

CHALLENGES FOR SUSTAINABLE AGRICULTURAL WATER MANAGEMENT IN INDONESIA

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ABSTRACT

Nowadays (2011) Indonesia with 240 million and uneven geographical distribution of population (Java with 7 % country area occupied by 60 % of population = 140 millions) has limited water resources and irrigation infrastructures (200 storage dam, 7.23 million Ha irrigated area) is still insufficient of food production. Annual imported food continuously increased: rice 0.5 – 2 million ton, wheat 5-7 million ton, soya bean 1.2 million ton, ground nut, cow, milk, sugar etc. Land and water resources for agriculture are continuously degraded in quantities and qualities. Due to massive deforestation, mining and large palm oil development accompanied with pollution from urban, domestic and mining; the damages to water resources ecosystem all over archipelago has reach critical condition. It is marked by: (i) increased flood and land slide disasters during rainy season, (ii) severe drought and water shortages during dry season and (iii) dirty and heavy polluted water all year round. The existing irrigation areas is decreased by conversion to urban, real & industrial estate areas, highway, railroad, airfield etc. In outer Java the utilization of dry land suitable for irrigated agriculture, originated from deforestation compete against user for palm oil and rubber plantations.

What will occur in the next 20 to 40 years from now, if there is no drastic change of the Land and Water Resources Management policy and practices as mention above, all together with still high and uneven population growth and urbanization? Certainly Indonesia will face two (2) big clusters of challenges in order to achieve sustainable water management namely: (1) the guarantee of sustainable water availability for food agriculture (70 – 80 % requirements) and for domestic, urban, industry and energy; and (2) the guarantee of sustainable irrigated agriculture land management with the areas and location sufficient and in harmony with future requirement. The aim of the paper is to answer both challenges. It will discuss the necessities of integrated natural resources management, intensification and securing existing irrigation areas, development of new irrigated agricultural areas and reformulation of national land and food policy.

1. DEGRADATION OF NATURAL RESOURCES ENVIRONMENT

In Indonesia high growth focus for economic development through large investment on natural resources extraction and infrastructures development (See Plate 1) during the last 40 years had stimulated fragmented sectors development by related agencies and private corporations added with high population growth, had resulted in intensive land use and drastic change of vegetation land cover (deforestation) in the watershed. Together with limited investment for water storage infrastructures, reforestation and land rehabilitation had impacted hydrological balance (*causes large yearly rivers discharge fluctuation*) with further consequences namely the occurrence of flood, land-slides, erosion and sediment deposition during wet season, while during dry season there were droughts, water deficits and fire of forest and land. In the developed watershed the occurrence of flood and drought was exacerbated by degraded water quality due to waste and pollution from domestic, urban and industry (See Plate 2).

Almost all over Indonesia the losses of property, agriculture, and lives due to flood and land slide disasters increase continually. Drought impact such as crop failure, cattle death, extinct of bio-diversity, decreased water availability for irrigated agriculture, DMI, and power are continually spread.

In theory the discharge or volume of flows water in the river (m³/second) all year round are the functions of three (3) main variables namely: (i) rainfall intensity, (ii) watershed condition & situation

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and (iii) river condition & situation. Rainfall variable is stochastic and beyond human control. While Watershed and River variables can be change by engineering measures intervention.

Consequently all the activities of human being and development in the watershed and rivers, depend on the coordination and engineering control may have negative or positive impact on water existence and natural resources system. Base on mutual reiterative interaction between “developments without criteria fulfillment” against “Natural / Water Resources system” it was identified seven (7) groups of complicated and heavy conflicts problems which created critical level (SOS) of damages and destruction of ecosystem of nusantara archipelago. The seven problems are described below:

- 1) *Over exploitation of non-renewable natural resources* such as: mining of mineral, oil & gas, coal, building material quarry etc. which socially and environmentally are not feasible have severely destructed natural resources system (ecosystem)
- 2) *Over exploitation of renewable natural resources* such as: forest, shifting cultivation, plantations estate, animal husbandry, fishery, biodiversity, fauna, water and land resources which socially and environmentally are not feasible have destructed the ecosystem (there are illegal logging, forest burning etc.)
- 3) *Improper Waste and Pollution management.* Unclear policy and weak management on solid waste and liquid waste (pollutants) as an unavoidable by - products of human activities and physical development has polluted rivers, lakes and reservoir and others water body. It causes degraded water quality, choked the drainage and added flood problem, and water treatment cost.
- 4) *Unbalanced infrastructures development* for houses and human settlement, urban, transportation, mining and industry spread over developed region without limit and against Spatial Plan (Java island in general and Jabodetabek region in particular); had exacerbated damages to the natural resources ecosystem
- 5) *Improper Land use policy* in term of land ownership and used permit and change. Inexistence of detail land-use prioritization. The Spatial Plan for land use mostly delayed while the local governments have a need to issue permit (concession) for estate plantation or other investor. Weak law enforcement in preventing irrigated area converted to houses, urban and industry area and for toll road, air field and harbor.
- 6) *Improper population management* in order to support sustainable development which reflected from: high population growth; excessive urbanization; migration to java island; lack of knowledge and skill training for rural peoples; and gap of the availability of development and business human resources among island, provinces and rural to urban.
- 7) *Limited development investment* for water resources, waste management, land conservation and forest rehabilitation in term of infrastructure (hardware) and human resources (software). Indonesia’s have limited infrastructures such as: storage dam 250 nos, irrigated area 7.23 million Ha, flood mitigation scheme, water supply treatment and distribution system, urban sewerage system etc. The yearly target for reforestation program: GERHAN, GN-KPA (1 million Ha) are much small compare to existing degraded / critical land (77 million Ha in 2006) and additional yearly critical watershed (around 1 million Ha)

