THE PROSPECT OF BETTER UTILIZATION OF THE POTENTIAL PRODUCTIVITY OF THE SOIL TO INCREASING RICE YIELDS IN INDONESIA[1)]

Tedjojuwono Notohadiprawiro[2)]

Nobody questions the role of science and modern techniques in pushing up effectively and efficiently agriculture production. Planting better varieties of crops, careful preparation of the land, well established irrigation and drainage, effective control of pests and diseases, and the proper use of fertilizers and manures are the five principal factors of successful crop production.

Sawah rice needs in the first place a puddled soil structure for best results. It makes also the transplanting of the young rice plants much easier. This specific type of structure can only be obtained by cultivating the soil while it is oversaturated with water. During most part of the growing period of the rice plants the field is flooded with a water layer of 5 to 10 cm thick. To promote soil aeration and to control the water temperature, the water is kept running with a reasonable low speed, except during and two or three days after fertilization to prevent losses of fertilizers. For this purpose also the water depth is reduced to just cover the soil surface.

Therefore it stands to reason to say that water is crucial for growing rice. It forms the basic factor to secure a rich harvest. Such a water management can only be done effectively by irrigation.

---

1) Background paper presented at the NAS-LIPI Workshop on Food, Djakarta, May 27 - June 1, 1968.

2) Faculty of Agriculture, Gadjah Mada University, Jogjakarta.

Agric. Sci., 1969, 1, No.3.

Types of rice growing.

There are several types of rice growing from the points of view of source and management of the water. Gogo or dry land rice (upland rice) is cultivated without ponding the water on the fields. It is watered by the rains. Two ways of gogo planting can be mentioned here, namely grown on permanent plots (gogo tegalan) and on temporary ones (shifting cultivated or gogo ladang). Sawah rice is grown by ponding water on the fields. If all the water needed should come from the rain, it is called rain fed sawah. It is called an irrigated sawah if irrigation water is used, either as the sole source of water or given supplementary to rain water. The irrigated sawah is subdivided into rural or wild irrigated/ sawah, according to the quality of the irrigation works (reservoirs, dams, and diversion and distribution channels) and the effectiveness of water distribution among the different parcels of an irrigation district or unit area.

A midform between gogo and sawah is the so-called gogo rantjah. At the beginning rice is planted as gogo and if afterwards water is adequately available, it is changed into sawah. It will be continued as gogo when water appears not enough to be ponded on the field. This method is employed to minimizing risk of failure in areas where the water supply for sawah can not be assured.

An irrigated sawah planted in the dry season is called a gadu. The possibility to plant a successful gadu crop depends on the availability of sufficient water. Modern varieties of rice have short growing periods. Thus the frequency the land can be put under sawah within a certain period of time, for example a year, is closely associated with the extent of water supply in that particular area; in other words, with the adequacy of irrigation.

All these types of rice growing should be kept in mind in order to get a clear understanding of the problem to be discussed.

/‾ semi technical irrigated and full-technical irrigated

Acreage and distribution of rice fields.

The total planted acreages and average yields of gogo, gogo rantjah and irrigated sawah in the principal islands and groups of islands are presented in table 1. Java and Madura together have close to 3½ million ha of irrigated sawah, that is about 55.5% of the total area of Indonesia used for gogo rantjah and irrigated sawah. Most of the gogo is found in Sumatra amounting almost 38% of the total gogo area of Indonesia. Approximately 76% of the gogo is found outside Java and Madura. Without exception the average yield of irrigated sawah and gogo rantjah is considerably higher than that of gogo.

The figure for irrigated sawah and gogo rantjah of Kalimantan seems to include other types of sawah, i.e. marsh and tide-water sawahs.
These two types of sawah are typical for the south and south-east provinces of Kalimantan, occupying an estimated 90,000 ha of land. As they give low yields, the average figure for irrigated sawah and gogo rantjah became consequently low.

The water factor in rice production.

