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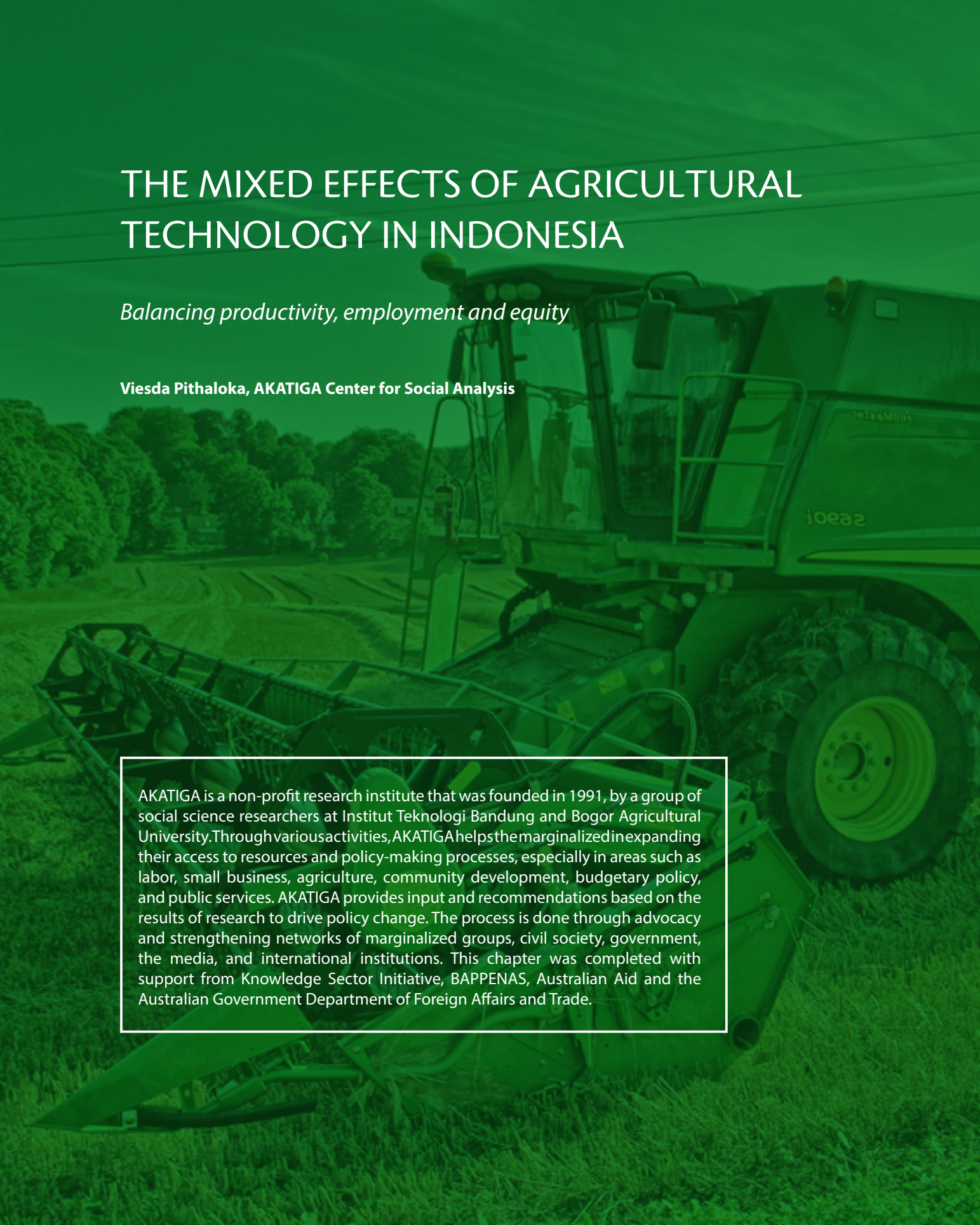