PLATE 1. THE ROLE OF NATURAL RESOURCES AND INFRASTRUCTURES IN DEVELOPMENT

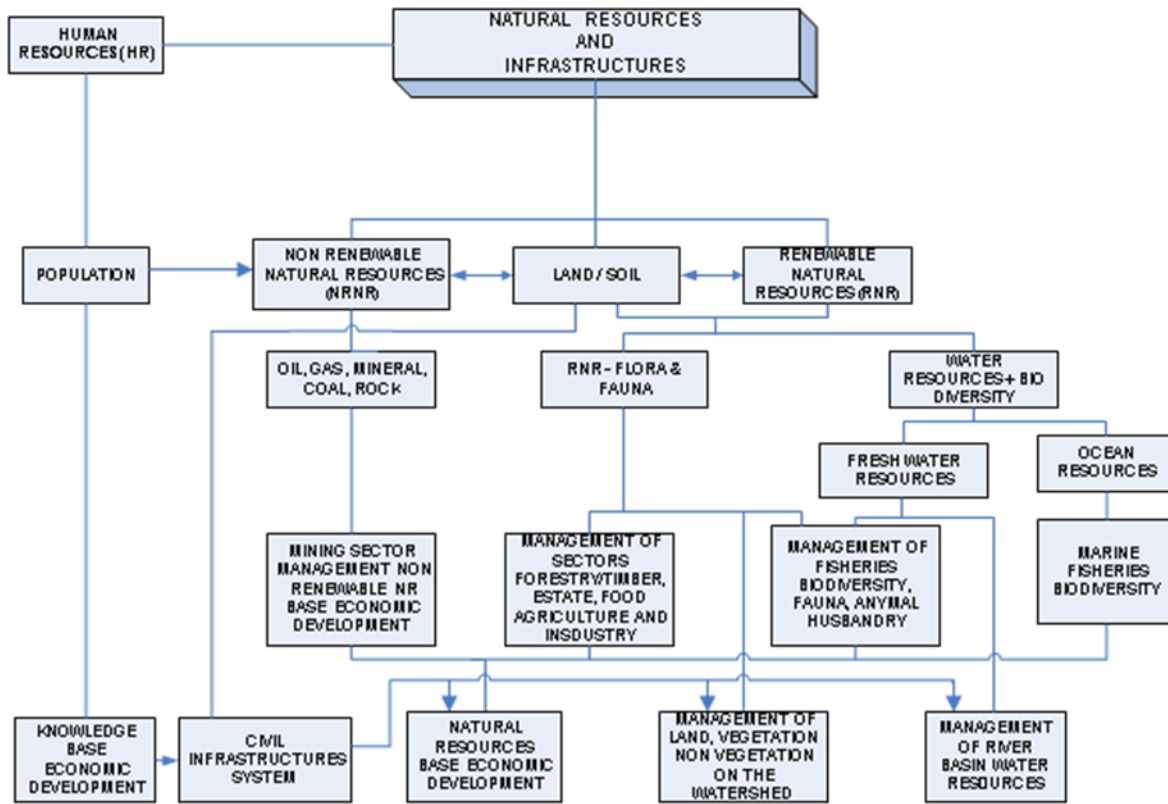
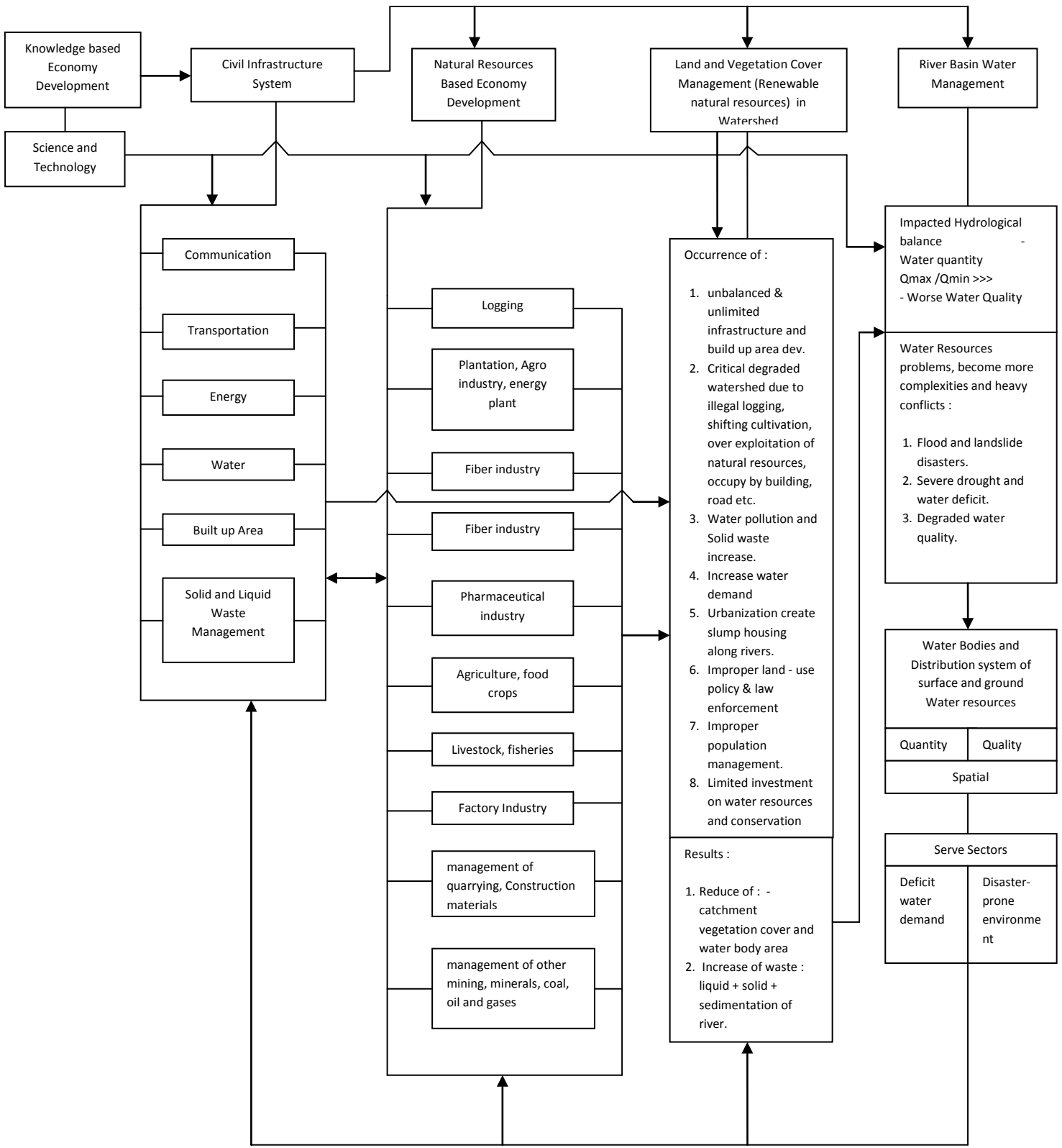


