(2,148,920,536)	1.266	11.177	(9.911)
2005	Vol (KG)	1,123,430,958	8,936,435,847	(7,813,004,889)	5.110	40.648	(35.538)
	Value (US $)	286,743,637	2,115,139,808	(1,828,396,171)	1.304	9.621	(8.316)
2006	Vol (KG)	861,218,660	11,456,509,068	(10,595,290,408)	3.866	51.433	(47.566)
	Value (US $)	264,154,679	2,568,453,184	(2,304,298,505)	1.186	11.531	(10.345)
2007	Vol (KG)	964,252,678	9,896,425,666	(8,932,172,988)	4.273	43.859	(39.586)
	Value (US $)	303,252,481	2,938,089,999	(2,634,837,518)	1.344	13.021	(11.677)
2008	Vol (KG)	812,330,390	7,414,294,673	(6,601,964,283)	3.555	32.444	(28.890)
	Value (US $)	348,914,178	3,526,961,275	(3,178,047,097)	1.527	15.434	(13.907)
2009	Vol (KG)	786,627,015	7,788,214,749	(7,001,587,734)	3.400	33.661	(30.261)
	Value (US $)	321,261,067	2,737,861,716	(2,416,600,649)	1.389	11.833	(10.445)
2010	Vol (KG)	892,454,415	10,504,604,324	(9,612,149,909)	3.755	44.204	(40.448)
	Value (US $)	477,708,177	3,893,839,917	(3,416,131,740)	2.010	16.385	(14.375)

Source: Statistical Yearbook of Indonesia 2011, Statistics Indonesia, processed

Table 1.1 shows that the export and import of main food commodities such as rice, maize, and wheat tend to increase. Imports of most food commodities sharply increased between 2009 and 2010, both in volume and value.

To address the lack of food supply, Indonesia must increase its agricultural productivity. Increased agricultural productivity depends on many factors such as human resources, science and technology, appropriate knowledge systems for sustainable agricultural, agricultural machinery, irrigation networks, empowerment and institutional capacity building initiatives for farmers, and sound macroeconomic policies on agriculture. To raise agricultural productivity, government and other concerned sectors must design a comprehensive agricultural system.



Source: Statistical Yearbook of Indonesia 2011, Statistics Indonesia, processed

Figure 1.1. Value of Exports and Imports of Food Commodities, 2004-2010

Design of the agricultural system cannot be separated from Indonesia's long-term vision: To create a self-sufficient, advanced, just, and prosperous Indonesia. In this regard, the government has created a development platform called the Master Plan for the Acceleration and Expansion of Economic Development of Indonesia (or MP3EI in Bahasa Indonesia). The MP3EI provides the building blocks to transform Indonesia into one of the 10 major economies in the world by 2025.

The MP3EI is often dubbed a breakthrough plan vital to economic acceleration. It reflects the government's optimism over the potential economic resources of Indonesia and its position in the global economy. Thus, the MP3EI is expected to boost Indonesia's bid to become a highly competitive country.

The MP3EI has laid out the following general strategies to achieve its goals (as outlined by the Coordinating Ministry for Economic Affairs, 2011:

1. To strengthen the Indonesian economic corridor
2. To strengthen national connectivity
3. To strengthen human resources and national science and technology

To strengthen the country's economic corridor, the government is mapping out the centers of economic growth based on the potential and advantages of each region. Each development area has a unique strategic role. Based on the identified strategic roles and suitability of specific geographical locations, the MP3EI has identified six economic corridors:

1. Sumatra Economic Corridor as a "Center for Production and Processing of Natural Resources and as the nation's Energy Reserves"
2. Java Economic Corridor as a "Driver for National Industry and Service Provision"
3. Kalimantan Economic Corridor as a "Center for Production and Processing of National Mining and Energy Reserves"
4. Sulawesi Economic Corridor as a "Center for Production and Processing of National Agricultural, Plantation, Fishery, Oil & Gas, and Mining"
5. Bali – Nusa Tenggara Economic Corridor as a "Gateway for Tourism and National Food Support"
6. Papua – Maluku Islands Economic Corridor as a "Center for Development of Food, Fisheries, Energy, and National Mining"

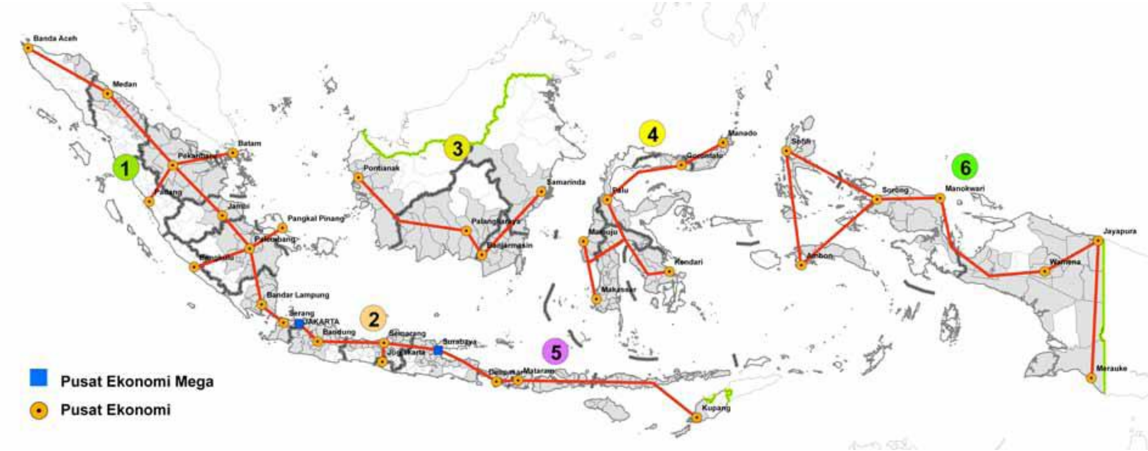


Figure 1.2. Indonesian Economic Corridor

Based on the objectives of this research, this study focuses on the Sulawesi economic corridor as the center of agricultural production and processing. While Java is the main food crop producer in Indonesia, Sulawesi is the third largest food producer in Indonesia. Its main agricultural produce consists of rice, maize, soybean, and cassava. Java Island is confronted by agricultural issues is limited farmlands and high rates of farmland-to-non-agricultural conversion.

Table 1.2 Percentage Distribution of Gross Domestic Product at 2000 Constant Market Prices By Industrial Origin Per Corridor, 2010

Industrial Origin	Sumatera	Java	Bali-NTT	Kali-mantan	Sulawesi	Maluku Papua	National
Agriculture, livestock, forestry & fishing	22	10	25	13	**34**	16	15
Mining and quarrying	19	1	13	30	6	55	11
Processing industry	24	31	7	31	12	6	27
Electricity, gas & water supply	1	2	1	0	1	0	1
Construction	4	6	5	4	7	4	6
Trade, hotel & restaurant	13	19	20	10	14	7	16
The transport and communications	6	7	9	5	8	4	6
Finance, real estate & business services	4	13	5	2	6	1	9
Services	8	10	15	5	13	6	9
Total	100	100	100	100	100	100	100

Sources: Coordinating Ministry for Economic Affairs, 2011

Based on in-depth interviews with the Ministry of Agriculture personnel, Sulawesi has a potential for agricultural development even if it is not yet a major food producer. Sulawesi has a unique biodiversity that can support raw materials-based industry development in biotechnology. If this happens, Sulawesi will be a major food supplier. Sulawesi's agricultural potential is also evident in its current contribution to the province's gross domestic product. Agriculture, livestock, forestry, and fisheries in the area contribute 34 percent to the GDP. This contribution is much higher than the agricultural sector in Sumatra, which is about 22 percent of the province's GDP, Java (10 percent), and the national agricultural sector, with an average of 15 percent. Based on these data, this study focuses on agriculture in Sulawesi.

Implementation of the MP3EI strategy, especially the economic corridor for agricultural development, cannot be done easily. The Indonesian government needs to determine the readiness of Sulawesi to be a center of agricultural production. Such readiness is important because the new vision and strategies of MP3I have an implication not only on policy implementation but also on farmers' use of indigenous agricultural knowledge and capacity to adopt agricultural technologies for sustainable agricultural development.

Developing the agricultural sector also depends partly on science and technology. Previous research has shown that there are two combinations of knowledge on the agricultural system: indigenous knowledge[1] and external/modern knowledge or technology. Most traditional farmers tend to rely more on their indigenous knowledge than on newly designed agricultural knowledge even if external knowledge is key to increasing agricultural productivity. External knowledge also induces innovation of production, harvesting, storage, and marketing of agricultural commodities. The appropriate agricultural knowledge will improve rural livelihoods, quality and yield, food security, and, overall, the economy (Asaba et al. 2006).

Indigenous and modern or external knowledge are not contradictory. They can be used and developed together to enhance agricultural productivity. According to Lemma and Hoffmann (2005), the more local people experiment with external technologies, the more they strengthen their indigenous knowledge and practices. Thus, how farmers adopt and apply indigenous and external agricultural knowledge is crucial to the agricultural development. In this regard, an assessment of the readiness of Sulawesi farmers is one of the prerequisites of MP3EI strategy implementation.

[1] Indigenous knowledge (IK) is an important component of the social capital of local communities and constitutes their main resource for their livelihoods. For centuries, farmers, particularly in developing countries, have been approaching agricultural production by using their IK to ensure food security and sustainable agricultural productivity (Mascarenhas 2003).

1.2. Research Problem and Objectives

Indonesia is currently facing at least two major challenges on the agricultural front. One is increasing imports of food agricultural commodities because of a supply lack. Two is the readiness of Sulawesi to be the center of development, production, and food processing in accordance with the MP3EI strategy.

The clustering of agricultural development in Sulawesi is not easy, since the largest food agricultural producer is Java Island. Shifting Indonesia's agricultural center from Java to Sulawesi will be a difficult transition owing to the following:

1. *Low farmer skill.* Most agricultural workers have low educational levels and do not have enough skills and knowledge to cultivate a farm.
2. *Lack of technology transfer systems.* Most farmers in Indonesia do not have access to appropriate technologies and sustainable production techniques. They simply plant and harvest without exploring new agricultural innovations.
3. *Limited and decreasing agricultural resource capacity*. The demand for land increases with population growth, technological and industrial advances and culture shifting. However, the availability of land does not increase and like remains so. Due to the conversion of land status from agriculture to non-agriculture, there is shrinkage of agricultural land in Indonesia.
4. *Lack of markets for farm produce and access to credit.* Agricultural innovations require investments and infrastructure. Unfortunately, there are fewer investments in agricultural activities compared to industrial activities. Farmers also have difficulty obtaining credit for their agricultural activities. Among the reasons behind this difficulty are the lack of collateral of land certificate, the routine repayment, the complicated procedure of proposing credit, and the limited fund of the government.
5. *Limited land to expand agricultural areas.* The growing population and land conversion lead to the shrinkage of agricultural land. Hence, to increase agricultural production by expanding agricultural land (through extension) is difficult.
6. *Low food productivity.* This is caused by low fertilizer use and inadequate irrigation networks.

Based on the foregoing, the main question that this research seeks to explore is how to construct an integrated model that will harness indigenous and modern agricultural knowledge that in turn will boost the food agricultural sector. More specifically, this research addresses four problems:

1. What are the socioeconomic conditions of farmers, including quality of access to credit facilities and technology?
2. What is the role of indigenous knowledge in enhancing food security?
3. What is farmers' adoption behavior toward new agricultural technologies?
4. What is the appropriate model to harness the indigenous and external agricultural knowledge?

In exploring the development of the food agricultural system and the revitalization of farmers' livelihoods, this study specifically aims to:

1. Assess government policies and strategies in agriculture.
2. Determine the socioeconomic condition of farmers.
3. Understand the role of indigenous knowledge in enhancing food security.
4. Investigate the adoption behavior of farmers toward new agricultural technologies.
5. Formulate appropriate recommendations for an agricultural system based on farmers' behaviors.

This research is expected to yield the following outputs:

1. Recommendations on agricultural policy in Indonesia.
2. Documentation of the role of indigenous knowledge and new agricultural technologies.
3. Recommendations for agricultural system development.

1.3. Research Contributions

Boosting the agricultural sector is crucial to economic development (Todaro 2000), more specifically in employment generation, income generation, poverty reduction, food production, capital mobilization. In this regard, this research hopes to contribute to efforts to empower farmers and encourage provincial governments to adhere to the country's economic agenda. Through revitalized and sustained agricultural efforts, other impacts on society will follow suit such as rapidly increasing income among the poor in rural areas, improved economic condition, and enhanced food security.

In particular, this research should achieve the following:

1. Fill the information gap in the use of indigenous and external agricultural knowledge.
2. Provide vital information about farmers' knowledge and behavior to facilitate the development of appropriate agricultural policies by the government.
3. Describe current conditions of farmers and the local government to implement the MP3EI.

CHAPTER 2. LITERATURE REVIEW

This literature review focuses on the use of indigenous knowledge and agricultural technologies to prepare Sulawesi, particularly South Sulawesi, and the Gorontalo provinces to be the food hub in Indonesia. It takes into account agribusiness concepts, and indigenous and external knowledge in agriculture (and how their interaction), as well as socioeconomic factors affecting farmers' lives.

2. 1. Agribusiness

The concept of agribusiness was introduced by Davis and Goldberd (1957). They defined it as "the sum total of all operations involved in the manufacture and distribution of farm supplies, production activities on the farm, and the storage, processing and distribution of farm commodities and items made from them." Agribusiness can be seen in two ways (Yamanie 2011), that is, as a system and as a field of business. As a system, agribusiness includes several elements that are interrelated in various forms of interaction and collaboration to achieve certain goals. Agribusiness is any business related to agricultural production activities, including utilization of agricultural inputs, cultivation, production, management of agricultural products (post-harvest, processing) and marketing.

The agribusiness industry includes production, processing, and distribution. Thus, the agribusiness system covers upstream to downstream industries, alongside several subsystems, namely, subsystem input supply, cultivation or production of biological subsystems, post-harvest subsystems, agro-processing or agro-industry, agro-marketing subsystems, and supporting subsystems. As a field of business, agribusiness seeks to integrate agricultural subsystems for profit.