The utmost importance of water in the production of rice is clearly established by what has been stated above. Table 1 shows, in a general way, that by converting gogo into irrigated sawah the yield may be increased tremendously. It is interesting to mote, that the smallest increases are encountered in Sumatra and Kalimantan, while the largest one is found in Nusa Tenggara. This difference in increase coincides with the difference of wetness of the climate. Sumatra and Kalimantan are the rainiest parts ot the country, while Nusa Tenggara as a whole is the driest. The increases are for Java and Madura 1.8, for both Sumatra and Kalimantan 1.6, Sulawesi 1.8 and Nusa Tenggara 2.7 times. This may prove that water is not only indispensable for growing sawah rice, but it is also one of the essential factors that determine the yield of the rice crop.

Another aspect of water is its quality. By using poor quality water, i.e. local available water from marshes and tidal swamps, the average sawah's yields of Kalimantan is very low; it is the lowest in Indonesia. In those marshy and tidewater areas insufficient water management and poor soil condition are the other factors that keep the yield low.

Table 2 presents a similar case found in Central Java, which has been taken as an example. Since both areas are relatively small and compact the other factors that govern or may govern the grow and yield of rice can be assumed as being similar. So the differences in yield are clearly illustrating the great influence of water. The better the management of the water and the more secured of it, the higher is the yield. Here again sawah is always more productive than gogo. A rural or wild irrigated sawah can produce twice as much as gogo. The yield can still be increased by practicing moderate management, i.e. using better yielding varieties, more thorough cultivation, control of pests and diseases, and a moderate dose of nitrogen fertilization.

Table 3 shows that the yield of gadu in the subdistrict of Binong is considerably lower than that of the west monsoon (wet season) crop. This is also true for the whole regency of Subang, although less pronounced. There is practically no difference in yield between the gadu and the gogo rantjah. One more proof is given here of the inferiority of gogo to gogo rantjah and sawah. The area has a very pronounced dry season. It is situated in a low lying land with an elevation between +7 and +30 meters; thus the temperature is hot. The existing irrigation is inadequate to supply the full amount of water required by the gadu crop. Therefore its yield drops much below the level of the wet season crop. That the problem here is a water shortage it is evident from the gadu yield figures of the Bimas Project. By giving the proper care to the crop, including sufficient supply of water, the yield has been boosted 2½ times for the entire regency and almost 4 times for the subdistrict.

The significance of proper management.

Water is only one of the factors of rice production. Although it has been commonly recognized that water is fundamental for the production of rice, it should be employed in a suitable combination with the other four factors to obtain satisfactory results. In this respect it is obvious that the soil is the conditional factor.

The combined effect on rice yield of the various cultural practices brought together in a certain management scheme is clearly shown in table 4. The combination of flooding by rain water with an improved variety yields 26.3% more than gogo with good cultivation and weeding. Under flooded condition the desirable puddled soil structure has a greater opportunity to develop and the growth of weeds is suppressed. There is no difference between the second and the third figures. It appears that pests control plays a significant role. The sawahs of the Bimas Project yield the best. They received the most complete treatment.

Another case is presented in table 9. It shows the influences of fertilizers and soil interacting upon the yield of full-technical irrigated sawah. The table 5, 6, 7, and 8 are intended to show the influence of the factors other than water. The figures listed in the "not-manured" column of each table were calculated from yield data of not-manured and not-injured plots. It has been assumed by HAUSER and SADIKIN(1) that they may be used as soil productivity indices. The yield increase by manuring in the four areas ranges from 8.4% to 23.5%, but mostly less than 10%. By the

Bimas Project the rate of increase became 105% to 179% and mostly well above 150%. These were dued to commercial fertilizers and planting better varieties. The increasing use of better varieties is illustrated by table 10. There has been also a shift in the main variety planted. Reports coming in from several parts of the country indicate that there is a relationship of the producing capacity of a variety to the soil condition. An example is given in table 13. Others can be found in the previously cited article of HAUSER and SADIKIN. This is certainly not an unexpected fact.

The influence of the soil on rice production.

That the soil has a considerable influence upon the yield of crops has since long been recognized. Sawah rice makes no exception to this. The influence is direct as well as indirect; the latter by interacting with the management practices. This is substantiated by the data in the tables 9, 11 and 12. From these cases it is evident that the alluvial soils are the best. In fact, these soils are the main sawah soils, especially in Java and Madura. Additional factors which make these soils particularly suitable for sawahs are the flatness of the relief and the easeness of the water management.