THE MIXED EFFECTS OF AGRICULTURAL TECHNOLOGY IN INDONESIA

Balancing productivity, employment and equity

Viesda Pithaloka, AKATIGA Center for Social Analysis

AKATIGA is a non-profit research institute that was founded in 1991, by a group of social science researchers at Institut Teknologi Bandung and Bogor Agricultural University. Through various activities, AKATIGA helps the marginalized in expanding their access to resources and policy-making processes, especially in areas such as labor, small business, agriculture, community development, budgetary policy, and public services. AKATIGA provides input and recommendations based on the results of research to drive policy change. The process is done through advocacy and strengthening networks of marginalized groups, civil society, government, the media, and international institutions. This chapter was completed with support from Knowledge Sector Initiative, BAPPENAS, Australian Aid and the Australian Government Department of Foreign Affairs and Trade.

INDONESIA

21,183

GDP per person employed (constant 1990 PPP $)

22

Internet users (per 100 people)

132

Mobile cellular subscriptions (per 100 people)

0.08

Research and development expenditure (% of GDP)

7

High-technology exports (% of manufactured exports)

CHAPTER 07

THE MIXED EFFECTS OF AGRICULTURAL TECHNOLOGY IN INDONESIA

Balancing productivity, employment and equity

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Introduction

Technology offers the potential to improve productivity in farm work and address the challenges posed by subsistence agriculture and food insecurity. The Ministry of Agriculture in Indonesia is actively introducing new technologies in the country's agriculture sector to increase crop yields, boost farm incomes and increase efficiency in agricultural production.

The results of the study indicate that not all technological interventions are appropriate across locations, and only some of these interventions enable the equitable distribution of income in the rural economy.

These investments in productivity-enhancing technologies in agriculture coincide with a large-scale structural transformation in the Indonesian labor market. In 2004, 45 percent of Indonesians were employed in agriculture. This figure fell to 35 percent by 2014.[1] As with any structural transformation, this movement of workers out of agriculture and into manufacturing and services is driven by a variety of push and pull factors. This chapter asks whether the agricultural technology policies implemented by the Indonesian government influence the process of structural transformation in a way that creates shared prosperity and takes into account the persistence of structural inequality in the rural economy.

The chapter draws substantially on a 2014 study in eight rice-producing villages in four

provinces of Indonesia, which examined the impact of the combine harvester – a machine used to harvest grain.[2] The Ministry of Agriculture has been actively promoting the combine harvester since 2012 through various grant- and loan-based initiatives. The results of the study indicate that not all technological interventions are appropriate across locations, and only some of these interventions enable the equitable distribution of income in the rural economy. The research finds that while the combine harvester improved total income from the harvest, it also eliminated wage employment for rural unskilled workers, altered the redistributive quality of the harvest, and exacerbated already high levels of inequality in rural Indonesia – partly because of how and where the technology was introduced.

The study begins by describing the continued reliance of Indonesian workers on agriculture as a significant source of employment, despite the ongoing movement of labor from agriculture to other sectors. It then proceeds to explain the context and political economy of rural, agriculture-based communities in Indonesia, drawing attention to the ways in which income and power are distributed and redistributed. Next, the study explains the impact of the combine harvester in the eight locations that it examined. Finally, it concludes with a discussion of how productivity in agriculture can be boosted without displacing farm labor and increasing inequality, and offers concrete policy recommendations to this effect.

While enhancing agricultural productivity is necessary for economic development, there are real social and economic costs to making the agriculture sector less labor-intensive.

The author argues that governments in developing and emerging economies must consider multiple factors when actively promoting the introduction of new technologies in the agriculture sector. While enhancing agricultural productivity is necessary for economic development, there are real social and economic costs to making the agriculture sector less labor-intensive. Even in a relatively urbanized and developed economy like Indonesia, a large proportion of workers depend on farm work. Further, conventional methods of agricultural production sometimes serve other aims too, like that of curbing inequality.