The agribusiness system in Indonesia is still likely to be implemented separately, so the distribution becomes unbalanced. In a situation where developing products are not centralized, the distribution is not optimal, resulting in fluctuating product prices (Sulistyo 2004). This happens because of the lack of coordination between farmers and government as policymakers, which arises from an imbalance of information between farmers, collectors, dealers, and public markets. The improper supply of tools, seeds, and distribution systems affect the cultivation and quality of farm products.

2. 2. Indigenous Knowledge, Information Diffusion, and Technology Adoption

Knowledge is an outcome of the modeling that will be applied to environmental management (Gadgil et. al. 1993). Most knowledge is qualitative in nature and based on geographical observations on a limited scale.

There are fundamental differences between indigenous knowledge (IK) and scientific knowledge (Warren 1991). Scientific knowledge is generated by universities, government research centers, and private companies. IK is knowledge or wisdom “technically” achieved and developed by societies, in particular localities, through careful observation and experimentation over the years with surrounding natural phenomena. Unlike IK, scientific knowledge is universal, not “context-related” and not bound to the local culture and environment.

Table 2. 1 Differentiation between Indigenous and Scientific Knowledge

	Indigenous knowledge	**Scientific knowledge**
Method	Observing and information gathering resulting in qualitative conclusions	Arranged and structured study resulting in quantitative information
Institutional frame	Individual**.** Knowledge is synthesized through trial and error experiences by the farmer.	Mostly generated in professional experiment centers and academe
Skill and scientific knowledge	Limited by observation skills	Utilizes methods and sophisticated tools
Perspective scale	Relies on local and specific experiences	General, does not rely on local experiences

Sources: Sunaryo and Joshi 2003

IK is traditional knowledge developed by local folk in specific conditions in a specific geographical area (Grenier 1998). IK is an integral part of the culture and history of a local community. It is knowledge accumulated over time owing to its significance. It can be defined as a cumulative body of knowledge and beliefs handed down through generations by cultural transmission about the relationships among humans and with their environment (Gadgil et al. 1993; Gorjestani 2000).

IK is also often called local knowledge (LK). Being an integral apart of the culture and history of a particular community, LK is unique and significantly different from the international knowledge system developed by universities, research institutions, and corporate entities. LK commonly used by local communities is utilized for policymaking in such areas as food safety, human and animal health, education, and natural resource management. Therefore, LK can be an important factor in sustainable development.

Indonesia has many traditional societies in various cultures, including those relating to agriculture. Since the country has thousands of islands, contours and soil fertility in each of the different areas generate a significant amount of IK. Following are bits of LK/IK on agriculture in Indonesia.

1. Before farmers plant food crops, they still rely on forecasts by indigenous environmental experts, who in turn depend on environmental observations that have accumulated over many years, such as cloud formations and what they mean to farmers. For example, animal-shaped white clouds signal an auspicious time to cultivate the land by cattle.
2. Stars and constellations are observed as well. Plough-shaped arrangements mean an appropriate time to open up the soil, while rice-shaped patterns signal a good time to plant rice, maize, and soybeans. Constellations showing long rice-shaped arrangements indicate a good time to plant long-lived rice. Shorter patterns of rice-shaped arrangements connote a good time to plant short-lived rice.
3. To anticipate climate change effects and variations in the rainy and dry seasons, farmers have developed a number of traditional water management technologies such as those involving water harvesting and efficient water use. They have adopted drip irrigation systems at the village level (JIDES in Bahasa Indonesia), irrigation systems at the farming level (JITUT), and observing certain time periods, and applying cropping-pattern management technologies.
4. To meet water their needs, farmers construct ponds to collect rainwater and increase soil water storage capacities. These are applied to crop irrigation during the dry season.

Noting the limitations of IK, Biggs and Clay (1981) said its usefulness to farmers depends on the following:

1. Capacity to manage knowledge;
2. Knowledge monopolization by social groups and specific genders; and
3. Economic stratification. Richer societies use and produce knowledge that is different from those of poorer communities.

Currently, much of the discussion on IK revolves around its linkage to some of the problems confronting global society such as poverty, hunger, and environmental degradation. IK can be tapped by the community to empower themselves without destroying their social framework and natural environment. Therefore, IK is built on social values that serve as a guide to interacting with others and harnessing nature. In this regard, IK can contribute significantly to the construction and reinforcement of self-reliance and community empowerment.

Besides IK, knowledge development cannot be separated from the influence of technology. IK as the sole basis for how the agricultural sector operates cannot support agricultural development and achieve food security. Agricultural development also requires the external elements of knowledge and technology. Development as a process does not always run smoothly. Diffusion of information and adoption of technology are the important components of this process. Based on the studies of Feder, Just, and Zilberman (1985), as well as of Besley and Case (1993), the adoption of technology can dramatically improve the well-being of agricultural households. Technology adoption must be preceded by information diffusion. Social structure is a determinant of the diffusion of information among village households.

Isham (2002) said there are at least three characteristics of social structure that can support diffusion of innovations.

1. *Group homogeneity.* The more homogeneous the group, the easier information is shared. When individuals share the same attributes and beliefs, communication is more effective.
2. *Participatory norms.* The higher the level of participation, the more interactive decision making becomes and the more rapidly knowledge is shared. In a village with specific social norms, innovators can share their new ideas and influence community opinions through the existing consultative mechanisms.
3. *Leadership heterogeneity.* Leadership heterogeneity refers to the degree to which leaders within the network differ in certain social and economics atributes or contacts across social subsystems. This can accelerate the diffusion of innovation. When there are leaders in the community who have the social and economic character, there will arise some differences in contacts across social subsystems. Therefore, leaders can learn about the use of innovations from outside sources and share it to the local villagers. Granovetter (1973) said that when leaders have different professions or higher socioeconomic status than other members of a social structure, an information link is formed between two different sets of agents. Such links are critical in information sharing about innovations across group.

Feder et al. (1985) also cited some factors that affect the adoption of agricultural technology. They are (i) farm size, (ii) risk exposure and capacity to bear risks, (iii) human capital, (iv) labor availability, (v) credit constraint, (vi) tenure, and (vii) access to commodity markets.

Indonesia deems the adoption of technology essential to improving food security. It also believes that the impact rate of knowledge development and technology will only be achieved if the parties who implement specific policies are completely involved in this undertaking. The impact of food research and development will be significant only if the farmer can apply it completely. Ideally, technological diffusion approaches a free-flow pattern. If there is little resistance to the diffusion process, then there is less need for technology assistance. However, if this diffusion process is hindered by flow-tight barriers, then there is no choice except reevaluating the choice of the technology developed. It is time to put the farmer or farming community at the center of agricultural technology diffusion.

Accelerating the development of agriculture requires public participations. Public participation can be achieved through the following:

1. *Structural approach.* Within a society, at the smallest unit such as households, there is a certain order or structure to manage the sustainability of the community. Each structure has its own tasks but still needs cooperation with other structures to execute the task efficiently. Agricultural development also requires institutional structures:
   a. Farmers groups in charge of production
   b. Production shops, banks, and other sectors involved in production
   c. Research and development agencies that produce technology
   d. Counseling agencies
   e. Policymaking institutions (Hermanto 2001). To achieve agricultural development goals, even though each institution has its own task, they must work together.
2. *Cultural approach.* Culture comprises behavior patterns among members of a group who communicate with one another using meanings, symbols, and other means of communication that are common to them (Colletta and Kayam 1987). Cultural elements include institutions or written and implicit rules in social, economic, political, and religious environments. Thus, any attempt to introduce a new technology to farmers must consider their culture to determine appropriate strategies (e.g., timing, approaches, knowledge intended to be shared, etc.).

According to Adnyana and Basuno (2001) such an approach is called an "improvement of indigenous knowledge", where new technology is disseminated in a participatory manner to ensure a sustainable application of specific farming technologies.

A strong cultural approach to agricultural development is found in Bali (Adiyoga and Wahyuni 2000). Every stage of farming activity is preceded by a traditional ceremony, which involves praying to deities for a bountiful harvest.

3. *Resource approach.* The resources of family farms should also be considered in the application of new technologies. Rejection of new technologies can happen if these farms lack human resources.

Technological interventions in addressing issues of food security are needed to increase purchasing power at all stages of food supply—ranging from technology development in food production, processing technology and food product development to transportation management of food and food storage technology.

Development programs and technological knowledge in Indonesia are grouped into four main programs:

1. Research and development
2. Diffusion and utilization
3. Institutional strengthening
4. Development program on knowledge capacity and technology of production system

Those programs can be applied to any activities to increase food security, such as research and development and technology introduction. The results of research and development activities can be disseminated, adopted, and used in food production activities. Indonesia's knowledge and technological mission for 2025 is to enhance the role of science and technology in improving public welfare through the following initiatives:

1. Developing plant cultivation, livestock, and fish technologies to meet the food needs of the community;
2. Increasing food diversity through the exploration and development of feasibility studies and food-processing technology;
3. Developing harvesting and post-harvesting technologies to minimize crop losses, maximize the availability period for food, facilitate the diversification of processed food types, and ensure quality improvement and food safety based on the commodities produced;

4. Developing food information systems (including a system for public education and socialization of government policy on food) to ensure a smooth flow of information between the centers of food production, the food processing industry, and the domestic and international markets;
5. Developing a food technology supervision system to protect consumers from contamination from hazardous chemicals and pathogenic microbes. Such a system should apply to cultivation, processing, and distribution.

Further evaluation of the comparison between local and scientific knowledge is expected to bring about the following possibilities (Sunaryo and Joshi 2003):

1. Local knowledge systems and scientific knowledge systems complete each other.
2. Both knowledge systems are aligned, but use different terms for the same thing. For example, indigenous knowledge says that sheep-shaped clouds mark the beginning of the rainy season, while scientific knowledge would classify these clouds as “stratus” or “cumulus”.
3. When both systems are contradictory, they should be subject to further scientific study.
4. Local knowledge can be refined and enhanced by scientific knowledge.

2. 3. Factors that Affect Farmers’ Socioeconomic Conditions

The measure of farmers’ socioeconomic status is essentially the same as socioeconomic indicators. Measures of socioeconomic conditions include educational attainment, number of family dependents, income level, household expenditure, and employment opportunity. Farmer well-being is determined by income structure, food expenditures, and Farmer Terms of Trade (FTT) (specifically explained below). These factors are further explained below:

1. The structure of farmers’ income indicates the main source of family income even if this does not always come from the agricultural sector. Overall, this income structure reflects the state of the agricultural sector in the national economy. It must be stressed, however, that if a farmer is enjoying a high level of income, it does not necessarily mean he is living prosperously. Farmer welfare is also determined by the amount of family spending.
2. One indicator of farmer welfare is how food expenditure reflects farmers’ living patterns. When a farmer’s income goes mainly to meeting his families’ basic

needs, agricultural work is still subsistent. Conversely, the greater the expenditure on non-food consumption, the more basic needs are met. This means that much of the income can be allocated for non-food or secondary needs to ensure a better quality of life. These needs include education, health, and leisure. The shift of farmers' expenditure also indicates a shift from subsistence farming to commercial farming. According to Engel's law, the proportion of household budget allocated to food declines as the household's income rises. As income increases, a greater proportion of it is allocated to the purchase of 'luxury' items while the proportion for food expenditure lessens.

3. The FTT is used to measure the exchange of agricultural commodities produced by farmers into products purchased for consumption or production needs. The FTT is the ratio of the indexes of prices received by farmers to an index of prices paid by farmers (in percentage). It reflects the relative level of farmers' welfare. The higher the FTT, the higher the farmers' relative welfare. In general, the FTT has three conditions: (i) the FTT > 100 means the FTT in a given period is better than FTT in the base year; (ii) FTT = 100 refers to a given period equal to the FTT in the base year; and (iii) FTT <100 means the FTT in a given period decreased compared to the FTT in the base year (BPS 2011).

2. 4. Findings from Earlier Research

Suhartini and Cahyono's (2009) study showed that both Central and East Java have a significant amount of IK and local techniques applied to their organic rice farming systems. Knowledge applied is both traditional and modern in nature. Local knowledge used most extensively pertains to the use of local materials, such as herbs (which serve as raw material for making organic fertilizer or organic pesticides), livestock wastes for organic fertilizer, and local rice varieties (or *mentik wangi*).

Local knowledge comes from several sources, such as the legacy handed down through generations, farmers' trials, as well as such sources as formal government agencies (e.g., Department of Agriculture; agricultural instructors), and nongovernmental organizations. In today's context, organic rice cultivation systems do not entirely rely on farmers' indigenous knowledge, but also on modern knowledge and technology such as the use of tractors in land processing and management of livestock waste to be processed into solid organic fertilizer by using a starter microbial decomposer (Suhartini and Cahyono 2009).

Cahyono (2007) presented some arguments on why IK is vital to improving farmer in a sustainable manner. While this study suggests that IK is not meant to replace modern knowledge in agricultural development policy, it is nonetheless an important factor that must be integrated within the framework of agriculture revitalization. Such significance not just lies in ecological and social initiatives but also in long-term economic undertakings.

Cahyono also showed that IK is a system of knowledge and practices that ensure the continued existence of germplasm in ways that have been understood for generations. In other words, this original wisdom functions as a “seed bank“ and as an “information and knowledge bank” for grassroots-level farmers. Ironically, when the seeds start to disappear from the local paddy fields and farmers’ warehouses, developed countries (which are aware of the importance of the existence of the seed and its economic value) struggle to conserve them by establishing international seed banks. If this process continues as projected in the future, farmers will have difficulty obtaining local (or native) seeds because the local distribution networks that maintain availability of these seeds will be lost.

Cahyono and Shinta (2005) and Purnamaningsih et al. (2007) showed that the existence of local rice at this time is extreme cause for worry. Local rice farms still exist in the current system, but they are limited in terms of the number of varieties, planting areas, frequency, and number of farmers. There are even indications that in some agricultural areas in Malang, some hybrid rice seed agents have entered local rice areas that are already very limited in size. If there is no policy or regulation to protect the existence of local rice, then local rice will is bound to become extinct. From an economic view, the contribution of the formal sector (seed companies, research institutes, and universities) as a whole to seed supply is relatively small compared to local or informal seed sources.

