Wheat and Paddy Cultivation and the Question of Optimal Cropping Pattern for Punjab

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This paper examines the causes of continued dominance of wheat-paddy cultivation in Punjab. It is argued that under the present scenario this cropping pattern represents best congruency of a variety of factors such as market infrastructure, MSP, capital base, etc. and gives the highest income level to cultivators. Recognizing the problems like declining water table, environment and degrading of soil caused by this cropping pattern, it is argued that these problems can be tackled through alternative legislative measures without disturbing wheat-paddy rotation. On the strength of economic theory and evidence of failure of crop diversification policy of the Punjab government launched recently, incompatibility of crop diversification with modern commercial farming has been brought out.

The confusion over the optimal cropping pattern for Punjab agriculture continues. There is a constant call by some economists for a massive shift of area from wheat and paddy to alternative crops like pulses, oilseeds and vegetables etc to change the existing cropping pattern in the State. They are projecting this diversification policy as a panacea for solving Punjab's current agrarian problems. The Punjab government has also adopted this 'shift area out of wheat and paddy' as a major plank of its agricultural policy and is making efforts to induce farmers to shift to other crops. In the 'crop adjustment scheme' submitted to the central government for approval and funding, the Punjab government has proposed to reduce the present area under wheat and paddy by about 30 percent, by shifting 10 lakh hectares to alternative crops. Punjab farmers, however, are firmly sticking to wheat and paddy cultivation and are in no mood to reduce the area under these two crops. The Central Government also does not favour any reduction in area under wheat and paddy at this juncture, because this will endanger the country's food security. The confusion over shifting of area from wheat and paddy to other crops has, thus, thickened. In view of this confusion, the question of wheat and paddy cultivation and diversification of cropping pattern needs to be examined in a holistic political economy framework, to find out the optimal cropping pattern for Punjab. The question of optimal cropping pattern for Punjab has to be considered, not only in the context of current agrarian crisis, but also keeping in view the goals and constraints of the next phase of agricultural development in the state. It needs to be emphasized that the 'wheat and paddy area reduction' policy being proposed so vociferously is not the outcome of any serious analysis of the agrarian crisis in the state. It actually emerged in the peasant lore in the early 1980s when there was a temporary glut of

paddy in the markets, and was picked up and projected as a panacea by some economists and journalists for solving the agrarian problems of the state.

A correct diagnosis of the current agrarian crisis in the state is a necessary condition for formulating an effective policy for solving this crisis and for finding out the optimal cropping pattern for the next phase of agricultural development in the state. The present agrarian crisis is the natural outcome of the level of agricultural development reached in the state. It is quite complex and has many dimensions. For a clear understanding, the core issues need to be separated from the peripheral problems. The core of Punjab's current agrarian crisis is the stagnation of farm incomes for the last many years, and farmers fear of imminent fall in their incomes if the World Trade Organization (WTO) agenda is implemented wholesale and thoughtlessly. For almost three decades (1960-90) farm incomes in Punjab have been rising steadily; as a result of expansion in sown and cropped area, extension of irrigation, introduction of new HYV seeds and chemical fertilizers and modern machines. After reaching a plateau in the early 1990s, farm incomes have stagnated since then. The joining of WTO in 1995 further exacerbated the problem by creating a fear psychosis about the fall in farm incomes as and when WTO stipulations are implemented. This stagnation and fear of fall in farm incomes is the central issue in the current agrarian crises. The fall in water table and environmental degradation are, no doubt, also issues of concern that need attention but certainly not the central issue. The policy challenge, for economists and policy makers of Punjab, is to devise a strategy that not only breaks this stagnation in farm incomes, but also ensures a steady rise in farm incomes in the years to come. A number of requirements must be kept in mind while designing this strategy. It should be realistic and feasible in terms of its financial and administrative demands. It has to be compatible with central government's food security concerns, and broadly acceptable to farmers of the state. Its short run and long run direct effects and indirect side effects and externalities must be properly weighted before hand. It should be congruent with the goals of the next stage of agricultural development in the state. Hastily drawn grandiose schemes that promise quick results but cannot be implemented are not only useless, but also dangerous because these distract the focus of policy markers and public from the real issue. The focus must be kept firmly fixed on the central issue: breaking the current stagnation and ensuring a steady rise in farm incomes in years to come. This central issue is the acid test for determining the optimal cropping pattern for Punjab agriculture.