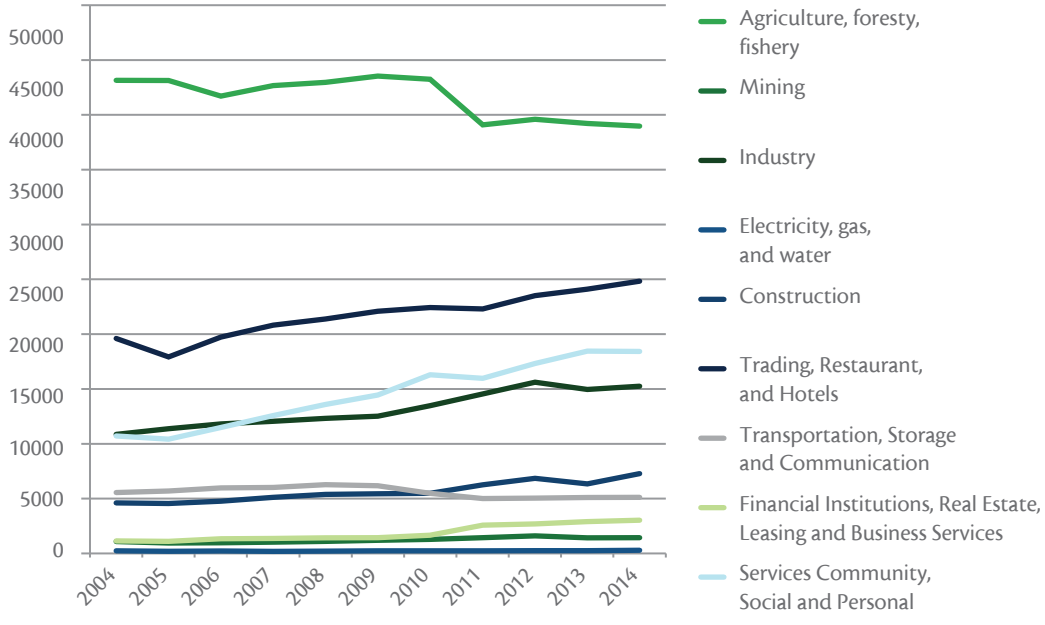
Indonesia's agriculture sector: Trends and policies

Despite the structural shift from agriculture to manufacturing and services in the Indonesian economy, the agriculture sector still plays an important role in the country's labor market, especially when it comes to employment for unskilled workers. Though the number employed in agriculture has declined by more than 4 million workers in the past decade – from about 43 million to nearly 39 million – agriculture still accounted for 35 percent of total employment in 2014.

Moreover, agriculture plays an important role in supporting food security in Indonesia. The nation's ability to support its own demand for staple foods has decreased over recent decades. While Indonesia produced all the rice it needed domestically in the 1980s, the demand has now outstripped the supply. As of 2014, Indonesia was a net importer of rice, importing about US$ 480 million more than it exported.[3] Despite high and sustained levels of economic growth, about

Figure 1

Total employment based on primary livelihood (in millions of person) 2004-2014



Source: National Labor Force Survey 2004-2014, Central Bureau of Statistics, Republic of Indonesia.

87 million Indonesians remain vulnerable to food insecurity,[i,4] and 36.8 percent of children under five were stunted as of 2007.[5]

It is in this context that the government has sought to improve agricultural productivity – to maintain the stability of the food supply and address food insecurity. It has introduced a variety of programs to improve agricultural productivity, like providing better storage facilities and infrastructure. In 2009, Indonesia declared its aim to become self-sufficient in rice, corn, soybean, beef and sugar production.[6] As evidence of the priority given to agriculture, Ministry of Agriculture's allocation now ranks in the top 10 among all ministries, though it is still far less than the budget given to other ministries for instance, of health or transportation (see Figure 2).[7]

According to the Employment Policy Direction 2014-2019,[8] the government of Indonesia plans to integrate agriculture, industry and energy policies to realize food and energy security. The coordination plan aligns with the effort to industrialize agriculture and improve the sector's productivity.

One of the government interventions in the agriculture sector is providing combine harvesters to rural farmers. The combine harvester, or simply the "combine," performs three distinct operations – reaping, threshing, and winnowing – as part of a single process.[9] The combine is expected to reduce wastage of food crops, maintain the quality of crops, extend the shelf life of agricultural products, and improve cost competitiveness of food crops. The combine is also more efficient for farmers because its operation is easier and faster than manual methods of harvesting.