According to Sunaryo and Josi (2003) IK develops in the local context and adapts to society’s conditions and needs. IK is also the result of creativity and continuous experiments seeking to enable internal innovations and external influences to adjust to emerging conditions. Therefore, it is wrong to think that indigenous knowledge is ancient, backward, or static. Unlike widespread scientific knowledge that is made popular through media, widespread indigenous knowledge usually spreads by word of mouth or through informal education.

Supriadi and Suharman (2009) said indigenous technology has a major role in the development of agriculture on marginal farms. While introduction of new technologies is often met with criticism, indigenous technology is often presented as a clear alternative. Both new and indigenous technologies have strengths and weaknesses vis-à-vis the development of agriculture, but the introduction of new technology usually pays less attention to socio-cultural and participatory norms. Although indigenous technology has been fused with indigenous culture and public participation, such efforts have paid less attention to profits. Combination of new technology with indigenous technology will result in a new technology that can be easily adopted by farmers. Partnerships between social scientists and technicians enhance creativity, which in turn facilitates the pursuit of agricultural innovation.

CHAPTER 3. RESEARCH METHOD

3.1. Data and Samples

This study was conducted in Sulawesi, Gorontalo and South Sulawesi, chosen because they are the center of agricultural activities in Sulawesi. Purposive random sampling was used. A total of 45 farmers in Gorontalo province and 60 farmers in South Sulawesi were tapped for the study. The sample size was bigger in South Sulawesi than in Gorontalo because it has a bigger farmer population. The total sample of farmers, 105, was considered sufficient because the behaviors of farmers tend to be homogeneous.

This research used secondary and primary data. The secondary data were obtained from literature, project reports, official documents, publications, and consultations with relevant individuals and institutions.

Data were collected from randomly sampled households. The primary data were generated using questionnaires, in-depth interviews, and focus group discussions (FGD) whereas the secondary data were obtained from the Ministry of Agriculture, local government, Statistics Indonesia, and Bank Indonesia. Primary data were derived using a structured and validated questionnaire consisting of both open- and closed-ended questions to elicit information from the respondents. The questionnaires used covered information on the socioeconomic conditions of the target households. Socioeconomic data consisted of information on households, land holdings and tenure, land use and cropping patterns, production costs, sellable products, and food situation.

In-depth interviews were conducted with experienced members of the community, policymakers, and agricultural experts. The experienced community members shared information on household coping strategies, indigenous knowledge, and technology adoption behaviors. The agricultural experts and policymakers provided information on agricultural policies, strategies, and problems, as well on the development of agricultural technology in Indonesia.

FGDs were held at the province level. Each group consisted of eight to 15 people, who provided perspectives on a host of issues confronting the agricultural actor. The participants included:

1. *Policymakers.* These consisted of relevant staff in privincial officials. The FGDs sought their knowledge and views on agricultural problems and implementation strategy.
2. *Farmers.* Information sought focused on farmers' perceptions of agriculture problems and issues surrounding income generation, welfare, market and financial

access, indigenous agriculture knowledge, current and developing technology, and women participation.

3. *Logistic Affairs Agent* (or BULOG in Bahasa Indonesia). This is responsible for food distribution and keeps data on the food agricultural market, food stock, and relevant policies in Indonesia.
4. *Financial institutions*. These provide information on the banking sector, specifically where it involves agricultural credit.

The field survey was conducted to facilitate deep understanding of the socioeconomic context of the study, including resource management and patterns, prevailing farmers' practices in cropping systems, crop productivity and yield, and socioeconomic constraints to production.

The questionnaire and in-depth interviews focused on the following:

1. Economic indicators such as income, cost of production, welfare, financial access, and access to market;
2. Agricultural policy and implementation;
3. Farmers' behaviors and external conditions that hinder the acquisition and sharing of, as well as access to, agricultural knowledge such as those dealing with the following:
   a. economic and social status
   b. demographic status: gender, age, education
   c. knowledge-sharing culture
   d. mode of adoption of new knowledge and culture technology
   e. institutional support and service
   f. availability and cost of agricultural inputs
   g. access to agricultural credit and market
   h. lack of agricultural knowledge sources

This research will provide a comprehensive description about the indigenous and external knowledge and current condition of Sulawesi as a new agriculture hub in Indonesia, because this research intensely studies farmer behaviors, agricultural technology adoption, government planning and strategy, and macroeconomic indicators.

3.2. Operational Definitions and Measurement of Variables

The primary variables and operational definitions used in this study are as follows:

No	Primary Variable	Operational Variable
1.	Welfare	• Farmers' income measured by agricultural products per harvest. Value of agricultural products differentiates between rainy season and dry season. • Expenditure of farmers measured by the average monthly spending of families
2.	Land Ownership	• Total farming area in hectares • Ownership status, i.e., one's own, owned by someone else (where one is hired to work), and rented
3.	Human Resources	• Availability of workforce as measured by ease of finding employment and origin of workers. • Labors competence as measured through workforce skill on farmland • Education level of labor • Participation of labor in agricultural training • System of wage paid to labor measured by the number of farm hands and how wage is given to labor
4.	Natural Resources	• The condition and topography of the farmland are indicators of the soil type, that is, wet or dry, flat, sloping or steep • Climate/weather as measured from the average rainfall or the existence of extreme weather during the year
5.	Production	• Agricultural cultivation patterns as seen in the farm system developed • Maintenance pattern as measured by the mode of provision of fertilizer and medicines (proximity) • Harvest as measured by the use of technology in harvesting, production quantities, and energy crops used
6.	Post-harvesting Handling	Post-harvest handling is measured by the mode of crop cultivation, the existence of a by-product of crop production, and mode of post-harvest handling.
7.	Marketing	Accessibility
8.	Financial	Accessibility
9.	Indigenous knowledge	Role of IK Sources of IK Adoption behavior

3.3. Methods of Analysis

Gorontalo and South Sulawesi were chosen for their agricultural potentials and conditions. For purposes of the research, specific locations within the study area were classified into three based on (i) advanced food crops, (ii) medium food crops, and (iii) low food crops. Such stratification is expected to provide a more complete picture that accurately illustrates the challenge of MP3EI in each province. Following are the selected districts in the two provinces covered by this study:

South Sulawesi:

1. Maros
2. Pangajene and Kepulauan (Pangkep)
3. Gowa

Gorontalo:

1. Gorontalo
2. Boalemo

3. Pohuwatu

Both quantitative and qualitative methods of analysis were applied to this study. For the quantitative descriptive statistical analysis, we used frequency distribution and percentage analysis of distribution or trends. Quantitative descriptive analysis was intended to provide a description of the agricultural profiles and socioeconomic conditions of the farmer respondents. Descriptive analysis is a statistical analysis of data that explains the observations without statistical testing. It aims to describe the characteristics of a sample or population observed using tables and figures.

The qualitative approach was the dominant approach used because it tended to give more attention to the subjective aspects of farmer experience and behavior. Conducting a qualitative descriptive analysis was aimed to clarify information on various field conditions and views on agriculture in general and as indigenous knowledge; as well as on the diffusion process and adoption of information technology in the sample area. Qualitative analysis also yields detailed descriptions of farmer behavior and agricultural conditions. It relies not only on interviews, questionnaires, and FGDs but also on a review of the literature, especially on indigenous knowledge and local wisdom.

This study also used policy analysis. Policy analysis determines whether one alternative policy can achieve a determined goal compared to other potential policies. Policy analysis is classified into two major fields. Analytical or descriptive policy analysis produces real information and clear images of policies and their environment. Perspective policy analysis involves formulating policies and proposals to improve social welfare, among others. The choice of a particular type of analysis to use is determined by the area of interest and the objectives of the study. This study's policy analysis was conducted based on Indonesia's agricultural policy documents and interviews with agricultural policymakers at the national level.

CHAPTER 4. ANALYSIS OF SOCIOECONOMIC CONDITIONS, INDIGENOUS KNOWLEDGE, AND TECHONOLOGY ADOPTION IN GORONTALO AND SOUTH SULAWESI

This chapter describes Indonesia's agricultural condition and provides an analysis of socioeconomic conditions, indigenous knowledge, and technology adoption in Gorontalo and South Sulawesi Province. Analyses were performed based on in-depth interviews, questionnaires, FGDs, and literature review. Discussion on socioeconomic conditions aimed to look into the profile of the agricultural sector in both provinces as well as of the sample farmers. It also looked into the issues and problems affecting the agricultural sector, in terms of production, natural resources, human resources, finance, and institutions. The discussion was expected to provide a snapshot of the readiness of South Sulawesi and Gorontalo to meet the MP3EI target. The next section analyzes indigenous knowledge and the technology adoption process in the study areas, and explains how it impacts productivity and the welfare of farmers.

4.1. Agricultural Conditions and Policies

Indonesia is not exempt from some of today's global issues, particularly climate change and food crisis. Like other countries, the country strives to improve food security for the benefit of its people. In the first three quarters of 2011, the agricultural sector (excluding fisheries and forestry) grew 3.07 percent, higher than the growth posted in 2010 (2.86 percent). Growth came from the plantation subsector (6.06 percent), livestock (4.23 percent), and food crops (1.93 percent). The agricultural sector (excluding fishery and forestry) contributed 11.88 percent to GDP in 2011, higher than the previous year (11.49 percent).

Table 4.1 Growth and GDP of Agricultural Sector (excluding fishery and forestry), 2009-2011

Sector/Subsector	2009 (%)	2010 (%)	2011* (%)
GDP growth	3.98	2.86	3.07
Food crops growth	4.97	1.81	1.93
Plantation crops growth	1.84	2.51	6.06
Husbandry growth	3.45	4.06	4.23
Contribution to national GDP	11.34	11.49	11.88

Source: Data from Statistics Indonesia, processed by the Ministry of Agriculture

*average growth of quarter I to III 2011

Although Indonesia is known as an agricultural country, agriculture, especially food crops, still experience problems, as follows:

1. *Climate change impacts*. Effects of climate change are seen in shifting cropping patterns, lack of water, and spread of plant pest and diseases that decrease agricultural production.
2. *Limited ownership of agricultural lands* areas *and high conversion rates*. Limited land areas on some islands in Indonesia prevent some farms from expanding. This condition makes the government's extensification program inapplicable. The study also shows that most farmers no longer have property rights over land. Aggravating this situation is the conversion of some agricultural lands to other uses. The resulting decreased food production threatens food security.
3. *Conversion of farmlands.* Some 9,152 hectares of agricultural land are being converted to non-farmlands per year (Statistics Indonesia 2004).
4. Farmers have *difficulty of accessing capital.* Limited funding severely hampers farmers' ability to improve farm production, quality of produce, add value, and compete with other farmers.
5. *Weak farmers' institutions* are still weak. Limited agricultural organizations and agricultural counseling agencies have hindered transfer of knowledge among farmers.
6. *Limited support for agricultural infrastructure.* This is especially true of irrigation infrastructure and rural roads, which results in less than optimal agricultural management.

Agricultural issues affected not only farm management but also food consumption patterns in Indonesia. Consider the following (Lakitan 2010):

1. *Indonesian people still depend on rice as staple food.* It remains more popular than other traditional sources of carbohydrates such as corn, sago, and cassava. Consumers in Indonesia consider only wheat and potatoes as substitute for rice. Thus, it is difficult to do food diversification.
2. *Indonesia relies on imports for some food commodities.* As such efforts to reduce food imports dependency is not easy. More so in light of the following factors: (i) the Indonesian population continues to grow; (ii) the farm food business is less competitive than other businesses, particularly in the industry and services sectors; and (iii) imported food items are relatively cheaper than domestically produced food.

Theoretically, agricultural policies must improve farmer welfare and increase agricultural production and food security. But within the framework of the Indonesian Economic Corridor, agricultural policy plays a more important role.

Agricultural development pursues industrial agriculture that is based on local resources and boosts food self-sufficiency, added value, export, and farmer welfare. The Ministry of Agriculture's mission for the period 2010-2014 seeks to undertake the following:

1. Realize sustainable agribusiness farming system that is efficient, based on knowledge, technology and local resources, and environmentally sound.
2. Create a balance of agricultural ecosystem to improve food self-sufficiency.
3. Secure germplasm and improve its use to support diversification and food security.
4. Empower farmers to become creative, innovative, independent, and capable of using science and technology and local resources to provide and serve high quality agricultural products.
5. Improve the quality of raw and processed foods.
6. Improve the production and quality of agricultural products used as raw materials in certain industries.
7. Set up vertically and horizontally integrated agricultural business.
8. Develop agricultural downhill industries that are integrated with local resources.
9. Promote the establishment of partner-based business systems and trading in agricultural commodities founded on healthy, honest, and fair business practices.
10. Promote professionalism and competency among public officials in the agriculture sector.

The Department of Agriculture set up 23 policy directions for agricultural development for the period 2010-2014 (Directorate General of Food Crops, Ministry of Agriculture 2011). Nine of these were related to the functions of the Directorate General of Food Crops:

1. Sustain and enhance the previous undertakings that have proven beneficial to farmers such as the distribution seeds, fertilizer subsidies, agricultural equipment and machinery; and operation of the Integrated School of Crop Management and Integrated School of Pest Management;
2. Continue and strengthen activities geared toward the empowerment of society such as nongovernmental organizations;
3. Stabilize rice and corn self-sufficiency through continuous production development;
4. Achieve soybeans self-sufficiency;
5. Develop organic fertilizer centers run by farmer groups;
6. Reinforce the germination and nursery institutions;
7. Escalate ecosystem balance and integrated pest and disease control;

8. Be actively involved in formulating macroeconomic policies for farmers, such as tariff and non-tariff protection in international agricultural trade, government procurement pricing, and determination of the highest retail prices of subsidized fertilizers
9. Improve the agricultural development management and “good governance”.

Crop development in Indonesia seeks to foster agribusiness to facilitate the production of food products that cater to all sectors of society (Directorate General of Food Crops 2011). The Directorate’s national crop development program seeks to improve domestic production, productivity, and the quality of food crops to achieve and sustain food self-sufficiency. The program’s priorities are the (i) national primary commodities, namely, rice, corn, soybeans, peanuts, green beans, cassava, and sweet potatoes; and (ii) local alternative commodities.