PLATE 2: Impact of Development on Water Resources



2. WATER RESOURCE INSTITUTIONAL SET UP AND IT'S MEASURES

2.1. Institutional Set Up

Who and what institutions responsible on de-gradated natural / water resources in Indonesia. First group are the institutions/agencies with mandate related to manage and preserve natural / water resources namely: (i) Ministry for National Planning and Bappenas; (ii) Ministry of Public Works a / o: DG Water Resources, DG Cipta Karya, DG Spatial Plan, National Water Council; (iii) Ministry of Forestry a / o: DG. Watershed Management; (iv) Ministry of Environment; (v) Ministry of Agriculture a / o: DG. Agriculture Infrastructure; (vi) Ministry of Energy and Mineral resources a / o Directorate Geology covers ground water.

Second group are the institutions/agencies related with sector development which impacted natural resources in general and water resources in particular namely: (i) Ministry for National Planning and Bappenas (ii) Ministry of Public Works a/o DG Highway, DG Urban Dev. / Cipta Karya; (iii) Ministry Of Transportation a/o DG. Land Transportation, DG Air Transportation and DG Sea Transportation; (iv) Ministry of Energy and Mineral Resources; (v) Ministry of Forestry a/o DG related Forestry Concession and Logging; (vi) Ministry of Agriculture a/o DG related to Plantation estate; (vii) Ministry of Home Affairs; (viii) Ministry of Industry; (ix) Ministry of Housing for People; (x) Ministry for Development of Receded Region; (xi) Ministry/Agencies related to Investment permit/license and (xii) Provincial and District/City mayor all related to infrastructure development and permit for investment and entrepreneurs.

2.2. On Going Measures

Having observed so many agencies involved in natural / water resources it is time now to look what measures have been done to overcome the problems. The complexities and conflicts are how to exercise the coordination among all related agencies and institutions so that it can be integrated and synchronize in planning, implementation, monitoring and evaluation of the management of WR, land, related natural resources and infrastructures in order to overcome river flow crisis.

In the framework of optimal development and management of resources in Indonesia the concept of integrated water resources management (IWRM) had been introduce since 1965 in Brantas river basin in east Java and Citarum river basin in West Java. Unfortunately within the last 40 years the economic development forces are stronger than regulatory and conservation measures makes the resources management tend to be inefficient, un-equity and unsustainable.

To realize integration of the above management in Indonesia nowadays, at least there are three groups of IWRM equally practice namely: 1) based on Laws related to water: Law no 7 / 2004 about Water Resources, Law no 41 / 1999 about Forestry, and Law no 32 / 2009 about Environment Protection and Management; 2) *Integrated Water Resources Management* concept from *Global Water Partnership* (GWP) and 3) Gerakan Nasional Kemitraan Penyelamatan Air (GN-KPA) translated: National Movement on Water Safeguard Partnership (NM-WSP).

Ministry of Public Works / DG Water Resources initiated IWRM through the formulation of "WRM Pattern" and "WRM Plan" (master plan) based on Water Resources Law no 7 / 2004. Ministry of Forestry proposed Integrated Watershed Management. Also Ministry for Environment has master plan for water quality management and pollution control for each river.

GWP in 2000 introduced IWRM with the definition: *"IWRM is a process which promotes the co-ordinated development and management of water, land and related resources, in order to maximize the*

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resultant economic and social welfare in an equitable manner without compromising the sustainability of vital ecosystems” For implementation IWRM translated to three pillars namely: the enabling environment, the institutional roles and the management instruments all embrace 13 change area need to be executed in WRM.

In the framework of the 13th World Water Day in 28 April 2005 the President of RI declare the National Movement on Water Safeguard Partnership, consist of six (6) components namely:

- 1) Regulation on spatial, physical development, land, and population.
- 2) Land and forest rehabilitation and water resources conservation.
- 3) Water destructive power Control.
- 4) Water quality management and pollution control
- 5) Water use saving and demand management
- 6) Water resources utilization in an equal, efficient and sustainable manner

Due to so many concepts on IWRM practiced parallel, it is apparent that to avoid inefficiency and conflict there is a must that all concepts can be combined to be only one concept adopted and followed by stakeholders

3. INTEGRATED NATURAL RESOURCES MANAGEMENT

3.1. Concept development

Water resources is one among so many elements of natural resources and it cannot stand itself separated managed since it has reiterative impact one with others. To review reiterative impacts of all development sectors against water resources (WR), there is a need to distinguish four domain / groups of management as follows (See again Plate 1):

- 1) The management of River basin water resources, domain
- 2) The management of Land, vegetation and non-vegetation on watershed, domain
- 3) The management of Economic development based on natural resources, domain
- 4) The management of Civil infrastructures system, domain.

The above four domains of managements are the objects of Spatial planning for overall development plan: at the level of national, provincial, district / city and sub-district.