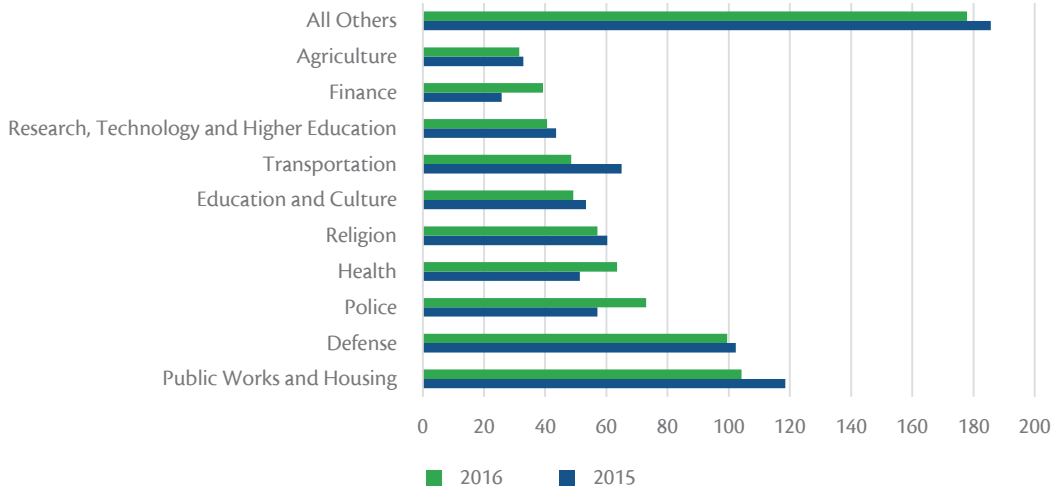
The Employment Policy Direction 2014-2019 strives to industrialize agriculture and improve the sector's productivity.

In 2012 the government launched a massive mechanization program – providing 62,221 pieces of agricultural machinery to farmers' groups throughout the country.[10] The machinery distributed included combine harvesters and other technologies, such as transplanters, dryers and rice mills.[11] The program also includes a training component to guide farmers on how to use the new technologies.

[i] *Food insecurity can be defined as the failure to achieve domestic food production capabilities through institutional support in securing the availability of adequate staple foods – in terms of quantity, quality, safety, and affordability, at the household level.*

Figure 2

Budget for state ministries and agencies (in trillions of Indonesian Rupiah) 2015-2016



Note: 2015 figures reflect the revised budget (APBN-P) while 2016 figures reflect the projected budget (APBN).

Source: State Budget of Indonesia, 2016.