4.2. Overview of Sulawesi Economic Corridor

The Sulawesi economic corridor development program seeks to make the province the center of production and processing of agricultural products, fishery, oil, gas, and mining. To support agricultural sector development, Sulawesi has six economic centers: Palu, Gorontalo, Manado, Makassar, Kendari and Mamuju. The Sulawesi Economic Corridor is poised to be the door to economic markets in East Asia, Australia and USA.

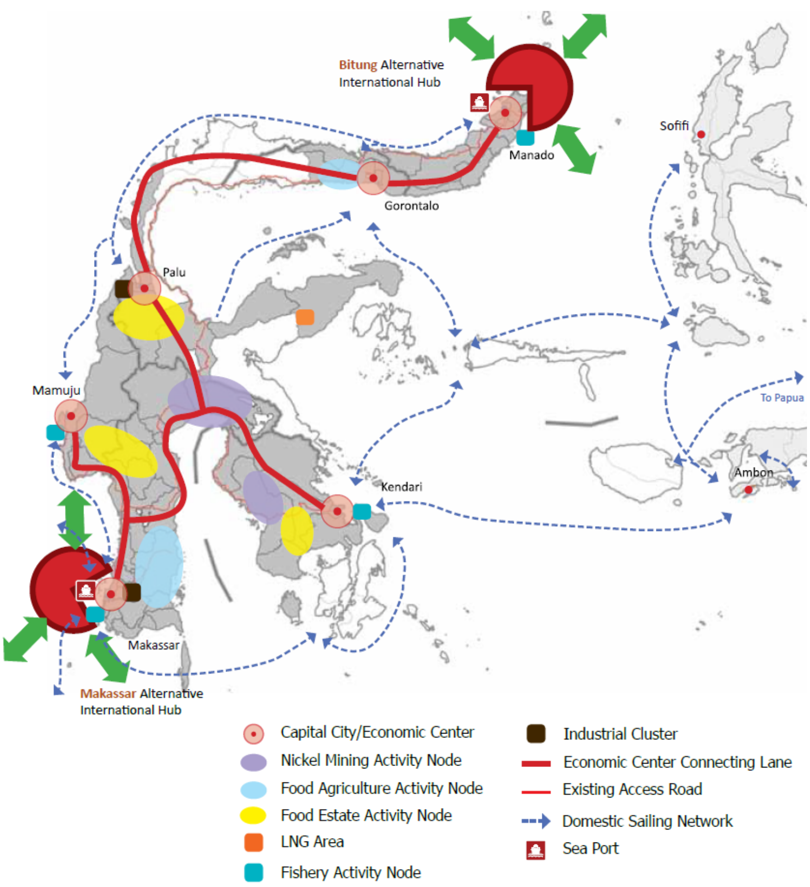


Figure 4.1 Sulawesi Economic Corridor

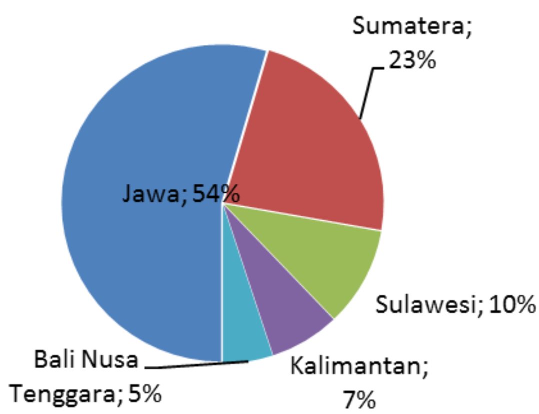
As of 2010, Sulawesi's economy was growing an average of 8.11 percent a year while Indonesia's economy in general was averaging a 5.75 percent growth per year. The main sectors contributing to the Sulawesi economy are agriculture (30.20 percent), trade, hotels, restaurants (16.04 percent), and services sector (13.74 percent).

Table 4.2 Gross Domestic Regional Products Based on Constant Price 2000 Sulawesi Economic Corridor

Province	2007	2008	2009	2010
North Sulawesi	14,344,302.07	15,902,073.26	17,149,624.49	18,371,201.12
Middle Sulawesi	13,683,882.46	15,047,428.54	16,177,335.03	17,437,129.13
South Sulawesi	41,332,426.29	44,549,824.55	47,326,078.38	51,197,034.67
Southeast Sulawesi	9,331,719.95	10,506,374.97	11,301,220.06	12,226,376.73
Gorontalo	2,339,217.51	2,520,672.95	2,710,737.05	2,917,412.57
West Sulawesi	3,567,816.12	3,998,502.00	4,239,460.87	4,744,309.49
Sulawesi	84,599,364.40	92,524,876.29	98,904,455.90	106,893,463.7
Indonesia	1,878,724,927.24	1,999,543,991.22	2,094,316,286.50	2,221,603,860.72

Source: Statistics Indonesia, 2009 - 2011

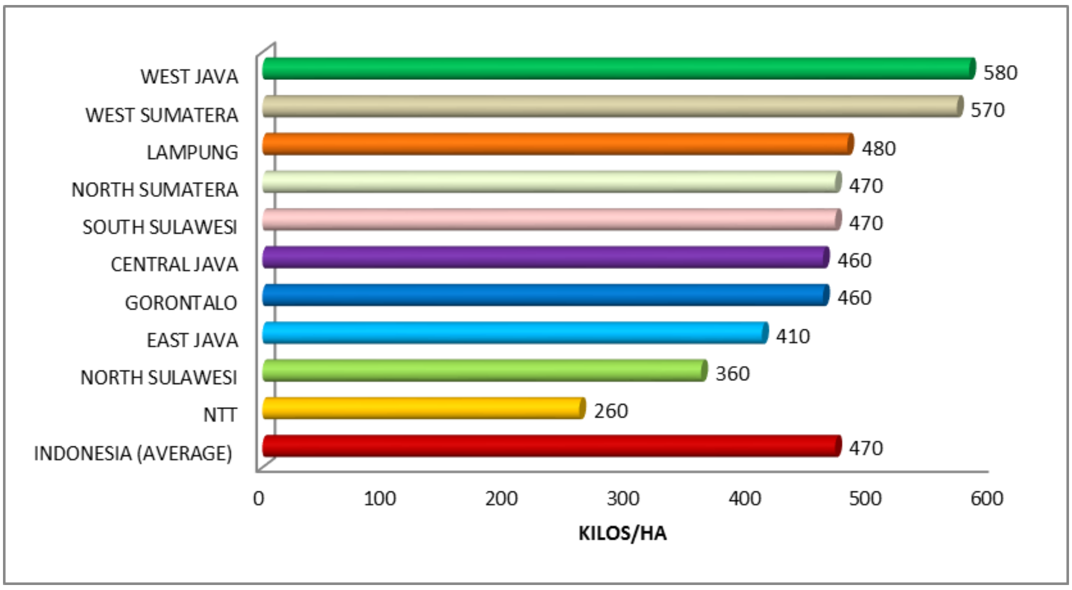
The development of food crops in Sulawesi will be concentrated mainly in Gorontalo and South Sulawesi. Today, the agricultural sector, particularly rice and maize in Sulawesi, has yet to reach its full potential. Until 2010, the major rice producer in Indonesia had been Java. Production of rice in Java accounted for 54 percent of the total rice production in Indonesia, followed by Sumatra, with 23 percent. Production of rice in Sulawesi contributed only 10.82 percent to the total rice production in Indonesia, lower than the contribution of maize to the total production of this crop, with 14.96 percent.



Sources: Committee on Accelerating and Expanding the Economic Development of Indonesia, 2011

Figure 4.2 Contribution of Each Island to Rice Production, 2010 (In Percent)

Meanwhile, maize production in South Sulawesi and Gorontalo is slightly higher than the average maize production across the rest of Indonesia, with 470 kilos and 460 kilos per hectare, respectively. The largest maize production in Indonesia is found in West Java and West Sumatra, with 580 kilos per hectare and 570 kilo per hectare, respectively.



Sources: Committee on Accelerating and Expanding the Economic Development of Indonesia, 2011

Figure 4.3 Maize Production, 2010 (In Kg/Ha)

Although the Sulawesi agricultural sector's contribution to the Indonesian economy is still relatively small, it has some potential to develop. Irrigation is one of the key components of strategic infrastructure that will help the province in its bid to become the next food center in Indonesian. The total irrigated areas in Sulawesi comprise about 1.02 million hectares or about 14 percent of the total irrigated areas in Indonesia (7.29 million hectares). Sulawesi's irrigated farmlands are spread over 63 percent of farm areas in South Sulawesi province, 7 percent in North Sulawesi province, 3 percent in Gorontalo province, 15 percent in Central Sulawesi province, 5 percent in West Sulawesi province, and 7 percent of in Southeast Sulawesi province. Of the total irrigated areas in Sulawesi, only about 33.56 thousand hectares (3.28 percent) have water reservoirs such as the Bili-Bili and Ponre-Ponre reservoirs in South Sulawesi, while the others still rely on river flow through reservoirs or free water intake.

There are two regions covered by the development of food crops in Sulawesi, namely:

1. Makasar-Maros-Sangguminasa-Takalar (Maminasata), which supports the development of agricultural crops for national food security, and corn; and
2. Gorontalo, which supports the development of corn crop through the establishment of urban infrastructure and facilities for corn processing.

Policy direction and strategy development in Sulawesi, especially on food security, seek to increase production and food productivity (particularly rice, maize, and soybeans) and plantations (mainly cocoa), and accelerate the irrigation rehabilitation and irrigation construction.

4.3. Socioeconomic Condition of the Agricultural Sector

Economic growth Gross Domestic Product of South Sulawesi and Gorontalo has accelerated over time. In 2010, the Gorontalo economy grew 7.63 percent, and South Sulawesi 7.78 percent. Growth in both provinces is higher than the national growth of 6.3 percent in 2010.

There are three major sectors contributing to the economy Gorontalo: agriculture, services, and the trade, hotel and restaurant sector. Based on the 2000 constant price, and with an output value of Rp 833.68 million, the agricultural sector contributed 40.88 percent to Gorontalo's GDP. The second largest sector, services, with an output value of Rp 568.65 million, accounted for 18.78 percent of the provincial GDP. The third largest sector, trade, hotels and restaurants, with a combined output value of Rp 412.09 million, comprised 16.46 percent of the province's GDP.

Table 4.3 Value and Share of Gross Domestic Product, 2010

Sectors	Gorontalo		South Sulawesi		Indonesia	
	Value (million Rp)	Share (%)	Value (million Rp)	Share (%)	Value (million Rp)	Share (%)
Agriculture	833.68	40.88	13,809.80	26.97	304,736.7	13.17
Mining and Quarrying	33.15	2.12	4,491.34	8.77	186,634.9	8.07
Manufacturing Industries	227.49	8.14	6,869.43	13.42	597,134.9	25.81
Electricity, Gas, and Water	16.52	0.16	529.82	1.04	18,050.2	0.78
Building	259.92	4.69	2,900.27	5.66	150,022.4	6.48
Trade, Hotel and Restaurant	412.09	16.46	8,698.81	16.99	400,474.9	17.31
Transport and communications	310.36	7.70	4 619,93	9.02	217,977.4	9.42
Finance, Real Estate, and Business Services	255.63	1.07	3,742.09	7.31	221,024.2	9.55
Services	568.65	18.78	5 535,55	10.81	217,782.4	9.41
Total	2,917.49	100.00	5,535.55	100.00	2,221,603.9	100

Source: Statistics Indonesia 2011

The three largest sectors that contributed to the South Sulawesi GDP were agriculture, trade, hotel and restaurant, and manufacturing. Agriculture, with an output value of Rp 13,809.80 million, contributed about 26.97 percent to the GDP. The trade, hotel and restaurant sector, with an output value of Rp 8,698.81 million, contributed 16.99 percent; the manufacturing sector, with an output value of Rp 6,869.43 million, contributed 13.42 percent.

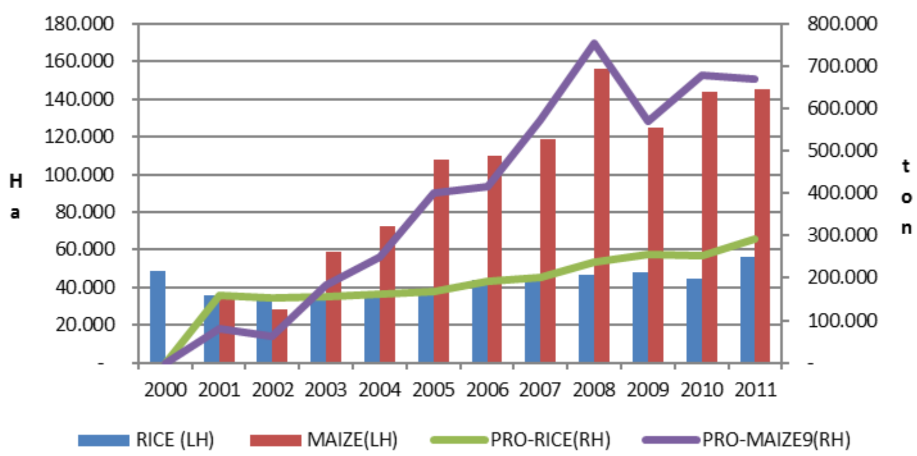
Table 4.4 Contribution of Agriculture Sector to the Economy 2006-2010 (In Percent)

Year	Gorontalo	South Sulawesi
2006	30.67	30.37
2007	30.61	29.47
2008	30.84	29.01
2009	29.54	28.57
2010	40.88	26.97

Sources: Gorontalo Statistics 2011, Sulawesi Statistics 2011, and Statistics Indonesia 2011

Table 4.4 shows the agricultural sector's contribution to the economy from 2006 to 2010. The contribution of the agricultural sector in Gorontalo increased from 29.54 to 40.88 percent between 2009 and 2010. This indicates a serious effort in the province to promote the agricultural sector. In contrast, between 2006 and 2010, the agricultural sector in South Sulawesi suffered a steady decline in its contribution, that is, from, 30.37 in 2006 to 26.97 in 2010.