To derive the proper solution concept, let's make observations on the ongoing IWRM practices. **Firstly:** The IWRM-GWP concept. IWRM definition clearly stipulated integrated management for WR, Land and Related resources (namely other natural resources and infrastructures) *in order to maximize the resultant economic and social welfare in an equitable manner without compromising the sustainability of vital ecosystems* through the process. It is apparent the definition starts from water resources expanding up to natural resources. With that argument, then the IWRM-GWP definition is more appropriate to become the definition for *Integrated Natural Resources Management (INRM)*. Eight years already the IWRM-GWP had been adopted in developing countries but the benefit still limited. It seems that the constraint in implementing IWRM-GWP is the inconsistency at the level of coordination which is only at the level of water resources while all other development sectors need to be coordinated in order to achieve maximum output are at the level of natural resources.

Secondly: National Movement on Water Safeguarding Partnership (GN-KPA = NM-WSP). Within 4 years after declaration NM-WSP has been able to integrate activities begun at national moved down to

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provincial, districts / cities, sub district and rural. Key factors for the success of NM-WSP is the level of coordination and problem solving which is not at the level of water resources but at the level of spatial regulation for natural resources and infrastructures as reflected by the six components of NM-WSP. Positive influence of the six components of NM-WSP is the atmosphere that all ministry level agencies consider themselves as formulator of NM-WSP that means they commit to support the implementation.

From the review against the two concepts: i. IWRM-GWP and ii. NM-WSP it can be concluded that NM-WSP with natural resources as the level of integrative coordination will be more successful compare to IWRM-GWP approach with water resources as the level of integrative coordination.

3.2. Frameworks for INRM – Basis for Sustainable Development

If the selection of the level of problem solving and integrative coordination is upgraded to natural resources than it is right to conclude that: the *development* must make renewable natural resources management (RNRM) which is the key for ecosystems sustainability namely: i) Land and vegetation and non-vegetation cover on the watershed; and ii) River basin water resources; together with iii) Population, as a basic guidance for long terms management of non-renewable natural resources (NRNR) and other RNR in the frameworks of the development of Natural resources base economy, with Knowledge base economy in a dynamically balance manner.

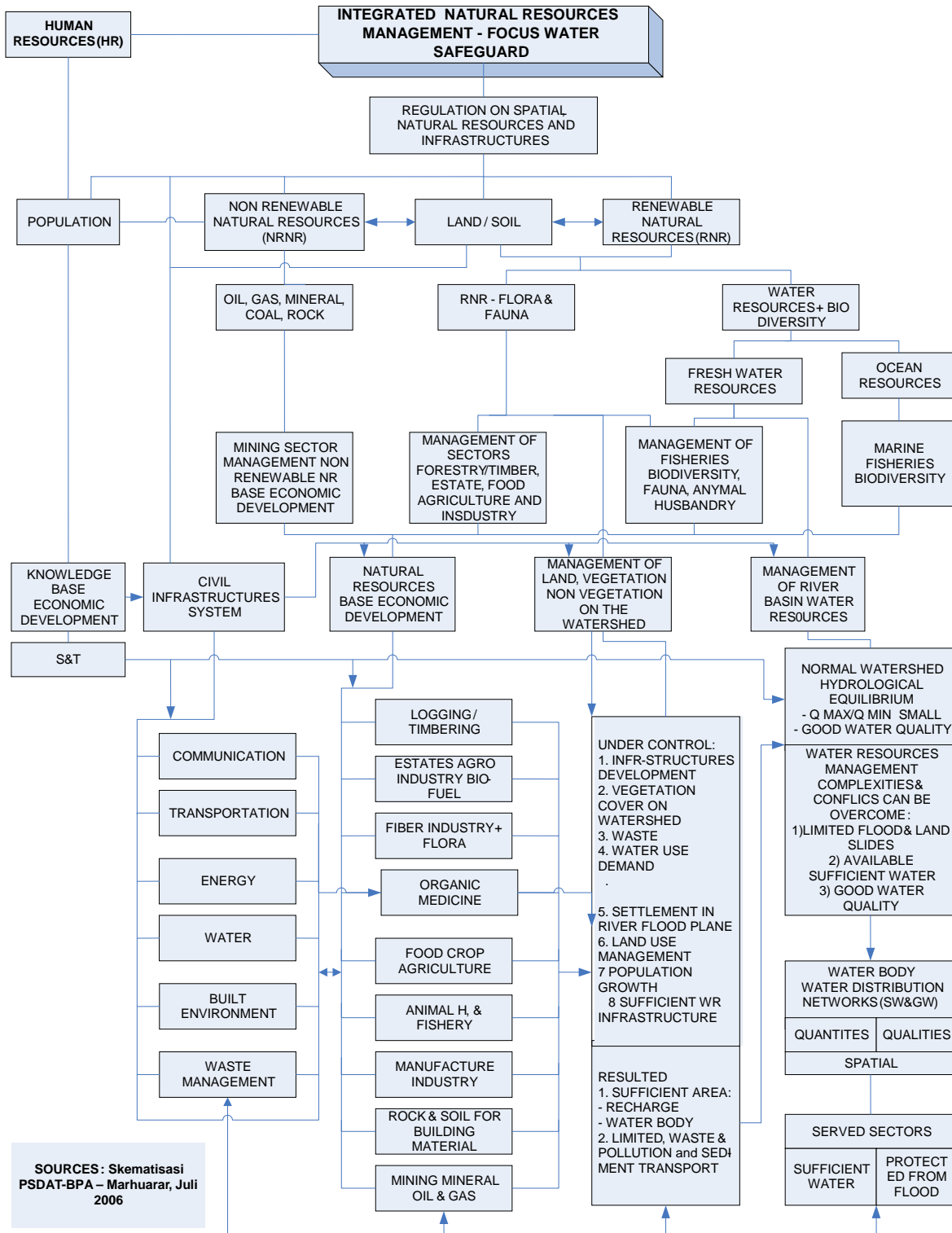
The above approach is called: *Integrated Natural Resources Management - Focus Water Safeguard (INRM-FWS)*. This concept through coordination will integrate: planning, implementation, monitoring and evaluation of performance for the four management domain above.