A part of the regosols, i.e. derived from volcanic ash and tuff, are also much used for sawahs. They have a large extension in Java and Sumatra. Less sawahs are found on latosols because these soils are particularly suitable for perennial crops, such as rubber, tea, coffee, cocoa, clove, pepper, oil palm and various kind of fruit. Grumusols and red-yellow mediterranean soils are also used for sawahs, but the extent is limited depending on the possibilities of irrigation. As the climate of both soil regions has a pronounced dry season, gogo and rain fed sawahs are restricted within the wet season and within areas which are locally moist or wet. Sawahs on organosols are mainly found in Kalimantan. Due to the low fertility, acid reaction, water of poor quality, and inadequate water management, the yields are low (see table 1). Some parts of the red-yellow podzolic soils are now being used for irrigated sawahs, for instance in the province of Lampong. Wiht good management (irrigation, complete and balanced fertilizing, and maintenance of organic matter) these soils can be developed to good agricultural land, including sawah.

Conspectus and epilogue.

The possibilities to increasing the yield of the existing sawahs are still great. To this end all cultural factors that govern the yield of rice should be developed simultaneously in order to reach an optimum and balanced level. It is of primary importance to know first how the proportional status of the various factors are now and to rank them according to their degree of influence on the yield of rice. All these data should be obtained for each region separately, whether it is a cultural or a natural unit, whatever the appropriate case may be.

Without any exception water is the first factor to be considered. The next is the soil factor. Soils control to a large extent the suit-ability of a variety for a certain region. The most adaptable scheme of soil management is obviously governed by the kind of soil, although when a point is reached which is close to the optimum level of response, it will be conditioned by the social and economic factors of the region. The third is the variety which has to be chosen or selected, or aspecially bred, to meet the specificities of the environment (climate and soil) where it will be grown. Fertilizers come next to variety. Without a variety which shows a high response to fertilizing, the use of fertilizers is absurd. On the other hand it is also ridiculous growing high yielding varieties without giving the proper attention to fertilizers. So far diseases of rice have never been reported as being serious. Pests are by far more important. In some areas they can take such a magnitude that yields are cut down almost to nothing. There are on the contrary areas where the degree of attack is so low that one can hardly speak of a pest. Hence, there is no general rule to rank pests. They should be evaluated area by area. Table 6 shows a case wherein pest is a serious problem.

A good few of the irrigation works in Java are today in a state of deterioration. Some of them were even totally broken down. Thousands of hectares of sawahs which formerly were full-technical irrigated ones are now resembling wild or rural irrigated, or even rain fed sawahs. The benefit of having new contracted irrigation works to enlarge the sawah land and to increase the frequency of planting sawah rice is in danger to be nullified unless the rehabilitation are carried through without delay.

Based on fertility, relief, and irrigability alluvial soils (the hydromorphic alluvials may be included) are graded as the best for sawah. In addition, their accessibility makes these soils fit for agricultural development. It is true that the fertility of alluvial soils are variable, depending on the source of the alluvium. Whatever the fertility status of these soils are, however, it is in a general way higher than that of the soils of the hinterland. Most of the alluvial soils of Indonesia are fertile though, ranging from moderately to highly. Those of Kalimantan are may be the least fertile. Another problem is that many of them are susceptible to floods. So for those areas flood control measurements should be an essential part of the operational plan. Enough experiences had been gained already in Java in using alluvial soils for sawah. From the various points of view mentioned above it is reasonable to turn our attention first to these soils whenever an agricultural extensification plan is to be set up. It has been estimated that Sumatra has 2,442,000 ha of alluvial soils, mostly still idle. 4,276,000 ha has been estimated for Kalimantan and 6,758,000 ha for West Irian. Sulawesi, Nusa Tenggara and Maluku together have 1,317,000 ha(2). The hydromorphic alluvial soils are not included in the figures.