Incompatibility of Diversification with Commercial Farming: Theory and Evidence

At the very outset it needs to be understood that a diversified cropping pattern is not possible on a modern commercial farm. Both economic theory as well as empirical evidence is quite clear and conclusive about the incompatibility of crop diversification with modern commercial farming. The cultivation of many crops in each crop season is the inherent trait of subsistence farming. It is the natural outcome of the autarkic state of a subsistence farmer engaged in meeting the limited customary consumption needs of his family. A modern commercial farm, on the

other hand, specializes in the production of one main crop in each crop season; the crop that is most profitable on a given land, climate and market environment in which it is operating. The factors and forces inherent in its own micro economic structure and in the macro market environment in which it operates induce as well as compel it to specialize in the most profitable crop of each season. The logic of relentless pursuit of profit maximization induces a modern commercial farmer to plant the most profitable crop of the season on the largest possible area of his farm. Being a 'price taker' in the market, this simple strategy of planting the most profitable crop on the largest area of the farm results in the maximization of profits. The minimization of unit fixed costs of specialized machinery and specialized crop culture skills, when a single crop is cultivated on a large scale, also compels him to plant the most profitable crop on the largest possible area of his farm.

The macro market structure in which it is integrated and operates also makes specialization in a single crop in each season a compulsion for a modern commercial farm. The emergence as well as the economic viability of modern marketing and processing infrastructure and arrangements for a particular farm product in a region is possible only if the marketed surplus of that product is sufficiently large in that region. When a large number of crops are grown in a region, then marketed surplus of none of these crops is sufficiently large for the economic viability of modern marketing and the processing infrastructure needed for each of these large numbers of crops. In fact, in a region with such a diversified cropping pattern, modern marketing and processing arrangements simply do not emerge in the first instance. The existence and sustainability of modern marketing and processing arrangements for a particular crop in a region, therefore, has a symbiotic relationship with farms of that region planting that crop on the largest possible area of their farms. This structural feature of modern marketing combines with the micro economic processes mentioned earlier to enforce the rule of crop specialization not only on each commercial farm, but also on the whole region. There is always a co-evolution and symbiotic coexistence of regional crop specialization and the farms of that region specializing in the cultivation of that particular crop. Neither economic theory admits any exception to this rule, nor is any exception to it found to exist in the empirical world.

Somehow, this stark fact has completely escaped the attention of those who are pleading for shifting to a diversified cropping pattern to solve the current agrarian crisis in the state. Whether one likes it or not, the fact is that Punjab farms have become fully commercialized modern farms and cannot escape the economic logic of profit maximization and crop specialization. In Punjab, the era of diversified subsistence farming is over forever and cannot be now resurrected. The complacent peasant soul has been irreversibly transmuted into that of a profit hankering modern commercial farmer. The choice in Punjab agriculture today, therefore, is not between wheat and paddy specialization and a diversified cropping pattern consisting of many crops grown in each season by each farmer. Rather, the choice open to commercialized Punjab farms is limited to specialization in wheat and paddy cultivation versus specialization is some other crop combination grown on equally large scale. The policy challenge, therefore, is to find out the optimal crop

specialization for Punjab given the current and plausible future goals, parameters and constraints under which the farm sector in the state is to operate.