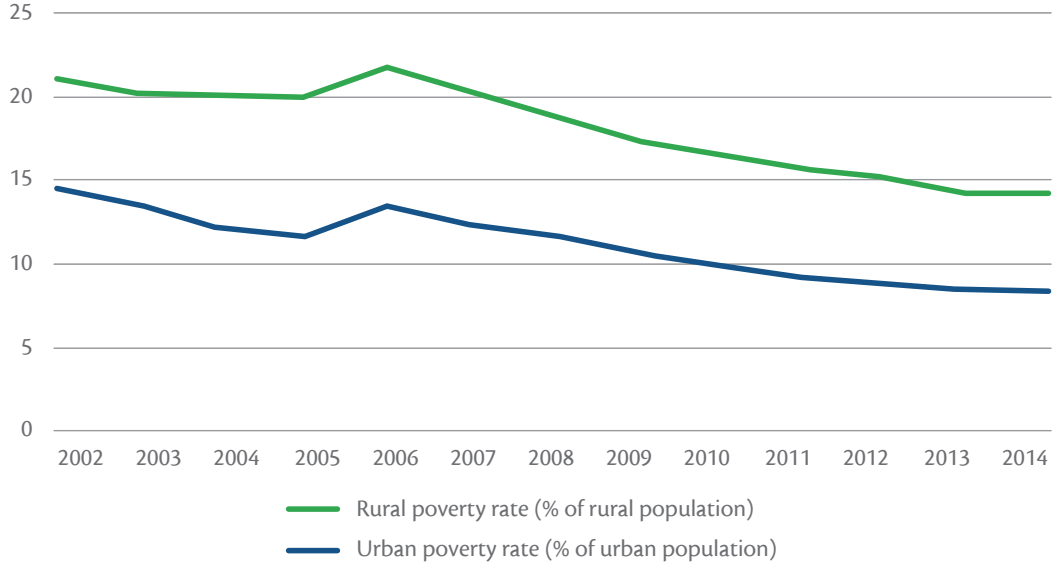
Inequality and labor in rural Indonesia

Agriculture in Indonesia is dominated by small-scale farming, but the distribution of land is not homogeneous, egalitarian, or static.[12] The rural economy includes capital-rich farmers, large landowners, medium-scale farmers, near-landless farmers and landless farm workers.[ii] More than half of farming households in Indonesia and about one-third of farming households in Java have less than half a hectare of land.[13] Seventy percent of Indonesians below the poverty line live in rural areas.[14]

Aided by strong economic growth, the percentage of people living below the poverty line has

Figure 3

Urban and rural povery rate, Indonesia (%)



Source: World Bank [iii]

[ii] For the purposes of this chapter, the definitions used are as follows: capital-rich farmers are those with more than 2 hectares of land plus substantial non-farm assets; large landowners are those with more than 2 hectares of land but no substantial non-farm assets; medium-scale farmers are those with 0.25-1.99 hectares of land; near-landless farmers are those with less than 0.25 hectares of land; and landless farm workers are those working on farms without any ownership of land.

[iii] These poverty rates are based on the Indonesian government's poverty estimates, and not on the international measure of poverty.

declined significantly in recent years (see Figure 3). However, the gains from this growth continue to be disproportionately captured by the middle and upper classes, fueling rising inequality. Between 2003 and 2010, the richest one-tenth of Indonesians increased their consumption as a share of income by 6 percent per year, in real terms. For the poorest 40 percent, it only increased by 2 percent per year – a surprising trend given that the poor tend to spend more of their income than the rich. The Gini coefficient – a standard measure of income inequality – has risen rapidly, from 30 in 2000 to 41 in 2013.[15]

Rural inequality has particular characteristics and drivers. Two AKATIGA studies on rural inequality, conducted in 2013 and 2014, across 20 villages in the main rice-producing areas of four provinces,[16] found that land ownership is the main factor that shapes inequality in rural areas. AKATIGA's research in the Wajo district of South Sulawesi showed that 67 percent of land in one village belonged to a single family, which brought in 72 percent of total income in the village, while 76 percent of the village's farmers were landless or near landless.[17]

Land ownership is the main factor that shapes inequality in rural areas.

Highly unequal distribution of land ownership and control are problematic for many reasons. In addition to posing the threat of food insecurity for a large section of poor, landless laborers, it also has negative effects on the distribution of employment opportunities and incomes in the agriculture sector and the rural economy overall, thus exacerbating inequality.

Capital-rich farmers in rural Indonesia often earn their income from three sources: agriculture and fisheries, rent collected from sharecroppers,[iv] and non-farm activities such as processing plants. Farmers with large landholdings often invest heavily in agriculture-linked non-farm activities that require substantial capital and provide high returns; such as trade, agro-processing, and renting out farm equipment including tractors and combines.[18] Although small in number, these landowners control a large slice of the rural economy through their diversified farm and non-farm investments.

The uneven distribution of land and income has inevitable political ramifications. Many of the rural rich obtain lucrative jobs or positions in village

[iv] *Those farmers who cultivate others' land with a shared tenancy agreement - such as being paid half the share of the rice yield.*

government or the civil services, which give them better access to government grants and subsidies. The impact of this nexus of economic and political power in shaping government initiatives in the agriculture sector will be discussed in the next section.

At the other end of the spectrum, landless farm worker households sometimes earn additional income in nearby factories or undertake informal service sector occupations. While in some cases their earnings from such activities may be higher than the income earned by operators of small farms, this depends largely on the characteristics of the local economy.