Facts have shown (table 13) that the improved varieties released by the Department of Agriculture are not invariably superior/variety will be able to maintain its superiority regardless of soil and climatic conditions. What is needed to increase rice production is that for each important locality or region an improved variety be available which is adapted to the natural conditions of that area. Thus breeding activities should be distributed among all important sawah areas throughout the country. Indiscriminating extension of so-called improved varieties can not be justified.

Similarly it also holds truth for fertilizers. Fertilization schemes which are established on the basis of administrative units, as have been and still be done in the Bimas project, are absurd.

Better utilization of the potential productivity of the soil means better planning and programming, There is an urgent need for a comprehensive plan in agriculture. The policy and scope should be clear and realistic. It has to be based on factual informations obtained by sound methods from reliable sources. All the data should be compiled, processed, and interpreted by a team of experts consisting of agriculturists, soil scientists, economists, irrigation specialists, and statisticians. A plan that has been made to meet a problem that just happen to show up at a time cannot be considered as a plan to develop agriculture.

/ to the so-called local ones. It is out of the question that a superior

Table 1. Acreage and distribution of rice fields in Indonesia and the average yields (1960).

Island or group of islands	Planted acreage (x 1000 ha)			Average yield of field dry stalk paddy (q/ha)[2]	
	Gogo[1]	Gogo rantjah[1]	Irrigated sawah	Irrigated sawah and gogo rantjah	Gogo
Java and Madura	329	714	3483	23	13
Sumatra	518	935[3]		30	19
Kalimantan	256	384[3]		19	12
Sulawesi	102	435[3]		24	13
Maluku and West Irian	4	-		-	11
Nusa Tenggara	157	322[3]		30	11
Indonesia	1366	6273		24[4]	15[4]

Source : Statistical Pocketbook of Indonesia 1961.

1) Estimated from harvested acreage using the average percentage of harvested to planted acreage of 95.4% of Java and Madura for the three types of cultivation, within the periods of 1931 - 1940, 1950 - 1959 and 1960.

2) Calculated from total production and harvested acreage.

3) No separate figures available for gogo rantjah and irrigated sawah.

4) Weighted mean.

Table 2. Influence of water on rice yield in the subdistrict of Bantarbolang (regency of Pemalang) and the subdistrict of Tulis (regency of Batang), Central Java.

Ketjamatan (Subdistrict)	Desa (Village)	Type of rice growing	Yield of field - dry stalk paddy (q/ha)
Bantarbolang	Wonoroto	Full-technical irrigated sawah [1]	26 [2]
	Pedagung	Semi-technical irrigated sawah [1]	15 [2]
	Purono	Rural or wild irrigated sawah	12 [2]
	Suru	Rain fed sawah	9 [2]
	Kuto	Permanent gogo	5 [2]
Tulis	Net specified	Full-technical irrigated + moderate management [3]	25 - 30 [4]
		Full-technical irrigated sawah	18 - 25 [4]
		Semi technical irrigated sawah	15 - 17 [4]
		Rural or wild irrigated sawah	12 - 15 [4]
		Rain fed sawah	8 - 12 [4]
		Permanent gogo	5 - 10 [4]

see page 132

Source : Government Farm Agriculture Service of Pemalang and Batang, respectively.

1. Upper Tjomal Irrigation Works.
2. Averages from sample plots of farmer's lands taken in 1967.
3. Bimas Project.
4. General ranges for the whole subdistrict.

The sampling areas of Bantarbolang have an elevation between + 100 m and + 300 m. The climate is between B and C (Schmidt and Ferguson). The soil is an association of brown and dark reddish brown latosol and brown regosol from intermediary volcanic tuffs. That of Tulis has an elevation ranging from +3 m to about +150 m. The climate is about B. The soils in the low land are dark grey and yellowish grey alluvial soils from clayey sediments. Yellowish red and dark reddish brown latosols are found in the low as well as in the higher lying lands.

Table 3. Relationships of rice yield to available water and management in the subdistrict of Binong, regency of Subang, West Java.