Ten Arguments on why Punjab should stick to wheat and paddy specialization

A careful analysis of the relevant goals, parameters and constraints clearly suggests that in the immediate short run, salvation of Punjab farmers lies in sticking to wheat and paddy specialization; no feasible alternative seems to exist to this crop combination. This crop combination also seems to be the optimal specialization even for achieving the long-term goals of agricultural development in the state. The long-term strategy has to focus on inducing and coaxing more and more farmers and farm labourers to shift to non-farm occupations. This will make it possible for farmers remaining on the land to cultivate bigger and bigger area and ensure a continuous rise in their incomes in the years to come. Wheat and paddy combination seems to be the most suitable specialization for enlarging farm size by speedy withdrawal of labour force from the farm sector of the state. In the immediate short run, as well as in the long run, there are sufficient and sound reasons, outlined below, for continuing with wheat and paddy specialization.

1. Only crop combination to sustain current farm incomes

At present, wheat and paddy are the only crops that can sustain the current income levels of Punjab farmers; no feasible alternative exists. None of the alternative crops being recommended, (pulses and oilseeds etc), to replace wheat and paddy, can ensure even half the income being earned by farmers from the cultivation of these two crops. Any sizeable reduction in area under wheat and paddy, as proposed in the crop adjustment programme, will result in a big fall in farm incomes. Farmers will not be alone to suffer from such a reduction in area under wheat and paddy; even incomes of agricultural labourers and other rural and urban strata dependent on agriculture will be adversely affected. It will have a devastating, depressing impact on the Punjab economy as a whole. Given the class mobilization and heightened political consciousness of the Punjab peasantry, such a big fall in farm incomes can spell political disaster and may endanger the hard won social and political equilibrium of the state.

2. Unmatched stability of wheat and paddy yields

The cultivation of wheat and paddy at the current scale is not only necessary to protect farmers' current incomes, but also to keep their income free from violent year to year fluctuations. The stability offered by wheat and paddy yields is not matched by any other crop. These crops have never completely failed during the last 40 years. Even in the worst years the fall in wheat and paddy yields has been only marginal. The alternative crops being recommended are very risky affairs; their yields fluctuate very widely from year to year. In the absence of any crop insurance system in the country, this yield risk plays an important role in the farmers' cropping pattern decisions. The net financial returns from these alternatives crops

are highly uncertain. That is why farmers are not willing to shift even small amounts of area to these alternative crops and are sticking to wheat and paddy cultivation.

3. High complementarity with country's food security needs

Further, wheat and paddy cultivation in Punjab has a high degree of complementarity, current as well as future, with the country's food needs and central government's food security concerns. The myth of overproduction of food grains in the country has already been exploded. All reasonable assessments of food situation in the country indicate a very precarious balance up to the year 2050. India will be barely self-sufficient in food grains up to that year. Given such a future food security scenario, no government at the center would agree to a massive reduction in wheat and rice production in Punjab. Rather, owing to its own food security compulsions, the central government would be willing to go a long way to sustain the cultivation of wheat and rice in Punjab. But such an active support from the central government cannot be expected in the case of the alternative crops being recommended to replace wheat and paddy. It is under no compulsion to extend such support to alternative crops.

4. MSPAP for wheat and paddy sustainability

It is reasonably sure that the existing system of Minimum Support Prices and Assured Purchase (MSPAP) of wheat and paddy will continue in the near future, despite the WTO membership. On account of its own food security compulsions, the central government cannot afford to abandon the MSPAP programme of wheat and paddy for many more years to come. This MSPAP programme of wheat and paddy is also not that incompatible with WTO stipulations as is being propagated by interested parties. The subsidies being given under this MSPAP programme are well within the WTO permitted norms and limits. It can and will be continued with minor modifications and with some window dressing to make it look congruent with WTO requirements. However, a similar minimum support prices and assured purchase programme cannot be now created for any other crop that may replace wheat and paddy. The fiscal crisis and budgetary compulsions of the central government and WTO pressure rule out the creation of a new MSPAP programme for the alternative crops being recommended to replace wheat and paddy. But without an effectively functioning minimum support price and an assured purchase programme, the cultivation of none of the alternative crops can be sustained for long. It is thus clear, that under the existing parameters and constraints, it is much easier for Punjab to press for and ensure the continuation of the existing tradition sanctified, food security necessitated and WTO compatible MSPAP programme for wheat and paddy than to get a new MSPAP programme created for any other crop that may replace wheat and paddy.