In most villages, the skewed landholding structure means that most young people have no realistic prospect of becoming farmers, at least not in their youth.

In most villages, the skewed landholding structure means that most young people have no realistic prospect of becoming farmers, at least not in their youth. Moreover, due to speculative investment in land and rising land prices, buying land is becoming an increasingly unrealistic option, except for those who are already rich. In the Karawang district of West Java, for example, land prices increased between two- and threefold in just three years between 2009 and 2014.[19] It is not surprising then that so many young rural men and women decide to find other jobs or informal work opportunities, whether in rural areas or through migration to cities or abroad.

Harvesting is an activity that absorbs a lot of labor and offers a short-term seasonal opportunity for poor farm workers in rural Indonesia to earn a relatively high daily wage. It is in this context then, that the harvest has historically acted as a redistributive mechanism, a counterbalance to prevailing inequality in rural economies. The combine, however, eliminates many of the employment opportunities that the harvest traditionally brings, as a later section will detail.

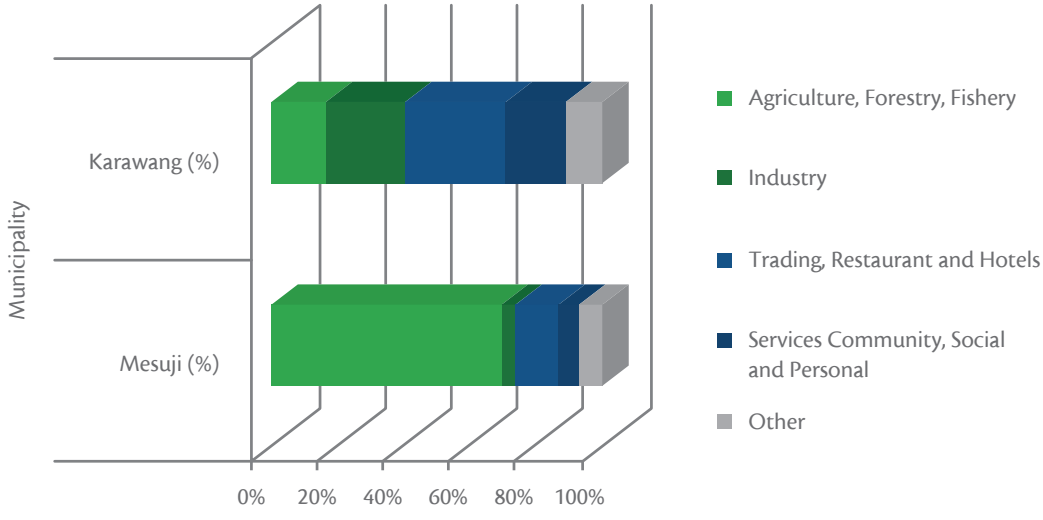
The tale of two rural economies

It is important to recognize that not all local economies in rural Indonesia are equal, particularly when it comes to the availability of non-farm work and the speed of structural transformation. Karawang in West Java and Mesuji in Lampung, two of the rice-producing regions of the country that were included in AKATIGA's study, demonstrate this variation.

In Mesuji, a regency on the island of Sumatra, agriculture still employs about 70 percent of the labor force, while other sectors remain underdeveloped. On the other hand, in Karawang, a regency not far from Jakarta, new industrial estates have been established that have created a diverse and vibrant local economy with a relatively tight labor market. In Karawang, despite the ongoing importance of agriculture –

Figure 4

Employed population (Ages 15+) by sector in Mesuji and Karawang 2014



Source: Karawang and Mesuji, Dalam Angka Reports, 2014.

specifically rice production[v,20] – only 16 percent of workers are still employed in agriculture. This is indicative of a widespread suburbanization process that is underway in Indonesia, wherein industrial activities are moving to once-rural urban peripheries, thus creating a mixed or "rurban" economy.