Desa (Village)	Av. yield field-dry stalk paddy of non-Bimas (q/ha) 1)		Av. yield field-dry stalk paddy of gadu crop of Bimas Project 1967 (q/ha) 2)	Av. yield field-dry stalk paddy of non-Bimas of whole regency, 1962 - 1967 (q/ha) 2)			
	Wet season crop 1966/1967	Gadu crop 1967		Wet season crop	Gadu crop	Gogo	Gogo rantjah
Binong	45	20					
Rantjaudik	50	23					
Tambakdahan	50	20					
Bodjongkeding	39	18					
Mariuk	45	19					
Kediri	42	20					
Tjitjadas	35	20					
Kihiang	35	17					
Tandjungsari	45	19					
Av. of subdistrict	42.9	19.6	78.5 (from 1130 ha)				
Averages of whole regency			59.3 (from 23,479 ha)	30.5	23.9	23.3	15.2

Source : 1) Agro-Economic Survey, Djatiluhur Project, 1967 - 1968.
2) Government Farm Agriculture Service of Subang.

See page 134

According to the classification of Schmidt and Ferguson the climatic type of the area is D. The elevation of the villages are, in the order of Binong to Tandjungsari, +22 m, +7 m, +11 m, +15 m, +10 m, +19 m, +30 m, +23 m and +25 m, respectively.

The soils are : an association of yellow podsolic and grey hydromorphic from acid sediments (Binong, Tjitjadas and Kihiang), an association of grey alluvial and low humic gley from recent clayey sediments (Kantjaudik, Tambakdahan, Mariuk and Kediri; a brown regosol from intermediary volcanic ash is also found in the first village), and grey alluvial from clayey river sediments (Bodjongkedjing and Tandjungsari).

Table 4. Influence of technical management on rice yield in the subdistrict of Tondjong, regency of Brebes (Central Java).

Type of rice growing	Management	Average yield of field-dry stalk paddy (q/ha) +)
Net specified irrigated sawah	Bimas Project	66.8
Full-technical irrigated sawah	Good yielding variety, good cultivation and weeding, and fertilization	60.9
Ditto	Good yielding variety, good cultivation and weeding, mechanical pests control, and manuring	59.0
Ditto	Good yielding variety, and good cultivation and weeding	55.0
Rural or wild irrigated sawah	Ditto	41.5
Rain fed sawah	Good yielding variety	29.8
Permanent gogo	Good cultivation and weeding	23.6

Source : Government Farm Agriculture Service of Brebes.

+) All figures are averages from the years 1963 to 1967, except the first (1965 to 1967) and the sixth (1964 to 1967).

The altitude of the area is around +170 meters. The climate is C. The soil is an association of brown and dark reddish brown latosol and grey regosol derived from intermediary volcanic tuffs, ashes and sands.

Table 5. Relationship of rice yield to management in the regency of Purwodadi-Grobogan, Central Java.

Ketjamatan (Subdistrict)	Desa (Village)	Av. yield field-dry stalk paddy of rain fed sawahs (q/ha) 1)		Av. yield field-dry stalk paddy of unspecified sawahs (q/ha) 2)	
		Non-Bimas before 1966	Bimas 1966 3)	Not manured 4)	Manured 5)
Gejer	Ledokdawan	31	56	19	20
Toroh	Karanganhardjo	35	60	18	23
Purwodadi	Genuksuran	24	49	17	25
Kuwu	Tandjungsari	29	70	23	22
Grobogan	Tanggunghardjo	28	57	28	25
Brati	Karangsari	29	38	25	26
Tawanghardjo	Plosoredjo	30	50	24	27
Penawangan	Watupawon	45	50	25	26
ditto	Kramat	55	70	25	26
Klambu	Selodjari	46	81	23	26
Average of the area		35.2	58.1	22.7	24.6

Source : 1) Bimas Project Report 1966. 2) Hauser and Sadikin, Contr. Gen. Agr. Res. Sta. Bogor, No. 144, 1956.

3) Fertilizers : 1 q ds + 0,75 q urea per ha, except for Kramat and Selodjari (without urea).

4) Estimated from figures of the district where the respective subdistrict belongs to, which are relevant for the main soils of the subdistrict.

5) Ditto of the whole region, i.e. the Rembang Hills and Adjacent Plains.

See page 137.