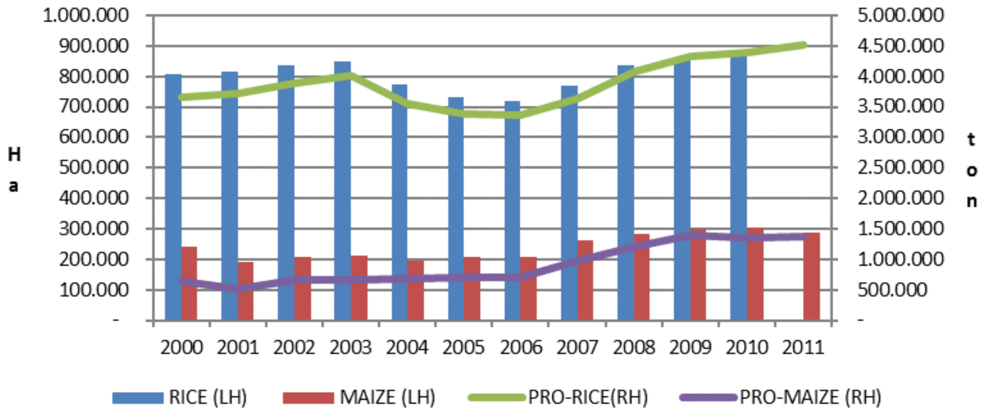
Farmlands planted to rice in Gorontalo are smaller in size than those where maize is grown. This is in line with the province's goal of scaling up maize cultivation. Figure 4.4 shows the production of rice and maize in Gorontalo. The left scale shows the size of harvested areas, while the right scale shows the amount of production in ton. In 2009, harvested maize areas declined about 20 percent, resulting in a 25 percent decrease in maize production. Rice areas harvested in Gorontalo are relatively stable.



Sources: Gorontalo Statistics 2011

Figure 4.4 Harvested Areas and Production of Maize and Rice in Gorontalo, 2000-2011

Overall, harvested areas and production of maize and rice in South Sulawesi are higher than those in Gorontalo. Harvested areas and rice production are greater compared to maize. In general, both production and harvested areas of rice and maize in South Sulawesi are relatively stable.

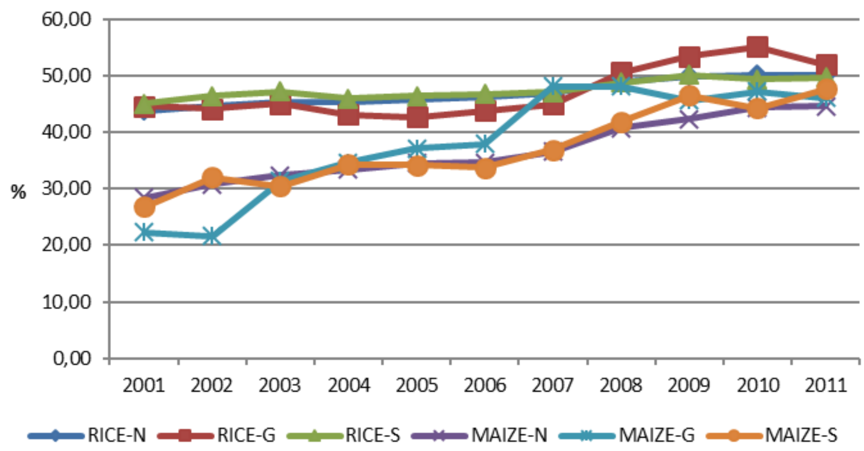


Sources: South Sulawesi Statistics 2011

Figure 4.5 Harvested Area of Maize and Rice Production in South Sulawesi 2000-2011

The linkage between harvested areas with the amount of production is reflected in productivity. Data show that production and harvested areas alongside productivity in Indonesia overall, South Sulawesi, and Gorontalo increased during the period 2000-2011.

Based on Figure 4.6 rice productivity in Gorontalo tends to be higher than the countrywide rice productivity, while rice productivity in South Sulawesi is lower. In 2010 and 2011, rice productivity across the country was at 50.15 percent and 50.17 percent, respectively, and at 55.2 percent and 51.7 percent, respectively, in Gorontalo. The highest recorded rice productivity in South Sulawesi to date, 49.44 percent, was achieved in 2009. When viewed in terms of land area and production, South Sulawesi has a much greater potential than Gorontalo for rice cultivation. However, it has lower productivity than Gorontalo and Indonesia. These facts indicate that South Sulawesi needs to improve rice production. In 2010 maize productivity in Gorontalo (47.22 percent) was higher than that of South Sulawesi (44.27 percent). This trend reversed in 2011, when South Sulawesi posted higher maize productivity compared to Gorontalo.



Source: Gorontalo Statistics 2011, Sulawesi Statistics 2011, and Statistics Indonesia 2011

Figure 4.6 Productivity of Maize and Rice in Indonesia, South Sulawesi, and Gorontalo 2000-2011 (In Percent)

Vital to crop productivity is crop management, which entails planting accuracy and proper breeding, cultivation, land management/production, fertilization, pest management, and harvest and post-harvest management handling.

Besides their agricultural condition, the socioeconomic condition of farmers is another important factor in improving crop productivity. The Indonesian Human Development Index (HDI) sets some socioeconomic indicators, including 85 years of life expectancy, primary education for all levels of society, and the level of expenditure and consumption that meets the standard of living. In Gorontalo life expectancy is 70.10 years, the average number of years of education is 7.40, and income per capita is Rp 7.75 million per year. In South Sulawesi, the life expectancy is 70.80 years, the average number of years of education is 7.20, and income per capita is Rp 15.84 million yearly. Based on these data, Gorontalo’s HDI is 70.28, lower than South Sulawesi’s, 75.63. Both HDIs show better welfare conditions in both provinces compared to Indonesia’s nationwide HDI, 60.00.

Table 4.5 Socioeconomic Conditions of Gorontalo, South Sulawesi, and Indonesia, 2010

Indicator	Unit	Gorontalo province	South Sulawesi province	Indonesia
HDI		70.28	75.63	60.00
Total population	Million	1,012,183	8,034,776	237,556,363
Labor force	Million people	0.46	3.91	116.5
Unemployment	People	23,573	276,869	8,319,779
Open unemployment rate	Percent (%)	4.61	8.4	7.14
Poor people	People	209,886	861,617	31,010,150
Percentage of poor population vis-à-vis total population	Percent (%)	20.74	10.72	13.33
GDP (constant price 2000)	Billion Rp	2.918	5.536	2,221.6
Economic growth	Percent (%)	7.63	7.78	6.43
Per capita income per year	Million Rp	7.75	15.84	27.1
Life expectancy	Year	70.10	70.80	69.4
Average length of education	Year	7.40	7.20	7.92

Sources: Statistics Indonesia, Gorontalo Statistics and South Sulawesi Statistics 2011

Another socioeconomic indicator of farmers is the state of their farms, as reflected in the workforce structure. As of August 2010, agricultural labor in Indonesia was pegged at 41.494 million, or 38.35 percent of the country's total workforce (Statistics Indonesia 2011). As such agriculture is the largest labor-absorbing sector in Indonesia. The sector's quality, however, is below par. Based on 2011 data from Statistics Indonesia, 75 percent of farmers in Indonesia either did not finish or only finished only primary school. Lacking formal training in agriculture, farmers learned their farming skills from the farmers among family members, notably parents.

Based on this study, farmers in South Sulawesi and Gorontalo are the subsistence type, who grow only enough to food to feed themselves and their families. Such finding is consistent with several previous studies on agriculture in Indonesia. In-depth interviews show that crops are largely unappealing to young people. This observation can be linked to the declining number of young farmers in both provinces, who think little of working in the agricultural sector. This kind of situation requires government intervention, especially in Gorontalo and South Sulawesi, which have a large contribution to the provincial economy and have a great potential to become Indonesia's food hub.

Another serious problem confronting both provinces is shifting agriculture (in which lands are cultivated temporarily before they are abandoned and become idle) and decreasing farmlands. Most farmers also face financial problems because of low and uncompetitive agricultural terms of trade. Financial burdens push farmers to sell their land, which is usually converted to non-agricultural uses. Population growth also causes a high agricultural conversion rate. What remains is 0.25 hectare of agricultural land that farmers make do with. Assuming a good harvest, farmers can earn Rp 300,000 per month (Kompas 2011).

Farmer Terms of Trade is another measure of farmer welfare. As earlier stated, FTT is the ratio of prices (e.g., farmgate) farmers receive to prices (e.g., production inputs) paid, multiplied by 100. Farmers are both producers and consumers. As producers, they receive payments for their crops. As consumers, they pay for goods and consumption needs.

Table 4.6 Farmers' Term of Trade (FTT) 2010

Province	Price Received		Price Paid		FTT	
	2009	2010	2009	2010	2009	2010
Gorontalo	117.78	130.10	119.23	124.7	98.79	104.30
South Sulawesi	125.28	131,30	122.67	129,67	102.13	101,26
West Sulawesi	128.95	137.20	121.47	130.8	106.16	104.90
Central Sulawesi	123.73	132.60	124.40	133.3	99.46	99.50
Southeast Sulawesi	131.71	138.00	120.88	127.6	108.96	108.20
North Sulawesi	120.30	133.50	119.93	129.0	100.31	103.50
Sulawesi	**124.63**	**111.90**	**121.43**	**107.57**	**102.64**	**103.61**
Indonesia	120.51	134.27	120.22	130.67	100.24	102.80

Source: Statistics Indonesia 2011

Table 4.6 shows the general FTT trend in Sulawesi corridor is greater than 100. This pattern indicates the price that is received by farmers exceeding the price that is paid by farmers. It also indicates that the farmers' purchasing power is good. The two sample provinces, Gorontalo and South Sulawesi, exemplied different conditions in 2009 and 2010. In 2009, Gorontalo's FTT was at 98.79, which meant that the prices received by farmers were much lower than the costs of meeting their basic or daily needs.

In 2009, the agricultural sector's contribution to Gorontalo's economy was relatively small (29.54 percent). Thus the lower FTT (<100) could be attributed to the relatively low value of agricultural output. These conditions changed in 2010 when agricultural contribution to the economy reached 40.88 percent. In that same year, the goverment undertook various agricultural revitalization programs that led to an increased agricultural output in Gorontalo. FTT also rose to 104.23 in that year, which means prices received by farmers were much higher than what they paid for their consumption needs. In this regard, the purchasing power of the Gorontalo farmers improved considerably.

The reverse happened in South Sulawesi. In 2009, the its FTT was at 102.13, only to drop to to be 101.26 a year later. This means that the revenues farmers received for their crops in 2009 were was higher than their expenditures. By 2010 prices of consumer and production goods were increasing faster than what the farmers were generating from their crops.

4.4. Agricultural Development in Gorontalo and South Sulawesi: Issues and Concerns

The following sections describe the results of in-depth interviews, questionnaires, and FGDs conducted in Gorontalo and South Sulawesi. As stated in Chapter 3, there were 105 respondents from Gorontalo (Gorontalo, Boalemo, and Pohuwato regencies) and South Sulawesi provinces (Maros, Pangkajene, and Kepulauan, Gowa regencies). The chairpersons of the Planning and Regional Development and the provincial agriculture offices were likewise interviewed for the study.

4.4.1. Respondent Profile

A great majority (average of 86.75 percent) of the respondents in both provinces are male farmers, who are generally the heads of household and main decision makers in their families. The female farmers generally take on a supportive role. Over 90 percent of the respondents are over 35 years old. There is relatively low interest in agricultural work among the younger generation. Young people with higher educational levels tend to choose to work in urban areas, both in the in a public and private sectors, resulting in inadequate human resources in the agricultural sector—a situation that is expected to continue in the long term.

Table 4.7 Respondents' Profile Based on Sex

Sex	Gorontalo		South Sulawesi	
	Frequency	Percent	Frequency	Percent
Male	40	88.89	55	84.62
Female	5	11.11	10	15.38
Total	45	100.00	65	100.00

Source: Primary data, processed

Table 4.8 Respondents' Profile Based on Age

Age	Gorontalo		South Sulawesi	
	Frequency	Percent	Frequency	Percent
<25	1	2.22	1	1.67
25-<35	3	6.67	10	16.67
35-<45	12	26.67	25	41.67
45-<55	14	31.11	15	25.00
55<	15	33.33	9	15.00
Total	45	100.00	60	100.00

Source: Primary data, processed

In terms of land ownership, most farmers in Gorontalo province have less than 1 hectare of agricultural land. In fact, 31.1 percent of them own only less than 0.5 hectares of land. One respondent correctly pointed out in an FGD that a relatively small size of land prevents farmers from enjoying the economies of scale and limits their access to credit.

Table 4.9 Respondents' Profile Based on Land Ownership in Gorontalo Provice

Land Size	Frequency	Percent	Valid Percent	Cumulative Percent
< 0.5	14	31.1	31.1	31.1
0.51 – 1	12	26.7	26.7	57.8
1.1-1.5	8	17.8	17.8	75.6
1.5-2	5	11.1	11.1	86.7
2<	6	13.3	13.3	100.0
Total	45	100.0	100.0	

Source: Primary data, processed

Unlike in Gorontalo province, farmers in South Sulawesi own relatively bigger parcels of farmland. Most farmers have more than 1 hectare of cultivated farmland. But even this size is inadequate to ensure farmers of substantial revenues from their produce. To enjoy economies of scale, farmers need at least 2 hectares of land, especially since farmers have to bear the high costs fertilizers, pesticide and labor.

Table 4.10 Respondents' Profile Based on Land Ownership in South Sulawesi Provice

	Frequency	Percent	Valid Percent	Cumulative Percent
< 0.5 ha	3	5.0	5.0	5.0
0.51 – 1	13	21.7	21.7	26.7
1.1-.1.5	20	33.3	33.3	60.0
1.51 – 2	14	23.3	23.3	83.3
> 2	10	16.7	16.7	100.0
Total	60	100.0	100.0	

Source: Primary data, processed

4.4.2. Average Harvest and Monthly Spending

The socioeconomic conditions of the farmer respondents in both provinces are relatively the same. These are reflected not only in land ownership and frequency of harvest but also in the value of harvests and the average monthly expenditures. Farmers in both provinces harvest twice a year—one in the rainy season and the other during the dry season. Since most of the farmer respondents' rice fields have good irrigations, harvest value during both seasons is more than Rp 1 million.