Now we can formulate the definition of INRM-FWS and its Plan frameworks as guidance for implementation. Considering the above explanation and definition of IWRM-GWP as reference it can be define: ***INRM-FWS is a process which promotes the co-ordinated management of (i) River basin water resources, (ii) Land, vegetation and non-vegetation on watershed, (iii) Development of natural resources base economy and (iv) Civil infrastructures system, in order to maximize the resultant economic and social welfare in an equitable manner without compromising the sustainability of vital ecosystems” (See Plate 3)***

While the INRM - FWS Plan Frameworks as guidance for implementation correspond with six components of the NM – WSP, but now is called “National Movement – Natural Resources Safeguard Partnership” (NM – NRSP) will be as follows:

- 1) *Regulation on spatial, natural resources, infrastructures, land, and population.*
- 2) *Land and forest rehabilitation and water resources conservation*
- 3) *Water destructive power and Earth movement Control.*
- 4) *Water quality management and pollution control*
- 5) *Saving of natural resources use and demand management*
- 6) *Utilization of natural resources in an equal, efficient and sustainable manner*

PLATE 3. INTEGRATED NATURAL RESOURCES MANAGEMENT – FOCUS WATER SAFEGUARD



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4. IRRIGATION AND FOOD INSTITUTIONAL SET UP AND IT'S MEASURES

4.1. The Institutional Set Up

Who and what institutions/agencies related to irrigation and food self-sufficiency? Main Agencies are: (i) Ministry for National Planning and Bappenas; (ii) Ministry of Agriculture a/o DG Food Crop, DG Agriculture Infrastructure, Agency of Food Security; (iii) Food Security Council; (iv) Ministry of Public Works a/o DG Water Resources provide Irrigation and Water Resources infrastructures; (v) Ministry of Health, (vi) Ministry of Industry related to food; (vii) Ministry for Development of Receded Region; (viii) Ministry for Home Affairs; (ix) Ministry/Agencies related to Investment permit/license and (x) Provincial and District/City mayor all related to infrastructure development and permit for investment and entrepreneurs.

4.2. The Importance of Food Availability and Balance

Recently Bayu Krisnamurthi wrote an Article with topic: "PANGAN RAKYAT SOAL HIDUP ATAU MATI 60 TAHUN KEMUDIAN". The article related to the speech of Ir. Sukarno, the first President of Indonesia with topic "SOAL HIDUP ATAU MATI" in April 27, 1952 on the occasion of foundation laying of the building of Faculty of Agriculture University of Indonesia which later on become Bogor Institute of Agriculture. In the speech Sukarno stressed the importance of providing food for peoples and he quoted it as matter of life or dead for the nation. After additional explanation about the Indonesian progress in food provision and the food deficiencies for 1000 million peoples in the world, he concluded although it is different with 60 years ago in the next decade of 21 century food availability still can be considered as a matter of life or dead for Indonesia.

To have a continuous record of Food Balance for any country (national and province / district) is required to measure the performance of the ruling government in food provision / delivery particularly and in people's welfare in general as an outcome of overall economic development policy during that period. What a pity actually that Indonesia as an agrarian and the fourth largest population in the world and with 60 percent of population is engaged in agriculture and food production is not capable in providing sufficient food for its people. Except in 1984 (rice production self-sufficiency) most of the year Indonesia is now in a *deficit food balance* with import of at least 9 (nine) food commodities. Quoted from the article "Kedaulatan Pangan & Nasib Pertanian Indonesia" by Yauri Tetanel modified with data from KOMPAS the imported food commodity by Indonesia is shown on the table as follows:

No	Commodities name	Annual import
1	rice	0.5 to 2 million ton
2	Soya bean	1.2 million ton
3	Wheat	5 – 7 million ton
4	Ground Nut	0.8 million ton
5	Green Nut	0.3 million ton
6	Dried Cassava (tapioca)	0.9 million ton
7	Cow	600 hundred thousand
8	Milk	964 hundred thousand ton(70 %)
9	Sugar, salt etc.	

4.3. On Going Measures for increasing Food production

There are two way to increase food production namely: (i) intensification of the existing irrigated and rain-fed agricultural area; (ii) Extension of new irrigated agricultural area.

4.3.1. Intensification of irrigated agriculture for rice production:

1) Production Formula

Rice (paddy) production in one year $P = \text{Irrigated paddy field area Ha (A)} \times \text{cropping intensity (CI)} \times \text{Yield / Ha}$

- Irrigated paddy field area is the sawah equip with irrigation canal for water distribution and drainage canal to evacuate excessive water. Indonesia has 7.23 million Ha irrigated sawah, consist of Irrigation scheme with three area classification related to responsibility of management: (i) Area < 1000 Ha responsibility of Kabupaten / Kota Governments around 3.492 million Ha; (ii) 1000 < Area < 3000 Ha responsibility of Provincial Governments around 1.423 million Ha ; (iii) Area > 3000 Ha responsibility of Central Government around 2.315 million Ha
- Cropping Intensity is the percentage of sawah cropped in one year (CI range 90 % - 200 %), depend on availability of water source in intake from river and efficiency of water distribution (system operation) and the availability of man / machine power. Efficiency of water distribution depends on condition of irrigation networks (canal and structures) and capacity of man power to operate the system.
- Yield / Ha is the productivity of one Ha / crop = ton paddy / Ha, depend on land tenure, crop water application and agriculture input (Yield range Java 4 – 6 ton; off Java 2.5 – 4.5 ton).