The altitude of the area is between +10 m to +55 m. It climate is C. The soil consists of grey regosol and dark grey grumosol from limestone and marl, grey and dark grey grumusol from clayey sediments, greyish brown and yellowish grey grumosol from soft marl, grey, greyish brown and dark greyish brown alluvial from clayey and sandy sediments, and some reddish brown mediterranean and lithosol from limestone and marl.

<u>Table 6.</u> Relationship of rice yield to management in the subdistrict of Dempet regency of Demak, Central Java.

Ketjamatan (Subdistrict)	Desa (Village)	Av.yield field-dry stalk paddy of full-technical irrigated sawahs (q/ha) 1)		Av.yield field-dry stalk paddy of not-manured unspecified sawahs (q/ha) 2)	Natural features of the area
		Non-Bimas before 1966	Bimas 1966 3)		
Dempet	Midjen	38	64		The altitude is about ±15 meters. The climate is D. The soil is a dark grey grumusol from clayey sediments.
	Mangunan Lor	37	65		
	D i t t o 4)	30	33		
	Megotan 4)	24	28		
	Kunir	40	89		
Average of the area, not injured		38.3	72.7	28	
Average of injured sawahs		27	30.5	–	

<u>Source</u> : 1) Bimas Project Report 1966.

2) Hauser and Sadikin, Contr. Gen. Agr. Res. Sta. Bogor, No. 144, 1956. Estimated from figures of the district where Dempet belongs to, which are relevantb for the main soil of the subdistrict.

3) Fertilizers : mostly 0,5 q ds + 1 q urea per ha.

4) Not protected against the pest Tryporyza incertulas, which is a common pest in this area.

Table 7. Relationship of rice yield to management in the regency of Sleman, Special Territory of Jogjakarta.

...tjamatan (...bdistrict)	Desa (Village)	Av. yield field-dry stalk paddy of rural irrigated sawahs 1) (q/ha): Non-Bimas, before 1966	Av. yield field-dry stalk paddy of rural irrigated sawahs 1) (q/ha): Bimas 1966 3)	Av. yield field-dry stalk paddy of unspecified sawahs 2) (q/ha): Not manured 4)	Av. yield field-dry stalk paddy of unspecified sawahs 2) (q/ha): Manured 5)	Natural features of the area
...i +190 m±	Sumberadi	55.80	73.10	26,5	31,9	The climate of the area is C. The soils are brown and grey regosols from intermediary volcanic ash and sand.
	Tirtoadi	50.20	71.94			
	Sinduadi	69.25	72.90			
	Sendangadi	48.24	60.60			
...an +240 m±	Tridadi	44.00	69.32	24.1	30.0	
	Trimuljo	49.20	56.00			
...el +330 m±	Pondokardjo	55.20	70.99	24.1	30.0	
...lik +380 m±	Sardonohardjo	36.00	86.00	24.1	30.0	
	Sarihardjo		73.95			
	ditto		66.25			
...age of area		50.99	70.11	24.7	30.5	

...ce: 1) Bimas project Report 1966. 2) Hauser and Sadikin, Contr.Gen. Agr. Res. Sta. Bogor, No. 144, 1956.

3) Moderate rate of application of ds and urea, i.e. about 1 q per ha of each.

4) Estimated from figures of the districts where the subdistricts belong to, which are relevant for the main soils of the subdistricts.

5) Ditto of the whole region, i.e. the Special Territory of Jogjakarta.

Table 8. Relationship of rice yield to management in the subdistrict of Ketandan, regency of Klaten, Central Java.

Desa (Village)	Av. yield field-dry stalk paddy of mostly semi-and full technical irrigated sawahs (q/ha) 1)		Av. yield field-dry stalk paddy of unspecified sawahs (q/ha) 2)		Natural features of the area
	Non-Bimas before 1966	Bimas 1966 3)	Not manured 4)	Manured 5)	
Ngawan	53	62			The area has an elevation of around +190 m. The climate is C. The soil is a grey regosol from intermediary volcanic ash and sand.
Senden	40	44			
Pepe	52	62			
Mandjungan	45	65			
Gatak	53	78			
Sekarsuto	44	61			
Djebugan	56	76			
Kewaren	53	60			
Tempursari	43	61			
Tjandiredjo	40	59			
Average of subdistrict	47.9	62.8	30.6	33.3	

Source : 1) Bimas Project Report 1966. 2) Hauser and Sadikin, Contr. Cen. Agr. Res. Sta. Bogor, No. 144, 1956.