Table 4.11 Respondents' Profile According to Frequency and Average Value of Harvests in Gorontalo Province

Frequency of Harvest			Average Value of Dry Season Harvest				Total
			Rp 401.000 – Rp 600.000	Rp 600.001 – Rp 800.000	Rp 800.001 – Rp 1.000.000	>Rp 1.000.000	
Average Value of Rainy Season Harvest	Rp 401.000 – Rp 600.000	Count	0	0	0	1	1
		% of Total	.0%	.0%	.0%	2.2%	2.2%
	Rp 600.001 – Rp 800.000	Count	1	2	1	1	5
		% of Total	2.2%	4.4%	2.2%	2.2%	11.1%
	Rp 800.001 – Rp 1.000.000	Count	0	1	1	7	9
		% of Total	.0%	2.2%	2.2%	15.6%	20.0%
	>Rp 1.000.000	Count	1	4	1	24	30
		% of Total	2.2%	8.9%	2.2%	53.3%	66.7%
Total		Count	2	7	3	33	45
		% of Total	4.4%	15.6%	6.7%	73.3%	100.0%

Source: Primary data, processed

Table 4.12 Respondents' Profile According to Frequency and Average Value of Harvest in South Sulawesi Province

Frequency of Harvest			Average Value of Dry Season Harvest					Total
			Rp 200.000 – Rp 400.000	**Rp 401.000 – Rp 600.000**	**Rp 600.001 – Rp 800.000**	**Rp 800.001 – Rp 1.000.000**	**>Rp 1.000.000**	
Average Value of Rainy Season Harvest	Rp 200.000 – Rp 400.000	Count	1	1	1	0	1	4
		% of Total	1.9%	1.9%	1.9%	.0%	1.9%	7.7%
	Rp 401.000 – Rp 600.000	Count	0	1	2	0	0	3
		% of Total	.0%	1.9%	3.8%	.0%	.0%	5.8%
	Rp 600.001 – Rp 800.000	Count	0	2	3	1	0	6
		% of Total	.0%	3.8%	5.8%	1.9%	.0%	11.5%
	Rp 800.001 – Rp 1.000.000	Count	0	0	5	2	0	7
		% of Total	.0%	.0%	9.6%	3.8%	.0%	13.5%
	>Rp 1.000.000	Count	0	1	3	4	24	32
		% of Total	.0%	1.9%	5.8%	7.7%	46.2%	61.5%
Total		Count	1	5	14	7	33	60
		% of Total	1.9%	9.6%	26.9%	13.5%	48.1%	100.0%

Source: Primary data, processed

In terms of expenditure, family spending ranges from Rp400,000 to Rp800,000. About 31.1 percent of the respondents in Gorontalo have monthly expenditures of Rp400,000 to Rp600,000; 20 percent spend between Rp600,000 and Rp800,000 monthly. In South Sulawesi, 36.6 percent of the respondents have expenditures of Rp400,000 to Rp600,000; 25.00 percent spend between Rp600,000 and Rp800,000 each month.

Nearly all respondents in both provinces said the value of their harvests is not sufficient to meet their families' daily needs. Households have an average of three to four dependents. To augment their limited farm incomes and meet their daily living expenses, the farmers look for other sources of income such as running a cart or kiosk business or taking on a second job by working on another farm or as a construction worker.

Table 4.13 Respondents' Profile According to Average Monthly Expenditure in Gorontalo Province

	Frequency	Percent	Valid Percent	Cumulative Percent
Rp 200.000 – Rp 400.000	3	6.7	6.7	6.7
Rp 401.000 – Rp 600.000	14	31.1	31.1	37.8
Rp 600.001 – Rp 800.000	9	20.0	20.0	57.8
Rp 800.001 – Rp 1.000.000	8	17.8	17.8	75.6
>Rp 1.000.000	11	24.4	24.4	100.0
Total	45	100.0	100.0	

Source: Primary data, processed

Table 4.14 Respondents' Profile According to Average Monthly Expenditure in South Sulawesi Province

	Frequency	Percent	Valid Percent	Cumulative Percent
< Rp 200.000	1	1.7	1.7	1.7
Rp 200.000 – Rp 400.000	5	8.3	8.3	10.0
Rp 401.000 – Rp 600.000	22	36.7	36.7	46.7
Rp 600.001 – Rp 800.000	15	25.0	25.0	71.7
Rp 800.001 – Rp 1.000.000	5	8.3	8.3	80.0
>Rp 1.000.000	12	20.0	20.0	100.0
Total	60	100.0	100.0	

Source: Primary data, processed

Gorontalo farmers plaint mainly rice and corn. Of the respondents, 57.78 percent are rice farmers (who responded they "always grow rice) and the rest, 42.22 percent, are corn farmers ("always plant corn"). Among the respondents in South Sulawesi, the majority (81.67 percent) "always grow rice," 11.67 percent "always grow rice and corn alternately," and 6.67 percent grow other kinds crops such as green beans, and pulses crops.

Table 4.15 Crops Planted by Respondents

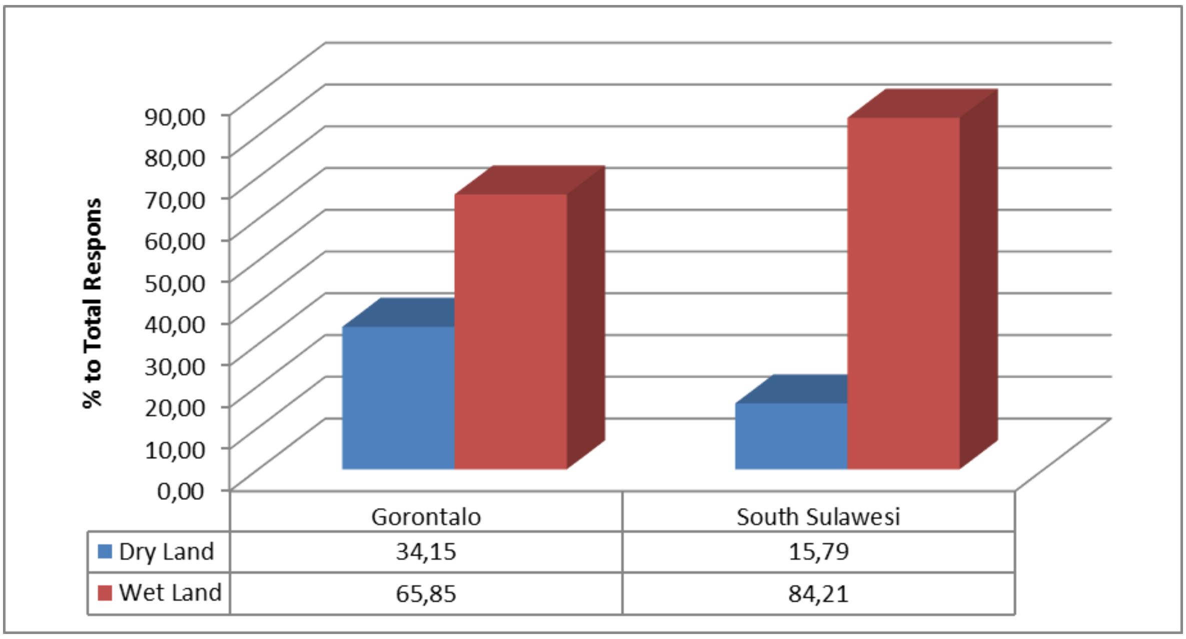
Jenis Tanaman Pangan	Sulawesi Selatan	Gorontalo
Rice	81.67	57.78
Corn	0.00	42.22
Rice and Corn	11.67	0.00
Others (green beans and pulses)	6.67	0.00
Total	100.00	100.00

Source: Primary data, processed

4.4.3. Ideal Natural Conditions for Good Crop Yields

Farmers are well aware of what kind of geographical conditions are conducive to farming: a vast expanse of land, abundance of nutrients, predictable rainfall patterns, and favorable climate. In both provinces, the expanse of agricultural land may be extended because land is still abundant. Their climatic conditions are the same, since dry and rainy seasons happen at the same time.

Among the respondents in Gorontalo, 34.15 percent said they use dryland while 65.85 work on wetlands. In South Sulawesi, 84.21 percent are into dry land farming and the rest into wetland farming. Based on farmland soil water content, farmers plant the suitable types of crops. Most farmers in South Sulawesi plant rice. In Gorontalo, they plant rice and maize.



Sources: Primary data, processed

Figure 4.7 Type of Land Cultivated by Farmer Respondents (Percentage)

Table 4.16 shows a cross-tabulation of availability of land and soil fertility in South Sulawesi and Gorontalo provinces. In both areas, 48.9 percent and 44.7 percent of respondents, respectively, said that land is still sufficient to conduct agricultural extension. In Gorontalo, 37.8 percent of respondents said land, which can be optimally used for agricultural extensification, is still abundant; 30.3 percent said the same in South Sulawesi. Other findings showed that 44.4 percent of respondents in Gorontalo and 58.9 percent of those in South Sulawesi find soil fertility good. These favorable conditions should help the farmers contribute to building a more advanced agricultural sector.

Table 4.16 Respondents' Perceptions of Land Availability and Fertility in Gorontalo and South Sulawesi Province (percentage of total answers)

Availability of	Fertility							
	Fertile		Ordinary		Barren		Total	
	Gorontalo	South Sulawesi	Gorontalo	South Sulawesi	Gorontalo	South Sulawesi	Gorontalo	South Sulawesi
Abundant land	35.6	21.4	2.2	8.9	-	-	37.8	30.3
Enough for extensification	8.9	26.8	40.0	17.9	-	-	48.9	44.7
Lack of extensification		10.7	13.3	12.5	-	1.8	13.3	25.0
Total	44.4	58.9	55.6	39.3	-	1.8	100.0	100.0

Sources: Primary data is processed.

Given the foregoing favorable soil conditions, Gorontalo and South Sulawesi have a great potential to become the centers of agricultural development in Indonesia. Such conditions also support the production of seven national commodities, namely, rice, maize, soybeans, peanuts, green beans, cassava, and sweet potatoes (Directorate General of Food Crops 2010).

Based on FGDs and in-depth interviews conducted, there are two major agricultural problems confronting the two provinces: shifting land use and climate change. Converting farmlands to non-agricultural (residential and industrial) uses leads to a decline in agricultural lands and crop production. Climate change, on the other hand, spawns long rainy and dry seasons, which disrupt farm management planning. Between the two issues, according to respondents in one FGD, shifting farmland use is much easier to address. Land use issues require the government's intervention to regulate areas that can be converted. Appropriate legislation and regulations policies have been formulated to deal with this problem, but enforcement at the local levels remains a problem.

4.4.4. Human Resources for Agriculture

In the new world economic order, the existence of human resources, both in quality and quantity, is the main factor driving the economy. Competent human resources and high-quality technology contribute to increased economic productivity, and these apply to the agricultural sector.

Both provinces still have sufficient human resources. In fact, farmers have no difficulty finding supporting labor within their communities. The average number of additional labor needed by each farmer is three to four, usually from local villages, particularly families or kin.

Table 4.17 Respondent Perception of Quality of Supporting Labor in their Areas (Percentage of total answers)

	Processing		Harvest		Post-harvest	
Labor Quality	**Gorontalo**	**South Sulawesi**	**Gorontalo**	**South Sulawesi**	**Gorontalo**	**South Sulawesi**
Unskilled	0.00	1.79	0.00	5.17	2.22	9.09
Semi skilled	91.11	78.57	93.33	74.14	91.11	60.00
Highly skilled	8.89	19.64	6.67	20.69	6.67	30.91
	100.00	100.00	100.00	100.00	100.00	100.00

Sources: Primary data, processed

The human resource problem in Gorontalo and South Sulawesi lies in the low quality of farmers and supporting labor, owing to their low educational levels. Farmers and farm hands in Gorontalo mostly finished only elementary school (51.11%) while in South Sulawesi, 53.45% of farmers and farm hands graduated from senior high school. Most farm laborers in South Sulawesi have attended some training programs organized by the local government, which helped them acquire farming skills like how to use new technology, how to breed and eradicate pests, and how to conduct post-harvest activities. In contrast, the majority (51.1 percent) of the respondents in Gorontalo have not attended any such training. This study shows that farmers with higher educational attainments have more training and skills.

Based on secondary data, fewer students are interested in agribusiness and agriculture than those who are interested in business and technology. In 2010 agriculture students in South Sulawesi numbered only 7,506, comparably smaller than the number of students enrolled in technology (42,961) and business (29,216) courses. In South Sulawesi, however, there more students of agricultural vocational courses compared to Gorontalo in the same year. In 2010, there were 5,168 students enrolled in agricultural vocational schools; 3,448 students in technological schools; and 3,956 students in business schools. Government must encourage young people to study agriculture to help boost the agricultural labor.

Table 4.18 Number of Students by Type of School, 2010

Province	Engineering	ITC	Health	Tourism	Agribusiness	Business and Management	Total
North Sulawesi	12,158	10,598	525	5,226	1,649	20,958	51,114
Central Sulawesi	7,258	6,253	729	2,511	5,471	10,887	33,109
South Sulawesi	42,961	26,052	12,902	9,895	7,506	29,216	128,532
Southeast Sulawesi	8,286	3,770	1,695	1,910	2,868	6,934	25,463
West Sulawesi	3,959	6,216	2,060	526	2,734	4,984	20,479
Gorontalo	3,448	2,901	60	1,026	5,168	3,956	16,559

Source: Statistics Indonesia, 2011

4.4.5. Alternative Banking Systems for Farmers

The banking sector as a source of credit for farmers plays an important role in agricultural development. In general, farmers have limited resources to manage their farms. Thus, they require financial assistance. Yet, farmers tend to avoid taking out bank loans owing to complex procedures and requirements imposed on them by banks. Such requirements, including proof of the capacity and willingness to pay, collateral, capital and economic condition, cannot be completed by farmers. When farmers cannot access the formal banking system, they resort to “alternative banking” to source needed funds for their agricultural activities. In South Sulawesi and Gorontalo, farmers’ loans mainly come from rice-milling services. Rice millers are not limited to running rice mills. They also lend money to farmers. As an alternative banking system for farmers, rice-milling companies extend credit facilities to farmers on easy terms within one day. Loan payment is calculated by the level of harvest**.** In South Sulawesi, farmer cooperatives are sources of loan funds.