2) Constrain in increasing rice production

From the above production formula anybody may derive constraint in increasing rice production as follows:

- Unreliable water availability during dry season Out of 7.23 million Ha irrigated area less than 0.9 million Ha equip with water storage (CI = 200 %), the rest are river runoff irrigation area. And it is apparent nowadays the dependable flow is decreased drastically due to change of land cover by deforestation of the watershed (CI < 150 %).
- Low overall irrigation water distribution efficiency: Irrigation Efficiency < 50 % due to canals and structures deterioration (high system losses), and Inefficient water use at farm level due to the absent of irrigation service fee.
- Low yield / Ha especially outer Java due to lack of skill of the farmer, low farm input because of poor farmer condition or tenant system and fertilizer falsification, small land ownership or just tenant (buruh tani)
- Non-existence of irrigation service fee benefited the land lord with ownership more than 2 Ha (free rider)
- Converted irrigated area to become real estate, urban area, industrial estate, palm oil, air-field etc. (yearly conversion > 50.000 Ha)
- Deficiency of Existing Role Sharing of Irrigated Agriculture Management

Table 1. Irrigation Management Responsibility according to Law No 7/2004

Irrigation Authority	Area/Responsible	Central Government	Provincial Government	Kabupaten/Kota Government	Farmer / WUA / Gabungan WUA
Area < 1000 Ha (3.491 M. Ha)	1. Farm System	-	-	Budged / Impl-tor B + I	No ISF WUA at Tertiary Gabungan WUA
	2. BQ+Q+Tert. Canal	-	-	B + I	Gabungan WUA
	3. Sec. + Prim. Canal	-	-	B + I	Gabungan WUA
1000 < A < 3000 Ha (1.423 M.Ha)	1. Farm System	-	Budged / Impl-tor B + I	-	No ISF WUA at Tertiary Gabungan WUA
	2. BQ+Q+Tert. Canal	-	B + I	-	Gabungan WUA
	3. Sec. Canal for Area < 1000 Ha	-	B + I	-	Gabungan WUA
	4. Sec. Canal for 1000 Ha < Area < 3000 Ha	-	B + I	-	Fed. WUA
Area > 3000 Ha (2.315 M. Ha)	1. Farm System	Budged / Impl-tor B + I	-	-	No ISF WUA at Tertiary GWUA
	2. BQ+Q+Tert. Canal	B + I	-	-	GWUA
	3. Sec. Canal for Area < 1000 Ha	B + I	-	-	GWUA
	4. Sec. Canal for 1000 Ha < Area < 3000 Ha	B + I	-	-	Fed. WUA
	5. Sec. Canal and Primary Canal for Area > 3000 Ha	B + I	-	-	Fed. WUA

The above Table 1, shows that for irrigated area larger than 1000 Ha (national and provincial irrigation scheme) the Kabupaten / Kota agency has no formal / regulated responsibility. Meanwhile the farmers are actually under the direct guidance of the lowest government system namely Kabupaten / Kota local government. The Central and Provincial government may guide the farmers but indirectly (through the Kabupaten / Kota agency). It can be said that clear role sharing for the management of all irrigation scheme with service area > 1000 Ha are absent, consequently if there are crop failure the three level of government blame each other.

3) On Going Program consist of (i) Operation & Maintenance and (ii) Rehabilitation and Upgrading.

4.3.2. Extension of new irrigated agricultural area

For extension program of 2010 – 2014, DG Water Resources had identified about 594.000 Ha land potential all over Indonesia as candidate for new irrigation development.

5. FUTURE MANAGEMENT OF IRRIGATED AGRICULTURE LAND FOR FOOD SECURITY / AUTONOMY

5.1. The Need of Comprehensive Food Policy

For almost 60 years post-independence begun by Sukarno followed by Suharto, Habib, A Wahid up to Megawati; Indonesia's food policy is similar e.g. swasembada beras (rice self-sufficiency). The history has proof that rice self-sufficiency mostly unachieved except only one year in 1985 during Suharto period. In 1996, before the end of Suharto period, GOI issued "Law No 7 / 1996 about FOOD". Base on this FOOD Law, starting 2004 – 2011, S. Bambang Yudoyono (SBY) introduced the policy of "agriculture revitalization" to increase agriculture revenue for GDP through development of agribusiness to absorb man power including self-sufficiency for rice, corn and soya bean. It is a pity that now Indonesia food balance showed large imported food commodity. Highly dependable of food security from others countries is the sign that Indonesia enters "Food Trap" (Kompas July 1, 2008)

To avoid this food trap and if food availability is a matter of life or dead of the nation still relevant for Indonesia then a comprehensive and clear long term food policy need to be reformulated as soon as possible base on the revise Law about FOOD which is now in process by Parliament. Comprehensive means it has considered: all of food commodities, food diversification, food quantity & quality, infrastructures and location of production, betterment of farmer / producer and how it arrive to the consumer with affordable price and others related aspects for the next 30 to 50 years (China has rice policy for the next 50 years). Long term vision for food must be combination of self-sufficiency, security, autonomy and sovereignty similar to USA, Canada and Australia. One of a very serious dilemma is future policy on wheat requirement; if consumption trend continue as of now then in 2025 imported wheat will be 18.679 million ton (Kompas July 1, 2008). To balance the future wheat import (in term of foreign exchange) then the future rice production must have surplus of at least 12 million ton ready for export in 2025 on top of the rice requirement in that year. It is a big jump of production capability which required radical measures to realize it.

In the context of sustainable Agriculture Water Management in supporting the need for intensification of the existing area and extension of new irrigated land in order to meet future rice demand; it is apparent that a proper food policy is a must as a basis for formulation of a sound long term irrigation development program. Of course it is understandable that proper long term food policy can't be formulated separated. It must be based on long term macro-economic development policy of the country. Ones the revise FOOD Law is issued the government can formulate new comprehensive food policy supported by (i) macro policy where the economy and politic is pro agriculture and farmer; (ii) clear direction toward autonomy for agriculture research and education; (iii) Bureaucracy Reformation and (iv) Strong commitment and leadership (IRHAM, KOMPAS Sept 16, 2008).