The distinction between Mesuji and Karawang becomes important in considering workers displaced by increasing mechanization of agriculture, and the employment options that lay before them. In a district like Mesuji, farm workers who lose employment have limited options. They take up work as rickshaw drivers, tailors or home-based artisans, or raise livestock like chickens, the latter of which involves significant capital investment and bears unreliable returns.[vi] Some also choose to migrate to other parts of Indonesia or even to Malaysia in search of work, for instance as laborers on palm oil plantations.

In contrast, a farm worker in Karawang who finds himself redundant, can earn up to IDR 4 million, or up to US$ 305, per month in more lucrative occupations available in his or her vicinity, that include factory work, construction, and wholesale and retail trading[21] (see **Table 1**).

Table 1

Non-agricultural work: Typical income

Work	Income (IDR) / Month	US$ Equivalent
Factory	1.6 - 4 million	122 - 305
Palm Oil Plantation in Malaysia	2 - 3 million	152 - 228
Construction	1.5 - 3 million	114 - 228
Retail	0.3 - 2 million	23 - 152
Rice Mill	~ 600,000	~ 46
Farm Work [vii]	0.38 – 0.75	29 - 57

Source: Nugraha, Yoga. A. & Rina Herawati.

[v] In 2015, Karawang produced 9 percent of total rice grain in the West Java province, the second largest rice producing province in Indonesia
[vi] Average monthly income from animal husbandry ranges from IDR 240,000 to IDR 600,000 (about US$ 18 to 45). See Yogaprasta A. Nugraha et al.
[vii] Although it doesn't fall within the classification of non-agricultural work, farm work has been included here for the purpose of comparison. Farm workers are paid IDR 25,000-50,000/day (US$ 2 – 4/ day), but since they don't work throughout the year (as agriculture involves waiting periods), they are estimated to work for approximately 15 days per month, in every season. See Yogaprasta A. Nugraha et al.

The differing nature and pace of structural transformation in areas such as Mesuji and Karawang should be taken into account when shaping policies that would be adopted by Indonesia's Ministry of Agriculture.

The combine harvester and its impacts on employment and inequality

In 2012, the government launched a massive mechanization program for the agriculture sector, providing 62,221 pieces of agricultural machinery to farmers' groups throughout the country.[22] The technology distributed included rice transplanters, dryers, power threshers, corn-shellers, rice milling units, tractors and water pumps, as well as combine harvesters.[23]

Based on AKATIGA's findings, combine harvesters have had two main effects on rural communities. First, the combine - like other technologies - has reduced the demand for labor while increasing productivity. Second, it has transformed the economic relationships inherent in the harvesting period, reversing the redistributive quality of the harvest and therefore increasing rural inequalities.

The combine has reduced the demand for labor while increasing productivity. It has also reversed the redistributive quality of the harvest, in turn increasing rural inequalities.

Prior to the introduction of the combine, about 30 manual harvesters would be contracted on a daily basis to cover approximately one hectare per day over the harvest period. Farm workers would typically earn IDR 40,000-50,000 (about US$ 3-4) per day during harvest season. Ultimately, this system resulted in farm workers earning about 89 percent of the total profits of the harvest, with the remaining profits going to the landowner, according to AKATIGA's findings.

With the introduction of the combine, the profit sharing arrangement has essentially been reversed. Approximately 80 percent of the total income of the harvest ends up in the hands of the owner of the combine harvester – who is nearly always the landowner. With the combine enabling three hectares of land to be harvested each day, only eight workers are hired

per machine during the harvest period. In other words, AKATIGA's research shows that both the redistributive effect and the employment effect of the harvest period are almost completely neutralized with the introduction of the combine harvester.

The rural elites have largely captured the government's provision of combine harvesters to local communities. The Ministry of Agriculture's program involves the direct donation of combine harvesters to farmers' groups. These groups are set up at the village level to increase farm income by encouraging partnerships and knowledge sharing among farmers. Ostensibly, a sharing mechanism in farmers' groups must ensure that the combine harvester reaches more people. But studies have shown that farmers' groups are generally dominated by village elites focused on gaining access to government funds, and that they lack transparency and accountability.[24] This means that channeling combine harvesters through farmers' groups is likely to ensure that it is the wealthy residents with large landholdings who gain access to the machine in the villages. AKATIGA's observations corroborate this. In its qualitative study, almost all those using a donated combine received it through a personal relationship with the local government.