5. Stable and growing demand and good export prospects

Every agricultural economist knows that marketing is the real rub in the successful cultivation of any crop. The experience of developed countries over the last century, has clearly and convincingly shown that there is no free market solution to the marketing problem of farm products. Institutional arrangements through cooperatives, marketing boards, direct and indirect government intervention are the only known solutions to the marketing problem of farm products. The marketing problems are particularly acute in the case of crops planted on a small fraction of the total cropped area, because area under such crops can fluctuate wildly from year to year. It is well known that markets for the more remunerative alternative crops, (such as vegetables and fruits), being recommended are extremely thin and uncertain. Even a small increase in the production of these alternative crops results in market saturation and price crash, thus causing untold misery to farmers who cultivate these crops. The stories of potatoes abandoned in fields and on the roads for want of market are too recurring to be ignored. In the absence of a well developed agro-processing industry and an effective minimum support prices and assured purchase programme, the marketing prospects of such alternative crops are indeed bleak and uncertain. That is why farmers are extremely reluctant to shift to the cultivation of such risky crops.

In sharp contrast to the above scenario, the market for wheat and rice is very large and stable. The existence of an efficient and functioning MSPAP programme for wheat and rice in the country has almost completely eliminated the marketing worries of farmers producing these two grains. Moreover, being commodities of mass consumption, with relatively longer shelf life even under ordinary conditions, and requiring very little processing, the demand for these two grains is quite large and stable. Further, the domestic demand for wheat and rice is growing steadily because of fast population growth and rising per capita incomes. All reasonable estimates show that there is little risk of domestic wheat and rice market being saturated till the middle of twenty first century. Even the export prospects of these two grains to neighbouring countries are good. The whole of Africa, Middle East and Central Asia is a food grains importing zone; Pakistan alone imports 20 to 25 lakh tones of wheat every year. It should not be difficult to create a stable export market for Punjab's wheat and rice in these neighbouring countries, by making suitable investments in transport and storage infrastructure and adopting a proper export marketing strategy. The shifting of some area to more exportable varieties of these two grains, durum wheat and basmati rice, can also help in creating a secure foreign niche for Punjab wheat and rice. In view of these contrasting marketing scenarios, it will be sheer folly to shift out of wheat and paddy cultivation in undue haste, towards the cultivation of new crops with small markets and highly uncertain marketing prospects.

6. Competitive advantage of Punjab in wheat and paddy

The economics of comparative cost advantage also suggests that Punjab should stick to wheat and paddy production. Punjab has a clear competitive advantage in wheat

and rice production in the South Asian market. The cost of production of wheat and rice in Punjab is the lowest among the Indian States. Punjab wheat and rice can compete even in the international market if the heavy farm subsidies being doled out to farmers by developed countries are withdrawn. Moreover, production efficiency and competitiveness of Punjab wheat and rice can be improved considerably by suitable investments in research, transport and storage infrastructure. It is much easier to retain and further strengthen the already acquired competitive advantage in wheat and rice production, than to acquire such an advantage in the production of new crops. The competitive advantage of a region and a people in the production of a particular commodity does not emerge suddenly in a single day; it evolves gradually over time as a result of the constellation of favourable factors and circumstances. Luckily, the circumstances have been favourable for the production of wheat and rice in Punjab during the last four decades. As a result, Punjab farmers have become quite good experts in wheat and paddy cultivation. The sub-routines of wheat and paddy culture have become part of their instincts and they feel quite comfortable in the cultivation of these two grains. But it will be very difficult, if not impossible, to quickly acquire the same degree of expertise in the cultivation of the alternative crops being recommended. The process of shifting to new crops is not all that simple and easy, as some economists naively think. The learning of a new crop culture is a long and tedious task and it is also not always successful. It is attempted only when the reward is handsome as well as certain. But there is little incentive for farmers to learn the culture of alternative crops being recommended. These alternative crops are not only much less remunerative than wheat and paddy, but the returns from these crops are also highly uncertain. That is why Punjab farmers are not willing to undergo the unpleasant and long task of learning the cultivation of the alternative crops being recommended.