3) Fertilizer : 1 q/ha urea; in Ngawan and Senden ds were also applied at a rate of about 1 q/ha.

4) Estimated similarly as for the other preceding tables.

5) Ditto.

Table 9. Relationships of the yield of Remadja to fertilizers and soil in the regency of Tegal, Central Java 1)

Ketjamatan (Subdistrict)	Desa (Village)	Altitude meters	Soil	Av. yield field-dry stalk paddy of full-techn. irrigated sawahs (q/ha)	
				Fertilizers applied as Bimas	Application rate less than Bimas
Kedungbanteng	Tanggara	+ 35 ±	Assoc. of yellowish grey grumusol and grey regosol from marl.	35.00	-
Kramat	Kemuning	below +10	Bark grey alluvial from clayey and sandy sediments.	-	25.00
	Tandjung-hardjo	ditto	ditto	-	35.25
	Madjasem	ditto	ditto	43.50	-
	Kemantren	ditto	ditto	43.75	-
	Bongkok	ditto	ditto	45.25	-
Average of Bimas of Kramat				44.17	-
Average of non-Bimas of Kramat				-	30.13

Source : 1) Government Farm Agriculture Service of Tegal.

Note : Remadja is the name of an improved variety of sawah rice. The recommended rate of fertilizer application in the Bimas Project is 1 q/ha urea + 0.5 q/ha ds. Less than Bimas generally means only urea, or urea + lower quantity of ds, or lower quantities of both urea and ds.

Table 10. Percentages of improved varieties planted in some areas of Central Java

Area	Within the period 1950 to 1954 included 1)				Bimas Project 1966 2)			
	Av.% of improved varieties planted	Improved variety mostly planted	Number of improved varieties	Number of local varieties	Av. % of improved varieties planted	Improved variety mostly planted	Number of improved varieties	Number of local varieties planted
Regency of Purwodadi-Grobogan	30.0	Bengawan	5	9	30 ± 30 ±	Bengawan Gembiro 3)	1	more than three
Subdistrict of Dempet	48.5	Brondol Putih	7	18	100	Sinta 4)	1	none
Regency of Sleman	81.3	Tjina (Hoing)	2	3	23 ± 77 ±	Sinta 4) Thomas and Gembiro 3)	3	2
Subdistrict of Ketandan	42.3	Bengawan	2	7	92 ±	Sigadis 4)	2	1

1) Estimated from the data of the distribution of varieties on each type of soil within the areas, available in Hauser and Sadikin (loc.cit). They were obtained separately for each area by dividing the total frequency of the improved varieties planted by the total frequency of all varieties planted.

2) Estimated from total acreage planted to improved varieties in the Bimas Project of the area divided by the total acreage of the same area.

3) Local varieties which yield better under the local condition of the area then the improved one.

see page 143

4) Have higher response to fertilization than the former improved variety. In the Bimas area of Sleman only about 3% of the area has now been planted to the variety Tjina which was mainly dued to its unfavourable characteristic in relation to fertilization (lodging).

Table 11. The influence of soil condition upon rice yield in the subdistrict of Binong, regency of Subang (West Java) 1)

Soil	Desa (Village)	Av. yield of sawah, field-dry stalk paddy (q/ha)		% increase from gadu to wet season crop.
		Wet season crop	Gadu crop	
Association of yellow podsolic and grey hydromorphic soils from acid sediments.	Binong, Tjitjadas and Kihiang Av.alt. +26 m.	38.3	19.0	102
Association of grey alluvial and low humic gley soils from clayey recent sediments (with an inclusion of brown regosol from intermediary volcanic ash).	Rantjaudik, Tambakdahan, Mariuk and Kediri. Av. alt. +12 m.	46.8	20.5	128
Grey alluvial soil from clayey river sediments.	Bodjongkedjing and Tandjungsari Av. alt. +20 m.	42.0	18.5	127

1) Compiled from the data of table 3.