These findings demonstrate that variables beyond total factor productivity must be taken into account when introducing new agricultural technologies. Local economic characteristics – such as the lack or abundance of non-farm work opportunities – will shape the degree of positive and negative impact from promoting new agricultural technologies. Policy frameworks must take into account these local and regional differences.

Variables beyond total factor productivity must be taken into account when introducing new agricultural technologies.

How to increase productivity and efficiency without exacerbating inequality

In a place like Karawang, promoting the combine harvester is a sensible policy approach. Broadly speaking, workers in this region who have been displaced by efficiency gains brought on by the combine have other employment options available to them. But in an area like Mesuji, the combine displaces workers who have few local employment alternatives, and increases local inequality by eliminating the redistributive quality of the harvest season.

This is why governments in developing and emerging economies must consider the characteristics of local and regional economies when introducing technologies for the agriculture sector. Economic development is partly underpinned by growing agricultural productivity. At the same time, the social and economic costs of making the agriculture sector less labor-intensive must be taken into account. Even in rapidly urbanizing countries, a large proportion of workers depend on farm work.

Governments in developing and emerging economies must consider the characteristics of local and regional economies when introducing technologies for the agriculture sector.

A smart policy approach can balance the competing priorities of an emerging economy like Indonesia by boosting agricultural productivity, enhancing food security, creating employment – especially for youth – and reducing inequalities. What follows is a set of recommendations towards such a balanced policy framework.

1. Promote different agricultural technologies based on the characteristics of local economies.

For regions like Karawang that are at an advanced stage of structural transformation and may even be experiencing farm labor shortages, introducing technologies like the combine harvester can dramatically boost agricultural productivity. In regions where the agriculture sector is still responsible for generating most employment, other technologies can be introduced that will improve efficiency without drastically reducing the labor-intensity of agriculture. For example, in China, the government introduced brush cutters[viii] and rice reapers[ix] in regions where the local workforce remained highly dependent on farming.[25]

[viii] *A brush cutter is a power tool worn with a shoulder harness, consisting of a rotary head with a small circular saw at the end of a boom, used for clearing various kinds of rank or low woody growth. With particular attachments, it can be used to aerate the soil before planting or destroy weeds after planting.*

[ix] *A rice reaper is a harvesting machine that cuts and gathers rice grain at the time of harvest.*

Governments in emerging and developing countries might also consider introducing pilots in regions with different economic and social characteristics in order to understand the impact of a particular technology before promoting it across all geographies.

2. Improve mechanisms for equitable distribution of farm-related grants, loans and subsidies.

There is adequate evidence now to demonstrate that farmers' groups, despite their intended purpose, are not the appropriate mechanism for ensuring that government programs to aid farmers reach those most in need. Other vehicles or models of delivery should therefore be considered. For example, groups of smallholder farmers – those owning less than one hectare of land – could be the beneficiaries of specifically targeted interventions. This would help address the problems of elite capture at the local level.

3. Invest in creating viable non-farm job opportunities in regions where the pace of economic development is slow.

Residents of regions like Mesuji deserve to reap the benefits of a more diverse, robust local labor market that offers a range of employment opportunities. The government should facilitate the creation of viable non-farm employment so that workers in regions like Mesuji are not perpetually dependent on labor-intensive agriculture for their livelihoods. For example, many parts of Indonesia are ripe for investments in agro-processing facilities. These could even take the form of medium-sized, producer-owned companies that give landless workers a scope for economic mobility. Some villages in Indonesia have already been successful in developing cooperatives in both farm and non-farm industries, such as village-owned rice mills.

If technology is to deliver on the promise of an equitable growth process, rising productivity cannot be the only consideration for its deployment.

If technology is to deliver on the promise of an equitable growth process, rising productivity cannot be the only consideration for its deployment. As this paper shows, context matters. And it is only by shaping technological initiatives to meet the challenges specific to an area and its people that governments can achieve the desired results.

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