7. Low opportunity cost of capital infrastructure in wheat and paddy cultivation

Furthermore, all the necessary machinery and other paraphernalia for wheat and paddy cultivation have been gradually acquired by farmers over the last four decades and are already in place. The opportunity cost of using this machinery and paraphernalia in wheat and paddy cultivation is almost zero. If 10 lakh hectares are withdrawn from under wheat and paddy then the marginal cost of using it on the remaining wheat and paddy area will go up sharply, thus pushing up the cost of production and lowering the net returns from these two crops. The creation of a similar modern paraphernalia and machinery for the alternative crops being recommended will require huge investments which the farmers are not in a position to make due to their strained financial position and heavy indebtedness. In the current scenario of fiscal crises, the government is also not in a position to make the huge investments to build the public sector storage, processing and marketing infrastructure needed to make the cultivation of these new crops successful and remunerative. In the absence of such public sector processing, storage and marketing arrangements, the farmers shifting to these new crops will be easy prey to the exploitation by private traders and processing firms. The bitter experience of

Punjab farmers over the last two years has convinced them about the risks involved in diversification through private contract farming.

8. Best congruency for double cropping and machine use

Among the crop rotation combinations available to farmers in Punjab today, wheat and paddy rotation is the most suitable for double cropping on an extensive scale. The dovetailing of sowing and harvesting seasons and the time span of their 'sowing to maturity periods' fits very neatly and makes these two crops ideal for double cropping on almost the entire sown area. The time gap between harvesting of wheat and sowing of paddy, and between harvesting of paddy and sowing of wheat, is sufficiently long to give farmers adequate time for carrying out the necessary tilling and other operations. Consequently, the sowing of both wheat and paddy can be done at the most suitable time for best yields, even by resource poor small and marginal farmers dependent on hired machinery. It is this feature of wheat and paddy that has enabled double cropping on an extensive scale and the resulting high farm incomes in the state. At present, no other crop rotation combination can match wheat and paddy rotation combination in this respect. To cite only one example, the cultivation of cotton does not properly dovetail with the cultivation of wheat because of the problems created by a considerable overlap in the sowing and harvesting periods of these two crops. The sowing of wheat on cotton planted lands gets delayed because cotton crop is still not fully harvested by the time best suited for wheat sowing. The same problem occurs at the time of cotton sowing, because wheat crop is not yet harvested when it is the ideal time to sow cotton. This overlap between sowing and harvesting periods of wheat and cotton not only creates considerable pressure and strain on farmers, but also adversely affects yields of both these crops because of delayed sowing. Similar overlap problems in sowing and harvesting periods are there in most of the other crop rotation combinations competing with wheat and paddy rotation combination. Furthermore, harvesting operations of both wheat as well as paddy are tractable to mechanization and are carried out with the same harvesting combine. This lowers the fixed cost per hectare of using the harvesting machine considerably and consequently reduces the overall cost of production of both these crops. No other crop combination has this attractive quality. This easy congruency of wheat and paddy in rotation and use of machinery is another factor that gives these crops a comparative advantage over any other crop rotation combination.

9. Most Suitable for Withdrawal of Labour from Agriculture

The shifting of area away from wheat and paddy cultivation cannot be separated from the question of optimal cropping pattern for Punjab in the next phase of agricultural development. In planning the optimal cropping pattern for the state the reduction of labour engaged in farming has to be the most important goal. Further increases in farm incomes in Punjab will now come more and more from enlargement of area cultivated by each farmer, rather than from yield increases. The enlargement of area cultivated by each farmer is possible only if number of farmers