5.2. Long Term Irrigation Development (for next 20 or 30 year)

5.2.1. Program clustering

Depend on Food Policy whether: Food Security or Food Autonomy or Food Sovereign, the required long term irrigation program can be divided into two clusters:

- (1) Program for maintaining, safeguarding and utilization of the existing Irrigation Schemes (intensification to increase CI and Yield/Ha) consist of: (i) Annual Operation and Maintenance program, (ii) Periodical Rehabilitation and Upgrading program, (iii)

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Agriculture Input program, (iv) Safeguarding of sawah from conversion and (v) Water resources development and conservation to maintain and improve water availability in rivers,

(2) Program for New Irrigation Development (extension) to cope with food requirement for population growth (1.4 % annually) and the income improvement. For the long term extension or development of new irrigated area several constrains area apparent in the field namely:

- Limited availability of land resources, - competition with palm oil estate and rubber plantation this need conversion of forest land for irrigated agriculture. Less land fertility in outer Java, one Ha loss in Java needed 2 to 3 Ha outer Java.
- Limited availability of water resources due to degraded watershed, required water resources (storage) development and conservation.
- Development of new extension area outer Java have less man power and skill of the population as farmer, this condition need mechanized and possibility of commercial farm with ownership of irrigated land area of 10 ha to 40 ha / farm (one up to 4 Quarter-nary plot).
- To facilitate bigger ownership of sawah plot (2 ha) and future establishment of commercial farming of 10 ha to 40 ha, there is a need a policy for land redistribution and allocation
- The mechanized food estate development by big investor as proposed in Merauke region may be complementary solution if all the infrastructures facilities provide by the investor not by APBN (equitable use of natural resources).

5.2.2. Formulation of Irrigation Development Program for 2040

In relation with long term support for increasing rice production through irrigation rehabilitation, upgrading and development program; the Ministry of Public Works under DG Water Resources had initiated two comprehensive studies e.g. (i) Formulation of Irrigation Development Program (FIDP) in 1994, JICA TA and (ii) Assessment of Option For Sustainable Irrigation Development in Indonesia in 1998, ADB TA 2679 INO.

(a) The JICA – FIDP team had done several basic studies includes:

- (i) Land and water potential study to estimate the irrigation development potential by region (Sumatera, Java, Bali & NT, Kalimantan, Sulawesi, Maluku & Irian Jaya and total Indonesia in 1990 available 10.944 million Ha);
- (ii) Projection of future supply and demand balance of paddy by region without new development, some 9 million ton of paddy will be deficit to meet the demand in 2020;
- (iii) The strategy to meet 2020 demand by having macro zoning of Indonesia for Formulation of Irrigation Development Program. In Table 2, below, zone 1 and zone 2 area judged to have large potential for development. Main target development area will therefore be Sumatera island. The flow of marketed Paddy by DOLOG as of 1991 rice surplus of Java send to outer Java from Surabaya. The projected flow of rice surplus for 2020 will be from Sumatera and South Sulawesi sent to Java through Jakarta harbor.

- (iv) Irrigation development scenario divided to three phases: Phase I, Trend development (1994 – 2000); Phase II, Trend and New development (2000 – 2011); Phase III, New development (2011-2020)

Table 2. Macro zoning for formulation of irrigation development program

Zone	Productivity	Future Deficit	Development Potential	Human Resources	Infrastructure	Evaluation
Zone 1, Northern Sumatera	High	Deficit	Big	Moderate	Moderate	Full Development
Zone 2 Southern Sumatera	Moderate	Deficit	Big	Moderate	Moderate	Full Development
Zone 3 Java and Bali	Very High	Deficit	none	High	High	Rehabilitation
Zone 4 Kalimantan	Low	Deficit	Big	Scarce	Scarce	Limited Development
Zone 5 Suluwesi	High	Surplus	Small	Moderate	Moderate	Limited Development & Rehabilitation
Zone 6 Maluku and Irian Jaya	Low	Deficit	Big	Scarce	Scarce	Limited Development

(b) The ADB TA 2679 INO Assessment of Option for Sustainable Irrigation Development in Indonesia had done several studies among others:

- (i) Simulation model for rice consumption for 25 years (1995-2020) based on population growth projection and per capita rice consumption.
- (ii) Determine the need for increased irrigation system development over 25 years, using production model based on yield and cropping intensity assumptions.
- (iii) They did Estimation of Changes in Land Area in Java and Irrigation Expansion Off-Java under Different Consumption, Yield and Cropping; and with 5 assumptions for Yield Cropping Intensity growth they showed Average Annual Balance for 5 and 25 year Time Frame (from table 2 of the Succinct Report herewith quoted only the 25 years result as shown in Table 3 below).

It is recommended that both studies of JICA – 1994 and ADB – 1998 need updating or restudy by Special Inter Agency Task Force to produce an up to date Formulation for Future Irrigation Development Program.

Table 3: Estimation of Changes in Land Area in Java and Irrigation Expansions Off-Java Under Different Consumption, Yield and Cropping Intensity Growth Rates.

Scenario	Annual Land Area Additions & Subtractions (ha)		Average Annual Rice Balance for 25 Years Time Frame ('000 tons)				
			Constant Yield and constant CI growth rates ¹	Incremental yield and constant CI growth rates ²	Stagnant yield and constant CI growth rates ³	Constant yield and slowing CI growth rates ⁴	Consumption demand decline, constant yield, slowing CI growth rates ⁵
	Java	Off-Java	25 Yrs	25 Yrs	25 Yrs	25 Yrs	25 Yrs
Base	-20,000	0	-26003				
Scen. 1	-12,500	0	-1842				
Scen. 2	0	0	-549				
Scen. 3	-20,000	50,000	-351	1300	-3045		-760
Scen. 4	-12,500	50,000	410	2111	-2317		-46
Scen. 5	0	50,000	1673	3458	-1107		1140
Scen. 6	-20,000	60,000	100	1757	-2645	-1421	-315
Scen. 7	-12,500	60,000	861	2568	-1916	-707	400
Scen. 8	0	60,000	2124	3915	-707	479	1585
Scen. 9	-20,000	70,000	550	2214		-976	131
Scen. 10	-12,500	70,000	1311	3025		-261	845
Scen. 11	0	70,000	1311	4373		924	2030
Scen. 12	-20,000	80,000				-630	
Scen. 13	-12,500	80,000				184	
Scen. 14	0	80,000				1370	