4.4.6. Infrastructure

According to respondents the development of agriculture in South Sulawesi and Gorontalo has been supported by the availability of adequate infrastructure. General road conditions in the two provinces are considered good. Every province has a sea port and airport, which support marketing of products and facilitate access to economic resources. However, to achieve the targets set out in MP3EI, two provinces still need some infrastructure, such as the following:

1. Better roads to reduce farmers’ dependence on commercial intermediaries or middleman;
2. Better irrigation facilities to boost production capacity, which is extremely vulnerable to weather changes.
3. Revitalized warehouse and storage capacity to increase durability and reduce the loss of food

4. Better agricultural facilities and trading centers to reduce farmers' dependence on intermediaries
5. New and improved irrigation systems at the farm level, drip irrigation systems at the village level, micro-hydro systems, pumps, wells, and ponds

4.4.7. Local Government Policies on Agriculture

The development of the agricultural sector in Gorontalo is based on a vision of innovative agricultural development that can produce higher and better yields. Its mission is to create an independent agricultural society as well as productive and educated entrepreneurs. Gorontalo's pursuit of a modern agricultural system aims to achieve a two-pronged goal: improve the quality of human resources to build a competency-based farming of corn and develop a marine economy. In Gorontalo, maize is the main crop used to develop agriculture because of vast tracts of agricultural land planted to it. Corn has been known as a source of public revenue and as an industrial commodity, and has an international market (export).

Based on interviews with the Department of Agriculture and Food Security in Gorontalo province, the vision and mission have been explained well enough to the farming communities, and other stakeholders. The pillars of agricultural development are as follows:

1. Provision of equipment, agricultural machinery, and transport
2. Provision of guarantee fund farmers
3. Provision of high-quality seeds, fertilizers, and pest control products
4. Extension of marketing support to farmers, with a guaranteed floor price for the crops
5. Networking among farmers, markets, agricultural input suppliers, and banks
6. Construction/provision of irrigation (simple irrigation, manual irrigation pumps) and agropolitan access roads.
7. Conduct of a pilot program and setting up of an exhibition space in each county/district
8. Human resource development of agriculture (farmers, workers, facilitators, and supporting labor)
9. Efficient role of corn in the research center and technology assessment.
10. Planning and coordination among government and farmers for agricultural productivity improvement

The provincial government of South Sulawesi has identified action plans to help achieve the MP3EI targets:

1. Productivity improvement through land management, agricultural machinery, high-quality seeds, planting, irrigation systems, and balanced organic fertilizer
2. Expansion of plantation areas through optimum land utilization.
3. Security of production by controlling pests, anticipating climate change, developing post-harvest management, and warehouse barn development.
4. Institutional strengthening and improvement of financial access, strengthening of agricultural institutions, construction and coaching of nursery, coaching and monitoring of production facilities, provision of training services for handling agricultural machinery and equipment, agricultural counseling services, counseling nurseries, utilization of food security credit and microcredit, and partnerships with stakeholders.

4.5. Indigenous Knowledge and Technology Adoption in Gorontalo and South Sulawesi

Analysis of indigenous knowledge and adoption of technology in Gorontalo and South Sulawesi is intended to determine (i) what kind of indigenous knowledge exists in Gorontalo and South Sulawesi provinces; and (ii) how information is shared and new technologies are adopted by the agriculture sector. This analysis looks into the (i) activities undertaken before farmers begin planting, (ii) cultivation, (iii) maintenance, and (iv) harvesting. These four steps make up the agricultural crop cycle. Following is a matrix outlining these activities in Gorontalo and South Sulawesi and when indigenous knowledge and technology adoption come in.

Table 4.19 Matrix of agricultural Processing Cycle and Connection with Indigenous Knowledge

Activity	Sub-activity	Indigenous knowledge applied	Mode of information dissemination with Remarks
Preparation before cultivation	Decision making on when is the right time to cultivate land	1. Weather forecasters or *paniti* and *palontara* 2. Farmers determine the season by the formation of clouds and constellations	1. New technology a. Condensation paper b. Ombrometer c. Hygrometer 2. Information distribution by: a. Agricultural counseling b. Involving weather forecasters in the Indonesian Agency for Meteorology, Climatology and Geophysics (BMKG – abbreviation in Bahasa) and the Assessment Institute for Agricultural Technology (BPTP – abbreviation in Bahasa) to determine the right time to cultivate 3. Information diffusion process and adoption are good enough 4. Today, new technology is more frequently used because only a small fraction of the younger generation know the indigenous knowledge
	Determining water land content	1. Alang-alang leaves *(Imperata cylindrica)* *2.* Awar leaves (*Euphorbia hirta L)* *3.* Opo-opo leaves *(Sonchus arvensis L)* 4. Water detection wire.	1. New technology a. Hygrometer b. Hydrometer 2. Information distribution by: a. Agricultural counseling b. Tapping the BPTP to determine the water land content 3. Information diffusion process and adoption are good enough. 4. Today the new technology is used more frequently because the marked plantation is no longer accurate due to unpredictable weather seasons
	Nurseries	1. Soaking seeds to know the high quality seeds. 2. Drying in the shade area (not exposed to direct sun) 3. Determining the sound of seeds 4. Brighter seed skin	1. New technology a. Integrated machinery b. New high-quality variety c. Experiment in flavor laboratory d. Organoleptic experiment e. Shift from monoculture to polyculture 2. Information distribution by: a. Agricultural counseling b. Involving the BPTP 3. Information diffusion process and adoption are good enough. 4. Today the new technology is used much more frequently even though the old type seed is still used.
Cultivation	Rice cultivation	1. Use plough and *singkal*	1. New technology

Activity	Sub-activity	Indigenous knowledge applied	Mode of information dissemination with Remarks
		2. Row general system with square or rectangle form. 3. Without barriers 4. Enough workforces. 5. Back cultivation system.	a. Dynamic and innovative integrated cultivation management b. Cultivation by *jajar legowo* style c. Use of less workforce d. Use of machinery e. Straightforward cultivation system 2. Information distribution by: a. Agricultural counseling b. Involving the BPTP 3. Information diffusion process and adoption is not practised enough yet; only 50 percent of farmers benefit from it.
	Maize cultivation process	1. *Tugal* tools 2. Cultivation space measured by feet size 3. 1-2 cultivation/clump	1. New technology: a. Space cultivation b. Apply orderly rows 2. Information distribution by: a. Agricultural counseling b. Involving BPTP 3. Information diffusion process and adoption are good enough.
Maintenance		1. The used of traditional tools to eradicate weed and grass 2. Manure 3. Compost	1. New technology a. Chemical fertilizer b. Organic fertilizer (liquid, solid) 2. Information distribution by: a. Agricultural counseling b. Involving the Assessment Institute for Agricultural Technology (BPTP– abbreviation in Bahasa) 3. Information diffusion process and adoption are good enough. Farmers apply them continuously because they benefit from them.
Harvesting	Rice	1. Ani-ani (ketam) 2. scythe	1. New technology a. IRRI (International Rice Research Institute) Stripper Gatherer b. Stripper chandue 2. Information distribution by: a. Center of agricultural developing mechanization b. Rice Knowledge Bank of Indonesia c. Involving the BPTP 3. Information diffusion process is conducive to farming.
	Maize	1. Picking 2. Peeling 3. drying	1. New technology is the stripper maize machine

Activity	Sub-activity	Indigenous knowledge applied	Mode of information dissemination with Remarks
		4. Prying, manual tools to remove maize from the cob	2. Information distribution by the Center of Agricultural Developing Mechanization 3. Involving the BPTP 4. Information diffusion process is good.

Source: Interviews, literature review, FGDs

4.5.1. General Review

The history of agriculture is replete with examples of farmers trying to innovate or create technologies for the production, processing, and storage of food. They also used animals to cultivate and harvest high-quality crops. In the course of time, many farming systems were developed and adapted to local condition and resources. It is also clear that farmers still depend on external agencies such as research, extensions, and commercial enterprises for innovations.

Technological adoption responds to the huge need for external knowledge. In Indonesia, agricultural cultivation technology has been advanced enough, especially for rice cultivation in paddy fields (Lakitan 2010*)*. A great deal of research has examined various aspects and stages of rice production, and recommended a number of agricultural technologies. Nowadays, the problem of technology has shifted from technological compatibility to farmers' technological adaptation capacity. General issues related to food crops technology are listed below (Lakitan 2010):

1. *The lack of technology adoption.* Adoption of rice cultivation technology in Java has only reached 65 to 75 percent of optimal technology, which is even higher than that of other islands. Technology adoption gap is linked to farmers' capital limitation and spawns non-optimal fertilizer utilization, uncertified seed utilization, and inappropriate use of pesticides. Lack of technology adoption lowers agricultural productivity by 20 to 25 percent.
2. *Limited technology orientation.* This focuses only on increasing productivity but pays little attention to the suitability of certain technologies to agricultural areas, the adequacy of raw materials, the capacity of farmers to adopt technologies, and the production costs.
3. *Poorly enforced agricultural policy.* Linkages between public policy and the direction of technology development are not optimal. The technology developed and implemented focuses more on increasing food production, but ignores the welfare of farmers.

The adoption of technology should take into account not only information sharing, farmers' participation, and structures but also the culture. Culture is a pattern of behavior that exists in a particular group whose members have purposes, symbols, and established means of communicating with one another (Colletta and Kayam 1987). Cultural elements include implicit and explicit rules on social, economic, political, and religious life. It evolves over long periods of time, is internalized in everyday life and reflected in an individual's behavior, including those of farmers, and society in general. Thus, every attempt to introduce a new technology to farmers must consider their culture and beliefs so that appropriate strategies can be used (in terms of timing and approach, for instance) to ensure effective technology adoption.

Based on in-depth interviews and FGDs, most farmers in South Sulawesi and Gorontalo gained their knowledge of farm management from the agriculture department. Less than 20 percent of respondents said they acquired agricultural knowledge from their forebears. This means that for the majority, the older generation of farmers did not have comprehensive notes of IK to share with the succeeding generations. Table 4.20 shows that on the average, approximately 20.42 percent of Gorontalo respondents and 26.99 percent of South Sulawesi respondents combine indigenous knowledge with knowledge learned from agricultural agents to improve their agricultural knowledge.

Table 4.20 Sources of Agricultural Knowledge (in percent)

Source	**Forebears (IK)**		**Agricultural agents**		**IK and agricultural agents**	
Knowledge	Gorontalo	South Sulawesi	Gorontalo	South Sulawesi	Gorontalo	South Sulawesi
Nursery	2.27	17.54	86.36	56.14	11.36	26.32
Cultivation pattern	4.44	29.31	68.89	43.10	26.67	27.59
Intensification	0	17.54	81.4	59.65	18.6	22.81
Fertilization	0	17.86	77.27	55.36	22.73	26.79
Pharmaceutical	0	9.26	77.27	59.26	22.73	31.48

Sources: Primary data, processed

4.5.2. Preparation

Indigenous knowledge is also fused with technology adoption in agricultural preparation, particularly in these activities: (i) determination of the time of planting, (ii) determination of water content, and (iii) nursery cultivation. Preparation for agricultural activities in South Sulawesi and Gorontalo begins with an estimation of a suitable planting period. Traditionally, weather forecasters, known as *pinati* or *palontara* in Indonesia, influence the determination of the planting time. Weather forecasters use the *Lontara* book, a documentation of natural events that occur based on the recorded experiences over the years. They can predict the onset of wet and dry months by observing cloud formations and colors. For example, a fleece-shaped cloud is an indicator of humidity or the onset of rainy season. Farmers also begin the planting period by looking at the plough or rice constellation.

Another interesting piece of indigenous knowledge in South Sulawesi and Gorontalo is that which is used to determine surface soil water content. Local people use *alang-alang* leaves (Imperata cylindrical or bladdy grass), *awar* leaves (Euphorbia Hirta L or tawa-tawa/gatas-gatas in Philippines), *opo-opo* leaves (Sonchus arvensis L or Field Sow Thistle), and water detection wire for this purpose. Two *alang-alang* leaves are placed on one's right hand and are made to cross each other at a 90º angle. Then the farmer carrying the leaves on his hand walks forward slowly. If the soil contains water, then the leaves will move and form a smaller angle, between 30º and 40º.

Figure 4.8 ***Alang-alang*** **Leaves (Imperata cylindrical)**

Indigenous knowledge of the planting time and surface soil water content is still used today, but it is now applied in conjunction with technology provided by the Department of Agriculture. The new technologies used are condensation paper (which helps one analyze the spread of dew condensation from the natural condensation process), ombrometers (measure rainfall volume), hydrometers (measure the specific gravity of liquids), and hygrometers (measure moisture content in an environment).

The use of these devices is an initiative of the Department of Agriculture alongside the Indonesian Agency for Meteorology, Climatology and Geophysics (BMKG – abbreviation in Bahasa) and the Assessment Institute for Agricultural Technology (BPTP – abbreviation in Bahasa). The delivery process for this technology has been running smoothly by following a cultural approach that involves weather forecasters and traditional local elders. Today, the determination of planting time is done using modern technology, since only a few of the young generation understand forecasting. Determining soil water content uses modern technology because marking plantations is no longer accurate.

The next activity in preparation for planting is nursery cultivation. From generation to generation, the seed selection process has been carried out by soaking the seeds into water mixed with ash and fungicide solution (to prevent mold) for three to four hours. Floating seeds are discarded while the sinking ones are used as basic seeds. To find out the percentage of the growing seeds, it is necessary to know the water content of seeds. A traditional way of doing this is by drying the seeds in a shaded area (not exposed to direct sun). Once the seeds are dry, they will rustle if milled by hand and their skin will look brighter.

Most farmers today have abandoned the traditional way of preparing rice seeds. The BPTP has introduced new technology in the form of an integrated rice-seeding machine, which has the following components:

1. Seed soaking and ripening machine that functions as a tool to sort and soak the seeds
2. Soil-smoothing device Mill
3. Feeding elevator
4. Soil grinder and seed sower
5. Nursery box

6. Nursery shelves

Aside from teaching farmers new technologies, agricultural agents also regularly visit them. The latter are taught how to prepare high-quality seeds based on phenotype and genotype observations. Whereas genotype is the set of genes responsible for a particular trait, phenotype is the physical expression of that trait. to create desired genotypes and phenotypes, farmers need manipulation activities in plant breeding. This manipulation involves either controlled pollination, genetic engineering, or both, followed by artificial selection of progeny. International development agencies believe that breeding new crops is important for ensuring food security and developing practices through the development of crops suitable for their environment.