Table 12. The influence of soil condition upon rice yield in the regency of Krawang (West Java) 1)

Soil	Ketjamatan (Subdistrict)	Fertilizer	Av. yield of gadu crop 1966, field-dry stalk paddy (q/ha).
Complex of yellowish red and yellow podzolic soils and regosol from sandstone and shale and an assoc. of red and reddish brown latosol and ground water laterite from intermediary volcanic tuff (with an inclusion of some grey hydromorphic soils from sediments). The main soil is the podzolic.	Tjikampek Alt. +48 m.	1 q/ha urea + some FMP	30.4 (from 35 plots)
Assoc. of low humic gley and grey alluvial soils from clayey sediment, grey and dark grey alluvial soils from clayey sediments (with an inclusion of yellow podzolic and grey hydromorphic soils from sediments).	Djatisari, Telagasari and Rawamerta. Range of alt. +8 - +28 m.	1 q/ha urea + some FMP	45.6 (from 362 plots)
Grey and dark grey alluvial soils from clayey sediments and some brown regosol from sandy sediments.	Tjilamaja. Alt. +6 m.	1 q/ha urea	43.2 (from 96 plots)

1) Compiled from Report on Food Project Dewi Sri Djaja.

Table 13. The yields of some improved and local varieties on different soils

Regency	Subdistrict	Village	Variety	Av. Yield field-dry stalk paddy (q/ha)
Kudus	Kaliwungu	Blimbing Kidul	(Sinta/Dara 60%) (Beton 40%)	50.2
		Sidorekso, Gamong and Karang Ampel	(Sinta/Dara 50%) (Beton 50%)	53.9
		Papringan, Kaliwungu, Kidjen, Gunung Lor and Gunung Kidul	(Sinta/Dara 40%) (Beton 60%)	51.5
		Prambatan Lor	(Beton 60%) (Rodjolele 40%)	62.0

The main soil of the area is an association of dark brown and brown mediterranean soils from intermediary volcanic tuff. Kaliwungu has a greyish brown planosol from tephritic volcanic tuff. Kidjen has an association of grey and greyish brown alluvial soils from clayey and sandy sediments.

Sleman	Mlati	Sumberadi	Gembiro) 65.89 q/ha	71.38
	Tempel	Pondokredjo	ditto)	
	Gamping	Trianggo	ditto)	
	Mlati	Tirtoadi	Tomas ....74.58 q/ha	
	Ngaglik	Sardonohardjo, Donohardjo	Tomas / Gembiro	
	Sleman	Tridadi	ditto (av. 73.67 q/ha	
	Pakem	Pakembinangun	Remadja 66.24 q/ha	73.71
	Tjangkringan	Argomuljo	Bengawan/Remadja 56.50 q/ha	
	Depok	Tjondongtjatur	Sinta/Remadja 81.35 q/ha	
	Turi	Girikerto	Sinta/Hoing 70.99 q/ha	
	Prambanan	Maduredjo	Bengawan/Sinta 93.50 q/ha	

see page 147

The soil of the whole area of Sleman is a greyish brown regosol from intermediary volcanic ash and sand.

Compiled from data of Bimas Project 1966. The % after each variety name in the regency of Kudus indicates the % acreage of sawah in the Bimas Project planted to that variety. It can be interpreted from the figures that the local varieties Leton and Rodjolele in that area were producing higher yields than the improved ones (Sinta and Dara). In the regency of Sleman the average yield of the local varieties Gembiro and Tomas was slightly lower than that of the improved ones. Sinta was the best, followed by Tomas. Gembiro stands slightly below Remadja, but better than Bengawan and may be better also than Roing.

REFERENCES

1. HAUSER and SADIKIN (1956). The Productivity of the Soils of East Central Java Based on the Yields of Sawah Rice, Part I - IV. Centr. Gen. Agr. Res. Sta. Bogor, No. 144.

2. MULJADI, D and S. ARSJAD (1967). Peranan Factor tanah dalam Perentjanaan Land Use. Paper presented at the Land Use Seminar, Djakarta.