¹Constant yield growth rates (Java 0,36% & Off-Java 0.96); constant CI growth rates (Java 0.76 % & Off-Java 0.68 %)

²Increased yield growth rates (Java 0,6% & Off-Java 0.96); constant CI growth rates (Java 0.76 % & Off-Java 0.68 %)

³Stagnant yield growth rates (Java 0,0% & Off-Java 0.0); constant CI growth rates (Java 0.76 % & Off-Java 0.68 %)

⁴Constant yield growth rates (Java 0,36% & Off-Java 0.96); slowing CI growth rates (Java 0.5 % & Off-Java 0.5 %)

⁵1999-2003 decline in consumption, constant yield growth rates (Java 0,36% & Off-Java 0.96); slowing CI growth rates (Java 0.5 % & Off-Java 0.5 %)

5.3.Improvement of Irrigation Management Role Sharing

To increase rice production through higher CI and Yield / Ha, all level of government agencies need to coordinate for better programming and implementing of wet and dry season cropping calendar annually. To achieve integrated program and implementation there are needs to improve / harmonize the role sharing among all level of governments in irrigation management especially on the national scheme (Irrigated Area > 3000 Ha) and the provincial scheme (1000 Ha < Irrigated Area < 3000 Ha. To harmonize role sharing there is a need to decrease the implementation role of national agency by transfer of implementation role to Provincial for canal networks serving; 1000 Ha < irrigated area < 5000 Ha. and to Kabupaten / Kota agency for canal networks serving area < 1000 Ha. The same pattern there is a need for Province agency to transfer implementation role to Kabupaten / Kota for canal networks serving area < 1000 Ha (See Table 4)

Moreover to increase the efficiency of farm water application through a better role sharing of the farmer there is a need to enact again as soon as possible the actual / legal ISF. (See Table 4 below)

Table 4, Modified Irrigation Management Responsibility

Irrigation Area/Responsible Authority	Central Government	Provincial Government	Kabupaten/Kota Government	Farmer / WUA / Gabungan WUA
Area < 1000 Ha (3.491 M. Ha)			Budged / Impl-tor	ISF
4. Farm System	-	-	B + I	WUA at Tertiary
5. BC+Q+Tert. Canal	-	-	B + I	Gabungan WUA
6. Sec. + Prim. Canal	-	-	B + I	Gabungan WUA
1000 < A < 3000 Ha (1.423 M.Ha)		Budged	-/ Impl-tor	ISF
5. Farm System	-	B	I	WUA at Tertiary
6. BC+Q+Tert. Canal	-	B	I	Gabungan WUA
7. Sec. Canal for Area < 1000 Ha	-	B	I	Gabungan WUA
8. Sec. Canal for 1000 Ha < Area < 3000 Ha	-	B+ I	-	FWUA
Area > 3000 Ha (2.315 M. Ha)	Budged	-	-/ Impl-tor	ISF
6. Farm System	B	-	I	WUA at Tertiary
7. BC+Q+Tert. Canal	B	-	I	GWUA
8. Sec. Canal for Area < 1000 Ha	B	-	I	GWUA
9. Sec. Canal for 1000 Ha < Area < 5000 Ha	B	I	-	Fed. WUA
10. Sec. Canal and Primary Canal for Area > 5000 Ha	B + I	-	-	Fed. WUA

5.4. Consolidation of Existing Irrigation Farming System and Area

The trend of Farm System of irrigated land in Java shows several deficiency and inefficiency among others: (i) continuous fragmented of land holding / ownership (now < 0,3 Ha / farmer), (ii) the shifting of ownership of irrigated land to land lord, (iii) Large number of member of WUA e.g. between 60 - 350 farmers / tertiary block area (TBA), (iv) inefficient supply of agriculture input, (v) inefficient land tenure due to very small sawah plot, (vi) older average age of farmer, (vii) inefficient farming for small size holding, (viii) ownership of irrigated sawah plot surrounding urban area and along the road / highway mostly are developer and other investor (candidate for conversion).

Out of 7.23 million irrigated land about 3. 5 million is in Java with 7 % of country area occupied by 60 % of population = 140 million. Considering the above facts and trends if strong food security is future vision for Indonesia food supply the only way is to overcome all of the above drawbacks. And the right answer is the consolidation of the existing irrigation farming system and area.

(i) Consolidation of irrigation farming system plot consist of several measures:

- Establish quasi commercial / corporate farming system in each Quaternary Block Area (QBA) size 5 Ha - 20 Ha as QBA Agriculture Cooperative Business (QBA-ACB) by the small land holding farmers,
- Prepare legal basis followed with Strengthen and Empower of the QBA, TBA, SBA and PBA Agriculture Cooperatives Business by the government.
- Provide continuous adult education and training for shifting the ordinary farmer to become non agriculture business man (service, home industry, transportation etc)
- Pilot test of QBA Agriculture Cooperative Business can be done asap. In each Irrigated Area equipped with Storage located in region north (Jatitluhur area) and south (Wadaslintang area) and east part of Java (Brantas and Bengawan Solo area)
- The same pattern can be piloting outer Java.

(ii) Consolidation of existing irrigated scheme area, consist of several measures:

- Base on Law no 41 / 2009 about “Perlindungan Lahan Pertanian Pangan Berkelanjutan” and “Spatial Plan Law” no 26 / 2007 it is a must that all existing irrigated area to be properly map and tie to Provincial and Kabupaten / Kota Spatial Plan PERDA as soon as possible.
- Prepare Government Regulation (PP) for selected conversion of irrigated land as additional or combine with existing regulation. The aim of the PP is to limit conversion at minimum by compulsory for developer or investor to pay the GOI 10 to 30 times of the cost / ha of developing new irrigated area outer Java (depend on the location of the converted area), on top of the market price of irrigated sawah.