in the state declines continuously. In terms of capital intensity, mechanization, land productivity and commercialization, Punjab agriculture has reached almost the level of developed countries and its structural transformation, through reduction in labour force, is long overdue. At the present level of agricultural development in the state, no more than 10 percent of Punjab labour should be engaged in agriculture. Owing to the constellation of many political and economic factors and circumstances, the withdrawal of labour from agriculture has been delayed considerably. Luckily for Punjab, wheat and paddy are the ideal crops for speedy withdrawal of labour from agriculture, because these are amenable to large scale mechanized farming. In fact, most of the operations in these two crops have already been mechanized and only the surplus labour lingering on Punjab farms needs to be shifted out. The need of the hour is a massive shifting out of labour from wheat and paddy cultivation, and not the shifting out of area from under these two crops. Most of the alternative crops being recommended to replace wheat and paddy are highly labour intensive. A massive shift to these labour intensive crops will trap majority of Punjab labour in farming for many more decades to come. Introduction of these new labour intensive crops will abort the process of labour shedding and structural transformation of Punjab agriculture that has already begun since the early 1990s. Rather than speeding up this process of structural transformation of Punjab agriculture, the proposed shift to other crops will put it in reverse gear. To sort out some peripheral problems, like falling water table and environmental degradation, it will be extremely unwise to ignore the long-term benefits of wheat and paddy cultivation in the structural transformation of Punjab agriculture.

10. Falling Water Table and Environmental Stress Problems Tractable Through Legislation

Lastly, the seriousness of falling water table and environmental degradation problems need to be properly assessed, and costs and benefits of different solutions to these problems properly weighted and evaluated. The fall in water table and environmental stress, no doubt, needs due attention but the fact remains that these are peripheral problems and not the main issue. But unfortunately, the gravity of falling water table and environmental degradation problems has been blown up out of proportion. The situation is not as alarming as the doomsayers are projecting. Somehow, it has become an intellectual fashion to exaggerate the severity of falling water table and environment stress problems. A mere fall in water table by a few meters does not indicate anything; only with reference to the optimal level of water table, it conveys whether or not the situation is worsening. However, little is known about the optimal water table level for different regions of Punjab as it is yet to be worked out. The optimal water table level is not a matter merely of water table depth in meters; the costs of pumping out ground water and returns from its use play a major role in determining the optimal level of water table in a region. The optimal level of water table is determined by the balance between the marginal social cost of pumping out ground water and the marginal social returns from its use. In the current discussions on falling water table, it has been implicitly assumed, without any basis whatsoever, that the present water table level is the optimal level; to be

maintained even at the cost of a large fall in farm incomes. This fetish of sustainability of present water table level is misleading the public and policy makers, and prevents a rational assessment of the optimal water table for different regions of the state.

Maintaining the present water table is not the end in itself. The end is to ensure a steady rise in farm incomes; the water table level is only one of the means to that end. Furthermore, in the commotion created on the falling water table, the beneficial effects of the fall in water table level are being completely ignored. It is conveniently forgotten that almost half of Punjab lands were water logged, when paddy cultivation started on an extensive scale in the late 1960s. But for paddy cultivation on an extensive scale, half of Punjab's land would have remained water logged even today. A major portion of the land under paddy today was not cultivable and not yielding anything much earlier simply because very little could be planted on it during the kharif season due to water logging. Furthermore, the fall in water table improves the prospects of growing cotton in the northern Malwa belt where it was an important kharif crop before being displaced by paddy. The fall in water table, therefore, is not all that bad, it has a positive side as well. The beneficial effects of the fall in water table should not be ignored in determining the optimal water table level for different regions of the state. Moreover, the problems of falling water table level and environmental degradation can be more cheaply solved through a suitable legislation strictly enforced. It will be counter productive to solve these problems by a sizeable reduction in area under wheat and paddy and causing a massive fall in farm incomes; that will be too high a price for solving these problems. When cheaper solutions are available, why is there a need to use the more costly ones?