Five criteria to find the high-quality seeds are

1. Pure and the name of the varieties[2] is known**.**
2. Healthy seeds that taken from old grain/corn
3. Harvested from healthy plants
4. Free from pests and plant diseases
5. Clean, not mixed with other varieties, grass seed, and impurities

Figure 4.9 Hybrid Maize "Bima" Variety

To ensure the quality of seeds, the farmers in both provinces were given a facility by the Department of Agriculture that they could use as a flavor laboratory. Such a laboratory helps farmers to analyze the flavor, check the presence of pesticide residues and aromatic hydrocarbons (potent atmospheric pollutants), and conduct and plant chemical analysis. Another test undertaken at the laboratory is sensory analysis of seeds (to determine weight, age, moisture content, growing time, and seed release time). Aside from the laboratory, the farmers were also given new seed varieties, which enabled them to harvest in a relatively shorter period of time and which proved resistant to pests and diseases.

Based on FGDs and in-depth interviews, the majority of respondents said biological diversity could be enhanced further and that shifting to from monoculture to polyculture farming systems was possible. They also reported that they had received agricultural

[2] The well-known local seeds are *Tajum* and *Maros*. The high-quality seeds are *Intanpari, merawu, Lete,* etc. Local corn seeds are *Lamuru FM, Pulut local* and *srikandi putih*. The high-quality corn seeds being developed are *Sayang* and *Bima* varieties.

counseling and supervision on biodiversity from the government, and were supplied with seeds. Seeds developed in both sample provinces came from the farmers' seed stocks and local sources. Government provides 25 kilograms of seeds per hectare. One hectare needs approximately 40 kilograms of seeds.

4.5.3. Cultivation

How farmers plant rice in South Sulawesi and how their counterparts in Gorontalo plant maize are well worth noting. Applying indigenous agricultural knowledge, farmers in Sulawesi plant rice use the row system with square patterns, or four rectangle patterns (tile cultivation model) without barriers. This activity relies mainly on manpower and a backward cultivation system.

Figure 4.10 Farmers make a *jajar legowo* planting line (left) and plants paddies using the *jajar legowo* system (right)

A technological innovation in planting introduced by the Agricultural Research and Development Department is called the *jajar legowo* system. This system is a model of cultivation that allots space between rows of planting. *Jajar legowo* system 2:1 means there is one empty row (20-30 cm) beside two rows of rice. The *jajar legowo* system 4: 1 means one empty row beside four rows of rice. Using the *jajar legowo* system saves on labor (only three farm hands are required for planting), since it entails the use of a remote-controlled planting machine. Not all farmers, however, use this *jajar legowo* method, since some of them still rely on IK and only limited information is available to them. Some 50 percent of the farmers (in both provinces) still use the conventional planting method.

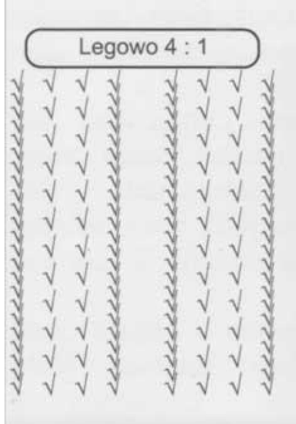



Figure 4.11 ***Jajar Legowo*** **2:1 (left) and 4:1 (right)**

In Gorontalo, the traditional way to plant maize is using *tugal*, where planting spaces between rows have a step size of one to two steps. The maize planting technology system uses a specific measurements for allocating row spaces: there is an orderly row of 75 x 40 cm with 2 corn seeds per hole or row of 75 x 20 cm with 1 corn seed per hole. Findings showed that most farmers were using new technology to plant maize.

In general, ploughs and *singkal* (traditional agricultural tool in Sulawesi) are used for land preparation, which begins at the edge and circles around to the middle. The process has to be repeated over time for an optimal result. Plow the land at a depth of 10 to 20 cm. Before the next processing, the area has already been flooded by water for a week to make it soft. The rice field embankment has to be cleaned of weeds, covered by mud to make it strong, and freed of water. The fertilizer used is manure and rice straws are already moldy**.** Nowadays, land processing utilizes the integrated crop management system and the dynamic approach by using rotary hoes and tractor machines. This new system is considered more efficient by farmers because it easily controls diseases and weeds, facilitates water management, and increases production by 20 to 30 percent.


Figure 4.12 ***Singkal*** **(left) and Plough (right)**

4.5.4. Maintenance

Regular and proper maintenance is required to optimize crop yields. Rice and maize maintenance programs require clearance of weeds, watering/irrigation system, fertilizers, tillage (for maize), and control of pests and plant diseases. Traditionally, farmers use tools like “porcupine” –a wheel encircled with a knife—and *gasrok* (a wheel roll fitted with a mower plate) to pull out grass and weeds. During fertilization, farmers tend to use the organic kind. Technological innovations applied during maintenance include the use of both organic and chemical fertilizers by the BPTP.

In Gorontalo, most farmers use a combination of chemical and organic fertilizers. In South Sulawesi, farmers mostly use more chemical fertilizers than organic ones. The ratio of organic fertilizer used to chemical fertilizer (urea plus) is 10 to 15:1.

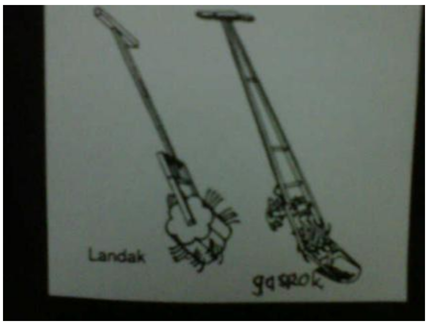


Figure 4.13 ***Landak*** **(left) and** ***Gasrok*** **(right picture)**

Farmers quickly adopted technology innovation in the form of fertilizer, which makes the soil more friable and lush, and improves the absorption and release of soil nutrients. They also use chemicals to eradicate pests. They prefer to use chemical fertilizers and pest control agents, which allow them to achieve higher productivity efficiently. They said chemical fertilizers and pest control solutions yield more crops than organic fertilizers and non-toxic and safe forms of pest control. Farmers, however, are fully aware of the negative effects of chemicals on crops. Yet they are faced with the dilemma of dealing with economic costs on a daily basis.

Figure 4.14 Pile of paddy straws decomposed to be used as fertilizer

4.5.5. Harvesting

New technologies used for rice harvesting are the IRRI (International Rice Research Institute) stripper gatherer and stripper chandue. The stripper gatherer system was developed by the IRRI Engineering and Silsoe Research Institute in the UK. The stripper gatherer can harvest, thresh and clean one hectare per day cheaper than conventional harvesting system in a small field. The stripper chandue is the modern tool used to separate rice grain from their stalks during harvest. This is a modification of the stripper SG 800, made by craftsmen from Pinrang regency.

The development of modern tools, signaling a shift from *Ani-ani* (traditional cutting tools), has made harvesting easier and faster. Such tools are used to cut the stems and separate the rice grain from the stalk. The remaining stem, about 30 to 40 cm long, is then used as compost by folding in the soil around it with a plough to let it decay. This method has been used since *Ani-ani* was the prevailing practice among farmers.

New tools used for maize harvesting are the maize stripper (this is a generic name), maize-picking and cutting tools. The maize stripper is a tool that separates the maize from the cob, but maize-picking and cutting tools are multifunctional, since they cut, harvest, and separate the maize from the cob. Notwithstanding the efficiency of these tools, farmers found their price prohibitive.

CHAPTER 5. CONCLUSION AND POLICY RECOMMENDATIONS

5.1. Discussion

This study has shed light on the relationship between technology diffusion and the public participation approach. Gorontalo tends to be homogenous in terms of age and educational levels. South Sulawesi is more heterogeneous. This heterogeneity is reflected in the society's attitudes toward self and life in general. Farmers in the district of Maros in South Sulawesi tend to be open to learning new technology in hopes of a better life. Such sectors show more optimism toward development. Farmers in the district of Pangkep tend to consign their lot in life to fate. As such, they see being poor farmers as something they must endure. Such an attitude makes them less open to new technology.

The Gorontalo farming community is open to new technology but has a low level of agricultural participation in technology adoption. The farmers' initiative to adopt new technology is low. They need government intervention, through a pilot project, to adopt the new technology. The success experienced by farmers in a pilot project strongly motivates them to adopt new technology. The institutional structural approach through farmers' cooperatives and farming communities are expected to effectively encourage the implementation of technology to improve the welfare of the people, especially farmers.

Unlike the Gorontalo farmers, those in the district of Maros have a high level of agricultural participation in technology adoption. New technology development initiatives are also emerging in the community. Based on field surveys, some young farmers are experimenting independently with developing an irrigation system that will address the water scarcity in the area during dry season. Other groups of farmers are trying to develop organic agriculture. Overall, these progressive-thinking farmers are not averse to sharing their ideas with other farmers. Given these scenarios, the structural approach can effectively encourage technology diffusion among the farmers.

For the farmers in the Pangkep who are lukewarm to new technology, cultural and structural approaches should be used simultaneously. As a medium of learning, the existing institutional approaches, such as those of farmers community groups (Gabungan kelompok tani – GAPOKTAN in Bahasa), can be used.

Both Gorontalo and South Sulawesi provinces have a high level of heterogeneous leadership. Elected community leaders in the provinces are elected are considered to have a higher capacity than the rest of the community at large are considered trustworthy. Leaders who are most involved in the process of technology diffusion are deemed the closest to community members, including district, village chiefs or headmen and traditional leaders. Therefore, the community leaders have a strategic role in technology diffusion.

Table 5.1 Summary of the linkage between technology diffusion and public participation approach

	Gorontalo	South Sulawesi	Approach (structural/cultural/resource)
Group homogeneity	Homogeneous in terms of education, age, and location	Not as homogeneous as Gorontalo	Gorontalo people are suited to the cultural approach. Diffusion of technology requires a pilot project. South Sulawesi farmers are more inclined toward the structural approach.
Participatory norms	Participation rate is low. Society tends to wait for new technologies.	The participation rate in Maros is high, and low in Pangkep.	
Leadership heterogeneity	High	High	

The combination of indigenous and external knowledge is expected to enhance productivity and farmer welfare. This study has shown the following impacts:

1. *Increased crops yields and reduced crops losses.* In Gorontalo, the impact of technology diffusion (in particular the use of Stripper chandue) combined with indigenous knowledge makes rice harvesting quicker. Crops covering one hectare can be harvested by four operators in just one day. If *Ani-ani and sabit (*scythe) are used on the same size of farmland, harvesting takes more time and operators (10-15). Expected losses, however, are just 2.9 percent. In South Sulawesi, the combined use of *Ani-ani* and IRRI stripper gatherer requires only four operators to perform harvesting and hauling, and another four to thresh rice (per area). The stripper can be operated over a narrow area, and its use results in a loss of only 2.6 percent.

   In Gorontalo, using technology, instead of free hand and *sabit* (scythe) to pick maize, renders harvesting faster by one to 1.5 hours, and requires only three to four operators. (The land is narrow and has an up and down slope.) Losses are estimated at 2.4 percent. However, in South Sulawesi, technology use makes possible harvesting of one hectare of land to be finished in one day by only two operators, with losses of 1.8 to 2.2 percent.
2. *Reduced risks of crop failure, pest attack, and diseases*. It is important to increase farmer knowledge of the use of pest-resistant crop varieties. Farmers also need farming area management skills to determine the appropriate amount of fertilizer

to use, to execute harvest and post-harvest handling methods, and to maintain integrated crops.

3. *Increased farmer welfare.* The respondents said their quality of life has improved, although to what extent they cannot say, from combining indigenous and external knowledge in their farming activities.

5.2. Policy Recommendations

Based on the research results, the following policy recommendations are offered:

1. *Strong enforcement of land use policy.* Although Indonesia has a land use policy, its implementation is weak. As a result, most farmers no longer have property rights over their lands, given the high level of conversion rate of farmland to non-agricultural conversion. Government has to set land use clearly and strictly.
2. *Integrated and sustainable agricultural infrastructure development policy*. Research results show that agricultural management cannot be optimized because of limited agricultural infrastructure, especially irrigation systems and rural roads. Government should identify and assess road and irrigation conditions, and build such structures, if necessary, in new areas designated as agricultural centers. Farm-to-market roads must be constructed to improve the welfare of farmers.
3. *Sustained agricultural development that relies on local resources.* This is seen to improve food self-sufficiency, quality of farm produce, and farmer welfare, as well as increase food exports. Most farmers combine indigenous knowledge with external knowledge of farming methods and practices, resulting in a higher productivity. Some farmers, however, cannot access agricultural technology because of a lack of information and resources. This problem is linked to farmers' capital limitation, and leads to the non-optimal fertilizer utilization, uncertified seed utilization, and inappropriate use of pesticides. Government should spearhead efforts to develop an efficient system of sustainable agriculture that is based on science and technology, utilizes local resources, and environmentally sound.
4. *Comprehensive farmers'* a *technology orientation.* Most farmers notion of agricultural technology focuses only on increasing productivity but gives less attention to the technology suitability of the agricultural area, the adequacy of raw materials, farmer capacity to adopt technology, and production costs. Agricultural training and counseling are needed to make farmers creative, innovative, and independent, and make them capable to adopt technology wisely and utilize local resources.

5. *Earnest promotion of food diversification.* Government should ensure its pursue a sustained national crop development program is sustained and continuously that promotes food diversification. Currently, such program covers the national primary commodities, namely, rice, corn, soybeans, peanuts, green beans, cassava and potatoes. Yet, this study shows that consumers generally consider only wheat and potatoes as substitutes for rice.
6. *Suitable approach to public participation in technology diffusion.* Based on character group homogeneity, participatory norms, and leadership heterogeneity, the Gorontalo province should apply the cultural approach to increase public participation in technology diffusion. The province of South Sulawesi is more inclined toward the use of a structural approach.

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