Short Run Strategy for Wheat and Paddy Cultivation

There are, thus, sufficient and solid economic reasons for continuing with wheat and paddy cultivation in the near future to avoid any fall in farm incomes. At present, a massive reduction in area under wheat and paddy is neither desirable, nor feasible; neither central government approves it, nor are Punjab farmers willing to do it. Only a gradual reduction in area under these two crops is possible and should be attempted. The pace of area reduction should be convenient to and decided by farmers themselves keeping in view their goals and constraints. A feasible and painless course for doing this would be to freeze wheat and paddy production at the present level, through a quota assigned to each Punjab farmer under the minimum support prices and assured purchase programme, leaving the question of area under these two crops to the judgment of farmers themselves. Such a policy will induce farmers to gradually reduce area under wheat and paddy by improving the yields of these crops. Guided by their own self-interest, farmers will produce their assigned quota of wheat and paddy on the smallest farm area possible. This strategy will not only keep current farm incomes intact, but will also ensure a steady rise in farm incomes from the other crops grown on the area gradually released from wheat and paddy cultivation. This policy will ensure a gradual and painless reduction in area under wheat and paddy to the extent it is permitted by the relevant economic

parameters and constraints. Furthermore, this policy is not only compatible with central government's food security concerns, but also does not require any central government subsidy for its implementation. Its administrative demands are very modest. Its implementation is simple and straight-forward at the farm level and it will not encounter any resistance from the farming community. On the area gradually released from wheat and paddy cultivation cotton and sugar cane have the best chances of succeeding. These two crops give comparable returns and the culture of their farming is known to Punjab farmers. The MSPAP programs already exist for these two crops. The crops being recommended, (pulses, oilseeds and vegetables etc.) have little chance of success.

Consolidation of Tubewell-Canal Network through Legislation

The question of water table level should be dispassionately and rationally evaluated to find out whether or not the water table level has really fallen below the optimal level. If the problem is found to be serious, then it should be tackled directly through suitable legislation. The number and spacing of tubewells should be regulated through a suitable farmer friendly law. The quantum and timing of pumping out water should be regulated through a properly tailored price regime and a strict control over the supply of power to tubewells by the Punjab State Electricity Board. Punjab is probably a unique case of a simultaneous existence of an extensive and integrated network of canals and tube wells. The canal system was planned by the government, but the tubewell network has evolved spontaneously and haphazardly over the last 40 years. Now this canal-tubewell irrigation network needs proper consolidation; to create a symbiotic irrigation system in which no tubewell should be at a distance of more than 15 Km from a canal or its tributary. The brick lining of canals and water channels also needs reconsideration because seepage from canals and water channels can help in maintaining the water table at the optimal level. The creation of such a symbiotic canal and tube well irrigation system will require the digging of a few more canals with marginal investment. The exiting network of flood drains can be easily remodeled to make it suitable for ground water recharging. Such a consolidation of canal-tubewell and drain network is quite feasible. It is much less difficult to accomplish than the consolidation of holdings that Punjab succeeded in doing in the pre-green revolution period.

Long Term Strategy for Structural Change and Shifting of Labour

In the long-run there is no alternative to a massive shift of labour out of Punjab agriculture, if farm incomes are to continue to grow. Wheat and paddy are the best available crops even from this long-term perspective of reducing labour engaged in agriculture. The reduction in labour engaged in agriculture can be engineered only through bold and innovative changes in laws and institutions; to induces and coax those who can and want to shift out of farming. The agricultural labourers and big landowners are the most suitable groups, at present, for being induced and coaxed to shift completely out of agriculture. A detailed and deep study of farm population reduction patterns, spontaneous as well as policy induced, in other countries may

also provide useful clues for devising a suitable strategy for shifting population out of Punjab agriculture. This structural change and shifting out of population from agriculture has already been delayed considerably, and cannot be avoided and postponed any further if farm incomes are to be kept growing in the years to come.

Conclusions

In the immediate short run as well as in the long run, wheat and paddy rotation is the optimal crop specialization for Punjab agriculture. No feasible alternative seems to exist. Punjab should stick to wheat and paddy cultivation and further improve its competitive advantage in these two crops. The falling water table problem should be tackled through legislation and by consolidating the canal-tubewell and flood drain network to make these symbiotic and sustainable.

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